Demographic Problems of Eastern India.

Proceedings of a Seminar held in Calcutta on 27th & 28th September, 1967.

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DEMOGRAPHIC PROBLEMS OF EASTERN INDIA

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President	: **Dr. C. Chandrasekaran**, Regional Adviser on Population Policy and Programmes, ECAFE, BANGKOK.
Inaugurated by	: **Sri Jyoti Basu**, Deputy Chief Minister, West Bengal.
Chief Guest	: **Sri Nani Bhattacharjee**, Minister of Health, West Bengal.
Opening address by	: **Prof. S. N. Bose**, F. R. S., National Profesor.
Welcome address by	: **Sm. C. Bose**, Director, Bureau of Applied Economics & Statistics, West Bengal

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Sectional Chairmen

1. Prof. P. K. Bose, M. Sc., D. Phil.
2. Shri S. P. Jain, M. A., F. I. A.
3. Prof. A. Ghosh, M. A., D. Phil.

Seminar Committee

1. Dr. A. C. Das, Dy. Director, Bureau of Applied Economics & Statistics, West Bengal (Chairman).
2. Sri K. P. Purakayastha, Dy. Director, Bureau of Applied Economics & Statistics, West Bengal.
3. Dr. S. Chakrbarty, Dy. Director, Bureau of Applied Economics & Statistics, West Bengal.
4. Sri S. Das Gupta, Dy. Director, Bureau of Applied Economics & Statistics, West Bengal.

FOREWORD

On the recommendation of the Demographic Advisory Committee and at the instance of the Ministry of Health, Government of India and the Department of Health, Government of West Bengal, the Bureau of Applied Economics & Statistics (formerly State Statistical Bureau), Government of West Bengal, organised a seminar on problems relating to Demography with particular reference to the Eastern Region of the country in September 1967. The seminar was held in Calcutta on 27th and 28th September, 1967 and was presided over by Dr. C. Chandrasekharan, Regional Adviser on Population Policy and Programme, ECAFE, Bangkok. Shri Jyoti Basu, Deputy Chief Minister of West Bengal inaugurated the seminar and Shri Nani Bhattacharjee, Minister of Health was the Chief Guest. Prof. Satyen Bose, F.R.S. National Professor delivered the opening address of the seminar session. Altogether 21 papers were submitted by eminent scholars and Research workers in the field of Demography and those papers were discussed in three different sessions of the seminar.

The topics selected for discussions at the three sessions were :

(i) Demographic Problems—General.

(ii) Population Growth and related social problems.

(iii) Technique of Population Analysis.

The three sessions of the seminar were conducted under the Chairmanship of Dr. P. K. Bose, Centenary Professor and Head of the Department of Statistics, University of Calcutta, Dr. A. Ghosh, Professor of Applied Economics, Jadavpur University and Shri S. P. Jain, F. I. A. formerly Director, Demographic Training & Research Centre respectively.

As the papers are of lasting interest and the discussions on the papers illuminating, these papers, speeches and discussions have now been brought together in the form of a brochure. It is hoped that the brochure will be found useful by students, research workers and the general public.

A Committee was formed with some of the senior officers of the Bureau to organise the seminar. I must appreciate the valuable services rendered by the members of the Seminar Committee, the other officers and staff of the Bureau to make the seminar a success.

(C. BOSE)
Director,
Bureau of Applied Economics
and Statistics,
Government of West Bengal.

The 3rd February, 1969.

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WELCOME ADDRESS

BY

SHRIMATI C. BOSE

Director,
Bureau of Applied Economics and Statistics
(formerly State Statistical Bureau)
Government of West Bengal,
CALCUTTA.

Hon'ble Deputy Chief Minister, respected Professor Bose, Dr. Chandrasekharan, guests and friends, I welcome you all to this Seminar on problems relating to Demography.

Shri J. L. Kundu, Financial Commissioner who was to deliver the welcome address is unable to attend the Seminar due to some urgent preoccupations. It has, therefore, fallen upon me to welcome you all to this Seminar which I am very happy to do with all sincerity and great expectations.

We are indeed very happy to have to-day with us our Deputy Chief Minister who has kindly agreed to deliver the inaugural address. I am also happy that the Hon'ble Minister of Health ~~who~~ has kindly agreed to be the Chief Guest.

We feel proud to have the great scientist Prof. Satyen Bose, National Professor, in our midst to-day to open the Seminar. As we all know, his life is dedicated to the advancement of science. We are really grateful that he has made it convenient to be with us here for some time.

Dr. Chandrasekharan, Regional Demographic Adviser, United Nations Economic Commission for Asia and Far East who was previously the Director of the Demographic Research Centre, Chembur, Bombay has travelled a long way from Bangkok to Calcutta to preside over this Seminar. I am indeed grateful for the trouble he has taken.

There are other eminent guests and research workers here to day. Many amongst them have come from stations outside Calcutta and have taken considerable trouble to attend the Seminar. We have also in our midst some experts from different institutions in Calcutta. I consider it a great privilege to be able to welcome you all heartily to participate in this Seminar.

In a developing economy with very high growth rate of population, studies, researches and exchange of views on Demographic problems are of great importance.

It is specially so in West Bengal where the growth-rate of population is much higher than that of food production. It is my earnest belief that the discussions and deliberations in this Seminar will be thought-provoking and interesting and will lead to further research on the subject.

We have been able to do very little for our honoured participants who have arrived from stations outside Calcutta. You are all aware that now-a-days, it is very difficult to arrange for confortable accommodation and conveyance for the delegates attending meetings and Seminars like that of the present one.

However, with our humble resources, we have been able to make some arrangements in this regard for the paticipants and this has been largely possible for the co-operation extended by other departments of the State Government. Our volunteers will remain always ready to render all assistance.

I wish to take this opportunity to thank particularly the Ministry of Health, Government of India, who have provided necessary funds for holding this seminar.

I would now request Dr. C. Chandrasekharan to take the chair and conduct the business of the session.

INAUGURAL ADDRESS

BY

Sri Jyoti Basu, Deputy Chief Minister of West Bengal.

Mr. Chairman, Prof. Bose and Friends,

I have been asked by Mrs. Bose to deliver, as she said, the inaugural address. Well, had I known about this I might have stayed away from this Seminar because I have no such pretention that I can give an inaugural address. That would involve so much learning that I do not think that I possess it. I frankly say when I was asked to come here and participate in this Seminar, even for a little while, I was not interested particularly because of my ignorance. I wanted Mrs. Bose to tell me what all this about and to give me if possible anything in writing subjects which may be discussed to-day and to-morrow in this seminar on the problems of Demography. She has been kind enough to hand me over some papers and just now when I came here I was given another paper "Demography and the Statistician" by Shri C. Chandrasekharan.

Now the thing that strikes me first is that as far as statistics is concerned, I think we are quite old to it although it is a new science for us. But since our planning started we have been depending on building up our statistical sections everywhere. Sometimes it arises in our mind as to whether all ~~this~~ statistics are correct because however much statistics might be based on scientific foundation. I can frankly tell you that sometimes it creates very great difficulties for us because the figures do not seemed to tally with the realities as they exist. Now whose fault it is, how exactly these things occur, I am not in a position to say. Whether it is the human factor or there is something wrong with the very process itself, I am not quite aware. As far as Demography is concerned it is a newer subject. Those who analyse our population problems, will be able to say what the difficulties are and what we can do in order to remove those difficulties. But this much is certain that it is a very important subject for us—for us who believe in planning and an ordered society. Without statistics, without demography I think it is hardly possible for us to proceed a step further and the more these things are based on scientific processes the better for all of us.

I have seen some of the subjects—not that I have read all the papers. On some of the subjects research has been done, papers have been submitted on which there may be discussions here within the course of these two days. The first thought that came to my mind was that will these just remain on paper or how exactly will these studies be undertaken—do some of the scholars or research workers study a particular subject on their own as they think fit or because of

the need which arose. As far as I am concerned I feel that research in every sphere is important. With regard to our population various aspects of research are very important. But in order not to waste much of our efforts it is necessary that there should be some inter-connection between this work which has been done by our scholars and research workers of the Government Departments, Government representatives, various State Governments and the Central Government. Because then we shall know exactly what we want, what should be given priority. Of course I am speaking like a practicalist. People might say that so far as research scholars and workers are concerned—they should not depend on any sort of directives from the Government. They should act as they please. Their work may be of use to-day or to-morrow. It is quite true. I do not decry that idea because some day or other any research work that has been done may be of some value. Because we do not have enough resources I feel we cannot have the luxury of dissipating the energies of our scholars and research workers. That is why I am saying that if there is some sort of coordination and better contact between the Government and such workers-the more we shall be helped in actual reality in trying to plan for our country in order to immediately undertake programmes which will be of use to the people. One subject has been touched upon by Sm. Bose when she was speaking and that is population and food production. Now I do not believe until some body convinces me more thoroughly with facts that we have anywhere reached the saturation point as far as our food production is concerned, not because I am a communist but from the very fact of life. In West Bengal I am informed-Statisticians may tell me better whether I am right or wrong-but I am informed that about 22 percent of cultivable or cultivated land is under irrigation. Well, for 15 years or a little more we have been planning and nobody will tell me that this is any where sufficient. Therefore, one can without fear of contradiction say that supposing we are able to irrigate much more within lesser time-many more acres within lesser time—then we may not reach self-sufficiency in West Bengal but we can go somewhere near reaching self-sufficiency. Suppose we can reach 40 or 50 percent and then there is intensive cultivation in place of one crop in many areas—I do not say in all areas—but in many areas in place of one two crops may be grown then surely to some extent our problems will be solved. But again problems will arise. Therefore while we discuss this problem of population, while we undertake statistical surveys, I feel we must have clear perspective before us—our ideology must be clear - ideology not based on abstract thought but on the realities as they exist. But anyhow it is important that in this sphere too we study, we come to conclusions. One may also discuss family planning, the rate of growth, the growth of different sectors of the population, how much growth is there among the workers, peasants, middle class, upper-middle class and so on from which paper conclusions may be drawn. Therefore, as I was saying that these are few random thoughts which arose in my mind when I was asked to be with you for a little while in this conference

and I thought then many eminent persons including Prof. Bose, our Chairman who are eminent scholars in this sphere will speak to us, and I am subject to correction. I always try to learn because primarily we want to utilise all the knowledge that is already there for the benefit of our people, for the advancement of our country in the shortest possible time and if out of these discussions and talks some conclusions are arived at—it may be useful for us. We shall be very grateful to the friends who are participating in this conference. If out of this conference we are told as to what exactly or how exactly as a Government we can help in the development of these studies we shall be grateful and I can tell you that we shall do all that is possible on our part to help in this respect. With these few words, friends I inaugurate this seminar on the problems of Demography in our country. Thank you.

—:—

ADDRESS BY THE CHIEF GUEST
SHRI NANI BHATTACHARJEE,
MINISTER OF HEALTH, WEST BENGAL.

It is indeed a great honour and privilege to have this opportunity of speaking before such an august body. I am not a specialist in any branch of science, not to speak of Demography. Some of you may know that I have chosen politics as a career when very young and my only speciality, if I may say so, has been to work in the labour peasant front. I have, therefore, doubts if I can do justice to the honour bestowed upon me by asking me to be guest-in-chief at the inauguration of a seminar on demographic problems.

However, having worked amongst tea garden workers and also among rural people for a long time and having had the opportunity of studying the problems relating to health in this State for some time now I can suggest for your deliberations certain broad problems on the subject. I am sure out of the learned discussions that would take place in this seminar certain recommendation would emerge which can be profitably utilised by our administrators, planners, technical experts and particularly family planning workers as guidelines in the different fields of their activities. Nobody can deny that the rapidly increasing population in the world, particularly in the underdeveloped and developing countries, is one of the basic human problems to-day. Increasing population by itself should not cause any alarm. In my talks at various meetings, discussions, etc., I have said that we should not be cowed down by the ghosts of 'Malthusian' demons. We all know that with the rapid advancement of science and technology it is possible to support a much larger population to-day at a reasonable standard than, say, 20 years back. In the underdeveloped countries the possibilities of rapidly increase of production by use of advanced technology have not been exhausted. The optimum is not in sight. But what should worry us is—population out-pacing the rate of development. In such circumstances there is need for lowering the birth-rate and keeping the growth of population within resonable limits. On the other end, we should mobilise all available resources, if necessary, by bringing about radical socio-economic changes to accelerate the pace of development and output. Unless these are achieved and if the rate of growth of population continues to outstrip the rate of development, all our efforts to ensure a better life to our people would be nullified.

I am told that in this country as well as in other countries in similar circumstances it is not the rate of growth that matters as much as the net addition to the population every day, every year and every decade. This is because of the already existing massive population. Take for example, West Bengal. In 1961, her

population was 3·49 crores within a density of over 1000 per square mile. One can well imagine the impact of the mean annual growth of 3 per cent to this already existing huge population. With the decrease in infant mortality and an increased life-expectancy the problem is becoming more acute every year. We are faced with the problem of finding employment for larger and larger number every year. The need demand for social services is multiplying. These and other related problems are well known to those who are participating in this Seminar.

I am sure you would be able to define in more concrete terms the Demographic Problems of this State as well as recommend proper solutions. I can only echo the sentiment of a more renowned person, "We have to run a race against time whether it is on the economic front or in regard to population", and I would like to add—let us hope we will win on both fronts.

DEMOGRAPHY AND THE STATISTICIAN *

BY

C. CHANDRASEKARAN

Regional Adviser on Population Policy and Programmes

ECAFE, BANGKOK

It gives me great pleasure to be with you this morning. One reason for it is because of my association with the city of Calcutta which extends to my childhood days. I still recall how while visiting the city as a boy of five. I tried to be smart, and while returning home with my parents rushed away from them in order to reach home first ; alas, only to get lost in the maze of the lanes in Bow Bazar. During my long period of service at the All India Institute of Hygiene and Public Health, and in fact every time I have visited this city, Calcutta has never failed to be a source of inspiration to. Another reason why I am happy to be here is because of my long association with Mrs. Chameli Bose, the Director of the State Statistical Bureau who is responsible for the excellent preparations for this seminar. Mrs. Bose and myself studied together at the University College, London when Statistics was just beginning to be recognized as a science. Although, over the years, our paths have not crossed, there is still a commonness in our endeavours in that both of us approach our special interests through the medium of statistics.

Just as statistical science was coming into its own in the thirties, Demography, today, is emerging as a separate discipline. India which played an important role in the development of statistical science has also taken a lead in giving shape and form to demography. The Demographic Training and Research Centre, Bombay which was established by the Govt. of India in 1956 has been serving as a regional institution for the training of demographers from all countries in the ECAFE region. It is a landmark in India's contribution to the development of demography. The alumni of this centre have distinguished themselves in many universities of the world and are holding important positions in the United Nations Economic Commission for Asia and the Far East and the United Nations Economic Commission for Africa. Since the establishment of this centre, demography has taken long strides in India, the most significant being the setting up of demographic research centres in different parts of the country.

In this assembly composed largely of statisticians I have thought it useful to discuss some of the relationships between Demography and statistical science, and point out some directions in which statisticians can contribute to the advancement of the field of demography.

*Address given to the Seminar on Problems relating to Demography organised by the State Statistical Bureau, West Bengal in Calcutta, 27-28 September 1967. The views expressed are those of the author and do not comit the United Nations or ECAFE in any manner.

Statistics form the foundations of demographic knowledge. Data obtained through population censuses and vital registration are basic to the study of demography. It is not surprising, therefore, that the United Nations Population Commission since its inception in 1946 has been working towards the promotion of periodic population censuses and the improvement of vital statistics systems in all countries of the world. However, the Population Commission is not the only organisation of the United Nations which has been striving towards these ends. The United Nations Statistical Commission has shown at least as much interest in these objectives. The United Nations Statistical Office which issues such publications as the **Demographic Year Book** has organised many training courses and Seminars in connection with the 1960 and 1970 census programmes. Prior to this the International Statistical Institute had evinced considerable interest in the improvement of census and vital statistics.

Apart from such overlapping organisational interests, it is to be recognised that a large proportion of the demographers in countries such as India, are drawn from the body of statisticians. A large part of the analysis involved in demographic work is being handled with great facility by statisticians. Even composite surveys, such as the National Sample Surveys, often undertaken solely by statisticians include data of a demographic nature. The differences between Demgraphy and statistics appear rather thin to many ; some others even feel that statisticians are well in a position to undertake demographic studies and research.

The role of demographer can be exemplified by reference to a characteristic such as age at marriage. This characteristic assumed considerable importance in India during the late 1920's, as the low age at which girls were married was considered a social evil. Through legislation known as the Sarda Act, the minimum legal age at marriage for girls was increased to 14 years, and subsequently to 16. Recently, there has been renewed interest in the subject, this time because of the possible effect which an increase in age at marriage might have on the number of children born and consequently on the rate of population increase.

Any discussion on this subject must begin with facts concerning the ages at which women marry. Because marriages, especially of Hindus, are not required to be registered, it is not possible to get information on age at marriage directly from official statistics. An attempt can be made to estimate it through sample surveys bearing in mind that the survey would provide the mean age at marriage for woman alive on the date of survey. How this estimate will be affected by differences in mortality or movement (if we are considering small areas) between those married early or late is not without significance in interpreting the results of the survey. If a large scale survey is not feasible, an estimate of age at marriage can be attempted by utilising the information on marital distribution by age, as given

in a population census. This procedure, however, assumes stable conditions of age at marriage over several decades in the past.

Two questions are pertinent in regard to discussing policy relating to raising the age at marriage. The first is : what is the reduction in fertility, reckoned in terms of number of children born, which will result by an assumed increase in age at marriage ? In other words if the minimum age at marrige is increased, say to 19 years, what is the reduction in the birth rate which can be expected therefrom ? The second question, and one that is often lost sight of in discussing the policy of raising the age at marriage is, what is the extent to which this policy can be implemented ? It is strange that in India where the Sarda Act was honoured more by breach than by practice, the feasiblity of actually implementing the provisions of legislation has not received the same attention as the effect which the policy, if implemented. will have.

Let us take the first question, viz. what is the reduction in the birth rate that can be expected by postponing the age at marriage of women ? In this connection it will be recalled that a few years ago, a study from Delhi claimed that raising the age at marriage of women to 19 years (the average age at present is about 16 years) will reduce the birth rate by 50 per cent. Instead of questioning the credibility of the claim, some policy makers hailed it as a godsend for solving our population problem. A little consideration will show that the relationship between the age at marriage and the number of children born is complex, especially when variations of age at marriage within the narrow range of 16 to 20 years are being considered. Comparative data from the Asian countries show how confusing the relationship can be. In many Asian countries the average age at marriage for females exceeds that in India ; in some of these countries women bear less children than they do in India while in others the reverse is true. In Thailand, for instance, the average age of females at marriage exceeds 20 years and the average number of children born per woman exceeds the Indian average by about 20 per cent. In Malaysia too, though women marry later than in India, they have larger number of children. A glaring example within our cultural context is the experience in Kerala, where, inspite of the estimated average age at marriage of females being 19 years, they bear more children than women in the rest of India.

A statistician will perhaps be inclined to think that the best way of dealing with the question is through developing 'models' using reasonable assumptions, but, here again, there are many imponderables ? If women marry at age y instead of age X, can it be assumed that their fertility will be reduced by the number of children they would have borne between the ages X and y ? Or, is it more appropriate to assume that woman whose age at marriage is increased from X

to y, will henceforth bear the same number of children as those who now marry at age y ? Both these assumptions can be questioned. As regards the second, it is known that those who now marry at a later age are also distinguished by other characteristics such as higher education or better economic status. These characteristics influence reproductive behaviour in ways other than through a mere increase in the age at marriage ; and without the occurrance of such corrleated changes, it is questionable if the fertility pattern of those who marry at age y, will be adopted by those whose age at marriage is increased from X to y. what about the first assumption that the number of children born will be reduced by the number that would have been born between the ages X and y ? Here one has to note that Indian women not only marry at an earlier age but, they also cease to have children at an earlier age, in comparison with women in communities not practising contraception. If the lower age at which women cease reproduction is related to the lower age at marriage, the possibilty that postponement of marriage might merely increse the age at which the last child is born, without affecting the actual reproductive span, will have to be recognised.

To confound the problem, some medical specialists are at pains to point out that early child-bearing affects future capacity to reproduce. In suport of this view, some data have been presented to show that the number of children born during the life-time of a woman increases with an increase in the age at marriage, of course within limits. At the same time it is also recognised that postponement of the first child-birth to a woman's later twenties might lead to difficult labour. Even, if this be so, there are no data on how maternal mortality or future productive performance is affected by this fact. I have not referred to several other aspects which are also related to the issue under consideration. One is the reduction in the number of women marrying, for as the age at marriage increases from X to y all women dying between these ages will die 'single' and not as 'married'. Naturally the contribution they would have made to the births in the community will be eliminated. Another aspect which is of interest is in what way the difference between the ages of husband and wife will be influenced if the age at which women marry is increased. This difference is of significance because it has a bearing on the expectation of life of the husband, and there fore on the age at widowhood.

I have discussed this question on the effect of age at marriage of women on fertility at some length in order to point out that demography is concerned with the study of human behaviour in the three fundamental aspects of population growth, viz. fertility, mortality and migration, and that demographic problems are extremely complex because these three aspects are interrelated with numerous economic and social factors. Often, the demographer has to deal with problems as might arise in the future rather than those of the present or of the past. The

premises on which he has to work are nebulous and inexact, and far different from theoretical formulations of the mathematical statistician. This lack of definiteness often necessitates the making of different sets of assumptions in demographic work.

As a case in point, when the Demographic ~~Trading~~ Training and Research Centre, Bombay studied the influence of an increase in age at marriage on fertility, three sets of asumptions on how age-specific fertility rates might be affected had to be made. The results obtained showed that if Indian women did not marry before they complete 19 years of age, the consequent reduction in birth rate might vary from 8 to 21 per cent.

I have been at pains to demonstrate to you that the relationship between age at marriage and level of fertility is very complex. The institution of marriage is, as is well-known, bound deeply by tradition and culture, and changes in marriage patterns are closely related to changes in the social and economic spheres. The mean age at marriage in India has been slowly increasing but it is doubtful if a large part of the change can be attributed to the raising of the age at marriage through legal measures. Such measures may appear justified as expressions of changes to be desired, but if past experience is any guide to the future, their effect on raising the age at marriage will be small. There is still less justification to think that such measures will help to reduce the birth rate to any considerable extent. Placing too much reliance on an increase in age at marriage for reducing the birth rate is likely to deviate our energies from more promising ways of dealing with this national problem.

I now wish to turn my attention to discussing some of the lines of work in which the demographer and the statistician could collaborate to the mutual advantage of the two disciplines. One of the preoccupations of the demographer is to make projections of the size of the population of its structure in terms of age and sex distributions, urban-rural break down and so on. A basic requirement for making population projectsions is accurate data on the size and characteristics of the population at a specified date and on prevailing levels of birth and death rates. Most of the developing countries of the world lack accurate vital statistics. In recent years, the demographer has evolved techniques by which the birth and death rate levels can be estimated, although aproximately, from such meagre information as the age distribution of the population and its growth rate. At the same time, efforts have also been directed towards obtaining information directly on births and deaths through retrospective sample surveys, sample registration systems and a combination of both these procedures.

I would refer those unacquainted with recent developments in these fields to a paper by Parker Mauldin entitled "Estimating rates of population growth" published in the proceedings of the International Conference on Family Planning

Programmes held in Geneva in August 1965, and published as Family Planning and Population Programmes by Bernard Berelson and others. In this review paper Mauldin has briefly described the work of the Indian National Sample Survey to estimate vital rates, the Pakistan Population Growth Estimation Study where data on births and deaths are collected through two systems—continuous registration and surveys—, the Thailand Survey to measure population growth which is in some sense similar to the Pakistan Study but has several important innovations in procedure, and several others. Mauldin ends his review in the following words : "Matching studies such as the Pakistan PGE provide a unique self-checking feature which forces recognition of the fact that each procedure is missing significant numbers of events. The procedure is difficult to police, is moderately expensive and requires skilled, dedicated and patient personnel, but at the present time it appears to be the best procedure available." Mauldin also suggests "A probability sample of registration areas probably would provide good data at relatively low cost and relatively small input of professional personnel. During the initial years of installing such a system check on a part of the sample should be undertaken with surveys, including individual matching of events."

In India much progress has been made in developing methods for improving vital statistics both through household sample surveys and sample registration. The method of cross-check now used in Pakistan and Thailand for checking the accuracy of data on births and deaths obtained through sample surveys was first tried in this country. The Mysore Population Study jointly undertaken by the United Nations and the Government of India developed techniques for improving the quality of data obtained through surveys, by the use of ancillary questions and built-in cross checks, and demonstrated their effectiveness. The National Sample Survey progressivley has improved the accuracy of the information on births and deaths obtained in its several rounds. A Standard Fertility Survey, developed by the Central Familly Planning Institute which involves periodic visits to selected households, has been tried with notable success in a rural area near Delhi and in the states of Kerala, Madras and Uttar Pradesh.

The Registrar General's programme of sample census and of sample registration are attempts to provide annual estimates of population, and of births and deaths. The sample registation scheme utilises part-time enumerators for recording vital events as and when they occur. This information is supplemented by that obtained during the course of the survey conducted each half-year. It is understood that all States which are co-operating in the project of sample regitration will switch over to full scale operations so that national estimates of birth and death rates for rural areas will be available from 1968. The scheme is likely to be extended to urban areas also.

The time is now most opportune for a high powered technical group to examine the whole question of procedures to be followed in this country for obtaining annual estimates of birth and death rates. What has to be kept in mind is the accuracy of the estimates provided, and to this group of statiscians it is not necessary to emphasize that the problem of estimation also involves the measurement of the degree of error or in-accuracy from which the estimate may suffer. The National Sample Survey in several of its rounds has provided estimates of birth and death rates, and because of its 'sub-samples' design the survey also provides a measure of error consistant with the use of this design. At the same time, investigations by Som and others on the quality of birth and death data obtained in the National Sample Survey point to the existence of large errors due to "recall lapse," whose influence on the estimate is likely to be much greater than that suggested by the 'standard errors' given by the Survey. The method of cross-check of data obtained from two sources, as used in the Sample Registration Project of the Registrar-General lso reveals possibilities of omissions and duplications in the information obtained in a large-scale survey such as the N. S. S. Hence the need for a thorough consideration of how estimates of national birth and death rates are to be obtained.

While on this subject of projections, I may add, that the problem of obtaining national estimates is now essentially one of 'Statistical Engineering'; to use Professor Mahalanobis's terms, as the necessary ground-work has been well laid by studies and researches over the past 20 years. But when we consider 'small area projection' such as projecting the population of a state or a city, in which case, in addition to births and deaths one has to reckon with the effects of internal migration the techniques available are, in fact crude. In this field, I am sure the statistician can make a useful contribution. A whole array of possibilities suggests itself. While periodic sample surveys for estimating the size and characteristics of the population may be an answer, it is also likely to be expensive, especially if estimates are required separately for a large number of cities. It may however, prove to be a more accurate procedure than that of estimating poulation by correlated characteristics such as number of tenements, volume of road traffic, etc. Economic indices such as working force or number of new industrial establishments might also be of assitance but, as I have indicated, there have not been many methodological studies which have attempted to project populations for small areas with the help of such ancillary data.

Time does not permit me to dwell at length on the new and expanding field of family planning which provides numerous venues of interest for statisticians of varied skills and tastes. At one level, the policy maker wants to know in general terms, the kinds of programmes that might prove effective, where they should be started, whether in urban or rural areas, what the requirements may be in terms of personnel, supply of contraceptives, clinic facilities etc. The programme administrator needs more specific details such as the degree of acceptability and use-

effectiveness of different contraceptives in various communities, promising ways of sensitising the population to the needs of family planning and of disseminating knowledge on family planning methods, and effective and inexpensive ways of to the people. Large scale family planning programmes is an innovation of the 1950's and we have not yet passed beyond the stage of experimentation or of using trial and error method.

On this occasion I will rest content by drawing your attention to one or two facts of family planning programmes which would be of interest to the theoretical statistician. In this age of the electronic computer, it is relatively easy to stimulate human reproductive processess through stochastic models under various assumptions of fertility control ; findings from such researches have been of great assistance in the formulation of family planning policies. By such studies, it is possible, for instance, to discuss the pros and cons of a sterilisation programme not merely in the abstract but in terms of the reduction in fertility which the programme might lead to.

Another aspect of interest to the statistician is the evaluation of family planning programme. Statisticians who are used mostly to designing controlled experiments of the factorial type will, I dare say, find new challanges if they interest themselves in this evaluative work. Some years ago, when our family planning programme had just started, it was relatively easy to assess the effectiveness of a set programme of action by using an 'experimental' area and comparing the changes which happend within it with a 'control' area which was not given any special treatment. But to-day, because of the extension of family planning programmes over a large part of our country it is difficult to think of a 'control' area where no programme is underway ; if one can be found it can well be classified as 'atypical' For this reason, one basic principle of classical designs viz. 'external control' is hard to apply, The application of the second principle viz. 'replication' does not seem practicable.

It is also, worthwhile, to point out the objectives of experimentation as they arise with respect to family planning programmes seem to be undergoing a change. It is no longer a question of finding out if a specific method is more acceptable than another ; or one method of communications works better than another. A programme is viewed as "a coordinated group of activities maintained over a period of time, aimed at fostering a particular type of human change," and a weakness in any one of the elements can hinder programme success. The object of evaluation is to find out weak the links, with a view to modifying them and thus to develop an effective programme. Looked at from this point of view, evaluation as applied to an ongoing programme is different from an assessment of the effect of "treatment" or

"dosage" as applied in some discussions of field research design. What statistical procedures and principles are applicable to progamme evaluation in these circumstances require to be considered seriously.

In summary, Demography and Statistics are inter-related. A Statistician is a demographer and he is not ; with greater understanding and interest in problems of population growth and related aspects of human welfare a Statistician can become a better demographer without necessarily losing his identity or association with statisticians.

Recommendation made at the Seminar on problems relating to Demography

The Seminar notes with satisfaction that research institutes and individual scholars have already taken up the study of the demographic problems of different States of India, and West Bengal in particular, and feels that the urgency of demographic problems and the nature of policies to be adopted may be placed in all their aspects before the appropriate Governments. It is imperative to set up demographic cells in the State Statistical Bureaus and other similar organisations. It is recommended that steps to establish such cells should be taken as early as possible.

2. Several studies and contributions have been made over the past 20 years for the improvement of procedures for estimating annual birth and death rates. The work of the Indian National Sample Survey and aid of the Office of the Registrar General in this field were particularly commended. But the Seminar felt that the estimation of the death and birth rates are so important for making population projections and for evaluating the progress of governmental actions in various fields that it is absolutely necessary at this time for the setting up of a high power technical group to review the procedures which can be applied for large-scale estimation of vital statistics. The Seminar feels that such a committee will not only lead to the improvement of vital statistics in West Bengal but also in other parts of India.

3. The process of urbanisation and consequent changes in the size and structure of the population are considered important aspects in the study of the relationship of the population growth and economic development. In view of the lack of proper methodology, the Seminar drew the attention of scholars to the need for improving the methodology for studying such relationship in small area projections.

4. The rate of growth of population in West Bengal in recent years has accelerated. The Seminar emphasized the need for developing realistic programmes for controlling the birth rate consistent with the aims and aspirations of individual couples. In this context, the Seminar emphasized the study of social and economic factors affecting fertility including the relationship between age at marriage and fertility. This was recognised a complex process.

5. Increase in educational status was considered as an essential step in the introduction of changes in behaviour which would contribute to limitation of family size. In view of this and other salutary effects which an increase in educational status will have, the Seminar felt that the education should be given a high priority in our plans.

6. It was felt in the Seminar that in order to arrive at conclusions which will have operational significance in demography, demographic research should be closely linked to socio-economic backgrounds. For this purpose in planning surveys and research projects careful planning of the objectives and its policy implications and the given socio-economic situations must be understood clearly.

7. For a closer linking up of economic and demographic results—the proposed cells in demography should associate professional economists health personnels and experts in other related disciplines in their work.

8. For closer association and strengthening of the research units in planning and other organisations, the Universities should be drawn closer to other activities so that more comprehensive and broad view could be taken in demographic work.

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Speech in the opening of the Seminar Sessions

By

Prof. S. N. BOSE, F. R. S., National Professor.

Hon'ble Mr. Chairman and the Delegates of the Conference.

I would request you to grant me a favour and allow me to speak the few words that I have got to remaining seated :

I have attended the inaugural sessions of this Conference on demography and have been impressed by the interest shown about problems of population. However it would perhaps be risky to arrive at firm conclusions and propose programmes and plans on the basis of arguments and statistics presented here. On the one hand the resources at our disposal were very limited. Also the responsibility of working out a future programme must remain ultimately with the people. There should be among them general literacy and consequent intelligent awareness about the present world problems, and the facts of life to enable them to decide on the future course for the nation to follow. At present though we strive to set up a democratic government by extending franchise to all adults during election, the educational qualifications ~~in general~~ remain generally at a sub-~~bed~~ level and the task of educating our people remains yet largely unfulfilled.

Our Chairman has very aptly discussed the various ways of controlling the rapid increase of the growth of population. In this Seminar the various aspects of the problem have been discussed, and statistical methods have been applied to the comparatively few data that are obtainable in our country. To arrive at weighty conclusions on the basis of statistics of such data is evidently a risky business. The conclusions may be challenged as unwarranted.

I will illustrate my remarks, by reminding you, that many years ago when we were under the British the question of granting representation on the strength of population of different communities came up for discussion. The rapid rate of increase of a particular community then considered as majority was ~~then~~ regarded as a distinct advantage for them. The Census of 1941 were utilised to determine the proportional representation of the Various Communities and tremendous consequence followed for the future of our country.

However doubts have been afterwards expressed about the correctness of the 1941 Census data, when the only methods of obtaining statistical data was on the reported counting of heads by agents who were always not uninterested nor very reliable persons.

When Statistics are brought in and applied to problems of immediate interests of a particular class or community, people often try to twist statistics to suit their prupose. Here Statistics may play tricks when its peculiar methods are employed to samples chosen in a particular fashion. We may thus always get results which we would like to get. Caution in such matters is therefore always desirable and the intensive discussions among Statisticians are very welcome. They should try to understand the essentials of the problem they want to tackle, and I hope here they will arrive at a mutually agreed conclusion, and say something which would help our Government.

I would add some remarks about the necessity of carrying on research by Independent institutions irrespective of any programme or Government planning. In a healthy body—politic, the Statisticians and Scientists should undertake to study problems on their own initiative. Their intelligence and methods would extract many results which can be subsequently utilised by the industries or by the Governments. In a country where the people are educated and thus alive to their own interests, the people themselves should form such institutions by their own effort. Of course suitable encouragement and funds by the Government will be always necessary. But the mind and intelligence that had to be applied should be directed by people and institutions capable of taking a unbiassed view of things. Thus in the country there should be persons with strong honest and independent opinion of who work and run institutions not always controlled by Government. Perhaps the Universities may often have such independent study circles but I should always welcome as in the present case, simultaneous co-operation of the Government Statistical Bureau, with people from other ~~other~~ departments and other non-Government institutions.

The face of problems changes rapidly with time: Formerly we thought of vast undeveloped land and forests here about us and thus looked upon the rapid increase of population as a source of comfort and strength. Now we are anxious about our excessive birth rate.

Britain has diverted its excess populations into her colonies like Australia or Canada. We have unfortunately no such places to go to, almost settle down our excessive population.

But I think we have to examine seriously whether we have fully utilised the enormous resources the nature has bestowed on us. Whether our fertile lands and our mighty rivers are utilised to the fullest extent possible, to support a healthy, teeming and happy population. It is not merely planning but willing and intelligent co operation at all levels that are needed. For it we require education

and awareness broadcast among the length and breadth of the land. Our friendly Nations are anxious to help us, and if in spite of their help and aid offered we are not able to solve our dfficulties then it will be really our own fault.

Now in the final remark : I very much appreciate this initiative in bringing to foreground here a tremendously weighty problem taken by the Director of the Statistical Bureau and I congratulate her for the able way the Conference has been organised. I hope this study will produce results lasting and enduring and beneficial to our country. The best minds and intellect from all the parts of our country have been here collected and are at work. I hope this Seminar will produce results which may be recorded and utilised by our Government and by all who have the good interest of our country at heart.

Thanking you,

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DIFFERENTIAL GROWTHS IN HINDU, MUSLIM AND CHRISTIAN POPULATIONS IN INDIA

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1. Introduction :

An excessive growth of human population in the near future has been apprehended in most parts of the world. In India, everybody seems alive to the problem of over-population, and measures for arresting the growth of Indian population include, among others, birth control and family planning practices. There has, however, been a doubt in some quarters as to whether or not such practices are adopted to the same extent by the different religious communities. As a consequence it has been felt that the rate of population growth in the monogamous Hindu community is less compared to the rate of growth in the polygamous Muslim community. A study of the comparative sex-composition and the fertility differentials among Hindus and Muslims may be revealing. The present paper gives the distribution of the population, for India as a whole and for some of the areas separately, among the three major religious groups, viz Hindu, Muslim and Christian, as has been observed in the censuses of 1951 and 1961 and as can be appoximately estimated for the decennial years till 2001.

A projection of the population in each religious group would call for the availability of fertility, mortality, nuptiality and migration data for each group separately Adequately classified data on these vital events are not available to us. Although, information on religion has been being collected in Indian census since 1911, the problem of present interest sprang up recently in post-independence days. This is why we started as our basic data with the number of Hindus, Muslims, Christians and 'others' (covering Budhists, Jains, Sikhs, persons with other religions and persuations person whose religions were not stated during the census) as enumerated in the 1951 and the 1961 censuses, only.

The attempt to find out growth rates for each state separately was rendered difficult by the reorganisation of states in 1956. In cases like West Bengal and Bihar where whole districts were transferred from one state to another, we obtained adjusted figures for 1951 by transferring the districtwise populations accorodingly and allocating the total population transferred into the three religious groups in conformity with the population composition as obtaining in 1951 of the state from which a transference had taken place. This approximation had to be introduced since the district population was not classified according to religion in available publications. Similar adjustments could also be made in cases

where the state shown in 1961 covered, in addition to the state with the same name existing in 1951, some other state or states (territory or territories). In the other cases where parts of districts were involved in the reorganisation this adjustment could not be suitably made. For this, the states of Madhya Pradesh, Andhra Pradesh, Gujrat, Kerala, Madras, Maharashtra and Mysore were considered in a group to render their total population in 1951 comparable to that in 1961.

Table I gives the percentage increase in the Indian population among the different religious communities during the decade 1951-61. The over-all growth rate among Hindus (20·9%) is the smallest and is smaller than that for the total population (21·6%). Percentage rise in the Muslim community exceeds the corresponding figures in the Hindu community in all areas except in Tripura, Manipur and Andaman & Nicobar Islands. The excess is considerably large in Bihar (12·09%) and Himachal Pradesh (47·65%). The group 'others' has shown a decline in West Bengal, Manipur, Andaman & Nicobar Islands and in the Southern and Western States. The number of Christians also fell down in Uttar Pradesh. The group 'others' has, however, been able to record a steep rise of nearly 50% in the Indian context.

II. Post-Censal Population Estimates :

Since population figures for the (three) religious communities were available only for two censuses, we have to make the post-censal population estimates by assuming either an arithmetic or a geometric progression. The geometric law is theoretically more defensible than the arithmatic progression in view of the fact that population begets population. To get component populations for the religions, however, arithmatic progression is better, since the components in this case add up to the total, if computed by using an arithmatic progression. To allow the total populations to increase in a geometric progression and to retain the proportionate distribution obtainable in an arithmatic progression, we use the modified arithmatic progression where the total population is assumed to follow its own geometric progression and the component populations, being calculated by assuming arithmatic progressions, are multiplied by the constant factor,

$$\frac{\text{Total Population by G. P.}}{\text{Total Population by A. P.}}$$

Denote the census years 1951, 1961, 1971, 1981, 1991 and 2001 by the values 1, 2, 3, 4, 5 and 6 respectively of the time variable t. Let P^1_t, P^2_t, P^3_t and P^4_t denote numbers of Hindus, Christians and others respectively in the year t and $P_t = P^1_t + P^2_t + P^3_t + P^4_t$ be the total population in that year. If $\frac{P_2}{P_1} = r$ and $P_2 - P_1 = d$, then the predicted populations for the 4 religious groups by the modified arithmatic progression method for the year t are

$$\left\{P_1^1 + (t-1)\,d_1\right\} \times \frac{P_1(1+r)^{t-1}}{P_1 + (t-1)\,d}, \text{ (where } d = \sum_1^4 d_i = P_2 - P_1)$$

$$\left\{P_1^2 + (t-1)\,d_2\right\} \times \frac{P_1(1+r)^{t-1}}{P_1 + (t-1)\,d},$$

$$\left\{P_1^3 + (t-1)\,d_3\right\} \times \frac{P_1(1+r)^{t-1}}{P_1 + (t-1)\,d},$$

and $$\left\{P_1^4 + (t-1)\,d_4\right\} \times \frac{P_1(1+r)^{t-1}}{P_1 + (t-1)\,d}$$

These, when summed, will give the predicted population for the year t assuming its own geometric progression viz. $P_1(1+r)^{t-1}$.

The difficulty of obtaining the sizes of the different religious communities by this method consists in the fact that in some of the states—West Bengal to be mentionted particularly—$d_4 < o$ and $P_2^4 = P_2^4 + d_4 < o$. This leads to an embarassing situation. To avoid this complication, the group 'others' was left out of consideration and the percentages of Hindus, Muslims and Christians reported in this paper for the states are in relation to the total number of Hindus, Muslims and Christians, P_t^1. Percentage rise $\frac{P_t^1}{P_1^1} = r^1$ in this modified total population P_t^1 appears in the last column of table 1.

The estimated post-censal Hindu, Muslim and Christian populations for the year t are thus obtained as

$$\left\{P_1^1 + (t-1)\,d_1\right\} \times \frac{P_1^1(1+r^1)^{t-1}}{P_1^1 + (t-1)\,d^1}, \text{ where } d^1 = \sum_{i=1}^{3} d_i$$

and $$P_1^1 = \sum_1^3 P_1^i$$

$$\left\{P_1^2 + (t-1)\,d_2\right\} \times \frac{P_1^1(1+r^1)^{t-1}}{P^1 + (t-1)^{d^1}},$$

and $$\left\{P_1^3 + (t-1)\,d_3\right\} \times \frac{P_1^1(1+r^1)^{t-1}}{P_1^1 + (t-1)\,d^1}$$

The distribution of the modified total population according to religion in year t is then given by the percentages

$\frac{P^1_1+(t-1)d_1}{P^1_1+(t-1)d^1} \times 100$. To get the percentage composition of the total population, we have to multiply these percentages by the ratio.

$$R_t = \frac{P^1_1(1+r^1)^{t-1}}{P_1(1+r)^{t-1}} = \frac{P^1_1}{P_1}\left(\frac{1+r^1}{1+r}\right)^{t-1}$$

to get percentages for Hindus, Muslims and Christians, the percentage of others can then be obtained by subtraction.

To have an idiea of the acceptability of post-censal population estimates using the percentage rise observed during 1951 to 1961, we calculate estimated mid-year populations for India for the years 1962, 1963, 1964 and 1965 and compare them with the corresponding estimates given by the Registrar General of India. Taking the 1961 census to relate approximately to the end of March, 1961, the estimated mid-year populations for 1961, 1962, 1963, 1964 and 1965 are $P_2(1+r)$, $P_2(1+r)^{\frac{1}{10}}$, $P_2(1+r)^{\frac{5}{10}}$, $P_2(1+r)^{\frac{9}{10}}$, $P_2(1+r)^{\frac{13}{10}}$ and $P_2(1+r)^{\frac{17}{10}}$ respectively. These estimates came out to be 441224038, 449961582, 458874755, 467919651 and 477184082 compared to the estimates of 442736000, 453407000, 464335000, 475526000 and 486987000 as prepared by the Registrar General of India. Accepting the letter values as true, our estimates fall short of the true ones by .3%, .8%, 1.2%, 1.6% 2.0% respectively.

III Population Growth in Hindu, Muslim and Christian Communities :

Tables 2 give the observed distributions of the total population among the three religions in 1951 and 1961 as also the predicted distributions for the decennial years upto 2001. Commenting on the figures for India as a whole, one finds that the percentage of Hindus in the total population is dwindling, while those of Muslims and Christians are gradually going up.

Figures for West Bengal as appearing in table 2.2 are not revealing of the true situation. This is because of the large inflow of Hindu refugees from East Pakistan during the decade 1951-61. Owing to this the percentage of Hindus has increased from 1951 to 1961, and based on this fact the predicted Hindu population has been found to account for a nearly constant percentage of the total population. Even then, the slight increase expected in the percentage of Muslims during the

years 1951 to 2001 is larger than the corresponding increase expected among Hindus. It is suspected that natural growths are much different and with the stoppage of immigration of Hindus and emigration of Muslims the population will show a greater percentage of Muslims in the future.

In Bihar the effect of differential growth rates is more prominent. The percentage of Hindus in Bihar's total population which stood at 87.31 in 1951 will fall through to an extent of 3.51 by 2001. Per contra, the percentage of Muslims is expected to register an increase of 3.43 during these years. The Christians population is also expected to account for a slightly larger percentage of the total. Rates either of fall or of increase will diminish gradually over the successive census years.

Orissa's total population will show a more or less constant proportion of Muslims. Of course, the proportion of Hindus will slightly go down.

In Assam again, the population will be gradually shorter of Hindus and will include more of Muslims. While the percentage of Hindus will expectedly come down from 69.54 in 1951 to 68.39 in 1961, the percentage of Muslims will go up from 23 55 to 25.21.

In Rajasthan, as in Orissa, the percentage of Hindus in the state's population is quite high. However, this will have a slight decrease of 1.07 during 1951 to 2001. Muslim population will grow relatively and the percentage of 6.41 observed in 1951 will reach the value 7.29 in the year 2001.

Table 3 gives the percentage composition of india's population according to religion. While the percentage of Muslims will slowly but monotonically increase, the percentage of Hindus which is marked by a large drop between 1951 and 1961 will go on diminishing till 1981, whereafter it will rise very slowly. The population which contained 85% of Hindus in 1951 will, however, have only 83% of Hindus in 2001.

IV. Concluding Remarks :

We hear a good deal now-a-days about 'population explosion' in India. The Goverment is adopting various measure for family planning and has also revised the laws of marriage. But we are sorry to state that all these measures relate mostly to the majority section of the population of India. Unless we can enforce all preventive measures for population growth to all sections of the population rigidly, we shall not be able to achieve our purpose. It can be seen from the above study that the growth rate of the majority community already shows a downward trend where as this is not evident in other cases. This problem of population control is a national one and it should be tackled in that spirit.

References

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2. Wolfenden, H H. (1954) : Population Statistics and their Compilation. Revised Edition. The University of Chicago Press.

Table I : Percentage Increase in Population among Hindu, Muslim and Christian Communities during 1951-1961.

State	Percentage increase among				
	Hindus	Muslims	Christians	Others	Total
West Bengal	41·41	41·82	16·86	—89·43	31·40
Bihar	14·66	26·75	19·00	—	19·78
Orissa	19·59	22·11	41·63	0·57	19·82
Assam	34·78	38·62	64·31	34·94	37·52
Uttar Pradesh	16·13	19·48	—17·95	19·73	15·11
Punjab	30·86	38·01	51·56	16·41	25·86
Rajasthan	25·38	31·69	104·60	33·59	26·10
Delhi	52·24	56·23	56·64	51·42	52·44
Himachal Pradesh	20·31	67·96	86·75	195·03	21·78
Tripura	80·58	67·96	90·78	110·12	78·71
Manipur	38·52	30·62	122·30	—20 95	35·04
Andaman and Nicobar Islands	252·71	54·67	89·31	—27·08	68·55
Madhya Pradesh, Andhra Pradesh, Gujrat, Kerala, Madras, Maharashtra and Mysore	18·12	19·79	24·78	—27 09	20·29
Over—all	20·89	32·60	31·51	49·40	21·64

Table 2.0 : Observed and Predicted Distribution of the Population among the Religious Communities.

INDIA

Year	Number of persons			
	Hindu	Muslim	Christian	Modified Total
1951	303,186,986 (87·43)	35,400,117 (10·21)	8,157,765 (2·35)	346,744,868
1961	366,526,866 (86·40)	46,940,799 (11·07)	10,728,086 (2·53)	424,195,751
1971	444,654,162 (85·68)	60,493,244 (11·66)	13,755,872 (2·65)	518,918,662
1981	540,603,783 (85·76)	76,751,293 (12·09)	17,393,713 (2·74)	634,793,199
1991	658,227,553 (84·76)	96,464,377 (12·42)	21,807,863 (2·81)	776,542,520
2001	802,256,961 (84·45)	120,494,585 (12·68)	27,190,327 (2·86)	949,944,465

Table 2·1 : Observed and Predicted Distribution of the Population among the Religious Communities.

WEST BENGAL

Year	Number of persons			
	Hindu	Muslim	Christian	Modified Total
1951	19,462,706 (79·24)	4,925,496 (20·05)	1,75,021 (0·71)	24,563,223
1961	27,533,358 (79·29)	6,985,287 (20·12)	2,04,530 (0·59)	34,713,175
1971	38.911,115 (79·32)	9;890,793 (20·16)	2,55,922 (0·52)	49,056,659
1981	55,001,003, (79·34)	13,994,356 (20·19)	3,32,123 (0·47)	69,326,870
1991	73,069,950 (79·35)	18,604,298 (20·20)	4,14.148 (0·45)	92,088,395
2001	84,461,263 (79·36)	21,515,194 (20·21)	4,55,850 (0·43)	106,432,308

Table 2·2 : Observed and Predicted Distribution of the Population among the Religious Communities

BIHAR

Year	Number of persons			
	Hindu	Muslim	Christian	Modified Total
1951	34.316,416 (87·31)	4,564,466 (11·61)	4,22,030 (1·07)	39,302,912
1961	39,345,517 (86·22)	5,785,631 (12·68)	5,02,195 (1·10)	45,633,343
1971	45,248,798 (85·40)	7,144,830 (13·48)	5,93,832 (1·12)	52,984,875
1981	52,135,745 (84·74)	8,682,967 (14·11)	6,99,163 (1·14)	61,520,738
1991	60,164,596 (84·23)	10,444,119 (14 62)	8,20,895 (1·15)	71,431,729
2001	69,505,039 (83·80)	12,472,503 (15·04)	9,61,835 (1·15)	82,939,381

Table 2·3 : Observed and Pradicted Distribution of the Population among the Religious Communities

ORISSA

Year	Number of persons			
	Hindu	Muslim	Christians	Modified Total
1951	14,318,411 (97·83)	1,76,338 (1·20)	1,41,934 (0·97)	14,636,683
1961	17,123,194 (97 63)	2,15,319 (1·23)	2,01,017 (1·15)	17,539,530
1971	20,487,953 (97·48)	2,61,446 (1·24)	2,67,409 (1·27)	21,017,619
1981	24,524.101 (97·37)	3,16,392 (1·26)	3,44,335 (1·37)	25,185,413
1991	29,363,067 (97·29)	3,82 035 (1·27)	4,34,930 (1·44)	30,179,680
2001	35,161,490 (97·23)	4,60 564 (1·27)	5,42,575 (1·50)	36,164,311

Table 2·4 : Observed and Predicted Distribution of the Population among the Religious Communities.

ASSAM

Year	Number of persons			
	Hindu	Muslims	Christians	Modified Total
1951	5,894,733 (69·54)	1,996,456 (23·55)	5,85,399 (6·91)	8,476,588
1961	7,884,921 (69 08)	2,765,509 (24·23)	7,64,553 (6·70)	11,414,983
1971	10,575,254 (68·80)	3,785,162 (24·62)	1,010,616 (6·57)	15,371,416
1981	14,203,947 (68·62)	5,151,858 (24·89)	1.344,177 (6·49)	20,699,149
1991	19,090,087 (68·49)	6,989,122 (25·07)	1,793,916 (6·44)	27,873,474
2001	25,671,575 (68·39)	9,464,172 (25·21)	2,399,642 (6·39)	37,534,420

Table 2·5 RAJASTHAN

Year	Number of persons			
	Hindu	Muslim	Christian	Modified Total
1951	13,862,150 (93·55)	9,49,348 (6·41)	6,762 (0·05)	14,818,260
1961	18,132,690 (93·13)	1,314,613 (6·75)	22,864 (0·12)	19,470,167
1971	23,758,625 (92·87)	1,781,511 (6·96)	41,323 (0·16)	25,581,852
1981	31,157,631 (92·70)	2,388,932 (7·11)	64,325 (0·19)	33,611,995
1991	40,883,622 (92·57)	3,184,631 (7·21)	94,030 (0·21)	44,162,800
2001	53,663,910 (92·48)	4,229,848 (7·29)	1,32,994 (0·23)	58,025,503

Table 2·6 PUNJAB

Year	Number of persons			
	Hindu	Muslim	Christian	Modified Total
1951	8,176,430 (96·18)	2,29,080 (2·69)	95,293 (1·12)	8,500,803
1961	12,930,045 (95·97)	3,93,314 (3·02)	1,49,834 (1·11)	13,473,193
1971	17,241,568 (95·86)	5,43,609 (3·02)	1,99,266 (1·11)	17,985,365
1981	23,002,694 (95·81)	(7,39,971 (3·08)	2,65,441 (1·11)	24,008,664
1991	30,695 796 (95·78)	1,000,223 (3·12)	3,53,862 (1·10)	32,049,166
2001	40,962,439 (95·75)	1,346,736 (3·15)	4,71,884 (1·10)	42,782,432

Table 3 : Percentage of Major Religious Communities to Total Population 1951—2001.

Year	Percentage to total population			
	Hindu	Muslim	Christians	Others
1951	84·98	9·91	2·35	2·76
1961	83·50	10·70	2·44	3·36
1971	83·24	11·33	2·57	2·86
1981	83·21	11·81	2·68	2·30
1991	83·29	12·20	2·78	1·75
2001	83·45	12·53	2·83	1·19

N.B.—In tables 2·0 to 2·6. figures in parentheses indicate percentages.

MARRIAGE TRENDS IN WEST BENGAL
UNIVERSALITY AND AGE
(CENSUS 1961)

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Scope of the Paper

The paper is the product of a study of the Census tables on demography, particularly on age and marital status. The object of the paper, as the title would suggest, is to analyse the institution of marriage with regard to the extent to which it prevails and the age at which it is most usually contracted. This indeed is a very large field of investigation, only the outskirts of which can be approached in these pages.

Prevalence of the Married

The feature most prominently brought out by the Census statistics is the high degree of the prevalence of the institution especially among females. In West Bengal only 55 per cent of the male population and 44 per cent of the female population are unmarried according to the 1961 Census. The proportions are for the entire population, that is to say, they include infants and children and also those suffering from bodily or mental affliction.

A comparison of the marital status classification for the past five Censuses shows interesting results. In 1921 out of 1,000 males only 480 were found to be bachelors. But in 1961 out of the same number of men as many as 553 were bachelors. As for the females there were 296 spinsters among every 1,000 women in 1921, but in 1961 out of the same number of woman 443 were found unmarried. The proportions under each Census for defferent civil conditions will be seen in Statement I.

These figures in themselves do not presume to give a measure of what we understand by universality of marriage. Because, for such a measure to be worthwhile only the population in or beyond the marriageable age group is to be taken into account.

The fact that there were in 1961 in the whole State 68 fewer married men and 50 fewer married women in 1,000 of each sex than there were ten years ago no doubt augurs well for the future. But sweeping conclusions on the basis of these figures alone will be rash, because we have also to take into consideration the question of age composition of the population which is so important a factor influencing its civil condition that statistics on the latter cannot

be considered in isolation of those of the former. A great majority of the unmarried males and females must indeed be young children and an enormous preponderence of the child and adolescent population would naturally make for a small proportion of the married persons. Meaningful comparison of the marriage statistics can therefore only be made by correlating civil status with age. The distribution of the population aged 15 years and above in India and West Bengal as per the 1961 Census, separately for each five yearly age group, by sex and civil condition is given in Statement II in which, too, the data for England and Wales for the same year are placed alongside for comparison.

Age of Marriage

The great difference that still persists between the Occident and the Orient in matters relating to marriage practice is shown by these figures. In England only 11 among 1,000 males of age group 15 to 19 are married. But among the same number of males in the same age group, 238 in India and 107 in West Bengal have entered on matrimony, a sprinkling having already been even widower and divorcees. By the time age group 35 to 39 i. e., a mean age of 37, is reached only 46 males in India and 53 in West Bengal out of 1,000 remain bachelors while in England there are still 132 of them who have not married. Among 1,000 old men aged 70 and above those who are unmarried number 28 in India and 12 in West Bengal, but 77 in England and Wales.

In India, as in West Bengal, the proportion of unmarried persons is higher among males than among females throughout life. But in England and Wales their proportion among the females exceed that among the males in age group 45 to 49 and beyond. It is precisely from this age group that the proportion of spinsters goes on increasing with every advancing period of life—a phenomenon which indicates that the impact of the earlier part of this century when marriage among females in that country was far less universal than at present has not yet been effeced from the returns.

The proportion of married persons is higher among famales than among males upto the age of 30 to 34 in India and of 35 to 39 in England and Wales. Among 1,000 girls in age group 15 to 19 the numbers that remain unwed are 292 in India, 253 in West Bengal and 934 in England and Wales. In other words, the chances that a woman of seventeen will be married are three to one in favour of the event in West Bengal, fourteen to one against it in England and Wales. By the time a woman reaches the age 22 she will have been married in all but (i) 6 per cent cases in India, (ii) 7·5 per cent cases in West Bengal and (iii) 42 percent cases in England and Wales.

Widowhood

Early marriage of girls is for the most part marriage to husbands much older in age, with its complement of inevitable widowhood. It is significant that in India and West Bengal the proportion of the wives to total females begins to decline as soon as the age period 25 to 29 is crossed owing to casualties among the husbands, while in England and Wales there is no falling off of this proportion even at age group 35 to 39. Before a woman reaches 50 the probability of her becoming a widow is at least 29 in 100 in India, 39 in 100 in West Bengal but only 5 in 100 in England and Wales. Only one seventh of the women in the age group 55 to 59 are widows in England and Wales but in India and West Bengal their proportions are one half and three fifths respectively. The approximate age from which widows begin predominating over the wives is 50 in West Bengal, 55 in India, 75 in England and Wales.

The proportion of widowers also naturally increases with each quinquennium but even at its highest in the age group 70 and above it is not much more than 3 in 10 in India or West Bengal, and is only a little less in England and Wales. The proportion of men whose wives are still living is the largest in age group 35 to 39 in India, as in West Bengal, and in age grcup 45 to 49 in England and Wales. Apart from the inequality of age at marriage, the preponderence of widows over widowers is caused by the greater frequency, even in Europe, of the re-marriage of the widowers than that of widows.

Divorce and Separation

Divorce and separation seem to have taken the heaviest toll in either sex in age group 30 to 34 and thereabouts in India and West Bengal and in age gorup 45 to 49 in England and Wales. Perhaps a revealing aspect of the statistics is that the relative incidence of divorce and separation is not as low in this country as is generally believed to be.

Inequality of Conjugal Age

There is one more subject, *viz.*, inequality of age of husband and wife, on which the local practice is worth comparing with the conditon prevailing in the west. From what has been discussed above it is clear that the age of marriage of women is very low in India and lower still in West Bengal. As the ratio ef wives to husbands in the early age periods is grossly disproportionate against the husbands most of the early marriages of girls are to husbands much older in age. Taking the average ages from the tables as they stand it is found that the mean age for husbands in West Bengal is 39.0 as compared to 30.1 for wives. In the absence of annual periods the mean has been calculated by assuming that the persons returning their ages at each quinquennial period enjoy, one with another, one half of the years included in the period. This is not admittedly the fact at the

extremes of youth and old age, but no correction is possible with the data at hand. The same calculation for India and England and Wales gives 38.0 and 47.0 respectively for husbands and 31.3 and 44.6 respectively for wives. That is to say, difference in years between the mean age of husband and wife is 2·4 in England and Wales, 6.7 in India and 8.9 in west Bengal.

Changes Since 1921

We have now elicited two main facts regarding the marriage system in West Bengal; first, the high degree of prevalence of marriage and, again, the early ages at which it is most frequently contracted. Against these facts, which, in themselves speak of a rather deplorable state of affairs, we must take into consideration the changes that have taken place since the past. Statement III shows the comparable marital status classification of 1,000 persons of each sex and quinquennial age group in 1921 and 1961. The 1921 proportions are for undivided Bengal. Figures for divorced and separated persons in 1961 have been merged with those for widowed.

Not many words are necessary to explain the changes. Men as well as women are marrying much later in life now then it was the practice with the earlier generations. About 6 in every 10 of the surviving males born in the year 1900 entered on matrimony before the age of 22, but had they been born forty years later only 4 of them would have been paired off by that age. A girl born in 1948 or 1949 had only 18 per cent, probability of her getting married before her twelfth birth day, but for her grandmother's contemporaries, i. e., for the girls born at 1908 or thereabouts, it was 54 per cent. certain that they would have been married off by the age of 12, and in 2.5 per cent cases they would even have been widowed. Of the girls of age group 15 to 19, i. e., of an average age of 17, one in four is now unmarried but 40 years ago the chances of finding a girl of this age still unmarried were as remote as five and a half in one hundred. Confirmation of the declining trend of early marriage also lies in the great fall in the proportion of widows. For example, in the nineteen twenties half of the women who had reached the precincts of age of 40 would have lost their husbands, but now out of four women of that age only one may suffer that bereavement.

Juvenile Marriage

Juvenile marriage is a subject the statistics on which deserve notice in some detail and this, incidentally, is also a field where revolutionary changes have taken place. Although the legal definition of child marriage is marriage of a boy under 18 or of a girl under 15, we are confining our investigation to child marriage in its extreme form, viz., marriage in age group 0 to 9. The figures for females are sufficient for a consideration of the question owing to the relatively higher

age of the husbands. The Census of 1961 has shown that in West Bengal 2 girls out of every 1,000 of age below 10 years have already donned bridal robes. There used to be a time in Bengal when early marriage was the rule rather than the exception. The mass unpopularity that the Child Marriage Restraint Act earned in this part of the country is still fresh in public memory. To realise how immensely things have improved from the past when a very large section of the community not only sanctioned but sanctified juvenile unions, we need only have a look at the earlier statistics. Numbers of girls per 1,000 aged below 10 found married or widowed or divorced were 55, 43, 159 and 2 at the Censuses of 1911, 1921, 1931 and 1961 respectively. The figure for 1931 recalls the great rush to get children of tender age married before the Sarda Act came into force on the 1st April, 1930.

Sex Ratio in Each Civil Condition

Relative proportion of the sexes in each civil condition at each period of life, data on which are given in Statement IV, is the next subject for examination. In West Bengal, as probably in most other parts of the world, unmarried women are less in number than the bachelors. The discrepancy is the widest at age period 25 to 29 when the number of spinsters is reduced to but a twelfth of their possible mates of the same age. In the case of the wedded, the ratio of wives to husbands decreases steadily from the earliest to the latest age recorded. Child brides are more numerous than boy husbands. So, at the early age periods the ratio is overwhelmingly in favour of the wives. The age at which the numbers of husbands and wives are most evenly balanced lies in the vicinity of twentyeight. When once this point of equality has been passed the ratio starts disfavouring the wives and the disproportion gets enormous particularly towards the end of life. The sex proportions among the widowed very but little with age and on an average the widows outnumber the widowers four to one. In the divorced and separated status there are 35 per cent more females than males. Within the age groups the variations are rather wide. The largest excess of females is at the earliest recorded age group of 10 to 14. Equality of the sexes lies somewhere within age period 30 to 44 and the largest deficiency of females is in the last recorded age group.

Excess of Husbends over Wives

The overall excess of husbands over wives is a matter with implications worth taking note of. It would seem quite natural to expect that in the total population there should be as many wives as there are husbands because under the Census definition only such persons could be returned as married who were in stable *de facto* union and whose spouses were alive. Excess of husbands over wives would therefore indicate one or more of the following phenomena, *viz.*, (i) Polyandry, (ii) Immigration of husbands and (iii) Emigration of wives. For

every 1,000 husbands there are 901 wives in West Bengal. As there is no suggestion of polyandry, nor of exodus of wives, the explanation of this difference must lie in immigration of husbands. It is probable that many of the wives who are missing here will be found in some other parts of India while, their husbands are busy carving out a living in this State.

Now the temporary absence of husbands on business reacts on the sex ratio of married persons will be best understood if we consider the figures for villages and towns separately. In the rural areas the number of the husbands is remarkably balanced with that of the wives : there are as many as 998 married women for every 1,000 married men in the villages of West Bengal. But in all towns and cities taken together the ratio is 657 : 1,000. Evidently there is an unusually large number of husbands living in the towns and cities without their wives. About 46 per cent of the husbands at Calcutta, for example, have not brought their wives to the city Immigration of husbands from the rural parts of the State is not alone enough to account for their excess in the towns, because, as we have seen just now, the villages themselves have a little more than their own quota of husbands. Most of the immigrating husbands in the urban areas therefore have come from places outside the State, where large parts of their incomes they earn in West Bengal are remitted and spent.

Maternity

The last important aspect of the data on marriage that may be brought within the ambit of this short paper is their relationship with the data on births. What we mean by birth rate is the number of births occurring among 1,000 persons in a year. But among these 1,000 persons births are expected to occur only to the married women of the reproductive age group, which broadly represents age 15 to 44. The proportion of married women of this age group in the total population is therefore a very important factor determining the rate of reproduction of the race. In West Bengal married women aged between 15 and 44 constitute a sixth of the total population. In England and Wales, they are less than a seventh. The relative distribution within this age group is also relevant but we are not going into these refinements here.

There is, however, one point which should not be passed over. It is that the number of mothers is not the only thing that shapes the birth rate. Frequency of births also depends upon a complex of social, economic, racial, regional and climatic factors, to speak nothing of the purely accidental or personal ones. A crude measure of the general rate of maternity, or of 'fertility' as it is called in the scientific parlance, in a given population can be had from the ratio of the number of children to the number of mothers in that population (crude because it does not make allawonces for mortality and migration either amongst mothers or

amongst children). This ratio, i. e., the number of children (smoothed for misstatements of age) in age group 0 to 4 per 100 married women of age group 15 to 44, is 103 in West Bengal, 92 in India and 59 in England and Wales. We have it then that in India, and in West Bengal, in particular, mothers, bear children not only too early but also too often.

But there is one paradox that seems to require an explanation. It is incontrovertible that the age of marriage has gone up, This rise should normally have acted as a check on the birth rate. But, from all accounts this check has not yet started operating. Birth rates still continue to be very high, if not higher than before.

The explanation is not far to seek. With the fall in the incidence of child marriage, early widowhood is now comparatively rare. As a result, the proportion of married woman in the age period with the highest fecundability, viz , 20 to 29, has become larger than ever before. In 1921, for example, out of 1,000 women of age group 20-24 and 25-29 each, only 879 and 826 respectively were married with their husbands living. In 1961, the corresponding proportion of married women in the same age groups were 897 and 918 respectively.

So West Bengal would seem now to be in a peculiar phase of demographic transition. A shift in the age of marriage has, instead of solving the problem of rapid proliferation, in fact aggravated it.

STATEMENT I

Marital status of 1,000 persons of each sex in general population of the State, 1921 to 1961.

Marital Status	Males					Females				
	1961	1951	1941	1931	1921	1961	1951	1941	1931	1921
1	2	3	4	5	6	7	8	9	10	11
Never Married	553	476	476	444	480	443	363	342	282	296
Married	416	484	469	516	473	428	478	462	505	465
Widowed/ Divorced/ Separated	30	40	55	40	47	128	159	196	213	239
Unspecified	1	...	...	...	...	1	...	...	...	...

STATEMENT II

Distribution of 1,000 persons of each sex and age group by marital status, West Bengal, India, England and Wales, 1961.

Age group	Country/ State	Never Married		Married		Widowed		Divorced/ Separated	
		M	F	M	F	M	F	M	F
1	2	3	4	5	6	7	8	9	10
	India	762	292	233	696	3	5	2	7
15-19	West Bengal	893	253	105	731	1	8	1	8
	England & Wales	989	934	11	66	...	....	....	....
	India	439	60	546	918	9	13	6	9
20-24	West Bengal	577	75	415	897	4	20	4	8
	England & Wales	691	420	309	578	...	1	....	1
	India	177	19	797	942	17	29	9	10
25-29	West Bengal	259	28	725	918	11	46	5	8
	England & Wales	294	157	702	834	1	3	3	6
	India	78	11	887	914	26	64	9	11
30-34	West Bengal	109	17	868	881	17	94	6	8
	England & Wales	175	110	817	875	2	6	6	9
	India	46	8	909	870	37	112	8	10
35-39	West Bengal	53	9	917	815	25	169	8	7
	England & Wales	132	98	856	875	4	13	5	14
	India	39	6	893	777	60	207	8	10
40-44	West Bengal	37	7	916	706	42	279	5	8
	England & Wales	107	97	877	859	7	27	9	17
	India	33	5	878	697	82	289	7	9
45-49	West Bengal	26	6	907	592	62	395	5	7
	England & Wales	95	105	883	828	12	50	10	17
	India	32	5	837	532	144	455	7	8
50-54	West Bengal	22	4	877	448	96	542	5	6
	England & Wales	89	122	879	779	22	84	10	15
	India	29	4	809	486	156	503	6	7
55-59	West Bengal	18	4	849	360	127	630	6	6
	England & Wales	86	138	869	706	37	143	8	13
	India	29	4	747	294	218	697	6	5
60-64	West Bengal	15	5	797	240	183	750	5	5
	England & Wales	79	144	850	609	65	237	6	10
	India	28	4	707	272	259	719	6	5
65-69	West Bengal	15	4	758	204	221	786	6	6
	England & Wales	73	152	812	493	111	349	4	6
	India	28	4	605	148	361	844	6	4
70+	West Bengal	12	3	674	112	307	881	7	4
	England & Wales	77	158	634	265	287	575	2	2

Note : The figures for India and West Bengal have been rounded off to adjust the returns under unspecified status.

STATEMENT III

Marital status classification of 1,000 persons of each sex and quinquennial age group, West Bengal, 1961 and 1921

Age Group	Year	MALES			FEMALES		
		Never Married	Married	Widowed	Never Married	Married	Widowed
1	2	3	4	5	6	7	8
10-14	1961	989	11	....	820	177	3
	1921	950	48	2	459	516	25
15-19	1961	893	105	2	253	731	16
	1921	766	228	6	55	882	63
20-24	1961	577	415	8	75	897	28
	1921	410	572	18	20	879	101
25-29	1961	259	725	16	28	918	54
	1921	155	813	32	12	826	162
30-34	1961	109	868	23	17	881	102
	1921	58	897	45	10	730	260
35-39	1961	53	917	30	9	815	176
	1921	30	913	57	8	613	379
40-44	1961	37	916	47	7	706	287
	1921	25	898	77	7	473	520
45-49	1961	26	907	67	6	592	402
	1921	19	884	97	4	361	635
50-54	1961	22	877	101	4	448	548
	1921	17	856	127	5	246	749
55-59	1961	18	849	133	4	360	636
	1921	15	826	159	4	189	807
60-64	1961	15	797	188	5	240	755
	1921	16	790	194	4	120	876
65-69	1961	15	758	227	4	204	792
	1921	17	754	229	3	120	877
70+	1961	12	674	314	3	112	855
	1921	20	692	288	6	90	904

STATEMENT IV

Proportions of the sexes at each marital status and age group, West Bengal, 1961

Age	Spinsters per 1,000 bachelors	Wives per 1,000 husbands	Widows per 1,000 widowers	Divorced or separated males per 1,000 divorced or separated females
1	2	3	4	5
All ages	704	901	4,059	1,352
10-14	697	13,922	5,596	21,086
15-19	262	5,439	6,378	8,068
20-24	120	2,002	4,185	2,049
25-29	88	1,034	3,533	1,184
30-34	116	775	4,266	1,047
35-39	113	606	4,536	905
40-44	143	567	4,906	1,013
45-49	166	467	4,544	958
50-54	168	415	4,556	984
55-59	176	324	3,781	841
60-64	351	299	4,080	838
65-69	219	204	3,453	963
70+	286	187	3,238	628

A broad view of Social Class mortality indices in Calcutta City

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The differential in mortality in segments of a community is a universal phenomenon which can only be minimised but can never be eliminated. All socialistic governments in the world are trying to achieve the differential as small as possible. Though the death rate in our country has declined in recent years the benefits of this decline enjoyed by the different sectors of the population have not been assessed anywhere as yet. This is time when we should launch such programmes as can lead us to assess how the social disparity is reflected by the mortality differential existing in the various segments of the community. With this end in view, the Indian Statistical Institute conducted a survey in Calcutta city. The results though obtained from a small data are sufficient to reflect what a high differential in death rate still does exist in the population.

The main object of this paper is to work out various mortality indices for the different social classes in the city in order to assess the mortality differential in the various segments of the population. The next step is to determine precisely by what mechanism or in what way one group of people is getting advantage over the other thereby giving clues to the causation of diseases contributing to their prevention. Thirdly, it considers other factors responsible for mortality variation.

The estimates for annual residential* deaths relating to the population for the summarisation of various rates and ratios were obtained from a random sample selected from a listing frame prepared from the mortality data for the first eighteen days of November, 1958 collected from all the Hindu burial grounds and burning ghats and kept in the records of Health Officer, Calcutta Corporation. The population base was estimated by a systematic random sample selected from the listing frame prepared by the National Sample Survey, Government of India for middle class family living survey, 1958.

The principle adopted here for social stratification was one based on a joint consideration of education and per capita monthly income of the household. The population had been classified into the groups as follows :

Social Class	Education		Per capita income
Upper Class :	I) Matric & above	—	Rs. 101 & above
Upper Middle Class	I) Matric & above	—	Rs. 21-100

	ii) Primary but below Matric	—	Rs. 101 & above
Lower Middle	i) Below Primary	—	Rs. 51 & above
Class :	ii) Primary but below Matric	—	Rs. 21-100
	iii) Matric & above	—	Rs. 0-20
Lower Class ;	i) Primary but below Matric	—	Rs. 0-20
	ii) Below Primary	—	Rs. 0-50

* The residential deaths are considered in order to get a pure and true allocated death rate.

The death rates or other indices shown in this paper are subject to number of limitations. The rates and ratios have been calculated here on the basis of a very small number of samples. The breakup of the data by selected causes of death and age groups naturally may involve statistics presented here to large errors of a random character due to the smallness of the sample size. Much effort has been made for the matching of the Socio-economic groups in the population with those of the deaths in registration book, yet the discrepancies involved may depreciate the accuracy of the rates to some extent.

The data treated here were compiled for the winter month of November only. Seasonal factors may, therefore, put undue weightage to some of the diseases, like those of respiratory system, while other diseases such as those of the gastro-intestinal system may show a lower incidence and may give a lower rate. A survey of the type carried out at least over the four different quarters of the year may give correct mortality rates for these groups.

The distribution of households among the four social classes, which has emerged from the preliminary analysis of the data collected in the survey shows certain interesting features.

Table I : Percentage distribution of the households selected for the survey by social class.

Households	Social Class				
	Upper	Upper middle	Lower middle	Lower	All classes
Bengalee	15.0(49)*	23·3(76)	23.9(78)	37.7(123)	99.9(326)
Non-Bengalee	4·1(6)	9·5(14)	28.1(41)	58.2(85)	99.9(146)
All households	11.7(55)	19·1(90)	25.2(119)	44·0(208)	100·0(472)

* Figures in parentheses indicate numbers.

The distribution in the above table shows that the Bengalee population in the city are generally living in a favourable condition in comparison with the Non-Bengalees. About 58 per cent of the households among the Non-Bengalees are in the lower layer of society where amenities of modern life hardly reach. These people live generally in thatched houses in the most insanitary surroundings and live from hand to mouth. Another 28 per cent of the households having a level higher than the above are also not much well off. And this 86 per cent is responsible for making the death rate among the Non-Bengalees higher than that of the Bengalees. Considering the total households, it is to be observed that more than two third of the households, have a very poor living condition, and it is this group which is more vulnerable to disease and death.

We shall now consider the age-specific death rates for the population belonging to different social classes and the factors directly responsible for such class difference in mortality experiences. In table 2 below, are shown age-specific mortality rates for the four social classes and the distribution of population in each social class.

This high mortality in the lower sections of the population as evinced in table 2, is associated with bad housing, over-crowding, mal-nutrition, lack of medical care and insanitary environments, and these are the commonest causes of disease, disability and death. The death rates in the different social classes are, therefore, worth studying and have been analysed in the table 3 below.

Table 3(a) : Death rates by nutritional level.

Stratum	Proportional expenditure on nutritive goods per family					
	0 — .19		.20 — .49		.50 & above	
	Death rate	% of population	Death rate	% of population	Death rate	% of population
Upper & upper middle	9.1	7.8	7.5	8.4	6.7	29.2
Lower middle & Lower	12.2	28.9	7.7	8.4	4·7	17.3
All Combined	11.4	36.7	7.6	16.8	5.9	46.5

(b) : Death rates by per capita room space+

Stratum	Per capita room space					
	.20		.21 — .75		.76 & above	
	Death rate	% of population	Death rate	% of population	Death rate	% of population

Upper & upper middle	14.1	8.6	10.5	20.2	5.0	12.2
Lower middle & lower	24.4	8.5	11.0	30.2	2.2	20.3
All Combined	19.2	17.1	10.8	50.4	4.0	32.5

(c) : Average cost of medical care per 100 disability days.

Stratum	Ratio of deaths per hundred deaths in		Average disability days for the train of events leading to deaths			Average cost of medical care per 100 disability days
	Hospital	Home	Bed	Not in bed	Total	
Upper	66	34	85	235	320	330
Upper middle	37	63	70	830	900	76
Lower middle	27	73	75	449	524	86
Lower	40	60	71	459	530	43

* This is a gross measure arrived at by dividing the total number of rooms in a household by the number of persons inhabited therein.

(d) : * Proportion of infant deaths & ** comparative mortality ratio for some important diseases by degrees of sanitation.

Cause of death	Degrees of sanitation			Total	Percentage
	1	2	3		
Typhoid	1 (33)	3 (100)	5 (167)	9 (100)	15·0
Diarrhœa	3 (82)	4 (109)	4 (109)	11 (100)	18·3
Dysentery	3 (43)	8 (114)	10 (143)	21 (100)	35·0
Ascries	1 (150)	1 (150)	—	2 (100)	3·3
Other infective & parasytic diseases	4 (71)	6 (106)	7 (124)	17 (100)	28 3
All cases	12 (60)	22 (110)	26 (130)	60 (100)	99·9
Percentage	20·0	36·7	43 3	100·0	

* Figures in the parentheses indicate C. M. R.

** C· M. R.$= \frac{\text{Observed death}}{\text{Expected death}} \times 100$

Nutrition : Both the population and the deaths were estimated from the sample population and deaths classified into three categories by the proportion intake of protective foods, such as, fish, milk, eggs etc. Due to smallness of data, the four strata were lumped into two, and death rates were calculated. From

Table 2 : Death rates specific for age and sex and percentage distribution of the population by social class.

Age group (in years)	Death rate by social class								% distribution of the population within each social class							
	Upper		Upper middle		Lower middle		Lower		Upper		Upper middle		Lower middle		Lower	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	male	Female
Under 1	59.6	70.0	95.1	132.0	129.7	188.0	178.3	220.0	1.2	1.4	1.9	1.1	1.8	1,5	1.6	1.2
1-4	5.5	—	6·6	7.8	7.2	12.0	7.8	15.1	3·2	2.6	5.0	5.1	5.2	5.0	5.3	3.8
5-29	.96	.95	1.2	2.4	1.9	3.1	2.6	3.9	26·6	22.9	30.2	22.4	27.6	23.5	33.1	21·2
30-49	—	3.5	4.1	4.1	5.7	5.5	7.8	5.7	15.4	12.4	14.7	8.6	15·3	8.2	15.2	7.7
50-59	10.0	6.4	13.7	9.3	16.0	12.9	19.2	23.8	7.1	2.3	5·1	1.9	4·7	3.0	4.0	3.1
60 & above	36.8	39·0	41·4	41.9	63.6	72.5	82.8	98 8	2.8	2.1	1.9	2.1	2·1	2.1	2.0	1.8
All ages	5.1	7.4	7.7	12.3	10.8	14.0	12.7	16·1	56.3	43.7	58.8	41.2	56.7	43.3	61.2	38.8

Table 4 : *Standardised Mortality Ratio (S.M R.) for **causes of death by Social class**

Causes of death	SOCIAL CLASS											
	Upper			Upper-Middle			Lower-Middle			Lower		
	Regd.D.	Std.D.	SMR	Regd D.	Std.D.	SMR	Regd.D.	Std.D.	SMR	Regd.D.	Std.D.	SMR
Malignant Neoplasm	61	145	42	184	238	77	306	277	110	491	380	129
Dysentery	61	153	39	122	252	48	306	294	104	613	402	152
Hypertertion	248	170	146	306	280	109	306	326	93	368	447	82
Pneumonia	184	265	69	368	435	84	491	451	108	859	693	123
Bronchitis	184	256	71	368	421	87	491	490	100	797	671	118
Gastro-enteritis	...			245	308	79	429	359	119	675	491	137
Nephritis	61	51	119	122	84	145	184	97	189	...	...	...
Asthma	122	119	102	184	196	93	245	228	107	306	312	98
Tuberculosis	122	256	47	245	421	58	552	490	112	920	670	137
Cor.-Thrombosis	61	136	44	306	224	136	306	261	117	306	357	85
Enteric fever	...	...	...	61	126	48	184	146	126	306	201	152
Tetanus	...	...	...	...	...	...	184	146	126	368	201	183

* S.M.R.$= \frac{\text{Regd. death}}{\text{Standard death}} \times 100$. D=Death Std.=Standard.

table 3 (a), there appears to have a differential in the death rates. In both sections of the population, the death rates are consistently higher and that to a significant extent as the nutritional level goes down and down (from right to left).

It can be observed that in the lower middle and lower classes the death rate in the group (0-.19) which takes only a negligible percentage of the important food items, is more than 2·5 times that in the group (·50 & above).

Housing : One of the salient indices for explaining the social condition is the per capita room space available to the inmates of the house, When death rates are calculated by room space per person available, the same trend may be observed as could be found in the case of nutritional intake, namely the rates of them who enjoy the maximum room space, are significantly lower than those of the other groups. The differentials observed are indeed very striking with rates in the lower group about five times higher than that of the most fortunate group. When compared within strata, it can be found that there exists a relatively small differential in stratum I, than that in the other. It may be concluded that overcrowding has got an unwholesome effect on the health of the people.

Medical Care : The health of a country depends very much on the medical and public health facilities avilable to its people. Morbidity, disability and mortality are related to these important items of consideration besides others, to a great extent. It is a known fact that various strata of the community enjoy these facilities in varying degrees. This is one of the primary reasons, why in the lower social classes morbidity and mortality predominate to a larger extent. In this survey, the per capita medical expenditure for the upper classes was found to be Rs. 330/- per 100 disability days. In connection with a particular incidence of death, while the lower classes could spend only Rs. 43·00 on an average, the other intermediate-classes had intermediate positions. The total disability days also showed an upward trend with the fall in the cost of medical care. In this survey among those who gave information on medical care statistics, it is found that 66 deaths out of 100 in the upper classes take place in hospitals or nursing homes. This rate falls with a shift downward in the social class.

Sanitation : The sanitary condition in which people live or spend most of their time certainly has got bearing on health. Generally it is seen that the ill-nourished people in the lower stratum of society, who live under the thatched roofs in most unhygienic surroundings, with little ventilation for air, inadequate sunshine, absence of sewerage system for the disposal of waste products, have to bear very high risk of mortality. Death from infection is, in fact, a result of the prevailing sanitary conditions in which the people live.

The sanitation codes according to the degrees of sanitation may be based on the sanitary condition of the household, such as, water supply type, privy type, general sanitation of the area, its environs and the housing condition, such as, Pucca or Bustee. Three qualitative categories may be considered according to the degree of sanitation such as Higher sanitation-1, Medium sanitation-2 and worst sanitation-3.

When infant deaths from some important diseases are analysed according to the sanitary condition, it is observed that where 26·6% of the infants in the higher sanitation group die in infective and parasytic diseases, 43·3% die in the worst sanitation group. Thus deaths due to important diseases in infants are 1·64 times higher in worst sanitation group in comparison with those in the upper classes. The figures show that the bulk of the deaths (about 66%) due to important diseases are from dysentery and diarrhœa. The differential seems to be very high in case of dysentery also.

The information gathered from the above tables suggest in general, that sanitary conditions, which are highly responsive towards health, are so sensitive in nature that even when a little improvement takes place in the general environmental condition, its effects are multiplied in reducing the whole group of infective and parasytic diseases ; particularly in case of dysentery, the beneficial effect is strongly felt in infant mortality than that in other adult groups. The other facts also bring it to the forefront that, the want of this vital necessity of life upsets the physiological condition so much so that its reflection is once noticed in the differential death rates between different segments of the population. The response function to these characteristics seems to be all the more conspicuous specially in the lower strata.

Rates of mortality due to various causes of death :

As the structure of the population consisting of different social classes varies considerably, some method of standardisation is needed in order that mortality rates in various classes can be more accurately compared. Mortality experience in each social class has been summarised here by means of standardised mortality ratio for certain important diseases. The purpose of the summarised table is to provide a conceptional relation between and the social classes and important causes of death. The table shows the standardised mortality ratio by causes of death and social classes.

S. M. R. shows an upward trend in the cause of lower social classes almost with every cause of death. Hypertention, however, shows an opposite trend. This feature is also observed in the study of data from U. K. Unlike the nature of the cause of death in U. K., gastro-enterities shows an upward gradient as the

social classes go down and down. While in U. K. studies, Nephritis shows almost a uniform ratio everywhere in the social classes, it shows an increasing trend with fall in social level. Coronary thrombosis is strongly correlated to social class, with highest ratio in Class II, and a steep gradient downward to social class IV. Bronchial asthma and cardiac asthma display no appreciable diffential between the social classes.

Infant Mortality

It is a known fact that the risk of death is the greatest in the first year of life. If deaths under this group are clasified into various segments, it is to be noticed that though infant mortality is conditioned by environmental circumstances, it is not so through out the whole period. Whereas the post-neonatal (4W-1Y) infants are readily susceptible to any change in the general living and sanitary conditions, they are not so at the neonatal period. Neo-natal deaths are mainly functions of antenatal, maternal care and diet. Any effective improvement in this segment may come only through medical achievements. It may, therefore, be said that any major improvement in post-neonatal mortality, will give a better index for general sanitation and public health measures, or in other words, the general improvement in the health condition in the country.

Analysis has been made to assess the mortality condition for various segments of the first year of life prevailing in different sections of the community. In finding out the real nature of the mortality conditions, available measures may be intensified in the right direction.

For a comparative study of the infant mortality for the three age segments and the influence of social class variation among them, as well as percentage age distribution of deaths at ages under one year by social classes, comparative ratio of deaths at age under one week, 1-4 weeks, 4W and above, is calculated. In table 5, the ratio shows a gradual upward trend from one social class to another in each specific infant age group.

Table 5 : Comparative ratio* & age distribution of deaths at ages under 1 year by social class.

Percentage age age distribution

	Social Class				
Age Group	Upper.	Upper middle.	Lower middle.	Lower.	All classes
Under 1 week	50 (2)	39 (7)	26 (7)	25 (9)	29 (25)
1-4 weeks	25 (1)	33 (6)	30 (8)	28 (10)	29 (25)
4W & over	25 (1)	28 (5)	44 (12)	47 (17)	42 (35)
Total under 1 year	100 (4)	100 (18)	100 (27)	100 (36)	100 (85)

Comparative ratio					
Under 1 week	32 (2)	112 (7)	112 (7)	144 (9)	100 (25)
1-4 weeks	16 (1)	96 (6)	128 (8)	160 (10)	100 (25)
4-W & over	11 (1)	57 (5)	137 (12)	194 (17)	100 (35)

$$* \text{C. M. R.} = \frac{\text{observed death}}{\text{expected death}} \times 100$$

The percentage age distribution in the above table maintains an inverse relation between neo-natal and post-neonatal periods among the social classes. Most of the infant deaths in the upper classes take place in the neo-natal period. The deaths in the post-neonatal period, which are mostly influenced by the living condition are proportionately much higher in the lower classes than those in the upper.

One of the most important indices of death, called comparative mortality ratio is calculated for infants by selected causes of death for different social classes which may give some indication as to the extent and intensity of infant diseases in different sectors of the population. Whooping cough, bronchitis Pneumonia—these three diseases being much as the common causes of death, and since sometimes they are written in association upon death certificates and assignment of death to one cause rather than another of the three diseases may depend much upon the nasological preferences of the certifying authority are lumped together. An overall picture of the mortality condition from the table shows a steady rise of the ratio in lower social classes.

Table 6 : Comparative Mortality ratio for selected causes of death under 1 year, by social class.

Cause group	SOCIAL CLASS				
	Upper	Upper middle	Lower middle	Lower	All Classes
T. B.	...	...	...	400(1)	100(1)
Wh. cough, Pneumonia & Bronchitis	18(1)	73(4)	127(7)	182(10)	100(22)
Gastro-enteritis	...	86(3)	111(4)	200(7)	100(14)
Congenital malformation	...	200(1)	...	200(1)	100(2)
Asphyxia	100(1)	100(1)	.	200(2)	100(4)
Prematurity	23(1)	93(4)	116(5)	163(7)	100(17)
Accidental injury at delivery	...	...	400(1)	...	100(1)
Meningitis	...		400(2)	..	100(2)
Rickets	...	111(2)	111(2)	166(3)	100(7)
All causes	17(3)	85(15)	119(21)	177(31)	100(70)

Regarding the variation in influence of each individual disease for variation in social classes, it is found that a much higher proportion of deaths due to T.B. still takes place in the lower social group. Deaths due to diseases of the respiratory system, such as Whooping cough, Bronchitis & Pneumonia jump up higher and higher as we go down over the social scale. Gastro-enteritis deaths which in most cases are caused due to bad living condition also show similar trend. Congenital malformation which is the malformatic condition since birth has got little influence on environmental circumstances, and as such there is little variation in the ratio between the social classes. Asphyxia which may be said to be caused due to interference with respiration at delivery has got no valid reason to cause difference in deaths over social classes. It is found to be increasing in the lower social classes. Prematurity depends more or less on the obstetrical causes before birth. The upper stratum generally takes special care as regards diet, nutrition and antenatal care in the gestation period. Naturally, the Upper social classes, as it is observed here, show comparatively a low mortality ratio than the classes which have no opportunity to avail themselves of these facilities. Ricket, which generally takes place due to malnutrition of the mother at pregnancy, is expected to be higher in the lower social classes and the death due to it is actually found to be so. From a study of the C.M.R for England and Wales, 1950 a more or less, consistent similarity has been observed.

Death rates during the first year of life have been calculated for the four social classes. The conventional method of calculating the infant mortality rate by setting the deaths per 1000 live births in the reference period has not been adopted here as data have not been collected in that way beforehand. Method adopted here is that of age-specific mortality rates. For the purpose of comparing the mortality in different groups, gross I. M. R. may serve our purpose. Table-7 below gives the social class differential in rates for the important classes of disease.

Table 7 : I. M. R. from selected causes of death by social class.

	Social Class			
Cause group	Upper	Upper middle	Lower middle	Lower
T.B.	—	—	—	4.0
Wh. cough etc.	18.1	20.8	40.0	40 3
Gasto-enteritis	—	20.8	28.2	29.9
Asphyxia	18.1	9.9	—	8.0
Prematurity	18.1	26.0	28.2	39.8
Other causes	45.7	31.8	28.7	27.6

There is only one case of T. B. death for infants in the sample giving a death rate of 4.0 in the lowest social group. All respiratory diseases combined together show the same gradient as found in C. M. R. making rates in the lower classes about 2.5 times higher than that in the upper ones. Though the difference observed is not so wide for gastro-enteritis, mortality rate is comparatively much higher for the lower stratum. In case of prematurity, an increasing trend is observed with a gradual fall in social status, while an inverse relation for asphyxia cannot be explained in this light. Deaths from other causes due to paucity of data, are lumped together, and a combined rate is calculated which shows a relation directly associated with social class. All these statistics substantiate the fact that the respiratory diseases, prematurity and to some extent gastro-enteritis and infectious diseases are the major causes of infant deaths and operate worsely, in the lower social classes having poor and unhealthy living condition. When compared with the similar table for England & Wales, infant mortality shows a similar feature, but with a much lower differential than can be seen in the present study.

Sex-ratio in cause of death : In planning public health programmes in a community, the authorities have to take into consideration, the incidence of diseases. Sex-ratio in the cause of death, having an important bearing on the differential in the mortality due to different diseases, forms an important study worth considering. In calculating the sex-ratio, the deaths in the two sexes are first standardised in accordance with the population base of one with that of the other ; the male deaths are then proportioned to per 100 those of females, for a particular group of disease. Due to insufficiency of data in each cell as a result of classification into age-sex and disease groups, the causes of death are lumped into more consolidated groups of 11 classes. Even by doing so, many of the cells are left blank, either for males or females making the comparison impossible in many of the age groups.

Table 8 : Sex-ratio in cause of deaths by specific age-groups.

Disease groups	Age-groups (in years)						
	0-1	1-4	5-29	30-49	50-59	60 & above	All ages
1. Infective & parasytic diseases	79	185	64	184	443	61	91
2. Malignant neoplasm	—	—	137	128	29	—	146
3. Diseases of the blood and blood forming organs	—	—	—	600	300	—	33
4. Diseases of the nervous system	—	35	—	248	160	52	141

5. Diseases of the circulatory system	—	7	—	50	100	—	100
6. Diseases of the respiratory system	53	39	48	650	566	126	124
7. Diseases of the digestive system	288	57	115	115	—	—	87
8. Diseases of the genito-urinary system	—	—	—	—	—	40	250
9. Diseases peculiar to early infancy	108	45	138	91	—	—	109
10. Symptomatic and ill defined diseases	103	41	125	120	161	48	96
11. Accidents, poisoning etc.	—	—	—	—	—	—	1000
All causes	93	63	85	174	147	67	125

Generally it is said that cancer is a disease of the old. But it shows that 15.3% of the cancer deaths in the females and 21.0% in the males take place in the age group 5-29 years making the sex ratio in this group as high as 137. While the next group 30-49 years also shows e predominance of male mortality, a considerable fall (29) in the ratio is observed in the higher ages 50-59 years. In case of the infective and parasitic diseases, less number of male in the infant group die only to overweigh the next age groups. From 30 & above males show enormously high deaths in comparison to the other age groups. As regards deaths due to blood and blood forming organs, it can be observed in the age group 30-59 years that men surpass females by about 4.5 times. Such an overwhelming difference cannot be explained in the present circumstances. A higher proportion of male deaths in camparison to the females can also be observed in diseases of nervous system. In circulatory diseases where deaths of the males are about 50% lower than that of the females in the age-group 30-49 years, the next age group 50-59 years shows a ratio of just 100. In respiratory diseases, surprisingly enough, where females die at a rate double than that of the males. In the earlier ages, men more than compensate it by making the proportion 5-6 times higher in the older ages. For diseases of the digestive system male infants show a higher degree of mortality than their female counterpart. The second age group shows an opposite picture. In the other groups of diseases, a tendency for a larger number of death in the males is observed. Diseases due to early infancy show no distinct pattern in the sex-ratio. Symptomatic diseases and diseases ill defined show a disfavourable sex-ratio for the males in the ages 5-59 years. Cases of accidents as observed a few among the males are, however, found to de absent in the females. For respiratory diseases where females fare high, males experience a higher sex-ratio everywhere in ages 30 years and above. In general

malignant neoplasm, diseases of the nervous, respiratory, genito-urinary systems and those of early infancy show a higher sex-ratio for males while infective and parasitic diseases, diseases of the blood and blood forming organs, diseases of the digestive system and other symptomatic diseases show a sex ratio in favour of the males. Circulatory diseases, however, show no differential.

In other studies in Europe, it has been ovserved that chronic illness has a tendency to rise with falling status. The percentages of deaths due to chronic diseases by social classes are analysed.

Table 9 : Percentage of the deaths among the persons affected by chronic illness within the respective social class.

Social class	Persons with chronic illness	Percentage of deaths.
Upper	20 (2) *	10
Upper middle	84 (10)	12
Lower middle	111 (16)	15
Lower	188 (33)	18
All combined	403 (61)	15

* Figures in the parenthesis indicate frequency of deaths.

Table 9 above shows a linearly increasing trend as we go down the social class, making the prercentage of deaths in the lower stratum nearly double than that in the first.

In fine, it may be concluded that a high differential in death rate exists in the population when analysed from different viewpoints. It is a natural phenomenon which may be observed in other developed countries which are already enjoying the benefits of freedom and prosperity since many days past. But while this disparity in other nations is gradually coming down as is observed from their historical studies, we are in the dark in assessing the fruits of our democracy and welfare state unless such studies, are undertaken from time to time. It is high time that studies of such nature, a prima facie need for planning of a welfare state, should be advocated and course of action taken at government level and from research institutions in the field.

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POPULATION GROWTH IN ORISSA

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I. POPULATION AND IT'S GROWTH.

Orissa had a population of 103.03 lakhs at the beginning of the century. It rose to 175.49 lakhs in 1961, thus registering an increase of 72 lakhs during the last sixty years. The rate of growth of population in the State has shown at increasing trend since 1901 except for two breaks, one between 1911 and 1921and the other between 1941 and 1951. During the last decade the rate of growth of population was 1.99 percent and during the decade between 1941 and 1951 the rate of growth was only 0.64 percent. This phenomenal increase in the growth rate is due to appreciable improvement in the survival rate and consequent reduction in the death rate from 29.9 in 1951 to 22.9 in 1961 on account of better public health measures administered during the Five Year Plans.

Density of population in Orissa :

The density of population in orissa was 292 and that of India was 370 according to 1961 census. The density of population of Orissa has increased by about 17% in 1961 than that of the density of population 1951.

The density of population varies enormously between different States. There are many factors that account for this variation in density. There is first of all, the influence of the configuration of land. Areas which are hilly mountainous contain a sparse population, whereas the density of population is high in the plains. The hilly regions in the Northern India has smaller density of population than the plains of Bihar, Uttar Pradesh and West Bengal. Similarly in the State the district of Koraput, Kalahandi, Sundargarh, Phulband, Koonjher have a smaller density than that of the density in the coastal districts. Phulbani is the most thinly populated district in the State with a density 120 per square mile. The district of Koraput, Kalahandi, Sundargarh, Sambalpur, Dhonkanal, Keonjhar have density between 150 to 250, Ganjam, Puri, Mayurbhanj, between 250 and 500 and Cuttack and Balasore above 500 per square mile. Since a majority of people in Orissa depend on agriculture, it is seen that the density is generally higher in the districts where rainfall is, more or less adequate, soil is fertile and facilities for agricultural development are available.

Occupational distribution :

The occupational distribution of the population provides an index of the economic progress of a country. As countries become highly developed, a larger percentage of the population becomes occupied in tertiary industries like commerce, transport, services, etc. and a smaller percentage depends on primary industries like agriculture, forestry etc.

Orissa's occupational pattern shows a relatively un-developed nature of her economy. The vast majority of the working population (73.8 percent) are engaged in agriculture, Household industry and manufacturing constitute 8.0 percent, construction, trade and commerce 3.0 percent and other services 13.39 percent.

Distribution between Towns and Villages :

Like a occupational disrtibution of population, the percentage of people living in the Urban areas is an index of the industrial progress in the State. As the State becomes more and more industrialised, a large percentage of the population will be found to be living in the urban areas. For example, in U. K. about 80 percent of the population live in towns. In France which maintains a balance between agriculture and industries, 52 percent of the people live in the Urban areas.

As compared to these countries, the percentage of population living in towns both in India as well as in Orissa is comparatively small. It is only about 17 percent and 6 percent according to 1961 census, which show the State of industrial backwardness of the State.

Age-groups :

Like many developing countries Orissa has a base heavy population having a large proportion of population in the early ages. 39 percent of the population were in the age-group 0-14 according to 1961 census. In 1951 the percentage was 37. The increase in the proportion of population in this age-group, increases the dependency burden on the earners. Nearly 8 percent of the population are in the older age-group 55 years and above. The percentage of female population in the reproductive age-group 15-44 years has slightly decreased from 45.39 percent in 1951 to 44.05 percent in 1961.

Sex Ratio :

In Orissa females out number males. According to 1961 census there are 1001 females for every 1000 males. In India, as a whole there are only 941 females for 1000 males. Only in the State of Orissa and Kerala there are more females then males. During 1951-60 there was a slight decline of the sex-ratio from 1022 to 1001.

Birth rates :

The birth rate during the decade 1941-50 was around 37. It has been estimated that the birth rate during the decade 1951-60 would be 39 per thousand, and it is presumed that there would not be any appreciable decrease in the birth rate until 1981.

From the age specific fertility rates of Orissa published by the Registrar General, it is seen that the fertility is fairly low in the age-group 13-17 and rises sharply in 18-37 and afterwards falls abruptly to a considerable extent. This large stretch of this fertility in the State shows that a small increase in the age at marriage is not likely to have dempening effect on fertility. Industrialisation and consequent urbanisation which are generally the most potent factors in the decline of fertility are not of immediate importance in bringing down fertility in Orissa. Besides it will atleast take two more decades before family planning, changes the living conditions and habits which will bring about any perceptible change in the level of fertility.

Expectation of life :

The result of high death rate is the extremely low expectation of life in Orissa as compared to the other States. Orissa, Bihar, Assam, Madras, Andhra Pradesh have comparatively lower expectation of life. The expectation of life in Orissa was 40.9 in 1961 and 30.5 in 1951. The annual increase in the expectation of life has been nearly one during the intercensal period 1951-60. This is, perhaps, due to the various public health measures taken up during the first two plans which might have resulted in the decline of mortality rate and appreciable increase in the survival rate.

Future Growth :

In the paper on "population projections of Orissa" published by the Bureau, estimates on the future population for Orissa have been made on the basis of certain assumptions. According to the first assumption the general fertility rate of 0.175 consistant with the birth rate of 39 per thousand around 1961 would ramain unchanged during 1961-81. The second assumption is that the rate of mortality would be decreasing such that the expectation of life at birth would steadily increase from about 41 in 1961 to 50 in 1976 and expectation of life continue at level 50 till 1981. On the basis of these assumptions, it has been estimated that the population of Orissa would be 192·30 lakhs in 1966, 212.28 lakhs in 1971, 235·87 lakhs in 1976 and 263·42 lakhs in 1981.

II. WORKING POPULATION :

According to 1961 census the working population formed 43.66 percent of the population thereby showing an improvement over 1951 rate of 37.37 percent. The participation rate in the State was not very different from India as a whole which the rate of 42.98 percent. The male participation rate was 60·75 percent with is higher than the female participation rate. The all India participation rates for males and females wage 57.12 and 27.96 percent respectively. The State's working population in 1961 was 76.91 lakhs comprising 53.28 lakh males and 23.23 lakh females. The corresponding working population in 1951 was 40·85 lakh

males and 13.88 lakhs females. Rural participation rates for both males and females were higher than the Urban participation rates. This may be due to the seasonal nature of agricultural activities and organisation of work in agriculture, there is a greater call, particularly during peak periods on young people, of women occupied at the same time with their house work, and on older people than in the non-agricultural sector, where the regular and constant rate of activity imposes no on the employment of these marginal categories of manpower.

Workers in agriculture :

The distribution of working population by occupational categories shows a preponderance of cultivators and agricultural labourers. They constituted 70.3 percent and 73·8 percent of the working population in 1951 and 1961 respectively. The proportion of working forces in all other occupational categories except household industry and Manufacturing has decreased in 1961. There was a slight increase in transport, storage and communications. Participation by female population in 1961 has significantly increased under cultivation from 4·74 lakhs to 11.68 lakhs. In other occupations there has not been much change. Since the number and proportion of females workers in agriculture has increased, it is very likely that the number of under-employed persons has also increased in the agricultural sector. At the same time, it may be said that the little increase in the number of workers in agriculture was perhaps, to a certain extent, due to the extention of irrigation and other such facilities during the last decade.

Workers in Industrial Category :

The number of workers engaged in the manufacturing activities in 1951 was 7.65 percent whereas in 1961 the proportion of workers engaged was 8.05 percent. Although the increase of additional workers in the sector was about 46 percent, the increase is not substantial in proportion to the total number of workers in 1961. Further, the male workers in manufacturing have increased by only 4% percent as against the increase infemale workers by 50 percent. As far as the comparatively faster rate of increase in the female warkers is concerned, it is likely that under employment in manufacturing particularly in the household sector might have increased to some extent.

During the First and Second Five Year Plans, an appreciable progress could be achieved in the large and medium industries sector even though Orissa has been one of the rich States of Indian Union and contained large deposits of good quality ironores, high grade coal, manganese chromite, fire clay, lime stone, china clay and buxite. It can be said that a beginning was made for the utilisation of these resources during the Third five Year Plan. Even though there has been a rapid expansion of industrial capacity in Orissa during 1961-66, the additional employment opportunities created in the industrial sector hardly exceeded over 40,000. In fact a major portion of employment in Orissa was pro-

vided in the village industry sector. A substantial portion of the additional workers (1.57 lakhs) who entered the manufacturing sector during the last decade must have been absorbed by these industries, possibly, accentuating at the same time the problem of under-employment in them, In short, the industrial sector could not make much head way in the last decade, and hence, could not provide adequate additional employment opportunities during the period.

Construction, Commerce & Transport :

The number of workers in industrial categories VI and VII i.e, in construction, Trade and Commerce decreased very moderately and in Transport, Storage and Communication sector there had been a slight increase during the last inter-censal period. The decreased in the number of workers registered by the two former categories was 39 percent and the increase in the Transport Storage and communication sector was about 52 percent. These rates have considerably declined in these three categories of the tertiary sector. This trend is true for both sexes. The decline in the proportion of workers in these three categories might have further accentuated the problem of un-employment in the rural areas.

Other Services :

The most outstanding feature depicted by the two censuses is the substantial increase in the number of workers in "Other Services" like public employment, education, health, domestic servants, lawyers etc. As against 7.4 lakhs persons engaged in these services in 1951 there were about 10.26 lakhs workers absorbed in this category in 1961. The additional workers taken-in by these services during the last decade was, therefore, of the order of 3 lakhs, thus registering a significant rate of increase of about 40 percent over the previous census.

Agriculture which has already attained the point of saturation in respect of its employment potential, the position of under-employment must have been further worsened on account of fresh addition of workers to the tune of 18 lakhs. The manufacturing sector did not show any satisfactory growth in the last decade. The proportion of workers in the industrial categories had a very insignificant increase from 7.7 percent in 1951 to 8.0 percent in 1961. This sector absorbed near about 9 0 percent of the total additional workers. On the all India level, however, this proportion has registered a slight increase of 1.6 percent. The proportion of workers in manufacturing at the all India level was 10.6 percent in 1961 whereas the proportion of workers in manufacturing in Orissa is much lower (8.0) than the all India average. This shows the relative industrial backwardness of the State.

The proportion of workers in construction, trade and commerce and transport, storage and communications together was 5.95 percent in 1951. It came

down to 3.01 percent in 1961. The All India proportion came down during the same period from 7.8 percent to 6.7.

Finally, the proportion of workers in "other services" to total workers was 13.54 in 1951 and this came down to 13.39 in 1961. The all-India proportion in this case has also declined though nominally from 10.5 percent to 10.4 percent during the same period.

From the foregoing analysis it is seen that there has been no shift of workers from agriculture to any other occupations inspite of heavy investments in the non-agricultural sectors of the economy on account of the stupendous rate of growth of population in the State. On the contrary the degree of un-employment in agriculture has further increased on account of fresh addition of workers to the tune of 18 lakhs during the decade 1951-60. Thus there has been no structural change in the distribution of workers during the intercensal period, and the structural weakness in the economy continued inspite of our best efforts due to increasing trend of demographic pressure in the State.

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PROSPECTS FOR A DECLINE OF INDIAN FERTILITY

By

DR. K. K. MATHEN

The growth of Indian population was rather slow from ancient times upto about a hundred years back. This is evident from the estimate of Indian population size of 100 to 140 millions in 300 B. C. and about 100 millions in A. D. 1600 and about 250 millions in A. D. 1871. From 1871 to 1966 the population of India has more than doubled itself. The present population growth is causing concern for two reasons. Firstly, the population is increasing at about 10 millons per year and secondly, the country has an overall density of about 400 people per square mile, which is higher than that of any of the other three largest countries of the world, China with a density of 140 per square mile, U. S. A. with 50 per square mile and U. S. S. R. with 30 per square mile are the other three largest countries of the world from the point of view of population size.

The high rate of population growth in the last hundred years has been brought about by a rapid general decline in mortality due to various technological discoveries which have helped to control diseases, famine and pestilence A curb on mortality without a similar curb on fertility has resulted in what demographers call a 'population explosion'. Efforts for improving the standard of living of large sections of our population are rendered more and more difficult by the vast addition in population.

Decline in fertility has been achieved in many Western countries and even in some countries of the East without much intervention from the Government. When the social, cultural and economic conditions of the people reached a certain stage, they themselves tried to control fertility by verious means which were available. During the last one hundred years various improvements have been effected in the method of controlling fertility When people had a determination to control their fertility, they could achieve it with whatever methods were known and available at the time. In England and many European countries the withdrawal method was the most frequently used method for a long period. When more sophisticated methods were available such as condom, diaphragm, pills, etc., people began to use these methods. The important lesson to learn is that there never was an ideal method for all people to use at any time but it was the will of the people that made them successful with the imperfect methods known and available to them.

A close study of the conditions which enabled the Western countries to successfully curtail their fertility reveals that there are certain secondary factors which are responsible for preparing the people to be competent in the known

family planning methods. Industrialisation, Urbanisation, education, women's participation in gainful employment and economic progress are found to have influenced people in controlling their fertility.

The five factors mentioned above are all interrelated. Industrialisation will create more urban societies, will have an effect in raising the economic status of the people and all these are favourable for spreading education. Progress of education and industries when they reach advanced stages will give more opportunities for women's participation in occupations other than agriculture and domestic service. All the above complex of factors generally act together in creating conditions favourable for the decline of fertility.

In the early stages of industrialisation men and women are attracted to industrial labour, as it gives generally more income than agricultural labour. As educational opportunities are more in urban areas, the children of industrial workers who are residing in such areas get more facilities for education than those of the labourers in agriculture. In the early stages of industrialisation opportunities for educated women's participation in gainful occupation in urban environment are limited. But at a later stage, such opportunities are more and women both educated as well as uneducated go into gainful occupations at a higher rate. Education of women in itself has two-fold effect in reducing fertility. It indirectly curtails effective reproductive life by raising age at marriage. It makes the women more competent to learn and practise modern methods of fertility control.

The stage at which education begins to have significant effect on fertility is not the same in different countries. In many developing countries it has generally been observed that just literacy or primary or secondary education does not exert any influence on curtailing fertility. Only when women's education goes upto the university stage, do we notice tangible effect on fertility.

Women's participation in gainful employment is a phenomenon favourable for reducing fertility. Though education of women enhances the opportunities of such participation, in general, the stage of development of the country has very significant part to play in this relationship. In India, for example, the percentage of urban women gainfully employed has declined from 32 p.c. in 1901 to 28 p.c. in 1961, in spite of progress in women's education. Urban population constituted only 11 p.c. in 1901, but in 1961 it constituted 18 p.c. Even though literacy rate has increased from 19 p.c. to 28 p.c. in the decade 1951 to 60 education of women above matriculation stage has progressed very slightly only. This percentage has reached the level of 0.1 only in the present decade.

A fertility survey conducted by the Registrar General of India, in 1961, has revealed the interesting information that in spite of the growth of industri-

lisation associated with large increase in urban population, urban influence has no significant effect on fertility of the people. In 12 states of India surveyed it was noted that in six (Andhra, Madhya Pradesh, Maharashtra, Mysore, Rajasthan and Gujrat) the general fertility rate was higher for the urban population than for the rural population. In the remaining six states in which the survey was conducted (viz. Assam, Bihar, Jammu & Kashmir, Orissa, Punjab and Delhi) the fertility rate was higher for the rural group. The difference between the urban and rural groups was not substantial.

The state of Kerala which is educationally advanced but industrially not advanced also gives some interesting lessons. A demographic survey conducted in eight towns of this state showed that neither economic differences nor caste differences have affected fertility in those towns. The only variable which had some impact on fertility was education of women and that too when it excedeed the matriculation stage.

It took about a hundred years for the decline in birth-rate to catch up with the decline in death-rate after the industrial revolution in the West. In India the death-rate began a fairly rapid decline from the decade 1921-31 onwards. The general death-rate of India which used to fluctuate between 40 and 50 per 1000 came down to 36 in the decade 1921-30 and underwent further decline subsequently. In the succeeding decades it was estimated as 31, 27, 23 and 18 respectively. Since 1961, it is showing evidence of a steeper decline. If we take 1921 as the beginning of mortality decline, we have completed a period of about 45 years of mortality decline. If it takes about hundred years as in Europe for the decline in birthrate to catch up with the decline in death rate, we have to wait more than fifty years.

The question which is engaging the attention of many people in India is whether it is possible to effect a shortcut in the normal course of attaining a decline in fertility. As we have already noted, the effect of the secondary factors on the fertility of the population is not of a magnitude which will produce any substantial decline in the fertility of the Indian population in the near future. The direct approach of making people accept family planning and practise it regularly is a big task which the Government of India has taken up. The work involved in this so enormous that only a small fraction of the population can at present be influenced in this way. What would be the possibilities of a breakthrough if a community which has the advantage of urban influence and better educational facilities is given the benefit of family planning services, is an interesting question.

West Bengal, a leading State in the country from the point of view of education, industrialisation and urbanisation, may be studied to find out the

prospects for the above breakthrough. As the population of Chetla Health Centre Area in Calcutta has a setup to enhance the possibilities of such a breakthrough and as demographic data of this area are available, we are Studying the data from the above point of view.

The Urban Health Centre, Chetla supplements the health services of the Calcutta Corporation to make the area a demonstration centre for teaching public health to students of the All India Institute of Hygiene and Public Health. The Health Centre provides for each of the eight sectors of the Health Centre Area (having a population of about 8000) additional staff to the extent of six health centre staff including medical officers, public health nurse, health visitors, midwife, and sanitary inspector. The centre aims at motivating married couples to practise family planning by giving talks at home and in the clinics run by the centre, besides distributing family planning material, arranging for sterilisation operation and follow-up of the acceptors for giving advice and further assistance.

The crude birthrate of Chetla population has reached a level of 25 per thousand in 1965. In 1964 it was 31 per thousand. As the population of Chetla dose not have a normal age-sex composition, it would be more appropriate to consider the general fertility rate of the population. In 1964 when the crude birth rate was 31, the general fertility rate (number of livebirths per 1000 women of the reproductive age) was 167. There was substantial difference between the bustee (slum) group and the non-bustee group with regard to this rate. The general fertility rate of the bustee population was 186, whereas that of the non-bustee population was only 151. The important lesson to be learnt from here is that the bustee population has still a high fertility rate and neither the influence of urban environment nor the facilities of the health centre has made any significant impact on its fertility but the non-bustee population has reduced its fertility to a great deal. A reduction of about twenty percent is implied in the fertility rate of this group.

Urban population generally begins to control its fertility, in advance of the rural population. One of the ways through which it is done is by postponing the age at marriage. During 1964 it was observed in Chetla that in the childbearing age 70 percent of the women only were married. The fact that 30 percent of the women of childbearing period are either single or widowed is significant. Twentynine percent of women in the age group 20-24 were unmarried, whereas in the same age group in the whole of India only 7 percent were single. A shift in age at marriage by about 5 years in the urban group compared to the general India population is evident.

The effect of education on reducing fertility is a subject of keen interest. The finding of Chetla population in keeping with the fertility survey conducted

in the State of Kerala, in India (already referred to) has been that the fertility is significantly reduced when women had education of a level above that of the school. The average number of children to a women of this group in Chetla was 2.6 compared to 5.7 to the group who had education from primary stage upto matriculation, 5.4 for those who were just literate and 4.4 for those who were illiterate.

Gainful employment outside their homes has been one of the factors associated with reduced fertility in urban societies of the Western countries. Let us examine how this factor acts in the urban population of Chetla. The average number of children born to gainfully employed women above 45 years was 4.0 compared to the overall average of 5.6 in the area. The percentage of women gainfully employed was rather low. In Chetla, the picture is not very encouraging. In the age group over 20 years the percentages of women gainfully employed among the three educational groups of illiterate, literate upto matriculation level were 25, 7 and 21 respectively.

Summary & Conclusion

How far the conditions which helped Western countries to reduce human fertility in the last hundred years would act in India have been examined in this paper. Industrialisation, urbanisation, spread of education, economic development and participation of women in gainful employment outside the home, have all contributed towards preparing married couples to control their fertility. In India, though all these factors operate in the same direction, their force has not begun to be felt is causing a decline in fertility except in very small sections of the population. Even when Government efforts to promote fertility control are persent in an urban population, as that of Chetla Health Centre Area, the results are not at all spectacular. The need for concentrated efforts and new approach and techniques where old methods have failed are indicated.

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Age-Specific Fertility Rate by Age at Marriage and Its Impact on Birth Rate

By

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1. In India a steady high birth rate coupled with a declining mortality rate has accelerated the growth rate resulting, in a population explosion. Consequently, the question of reducing the birth rate by controlling the fertility rate has become a national problem. The marriage-age for the females being low, they start their reproductive life almost simultaneously with the attainment of puberty. Hence, an upward shift in the marriage-age for females, it is widely felt, would result in a reduced birth-rate. In this perspective, the question of postponement of marriage for females as one of the measures of fertility control deserves a close examination.

2. In previous studies (Das, 1964, 1965) it has been observed that the postponement of marriage results in a lateral shifting of reproductivity over the reproductive life, but it does not reduce the birth-rate. It may be that there exists a critical line below which postponement of marriage does not have any appreciable effect on birth rate. The present paper examines the fertility pattern and the birth rate by age at marriage and thereby throws light on the effect of postponement of marriage on these rates rather than attempting to measure the same.

3. The State of Kerala has been chosen for the purpose of this study since "The only State in India where female marriage-age is between 19 and 20 years in Kerala. It was 19·2 years in 1931-41, 19.4 years in 1941-51 and 19·9 years in 1951-61 decade". The data which form the basis of this study were collected through the enquiry "Population, births and deaths" of the 20th round (1956-66) of the National Sample Survey. A brief description of the sampling design and estimation procedure is given in the Appendix.

4. Firstly, age-specific fertility rates for different marriage-ages have been determined with a view to examining whether the fertility curves follow the same pattern for different marriage-ages. Next, the fertility rates have been fitted to a stationary population so as to find out if the marriage age is having any impact on birth-rate.

5. The age-specific fertility rates by marriage-age are presented in Table (1) and Diagram (1). The Diagram shows that the age-specific fertility curve for the marriage-age 'below 15 years' follows a parabolic path. It starts at a high level, rises progressively, attains the highest level in the age-group 20-29 and then declines steadily. The curve for marriage-age 15-19 years also follows a parabolic

path starting at a higher level, remaining at a steady level over the age-group 20-29 and then declining steadily. On the other hand, the fertility curves for marriage-ages 20-24 years and 25-29 years follow almost a linear path, with a negative gradient, the curve for the marriage-age 25-29 being steeper than that for the marriage-age 20-24 years. The fertility curve for the marriage-age 20-24 years starts at a high level and then declines to a fairly high level in the age-group 40-44 years (higher than the minimum of the first two curves). The same for the marriage-age 25-29 years also starts at a very high level and then declines sharply to a level as that of the first two parabolic curves at age 40-44 years.

6. Table (A1) of Appendix gives the age-specific fertility rate (r), the standard error (SE) of r and and the interval $r \pm 2.SE$ for the marriage-ages 15-19 and 20-24 years. The table shows that standard errors of r for the marriage-age 20-24 are higher than the corresponding errors for the marriage-age 15-19. It may be observed that the interval $r \pm 2$ SE of the fertility rate (r) at each of the age groups 35-39 and 40-44 for the marriage age 20-24 does not overlap that for the marriage-age 15-19 years. This clearly indicates that the fertility rate for marriage-age 20-24 years at ages 35-44 is higher than that for the marriage-age 15-19 years even though the difference between them cannot be precisely estimated. The number of mothers being small, the standard errors have not been calculated for marriage-age below 15 years and 25.29 years. Nevertheless, the range of veriation of sub-sample estimates in Table (1) will furnish an idea of the dimensional magnitude of the fertility level. Here it may be noted that the fertility rate at age 30-34 for the marriage-age below 15 is lower than that for the marriage-age 15-19 years and this in its turn is lower than that for each of the marriage-ages 20-24 years and 25-29 years. At age 35 and above, fertility rates for marriage-age below 15 years, 15-19 years and 25-29 years are of the same order of magnitude while all of them are much lower than those for marriage-age 20-24 years.

7. The age-specific fertility rates given in Table (1) were fitted to the 1951 census female life-table population (i) taking into account the incidence of termination of marriage owing to widowhood, divorce and separation as per 1961 census proportion of widowhood, divorced and separated females and (ii) assuming no termination of marriage. The female birth rates thus obtained are presented in Table (2). The table shows that the female birth rate for the marriage-age below 15, 15-19 and 20-24 years are of the same order of magnitude whereas the birth rate for the marriage-age 25-29 years is much lower. Thus it is seen that pushing up of the marriage-age upto early twenty may not produce a marked decline in birth rate. It has already been mentioned in the previous paragraph

1/ S.N. Agarwalla, "Effect of rise in female marriage-age on birth rate in India." World Population Conference, Belgrade, 1965.

that postponement of marriage upto early twenty results in a higher fertility at higher ages. This might be compensating the loss in reproductivity in early reproductive life due to late marriage yielding the same level of birth rate as that in early marriage.

8. The above analysis throws sufficient light to show that by the postponement of marriage upto early twenty a significant dacline in the birth rate cannot be expected if fertility remains uncontrolled. The critical age above which the marriage should be postponed in order to cause a pronounced fall in birth rate lies in the neighbourhood of mid-twenty. Thus the scope for the postponement of marriage being used as one of the effective measures to control birth rate appears to be rather limited. In view of the above interesting results, however, further studies in this line would be worthwhile.

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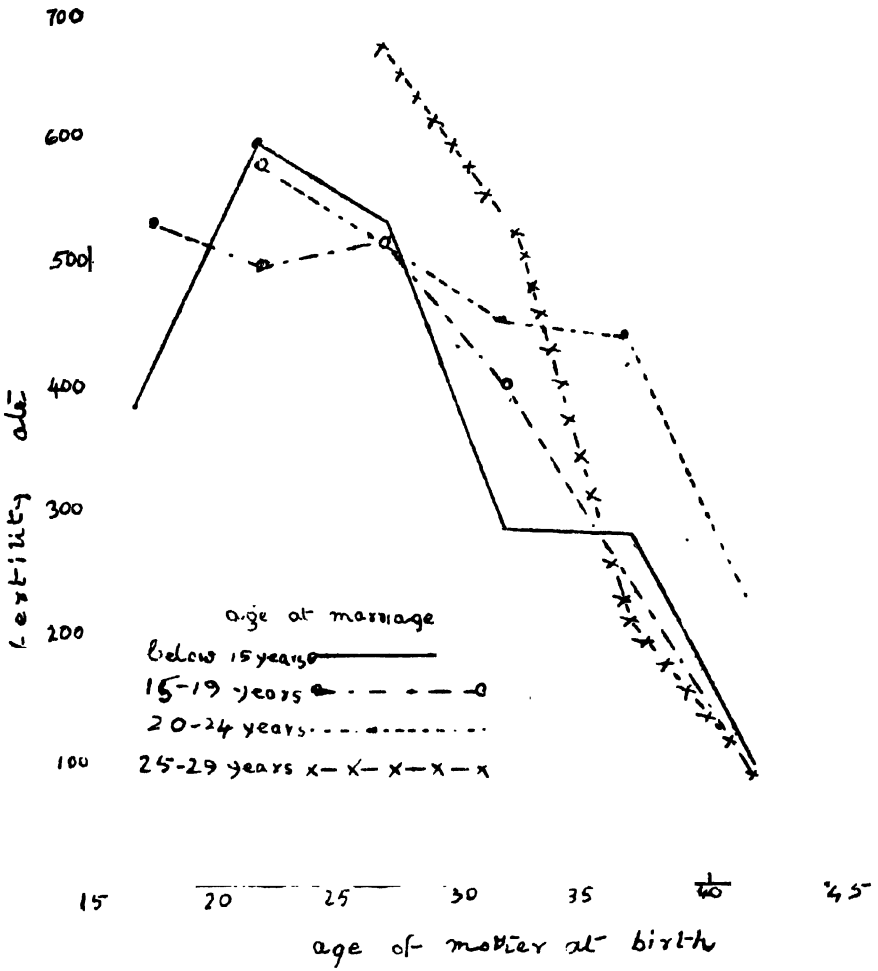
Table (1) : Age-specific marital fertility rate by marriage-age in Kerala rural households, NSS 20th round.

		mother's age at birth					
age at marriage	sample	15-19	20-24	25-29	30-34	35-39	40-44
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
12-14	1	450	429	604	312	375	167
	3	344	704	486	258	182	33
	combined	385	597	534	285	283	93
(no. of mothers)		(26)	(36)	(59)	(65)	(46)	(27)
15-19	1	412	533	534	493	228	72
	3	634	466	447	315	260	86
	combined	532	498	518	401	246	80
(no. of mothers)		(186)	(314)	(302)	(289)	(315)	(182)
20-24	1	—	696	684	482	607	288
	3	—	421	368	438	325	155
	combined	—	579	520	456	441	221
(no. of mothers)			(89)	(102)	(68)	(68)	(52)
25-29	1	—		429	800	286	200
	3	—		808	433	143	—
	combined	—		675	525	214	91
(no. of mothers)				(20)	(20)	(14)	(11)

Table (2) ; Female birth rate by age at marriage in Kerala ; rural households, NSS 20th round.

	age at marriage			
Population	12-14	15-19	20-24	25-29
(1)	(2)	(3)	(4)	(5)
subject to incidence of widowhood, divorce or separation	33.3	56 5	51.4	35.2
assuming no termination of marriage upto 45 years	56.7	59.6	54.8	37.0

Diagram (1) : Age-specific marital fertility rate by marriage-age



APPENDIX

Sampling Design and Estimation Procedure of the Population Enquiry in the National sample Survey

1. The National Sample Survey (NSS) was started by the Government of India in 1950 for collecting data on various types of social, economic and agricultural characteristics. The NSS is a nation-wide, multisubject, integrated and continuing sample survey being conducted by a permanent whole-time survey staff,

using the methods of personal interview and direct physical observation. Being a continuing survey, the NSS is conducted in the form of successive **rounds** of one year duration. The 20th round of the NSS was conducted during July 1965—June 1966. The population enquiry was one of several equiries canvassed during this round.

2. The sampling design of the population enquiry was a stratified scheme with two-stage selection within each stratum. In all fifteen strata were formed by combining neighbouring tehsils with similar population density and crop-pattern. The first-stage units were villages and the second-stage units were households. From each stratum, 24 villages were selected systematically with probability proportional to size, where size was selected to village population as 1961 census. The 24 villages per stratum were selected in the form of four independent sub-samples of 6 villages each. In the second stage, households (on an average 20 per sample village) were selected systematically with pre-specified interval and random start. The over-all design was self-weighting (i.e. requiring only one constant multiplier) for estimation of state total of any characteristic.

3. The present study was based on sub-samples 1 and 3 only as the schedule for sub-samples 2 and 4 were not readily available to us.

4. The State total of a characteristic (say, number of births) was calculated separately for each of the sub-samples 1 and 3 ; the combined estimate based on both the sub-samples was obtained as the mean of the two sub-sample estimates.

The ratio estimate (of say, fertility rate) from sub-sample 1 was obtained as the ratio of the sub-sample 1 estimates numerator and denominator ; similarly for sub-sample 3. However, the combined estimate of the ratio was given by the ratio of the combined estimates of numerator and denominator. The standard errors were estimated on the basis of stratum-wise differences between the sub-sample estimates and these are given in Table (A. 1)

Table (A. 1) : Estimates of fertility rate (r), the standard error (SE) of fertility rate by present age and age at marriage.

age at		age-group					
marriage	item	15-19	20-24	25-29	30-34	35-39	40-44
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
15-19	(r)	532	498	518	401	264	80
	(SE)	53	41	38	38	19	7
	r ± 2SE	426-638	416-580	442-594	325-477	209-284	66-94
20-24	(r)	—	579	520	456	441	221
	(SE)		100	98	58	78	63
	r ± 2SE		379-779	324-716	340-572	285-597	95-347

Summary discussions of papers of the Seminar on General Demographic Problems under the Chairmanship of Dr. P K. Bose, Centenary Professor and the Head of the Department of Statistics, University of Calcutta.

Until and unless there is a considerable improvement in the quality of raw data in the field of Demography, solutions of Demographic with problems will not be so easy, though the President mentioned in his address that there is, at present, a lot of improvement in raw data, it is the personal belief of Dr. Bose that the improvement is not up to the mark. In this connexion he quoted a few lines from Davis's Book.

A] Mr. J. Dutta Gupta : Presented his paper on "Marriage Trends in West Bengal : Universality and Age (Census 1961)."

Open for Discussion :—

1. Mr. M. V. Raman : A trend in upward revision of the age at marriage should be rationalised from the viewpoint of health of the couple.

2. Mr. S Dutta Roy, : The Census data of 1921 were defective due to an epidemic outbreak that year. So number of widows found in the year 1921 should not be compared with that of 1961. Some other Census data should be taken into consideration.

3 Prof : S. P. Mukherjee : The ratio of wives to all females, as considered in the paper, does not indicate the incidence of widowhood alone. Effects of celibacy, divorce and separation will also be mingled up. The author should consider the ratio of wives to all females once married and neither divorced by nor separated (except through death) for their husbands. Secondly, one should study the conditional age distributions in a two-way table showing ages of the married partners to study the inequality of conjugal ages. The difference in the mean ages alone is not revealing.

4. Dr. A. C. Das, : As health condition of West Bengal has improved a lot, a time will come, as it appears from the paper, when the likelihood of being widow will be almost nil. This does not seem practical. So there need not be any fear of rapid proliferation from this declining chance of widowhood.

Reply of Mr. J. Dutta Gupta :

(1) Due to Sarda Act, 1931 Census data were not taken into consideration.

(2) Limitations are there. The paper may be accepted along with these limitations.

B] Prof. S. P. Mukherjee : Presented the paper on 'Differential growths in Hindu, Muslims and Christian populations in India' by Dr. P. K. Bose and Prof. S. P. Mukherjee.

Open for Discussion :

No one made any comment.

C] Dr. K. K. Mathen : Presented his paper on 'Prospects for a decline of Indian fertility'.

Open for Discussion :

1. Mr. S. B. Mookherjee : Secondary factors i. e. urbanisation, industrialisation etc. are not independent of the primary factor viz. family planning. So reduction of birth rate cannot be made only through secondary factors as such. This has been noted in so many western countries. Inspite of great influence of industrialisation, urbanisation etc. upper class adopts family planning earlier while lower class at later stage. So there exists fertility differential among the social classes. That is why family planning should be extended first, while the secondary factors will operate side by side.

2. Mr. Jain : Education with employment among females outside home will also help to reduce the fertility rate.

3. Dr. C. Chandrashekharan : The average number of children (born to an educated class) of the order 2.6 in the whole span of life is less noteworthy. We have to achieve something reasonable in a short period of time.

Reply of Dr. Mathen :

(a) Better education in women will help to adopt family planning better.

(b) If we cannot check fertility rate by the primary factor in Chetla where all the secondary factors exist, it will never be possible to check fertility by the primary factor alone in India where the influence of secondary factors is not much appreciable.

D] Mr. B. Chakravorty : Presented his paper on 'A Broad view of social class mortality indices for Calcutta City'.

Open for Discussion ;

Prof. S. P. Mukherjee : Suitable cause-of-death rates may be derived from an analysis of the date to locate the loading cause of death. If i and j

denote two causes of death. If $\dot{d}_x$ and $\ddot{d}_x$ denote the number of death to persons aged x l. b. d. from these two causes respectively the aggregate potential years of life lost through the operation of these causes are

$$T^1 = \sum_{x} e^{\circ} \; d^1 \qquad T^2 = \sum_{x} e^{\circ} \; d^2$$

sometimes an upper age v (say 65, 70 etc.) can be taken to define

$$T^1 = \Sigma(V-X)\, d^1 \quad \text{and} \quad T^2 = \Sigma(V-X)\, d^2$$

E] Mr. R. N. Behera: Presented his paper on 'Planned Development and population growth in Orissa.

Open for Discussion:

1. Prof S. P. Mukherjee: How does the author get projected populations for age groups 6-11, 11-14 and 14-17 from the Census data?

2. Mr. S. B. Mukherjee: (A) Subject is plan Development and not Demography.

(B) It is not possible at this stage to remove all the regional economic disparity by regional planning. In that case we may be doing away with maximum income from meagre resources; less income means less saving, which in its turn, means less investment in the years to come, as income comes from investment. So in subsequent periods income will be reduced to a considerable extent paving the way for a recession in economy. That is why the thought of regional planning should be driven out.

(C) Rate of growth of population is not necessarily inversely proportional to rate of economic growth.

Reply of Mr Behera:

(1) Sprague's multiplier has been used. The Chairman Mr. Jain further clarified the matter to the questioner.

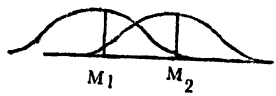
(2) The problem has been attacked from the socialistic viewpoint. Equal distribution of wealth is the fundamental objective in the socialistic pattern of our society.

F] Mr. S. B. Mukherjee: Presented the paper on "Specific fertility by age at marriage and its impact on birth rate' by N. C. Das and A. S. Roy.

Open for Discussion:

1. Mr. S. B. Mukherjee: Due to postponment of marriage, there will be an upward shift of the mean age of child birth as given in the figure (from

M_1 to M_2). It has been noted in so many western countries. If we want to decrease the growth rate of the population making net reproduction rate constant the length of a generation will increase (in an uncontrolled fertility region). Let R_0 be the net reproduction rate, T be the length of a generation and r be the annual growth rate.



We can establish the formula in a stable population.

$$r = \frac{1}{T}(\log_e R_0)$$

Higher value of T (due to upward shift of the age at marriage) will result in lower value of r, R_0 remaining constant. This is a fallacy.

2. Dr. Saxena : (a) Consistency of age-specific fertility curve will not be there due to postponement of marriage.

(b) The length of a generation in a stable population depends on the two factors—

(I) Age-sex composition of married females.

(II) Age-sex specific fertility rates.

So consideration for postponement of marriage in reducing birth rate with the measuring rod 'T' (as by previous commentator) needs careful observation.

3. Mr. Jain : The postponement of marriage in reducing the birth rate should be given more careful thoughts.

Recorders :—Sd/- R. N. Mondal, 6.10.67.

Sd/- A. K. Dhar, 6.10.67.

West Bengal - a Demographic Profile, 1961

By

Shri P. B. Desai.

This paper proposes firstly to direct attention to relevant statistical data for the assessment of the position of the State of West Bengal in the Indian Union and, secondly, to consider inter-district variations of pertinent demographic and economic variabels. We will use data mostly from the 1961 Ceusus of India and supplement them with the secondary data from official statistical publications, like State and All-India Statistical Abstracts relating to the same or an adjacent year.

I : Position of West Bengal in Indian Union

For an idea of the relative position of West Bengal within the Indian Union, we will consistently consider the share of west Bengal in the relevant aggregates for the country as a whole. We give these data in a series of tables in the appendix A.1 to A.7. The data relate to land utilisation, population composition, employment, joint stock companies at work and power consumption.

Bengal and Punjab were the two provinces of the undivided India, whose economies were severely disrupted by the partition of India. It is even possible to view that the impact of disruption was much more telling for West Bengal as compared to Punjab. It is also evident that the strain of partition in terms of chronic immigration over the new international border has continued to create problems for West Bengal.

Inspite of all this, the State of West Bengal appears to have made remarkable progress in rebuilding her economy. Especially notable is the adjustment of jute cultivation within West Bengal to compensate for the loss of the sources of supply of raw jute which went to East Pakistan. The 1961 economy of West Bengal is vastly different from the one with which the State began as a member of the Indian Union in 1950.

West Bengal accounts for only 3 per cent of the geographical area of the Indian Union. Land use distribution, however, indicates that its share in net area sown, as well as in that part of the net area which is sown more than once, is comparatively larger. Larger still is her share in the area under irrigation. The distribution of area according to crops sown, however, indicates that the preponderance of foodgrains is comparatively much greater for West Bengal. 71 per cent of the area under crops is devoted to rice cultivation, while 14 per cent of the area produces other foodgrains, including pulses. West Bengal thus accounts for nearly 13 per cent of area under rice in the country as a whole. Among other crops, jute is the most important, claiming as much as 51 per cent of the

area under jute for the country as a whole. Tea plantations are important both as providing a cash crop and a base for a processing industry. But the nature of farming represented by these plantations is quite different from the remaining bulk of agriculture. On the whole, it is evident that agriculture is a much less diversified economic activity in West Bengal as compared to the rest of the Country.

West Bengal, with three per cent of area, accounts for over 8 per cent of India's population. The density evidently is much higher than in the rest of the country. Among the 16 States, ranged according to density, West Bengal occupies the second position, after Kerala, with a density of 1021 per square mile as campared to only 358 for the country as a whole. If attention is directed to the above proportions for agricultural produce, it will be seen that only in the case of rice the State's share in area under cultivation is higher. But yield of rice per acre is comparatively lower in West Bengal and so its share in actual production would be mucn smaller. In any case, West Bengal accounts for only 4.7 per cent of the land under food crops in India. which is a considerably smaller proportion as compared to its share in the total population.

Referring to the data regarding the composition of population according to different characteristics, it will be seen that the position of West Bengal differs considerably from the aggregate situation in the country as a whole. West Bengal has a greater component of scheduled caste population and smaller one of scheduled tribe population. According to the religion, Muslims form 20 per cent of the State's population as against less than 11 per cent in the country as a whole. Correspondingly, the proportions of both Hindus and the combined group representing the other religions are smaller.

In respect of urbanisation, the position of West Bengal is evidently much better. Proportion urban in its population comes to 24.5 per cent as against only 18 per cent for India. West Bengal's share of the population in the larger towns and cities of India is considerably higher than the above noted share of 8 per cent in the total population. The average population size of towns for West Bengal comes to as high as 46,418 and among the States it occupies in this respect the first position. For the country as a whole, this average measures only 29,236. The evident reason for this is the great conurbation of urban units around Calcutta itself.

If literacy and education are taken to reflect the quality of population West Bengal must be considered as favourably situated. Literacy rate for the State was 29.3% in 1961 as compared to 24.0% for India as a whole, while the State's proportion of educated persons amounted to 9.5% as against only 7%.

Nearly 11% of all educated persons in India were thus found to be living in West Bengal.

An important feature of demographic structure in West Bengal is a comparatively much smaller sex ratio of the population which comes to 878 for the State as compared to 941 for the country as a whole. With regard to age structure, the population of West Bengal appears to be slightly younger. The proportion it claims in the aggregate of persons in 15 to 34 years age-group is 8.3 per cent. The children's group is almost as sizeable in West Bengal as in the country as a whole. Persons in the working age (15-59) form slightly higher proportion of the total in West Bengal. The dependency load is, therefore, somewhat smaller. The relative importance of younger age-groups is also reflected by index of ageing as well as child-woman ratio.

As the data on place of birth indicates, migration content of the population in Wast Bengal is significantly higher. 37.2 per cent of the population in West Bengal were born outside the place of enumeration as compared to the corresponding 33 per cent of the country as a whole. It is notable, however, that the proportion amongst the immigrants of those born outside the State is also much higher for West Bengal. Indeed, of the total number of persons enumerated as having their birth place in Pakistan, nearly 37 per cent were enumerated in West Bengal. Persons born in Pakistan account for nearly 9 per cent of the total population of the State. In the small fraction of population representing those born in other foreign countries, West Bengal claims over 15 per cent. In any case, West Bengal claimed 7.5 per cent of the aggregate comprising persons born in the place of enumeration and as much as 9 per cent of the aggregate number of persons born outside the place of enumeration.

The labour force data of the census indicates that the working force participation rate is considerably smaller for the State as compared to that of the country as a whole. The male participation rate is 54 for the State as compared to 57.1 per cent for the country as a whole. While the corresponding rates for the females are 9.4 per cent only as against 27.9 per cent. But industry-wise distribution of workers appears to be much better for West Bengal. Agriculture accounts for 53.8 per cent of workers in West Bengal as against 69.5 per cent for the country as a whole. In respect of household industry, the West Bengal proportion is comparatively smaller. But manufacturing other than household industry claims as high as 11.4 per cent of workers in West Bengal as compared to only 4.2 percent for the country as a whole. The position of West Bengal can be considered to be favourable also in respect of trade and commerce ; transport, storage and communication ; and other services. In any case, with only 8 per cent of India's population West Bengal accounts for 6.1 per cent of aggregate number

of workers in the country, of 16.5 per cent of workers in manufacturing, other than household industry, 13.0 per cent of those engaged in transport, storage and communications, 11.1 per cent of those in mining, quarrying etc., 9.3 per cent each, of those in other services and construction. Another feature of employment may also be noted in respect of non-agricultural workers. Of the total non-agricultural workers in India, West Bengal accounted for 10.7 per cent but among them 67.4 per cent are reported to be "employees" the corresponding proportion for the country as a whole being only 50.6 per cent. Consequently, the share of West Bengal in the aggregate number of persons reported to be enjoying "employee" status comes to 14.2 per cent.

Data from the non-census sources presented in the tables relate to power, sectoral distribution of employment and joint stock companies at work. In the field of power, West Bengal's share comes to 9.1 per cent of the total power generation in India. Thermal power claims over-riding importance in West Bengal. It accounts for 97 per cent of total power generation in West Bengal as compared to the corresponding around 44 per cent in the country as a whole. Accordingly, the share of West Bengal in thermal power is as high as 20 per cent. A significant feature of the pattern of consumption of electricity in West Bangal is the relative importance of high voltage industrial power, which claims 67 per cent of total consumption in the State as against the corresponding figure of over 59 per cent for the country as a whole. Among other uses of power, domestic consumption is relatively more important in West Bengal.

Sectoral distribution of organised employment for 1960-61 indicates many fields in which West Bengal has much more than its proportionate share in the total employment for the country as a whole. This is a case, for example, in respect of the public sector, industry (i e. employment in registered factories), mining and plantations and also commercial establishment. West Bengal claims nearly 16 per cent of the total central government employment in the country as also of employment in quasi-government organisations. In the field of industry, West Bengal's importance is indicated by the proportion of nearly 19%, it claims in the total employment of registered factories in the country as a whole. The leading industry in both the State and the Country, is textiles. For West Bengal, the domination of jute manufacture in the textile field is evident. Total textile employment of West Bengal comes to 21.5 per cent of the employment in the country as a whole. Relatively speaking, basic metals, metal products and rubber goods industries are comparatively more important in West Bengal. In the field of mining, coal claims overwhelming importance. Over 31 per cent of coal miners of India are in West Bengal. Similarly, tea is the only plantation crop of West Bengal ; it claims 23.3 per cent of total employment of tea plantation in India. For the remaining commercial sectors, the share of West Bengal in all India total comes to 20.2 per cent.

A final reference may be made also to the data pertaining to joint stock companies at work in 1960-61. We have indicated in the table the share of West Bengal in the paid-up capital of different types of joint stock companies. In the aggregate paid-up capital, West Bengal claims as much as 22.4 per cent. The comparative distributions of paid up capital according to different types of industries represented by those companies for West Bengal and India indicate that the share of West Bengal is proportionately much higher in the paid-up capital for companies in the field of railway transport, agriculture and allied activities and tobacco manufacture, leather products, trade (wholesale and retail trade), real estate and also textiles.

The foregoing facts indicate that the level of development of West Bengal compares favourably with the overall situation in the country as a whole. A recent census publication on levels of regional development in India in fact indicates that the proportion of population in the highest of the 4 categories of development into which individual districts were divided, comes to 58 per cent for West Bengal as compared to the corresponding 31 per cent for the country as a whole.* It may be added, however, that this position obtains on account principally of Calcutta and its surrounding cities. In fact, the three districts of Calcutta, Howrah and Hooghly are industrially much more advanced than the rest of West Bengal as the following comparative analysis of district-wise data would serve to indicate.

II : The Districts of West Bengal

From the point of view of physical geography, the truncated State of West Bengal gives an impression of high degree of homogeneity. Apart from the northern, western and south western fringes characterised by highly terrain, the bulk of the State represents a monotonously flat alluvial reverine track, in which monoculture of rice preponderates Land utilisation statistics indicate paucity of forest land in most of the districts. Only in the northernmost districts of Darjeeling and Jalpaiguri and southern districts of 24-Parganas, the area under forest is substantial. In Purulia and Bankura extension of Chhota Nagpur plateau explains the existence of some forests. In the remaining bulk extending from Cooch-Bihar in the north to Howrah in the south, there are indeed no forests. Net area under cultivation varies from district to district from a maximum of 82·1 per cent of total area, recorded according to revenue records to 31·8 per cent for Darjeeling. The net area sown, however, exceeds 70 per cent in Birbhum, Hooghly, Nadia, Murshidabad, Malda, Cooch Bihar and West Dinajpur. Proportion of net area sown more than once is substantial only in the plane districts of Cooch-Bihar, West Dinajpur, Malda, Murshidabad and Nadia. There

* See : Levels of Regional Development in India : Part I-A (i), Census of India, 1961 By A. Mitra, Page 19.

is considerable variation in agricultural productivity between the districts. The yield of rice per standard acre varies, for example, from around 9 maunds in Cooch Bihar to over 15 mounds in Howrah. Lack of diversity of agriculture is reflected in the proportions of area under different crops. Proportion of area under rice is as high as 90 per cent in Bankura and over 80 per cent in 24-Parganas, Midnapore, Purulia, Burdwan and Birbhum. Rice cultivation occupies a smaller proportion of area only in Darjeeling and Jalpaiguri ; in the former district, the other principal crop is tea, while in the latter tea and jute together account for a substantial proportion. Of the remaining districts only in Cooch Bihar a non-food crop, namely, jute, claims some importance. If we consider the proportion of area under all foodgrains, Purulia placed at the top with 98.1 per cent and Darjeeling at the bottom with 64 per cent. From the point of view of crop pattern, the three northern districts appear to form a class by themselves, while among the remaining 13 districts, the only striking departure from the general pattern appears in the case of Calcutta, which is entirely an urban district with no agriculture base.

Considering the size of district population together with the area of the district, Calcutta again stands out as recording by far the higest density among the districts of the State. The area of Calcutta district measures only 0.1 per cent of the State as a whole but its population forms a proportion of 8.4 per cent and so the density amounts to 73,642 per square mile. Among the remaining districts, the variation in density extends from only 497 per square mile for Darjeeling to 3,639 for Howrah. The density is generally low in the south western and the northern districts.

Distribution of population by rural urban residence indicates considerable variations in the degree of urbanisation between the districts. The urban praportion in 1961 varied among the 15 districts (barring the hundred per cent urban district of Calcutta), from a maximum of 40·5 per cent for Howrah to only 4·2 per cent for Malda. Only the three districts surrounding Calcutta, namely, 24-Parganas, Howrah and Hooghly, show a proportion higher than that of the State as a whole. Apart from this, there were three districts Darjeeling, Nadia and Burdwan, for whom the proportion was semewhat higher than for the country as a whole.

If we direct our attention to the proportion of population in towns of the first three size classes (20, 000 + towns), the State proportion amounts to 22.3 per cent ; among the 15 districts it is higher than this in the case only of 24-Parganas, Howrah and Hooghly. The lowest proportion in this respect is claimed by Birbhum, where only 3.2 per cent of the total population lived in 20.000+towns. Further, if we confine attention to population in the cities, we

have, apart from calcutta, only four districts with this category of population ; for Howrah among them the proportion is 31.6 per cent, for 24-Parganas 13.3 per cent, for Birbhum 9.0 per cent and for Midnapore 3.4 per cent. The uneven distribution of urban population is reflected also in the relative share claimed by different districts in the total urban population of the State. Calcutta here claims as much as 34.2 per cent and is followed by 24-Parganas with 23.4 per cent. At the other end, the share of Malda is only 0.6 per cent and of Cooch Bihar 0.8 per cent. Of the total city population in the State, Calcutta accounts for 67.7 per cent, 24-parganas for 17.3 per cent and Howrah for 13.3 per cent.

Consideration further of selected characteristics of population, indicates marked differences recorded by the urban district of Calcutta as compared to the rest of West Bengal. These data further indicate that the three districts surrounding Calcutta record smaller deviations from the corresponding values for Calcutta than the corresponding deviations shown by the remaining districts. Sex ratio, for example, is only 612 for Calcutta, while it is as high as 981 for Bankura. Howrah records in the second place after Calcutta, a ratio of 808. In this connection, it is notable that the northern districts where tea gardening is of considerable importance, recorded smaller sex ratios ; for Darjeeling the ratio was 864, and for Jalpaiguri, 854 while among the remaining districts, the ratio varied from 906 to 981. Similarly, child-women ratio is the lowest at 488 for the Calcutta district and the highest at 899 for Murshidabad. Surprising deviation from the State ratio in this connection is shown by Purulia, which records a ratio of only 595 as against the State ratio of 753. Literacy again is the highest for the Calcutta district and is higher for the three surrounding districts as compared to the remaining 12 districts of the State. The lowest literacy rate of only 13.8 per cent is recorded by Malda, Only 5 districts, including Calcutta, its three surrounding districts and Burdwan, recorded literacy rates higher than of the State as a whole. Of the remaining 11 districts, the literacy proportion for as many as 8, is even smaller than the all India rate of 24 per cent.

Turning now to the distribution of population by place of birth, it will be seen that here again Calcutta stands out as recording the highest proportion of migrants, i.e., all persons born outside the place of enumeration. Migrants constituted in Calcutta a majority of nearly 53 per cent of the total population. The range of variation in this proportion between the remaining districts extends from 25.5 per cent for Murshidabad to 46.2 per cent for Jalpaiguri. This proportion for the State as a whole amounts to 37.2 per cent. Among the districts, the migrant proportion for West Dinajpur is about the same as of the State, for another group of five districts, it is smaller and for the remaining 10, it is higher. Reference may also be made in this connection to the migrants who came

from other states of India. Here, the range of variation in the Proportion extends from only 0.6 per cent for Bankura to as much as 23.2 per cent for Calcutta. The State proportion here, being 16.7 per cent, is exceeded only by the district of Calcutta. Among the remaining districts this proportion is sizeable in the case of Howrah, Jalpaiguri and Darjeeling. It is interesting to refer further to migrants born in Pakistan. The districts in which this category of migrants is substantially represented include Nadia with 29.3 percent, Cooch Bihar with 24.8 per cent, Calcutta with 18.1 per cent, Jalpaiguri with 16.0 per cent, West Dinajpur with 13.0 per cent and 24 Parganas with 12 5 per cent of their population representing immigrants from Pakistan. The incidence of Pakistani immigration is not significant for Purulia and Bankura.

For an idea of the inter-district variation in the character of economic activity we will refer first to the industrial classification of workers in 1961 and then to the data regarding employment in registered factories. The distribution of workers indicates that Calcutta's economy is wholly non-agricultural. The proportion of workers engaged in agriculture, including both cultivators and agricultural labourers, varies from 23.8 per cent for Howrah to 46.2 per cent for Burdwan, to 77 per cent for Bankura, to 82.9 per cent for West Dinajpur and 83.6 per cent for Purulia, at the other extreme. The districts where agricultural activity predominates includes Cooch-Bihar, Dinajpur, Midnapore, Purulia, Birbhum and Bankura. On the other hand, agricultural workers account for less than half the workers in Darjeeling, Jalpaiguri, 24-Parganas, Howrah and Burdwan. Manufacturing activity is correspondingly more important for Calcutta, 24 Parganas, and Howrah. The latter district stands out with the highest proportion of its working force engaged in this activity. In respect of the tertiary proportion of the labour force, Calcutta's 70.6 per cent is followed after a big gap by 33.2 per cent for Howrah. For the State as a whole, the tertiary proportion amounts to 24.3 per cent only. Apart from Calcutta and Howrah, 24-Parganas is the only district which records such a sizeable tertiary sector. Even for Burdwan, the proportion is smaller than for the State as a whole. On the whole, it would be seen that the level of development indicated by labour force distribution is significantly different for Calcutta, its three surrounding districts, Burdwan, Darjeeling and Jalpaiguri as compared to the rest of the State. Calcutta's domination in the field of tertiary sector is striking and it is very well recognised that its overwhelming importance in this respect is derived from the fact that it is by far the most dominant outlet for the export trade in the vast hinterland extending over Bihar, Orissa and most of Uttar Pradesh. For the rest, the proportion constituted by workers in manufacturing industries indicates the relative intensity of development to the higher for Howrah, 24-Parganas, Hooghly and Burdwan only.

Per cent distribution of the number of registered factories again highlights the importance of Calcutta as commercial and industrial Centre. 38.8 per cent

of the total number of factories in West Bengal are located in the district of Calcutta. The share of Howrah here is 19.7 per cent, of 24-Parganas 15.3 per cent, and of Jalpaiguri 5 2 per cent. For the remaining districts, the share is less than 5 per cent, and among them it is less than 1 per cent for Cooch-Bihar, West Dinajpur, Malda, Murshidabad and Nadia. The factories, however, differ in the size of employment and so a further reference may be made to the proportion claimed by each district in total employment in registered factories of the State. This proportion varies from only 0.1 per cent, for Cooch Bihar to 32·5 per cent for 24-Parganas. The districts with less than 1 per cent. share each are West Dinajpur, Malda, Murshidabad, Nadia, Purulia, Birbhum and Bankura. At the other end, 24-Parganas is followed by Howrah with a share of 20.4 per cent, then by Calcutta with 19.1 per cent. The other districts for which the share may be considered sizeable are Burdwan with 8.5 per cent and Hooghly with 10.4 per cent. Average size of employment is quite sizeable for factories in Hooghly, 24-Parganas and Burdwan. In the tea growing districts of Darjeeling and Jalpaiguri, on the other hand, the factories are of moderate size.

For an overall view of the comparative levels of development, two of the above noted variables, namely, proportion of population in urban areas and the proportion of non-agricultural employment deserve special notice. Accordingly we indicate below the order of importance in which these districts are arranged according to the urban proportion and give corresponding proportions of non-agricultural labour force.

The degree of urbanisation and proportion of non-agricultural labour force for different districts of West Bengal.

District	Per cent urban	Per cent non-agricultural workers
Calcutta	100 0	100.0
Howrah	40.5	74.2
24-Parganas	31.8	50.9
Hooghly	26.0	50.0
Darjeeling	23.2	59 6
Nadia	18.4	40.4
Burdwan	18.2	53·8
Jalpaiguri	9.1	53.5
Murshidabad	8.5	36.1
Midnapur	7.7	24.1
West Dinajpur	7.5	17.1
Bankura	7.3	23.0
Cooch Bihar	7.0	18·8
Birbhum	7.0	25.7
Purulia	6.8	16.4
Malda	4.2	35.7
WEST BENGAL	24.5	45·2

According to urban proportion, only the 4 districts of Calcutta, Hooghly, 24-Parganas and Howrah can be considered in relative terms to be developed districts Only for three other districts, the proportion exceeeds 10 per cent., namely, Darjeeling, Nadia and Burdwan. The rest are almost entirely rural districts. The proportion of non-agricultural workers exceeds the corresponding State porporation in the case of as many as 7 districts, including the above four with a high level of urbanisation, and the districts of Darjeeling. Jalpaiguri and Burdwan. Among the latter three districts the non-agricultural proportion of the labour force is so high in Darjeeling and Jalpaiguri on account of the tea processing industry, while for Burdwan the explanation lies in the more recent growth of industries based on mineral resources. The combined view would indicate that the 4 districts of Calcutta, Howrah, 24-Parganas and Hooghly are well placed from the point of view of development, since there is a correspondence between degree of urbanisation and proportion of non-agricultural labour force. There is on the other hand one district for which there is a striking disparity between proportion urban and proportion non-agricultural labour force, namely Burdwan. A partial explanation for this disparity is provided by the relative importance of mining activity, which does not appear to have given rise so far to any sizeable urban centre.

The existing inter-district disparities in the level of industrial activity as well as in the degree of urbanisation are convincingly highlighted by 'the Functional Classification of Towns', attempted by the Registrar General of India.* The basis for this classification is the industry-wise distribution of non-agricultural workers enumerated by the 1961 Census. It will be sufficient here to refer to the broad classification into the main industrial categories of the State's 80 towns and town groups in the first three size classes. These are distributed over the 16 districts of the States, as shown in the appendix table B.12. Calcutta, the largest among them, is classified as a trading Centre. Trading has been its historical role as the Primate City with a vast hinterland stretching across the central, northern and eastern India. It may be noted however that even so Calcutta has a very sizeable industrial sector. As pointed out earlier, Calcutta claims by far the lagrest share in the total number of registered factories in the State, it accounts for nearly a fifth of the State's factory employment and over a fourth of its enumerated working force was engaged in 1961 in manufacturing activity (other than in household industry). Much more important is this trading primate's role in attracting industries to locate in its vicinity and in giving rise thereby to a long series of sattelite industrial cities along the Hooghly. In consequence, Calcutta Metropolitan District presents itself today as one of the world's largest industrial conurbation.

The concentration of almost the entire industry of the State around Calcutta is evident from the above noted table (B.12). Of the 80 towns included

in this table, 40 are classified as manufacturing centres. 34 of them are located within the zone of Calcutta's direct influence ; 19 of them in the 24-Parganas, 5 in the Howrah and 10 in the Hooghly district. Five of the remaining 6 manufacturing centres are located in close vicinity to each other on the State's border with Bihar in the Asansol sub-division of the Burdwan district ; here, we find today the emergence of an alternative industrial complex, thanks very largely to planning. The remaining lone representative of this manufacturing category of towns in the rest of West Bengal is a comparatively small township, Jangipur, in the district of Murshidabad.

'Functional Classification of Towns' by Ashok Mitra, in 'Patterns of Population Change in India 1951-61' Ed. by Ashish Bose, Institute af Economic Growth, Delhi 7.

A. BASIC STATISTICAL DATA*

A. Position of West Bengal in the Indian Union

	India -000 Hectares	%	West Bengal -000 Hectares	%	% Share in India
A-1 Land Utilisation (1958-59)					
Total area according to revenue records	296,054	100.0	8,852	100.0	3.0
Area under forest	51,885	17.5	1,071	12.1	2.1
Area not available for cultivation	46,797	15.8	1,296	14.7	2.8
Other uncultivated area	39,410	13.3	694	7.8	1.8
Current fallows	24,037	8.1	559	6.3	2.3
Net area sown	133,955	45.3	5,232	59.1	3.9
Area sown more than once	19,670	—	860	—	4.4
A.2 Irrigation (1958-59)					
Total area under irrigation	23,420	100.0	1,351	100.0	5.8
Irrigation by Govt. canals	8,387	35.8	391	28.9	4.7
Irrigation by private canals	1,276	5.4	387	28.6	30.3
Irrigation by tanks	4,729	20.2	368	27.3	7.8
Irrigation by wells	6,749	28.8	16	1.2	0.2
Irrigation by other sources	2,288	9.8	189	14.0	8.3

*The author wishes to acknowledge assistance received in compilation of this data from his colleague, Mr. Vir Narain of the Institute of Economic Growth, Delhi.

	India		West Bengal		
	-000 Hectares	%	-000 Hectares	%	% Share in India
A.3 Crop Pattern : Area under different crops - 1962-63	143,500	100.00	6,274	100.00	4.37
Rice	34,787	24.24	4,445	70.85	12.78
Wheat	13,458	9.38	49	0.78	0.36
Jowar	17,748	12.37	2	0.03	0.01
Bajra	10,712	7.47	-	-	-
Other cereals	14,629	10.19	120	1.92	0.82
Total cereals	91,334	63.65	4,616	73.58	5.05
Gram	9,194	6.41	162	2.58	1.76
Tur	2,363	1.65	40	0.64	1.69
Other pulses	11,688	8.14	531	8.46	4.54
Total foodgrains	114,579	79.85	5,349	85.26	4.67
Oil seeds	14,518	10.12	146	2.33	1.01
Cotton	7,973	5.55	-	-	-
Jute	848	0.59	435	6.93	51.30
Sugar	2,291	1.61	31	0.49	1.35
Tea	333	0.23	83	1.32	24.92
Other crops	2,958	2.06	230	3.67	7.78

	India		West Bengal		
	Person	%	Person	%	% share in India.
A. 4 Population composition—1961					
Total population (—000's)	439,235	100.0	34,926	100.0	8.0
Residence : Rural ,,	360,298	82.0	26,385	75.5	7.3
Urban ,,	78,936	18.0	8,541	24.5	10.8
Effective urban class (I + II + III)(-000's)	60,403	14.8	7,804	22.3	12.9
City ,,	35,124	8.0	4,829	13.8	13.7
Scheduled cast population ,,	64,449	14.7	6,890	19.7	10.7
Scheduled tribe population ,,	30.130	6.9	2,054	5.9	6.8
Religion : Hindus ,,	366,527	83.5	27,523	78.8	7.5
Muslim ,,	46,941	10.7	6,985	20.0	14.9
Others ,,	25,767	5.8	418	1.2	1.6

A. 4. Population Composition (contd.)

Education :						
Literate persons all	,,	105.526	24.0	10,226	29.3	9.7
Educated persons all	,,	30,853	7.0	3,303	9.5	10.7
Matriculates and above	,,	6,784	1.5	666	1.9	9.8
Sex : Male	,,	226,293	51.5	18,599	53.3	8.2
Female	,,	212,942	49.5	16,327	46.7	7.7
Ratio (females per 1000 males)	,,	941	—	878	—	—
Age : Children (0-14 yrs)	,,	180,081	41.0	14,291	40·9	7.9
Youths (15-34 ,,)	,	140,639	32.0	11,630	33.3	8 3
Adults (35-59 ,,)	,,	93,326	21.3	7,246	20.7	7.8
Old persons (60+)	,,	24,712	5.6	1,749	5.0	7.1
Persons of working age (15-59 yrs)	,,	233,965	53.3	18,877	54.0	8.1
Dependency ratio (0/00)		875	—	850	—	—
Index of aging 0/0		13.7	—	12.2	—	—
Child-women ratio 0/00		71.9	—	75.3	—	—
Place of birth :						
Persons born in the place of enumeration	(—000's)	294,136	67.0	21,942	62.8	7·5
Persons born in other place		91,877	20.9	5,821	16.7	6.3
Persons born in other districts of the same state		28.817	6.6	1,679	4.8	5.8
Persons born in the state of enumeration		414,830	94.5	29,442	84.3	7.1
Persons born in other states of the Union		14,641	3.3	2,239	6.4	15.3
Persons born in Pakistan		8,308	1.9	3,069	8.8	36.9
Persons born in other foreign countries		1,157	0.3	177	0.5	15.3
Persons born in outside India		9,465	2.2	3,246	9.3	34.3
Total persons born outside the place of enumeration	,,	144,800	33.0	12,985	37.2	9.0
Working Force :						
No. of workers	,,	188,676	43.0	11,580	33.2	6,1
No. of male workers	,,	129,171	57.1	10,040	54.0	7.8
No. of female ,,	,,	59,506	27.9	1,540	9.4	2.6
Industry-wise Distribution of workers :						
I. Agriculture-Cultivators	(—000's)	99.621	52.8	4,439	38.5	4.5

A. 4 Population Composition (contd.)						
II. Agriculture Labourers (—000's)		31,522	16.7	1,772	15.3	5.6
+ I to II	„	131,143	69.5	6,231	53.8	4.8
III. Mining, Quarrying etc.	„	5,221	2.8	578	5.0	11.1
IV. Household Industry	„	12,031	6.4	487	4.2	4.1
V. Manufacturing other than IV	„	7,975	4.2	1,319	11.4	16.5
VI. Construction	„	2,060	1.1	151	1.3	7.3
III to VI	„	27.287	14.5	2,535	21.9	9.3
VII. Trade & Commerce	„	7,654	4.0	872	7.5	11.4
VIII. Transport, Storage & Communication	„	3,019	1.6	392	3.4	13.0
IX. Service	„	18,572	10.4	1,550	13.4	7.9
VII to IX	„	30,245	16.0	2,814	24.3	9.3
Employment Status :						
Non-agricultural workers excepting IV	„	45,502	100.0	4,862	100.0	10.7
Employers	„	2,055	4.5	135	2.8	6.6
Employees	„	23,025	50.6	3,279	67.4	14.2
Single workers	„	16,764	36.9	1,251	25.7	7.5
Family workers	„	3,658	8.0	197	4.1	5.4

	India		W. Bengal		
	No. of Establishments.	Workers. (-000's)	No. of Establishments	Workers. (-000's)	% share W.B. in total workers in India
A. 5. Employment in Selected Sectors - 1960-61					
Public Sector :					
Total	—	7,809	—	775	9.9
Central Govt.	—	2,259	—	356	15.8
State Govt.	—	3,166	—	198	6.2
Quasi-Govt.organisations	—	983	—	157	16.0
Local Bodies	—	1,400	—	64	4.6
Industry :					
Registered Factories	50,095	3,918	4,333	739	18.9
Food (except Beverages)	15,130	557	987	61	11.0
Textiles	5,555	1,206	270	260	21.5
Paper & paper products	256	82	50	13	15.9

A. 5 Employment in Selected Sectors—1960-61 (cotd.)

Printing etc.	3,112	108	251	17	15.8
Rubber & Rubber goods	385	39	44	24	61.2
Chemicals & Chemical products	1,498	146	218	23	16.0
Non-metalic minerals	2,080	193	105	21	10.7
Basic metals	1,287	178	356	78	44.1
Metal products	2,722	135	613	46	34.0
Machinery manufacture	3,770	215	270	45	20.8
Mining :					
Total	3,016	671	—	131	19.5
Coal	851	411	—	129	31.3
Plantations :					
Total	97,685	1,224	303	197	16.1
Tea	8,934	845	303	197	23.3
Commercial Establishments-					
Total	1602,952	2,069	211,188	417	20.2
Shops	1348,028	1,056	190,042	186	17.6
Restaurants and Theatres	90,153	332	10,644	35	10.4
Other establishments	164.771	681	10,502	198	28.9

A. 6 Joint stock companies at work, 1960-61

	India			W. Bengal			
	No.	paid up capital (Rs. 000)	%	No.	Paid up capital (Rs. 000)	%	%share in India
Agriculture & allied activities	1283	462,005	2.54	643	237,543	5.82	51.5
Mining and quarrying	873	1,344,160	7.39	579	300,930	7.37	22.4
Food stuffs, textiles, leather etc.	10111	12,074,226	66.39	3964	2,315,969	56.75	19.2
Sugar industries	209	442,053	2.43	60	60,283	1.48	13.6
Tobacco	58	197,327	1.09	26	168,513	4.13	85.4
Textiles	1433	2,347,803	12.36	458	561,371	13.75	25.0
Leather & leather products	148	39,604	0.22	60	16,852	0.41	42.6
Iron & steel (basic Mfs.)	505	3,791,485	20.85	363	352,914	8.65	9.3
Chemical & chemical products	1562	1,189,402	6.54	648	175,002	4.29	14.7
Products of petroleum & coal	32	292,804	1.61	12	1,459	0.04	0.5
Manufacture of cement	33	415,206	2.28	9	14,116	0.35	3.4

A. 6 Joint stock companies at work. 1960-61 (contd.)

Construction and utilities	669	541,917	2.98	199	94,508	2.32	17.4
Commerce and trade (total)	9461	2,891,271	15.90	3817	958,217	23.48	33.1
Trade (wholesale and retail)	5693	1,157,788	6.37	2513	499,818	12.25	43.2
Real estate, land & estate co.	687	279,540	1.54	462	147,077	3.60	52.6
Insurance co.	258	239,215	1.31	90	32,898	0·81	13.8
Banking & other financial co.	1839	909,017	5.00	362	192,329	4.71	21.2
Transport & communications (total)	1764	610,249	33.56	432	91,987	2 25	15.1
Transport by water	113	439,607	2.42	65	46,812	1.15	10.6
Transport by road	1351	89,345	0.49	227	8,498	0.21	9.5
Railway transport	14	23,617	0.13	11	18,914	0.46	80.1
Community & business services	613	96,134	0.53	353	42,561	1.04	44.3
Personal and other services	1375	165,470	0.91	576	39,622	0.97	23.9
GRAND TOTAL :	26149	18,185,432	100.00	10563	4,081,337	100.00	22.4

		India	%	W. Bengal	%	% of India
A. 7. Power. 1962--63						
Power generation	Total (K.W.)	5,779,795	100.0	526,910	100.0	9.1
i) Steam	,,	2,536,343	43.9	511,150	97.0	20.2
ii) Oil	,,	327,152	5.7	8,552	1.6	2.6
iii) Hydro	,,	2,916,300	50.4	7,208	1.4	0.2
Consumption of Electicity Total in million (K.W.H.)		18,679	100.0	3,043	100.0	16.3
i) Domestic heat & small power (K.W.H·)		424	2.3	90	3.0	21.2
ii) Domestic lights & Fans (K.W.H.)		1,494	8·0	324	10.6	21.7
iii) Commercial heat & small power (K.W.H.)		273	1.5	30	1.0	11.0
iv) Commercial lights & fans	,,	775	4.1	101	3.3	13.0
v) Industrial power low & medium	,,	2,007	10.7	186	6.1	9.3
vi) Industrial power (high voltage)		11,103	59.4	2,035	66.8	18.3

A. 7 Power. 1962-63 (contd.)

vii) Public lighting	(K.W.H.)	245	1.3	26	0.9	10.6
viii) Traction	,,	724	3.9	154	5.1	21.3
ix) Irrigation	,,	1,104	5.9	3	0.1	0.3
x) Public waterworks, sewage pumping	,,	531	2.9	95	3.1	17.9

B. The District of West Bengal—Comparative position

B. 1 Area, population, density and population growth for 1951-61

	Area		Population		Density	Growth rate 1951-61
	Sq. M.	%	No.	%		
Darjeeling	1160	3.4	624,640	1.8	497	35.9
Jalpaiguri	2407	7.1	1,359,292	3.9	570	48.3
Cooch Behar	1289	3.8	1,019,806	2.9	776	52.4
West Dinajpur	2052	6.1	1,323,797	3.8	642	35.5
Malda	1436	4.3	1,221,923	3.5	878	30.3
Murshidabad	2056	6.1	2,290,010	6.6	1,105	33.5
Nadia	1514	4.5	1,713,324	4·9	1,135	49.6
Calcutta	40	0.1	2,927,289	8.4	73,642	8.5
24-Parganas	5285	15.6	6,280,915	10.0	1,114	40.8
Hooghly	1216	3.6	2,231,418	6.4	1,841	39.1
Howrah	575	1.7	2,038,477	5.8	3,639	26.5
Midnapore	5258	15.5	4,341,855	12.4	826	29.3
Purulia	2415	7.1	1,360,016	3.9	565	16·3
Birbhum	1757	5.2	1,446,158	4.1	830	35.5
Burdwan	2716	8.0	3,082,846	8.8	1,139	40 7
Bankura	2653	7·9	1,664,513	4.8	629	26.2

B. 2 Land utilisation 1958-59

	Total	% Area					%
		Forest	Net available for cultivation	Other Uncultivated	Current Fallow	Net area sown	Area sown more than once
Darjeeling	100.0	37.9	23.5	5.8	1.0	31.8	17.0
Jalpaiguri	100.0	23.7	17.1	10.6	1.3	47.3	4.4
Cooch Behar	100.0	—	13.8	8.1	0.6	77.5	15.9

B. 2 Land utilisation 1958-59 (contd.)

West Dinajpur	100.0	0.2	11.5	4.9	1.0	32.1	19.3
Malda	100.0	0.3	10.0	4.7	13 3	71.7	20.2
Murshidabad	100.0	neg	14.1	6.0	6.3	73.6	30.4
Nadia	100.0	neg	14.8	7.2	4.6	73.4	35.0
Calcutta	—	—	—	—	—	—	—
24-Parganas	100.0	29.0	17.6	6.5	2.6	44.3	6.5
Hooghly	100.0	neg	19.8	3.5	4.1	72.6	7.6
Howrah	100.0	—	24.1	2.8	9.0	64.1	9.7
Midnapore	100.0	10.7	10.2	6.9	8.0	64.2	4.5
Purulia	100.0	13.0	14.9	22.0	16.1	34.0	2.6
Birbhum	100.0	0.7	15.7	3.5	6.1	74.0	7.0
Burdwan	100.0	2.1	19.7	6.0	4.9	67.3	4.0
Bankura	100.3	19.7	6.0	11.8	15.2	47.3	4.7

B. 3 Land utilisation, relative shares of each district, 1958-59

	Share of the district in W. Bengal						
	Total	Forest	Net available for cultivation	Other Uncultivated	Current Fallow	Net area sown	Area sown more than once
Darjeeling	3.5	11.0	5.6	2.6	0.5	1.9	1.4
Jalpaiguri	7.0	13.6	8.1	9.4	1.4	5.6	3.1
Cooch Behar	3.8	—	3.6	3.9	0.4	4.9	6.2
West Dinajpur	6.3	0.1	4.9	3.9	1.2	8.7	12.4
Malda	4.1	0.1	2.8	2.4	8.6	5.0	8.5
Murshidabad	6.1	neg	5.9	4.6	6.1	7.5	19.0
Nadia	4.4	neg	4.5	4.0	3.2	5 5	15 9
Calcutta	—	—	—	—	—	—	—
24-Parganas	16.6	39.8	20.0	13.7	6.8	12.4	11.2
Hooghly	3.5	neg	4.8	1.6	2.3	4.4	2.8
Howrah	1.6	—	2.7	0.6	2.3	1.8	1.6
Midnapore	15.4	13.5	10.7	13.5	19.5	16.7	7.1
Purulia	7.0	7.6	7.1	19.7	18.0	4.0	1.9
Birbhum	5.1	0.3	5.5	2.3	5.0	6.4	3.7
Burdwan	7.9	1.4	10.6	6.1	6.1	9.0	3.2
Bankura	7.7	12.6	3.0	11.7	18.6	6.2	2.0

B. 4 Irrigation—1960-61

	% Share in the State of area irrigated by source						% area irrigated by source				
		Govt.	Private					Govt.	private		
	Total	canal	canal	Tank	Well	Others	canal	canal	Tank	Well	Other
Darjeeling	1.7	0.2	0.4	—	—	10.6	4.3	6.8	—	—	88.9
Jalpaiguri	5.3	2.5	15.2	0.3	12.3	0.2	13.6	81.9	1.4	2.7	0.4
Cooch Behar	0.9	—	1.0	—	47.3	0.6	—	31.7	—	58.5	9.8
West Dinajpur	1.2	—	1,9	2.1	1.3	0·4	—	45.2	49.2	1.3	4.3
Malda	1.2	—	1.7	2.6	—	0.1	—	40.0	59.3	—	0.7
Murshidabad	6.5	7.0	4.1	7.7	—	8.9	30.9	18.0	32.1	—	19.0
Nadia	0.6	—	1.4	0,1	—	0.9	—	70.5	6.3	—	23.2
Calcutta	—	—	—	—	—	—	—	—	—	—	—
24 Parganas	4.3	—	12.9	1.9	—	0.4	—	86.8	11.9	—	1.3
Hooghly	7.0	7.0	7.0	3.4	1.8	14.2	29.2	28.8	13.2	0.3	28.5
Howrah	1.8	0,1.8	4.6	0 2	—	2.9	1.2	73.4	2.5	—	22.9
Midnapore	20.5	11.0	33.7	11.2	17.9	31.5	15.4	47.1	14.9	1.0	21.6
Purulia	6.0	—	0.2	21.8	3.3	0.1	—	0.9	98.2	0.6	0.3
Birbhum	17.2	30.4	5.1	16.4	1.0	17.8	51.2	8.5	26 0	0.1	14.2
Burdwan	16.9	38.8	4.8	10.3	7.9	9,9	66.5	8.1	16.6	0.6	8.2
Bankura	8.9	3.0	6.0	22.0	7.2	2.0	9.7	19.2	67.1	0.9	3.1

B 5 Percentage distribution of gross areas sown according to crops 1960 61

	% area under various crops							
	Foodgrains		Other food					
	Total	Rice	grains	oil seeds	Jute	Tea	Others	All
Darjeeling	64.0	29.8	34.2	0.9	1.8	24 6	8.7	100.0
Jalpaiguri	65.2	61.3	3.9	2,6	11.5	17.6	3.1	100.0
Cooch Behar	74.5	69.1	5.4	3.2	14.7	—	7.6	100.0
West Dinajpur	82.8	75.7	7.1	5.2	8.6	—	3.4	100.0
Malda	84.5	51.5	33.0	4.7	5.8	—	5.0	100.0
Murshidabad	80.9	50.1	30.8	5.2	8.9	—	5.9	100.0
Nadia	81.4	47.1	34.3	5.4	6 4	—	6.8	100.0
Calcutta	—	—	—	—	—	—	—	—
24-Parpanas	91.1	81.6	9.5	0.5	3.3	—	5.1	100.0
Hooghly	80.6	70.6	10.0	0.4	8.6	—	10.4	100.0
Howrah	92.5	74.2	18.3	—	3.3	—	4.2	100.0

B. 5 Percentage distribution of gross areas sown according to crops 1960-61 (contd.)

Midnapore	95.1	85.5	9.6	0.5	0.8	—	3.6	100.0
Purulia	98.1	88.1	10.0	0.7	—	—	1.2	100.0
Birbhum	94.3	79.9	14.4	0.8	—	—	4.9	100.0
Burdwan	94.0	86.5	7.5	0.6	1.3	—	4.1	100.0
Bankura	95.6	90.3	5.3	0.8	0.3	—	3.3	100.0

B. 6 % Share of districts in the total State area under defferent crops—1960-61

	% Share of the districts in the state under various crops						
	Total food grains	Rice	Other food grains	Oil seeds	Jute	Tea	Total
Darjeeling	1.3	0.7	4.2	0.7	0.7	66.3	1.8
Jalpaiguri	3.7	4.2	1.3	5.7	12.3	33.7	4.9
Cooch Behar	3.7	4.2	1.6	6.5	14.0	33.7	4.4
West Dinajpur	7.8	8.6	4.0	19.4	15.4	—	8.2
Malda	5.5	4.0	12.8	12.2	7.2	—	5.7
Murshidabad	8.8	6.5	20.0	22.3	16.4	—	9.5
Nadia	6.9	4.8	17.2	18.0	10.3	—	7.3
Calcutta	—	—	—	—	—	—	—
24-Parganas	12.4	13.3	7.9	2.9	8.6	—	11.9
Hooghly	4.1	4.83	3.0	0.7	8.2	—	4.4
Howrah	2.0	1.9	2.5	—	1.4	—	1.9
Midnapore	17.1	18.5	10.2	3.6	2.7	—	15.6
Purulia	4.8	5.2	2.9	1.4	—	—	4.2
Birbhum	6.6	6.7	6.0	2.2	—	—	6.1
Burdwan	9.1	10.0	4.3	2.2	2.4	—	8.4
Bankura	6.2	7.1	2.1	2.2	0.3	—	5.7

B. 7 Distribution of district population by residence (rural=urban)—1961

	% Population in				Share in W. Bengal			
	Rural	Urban	20,000+ towns	Cities	Rural	Urban	20,000+ towns	Cities
Darjeeling	76.8	23.2	21.0	—	1.8	1.7	1.7	—
Jalpaiguri	90.9	9.1	7.2	—	4.7	1.4	1.3	—
Cooch Behar	93.0	7.0	4.1	—	3.6	0.8	0.5	—

B. 7 Distribution of district population by residence (rural=urban)—1961 (contd.)

West Dinajpur	92.5	7.5	4.5	—	4.6	1.2	0.8	—
Malda	95.8	4.2	3.7	—	4.4	0.6	0.6	—
Murshidabad	91.5	8.5	4.8	—	7.9	2.3	1.4	—
Nadia	81.6	18.4	17.9	—	5.3	3.7	3.8	—
Calcutta	0.0	100.0	100.0	100.0	0.0	34.2	37.5	60.7
24-Parganas	68.2	31.8	29.5	13.3	16.2	23.4	23.8	17.3
Hooghly	74.0	26.0	23.7	—	6.3	6.8	6.8	—
Howrah	59.5	40.5	39.6	31.6	4.6	9.7	10.4	13.3
Midnapore	92.3	7.7	5.8	3.4	15.2	3.9	3.2	3.0
Purulia	93.2	6.8	3.5	—	4.8	1.1	0.6	—
Birbhum	93.0	7.0	3.2	—	5.2	1.2	0.6	—
Burdwan	81.8	18.2	14.8	9.0	9.6	6.6	5.8	5.7
Bankura	92.7	7.3	5.6	—	5.8	1.4	1.2	—

B. 8 Selected characteristics of population—1961

	Sex Ratio	Child women ratio	% literate	% Scheduled castes	% Scheduled tribes	Labour Force Participation rates All	Male	Female
Darjeeling	864	730	28.7	13.2	15.4	42.6	53.4	30.1
Jalpaiguri	854	869	19.2	30.8	26.1	38.4	54.9	19.2
Cooch Behar	890	871	21.0	4.7	0.9	31.8	56.8	3.7
West Dinajpur	906	858	17.1	21.6	12.8	32.7	56.5	6.5
Malda	965	863	13.8	13.4	8.1	32.8	53.4	11.5
Murshidabad	974	899	16.0	12.3	1.4	29.0	51.1	6.3
Nadia	948	829	27.2	20.4	1.3	27.2	49.5	3.6
Calcutta	612	488	59.3	4.3	0.1	40.4	61.4	6.1
24 Parganas	866	760	32.5	24.3	1.9	29.4	52.2	2.9
Hooghly	892	772	34.7	19.9	4.0	30.5	51.1	7.5
Howrah	808	731	36.9	14.7	0.3	30.9	53.7	2.6
Midnapore	952	736	27.3	13.0	7.6	32.4	52.5	11.3
Purulia	973	595	17.8	14.8	19.3	48.7	58.7	38.3
Birbhum	973	820	22.1	29.1	7.4	31.2	52.4	9.5
Burdwan	858	748	29.6	24.4	5.8	33.7	54.9	9.0
Bankura	981	700	23.1	29.6	10.4	36.4	53.7	18.8

B. 9 Distribution of population by place of birth—1961

	Born in place of enumeration	Else where in the district	In other district of State	In the State	Out side the state	In other countries	Born in Pakistan	Born in other countries except Pakistan	All born outside the place of enumeration
Darjeeling	61.9	11.0	2.2	75.1	10.7	14.2	6.1	8.1	38.1
Jalpaiguri	53.8	12.8	2.5	69.1	11.7	19.2	16.0	3.2	46.2
Cooch Behar	58.2	12.6	1.1	71.9	2.9	25.2	24.8	0.4	41.8
West Dinajpur	62.8	16.5	2.7	82.0	4.6	13.4	13.0	0.4	37.2
Malda	70.9	19.3	1.6	91.8	2.5	5.7	5.3	0.4	29.1
Murshidabad	74.5	18.8	2.7	96.0	0.9	3.1	2.8	0.3	25.2
Nadia	54.1	10.6	4.1	68.8	1.6	29.6	29.3	0.3	45.9
Calcutta	47.3	—	10.6	57.9	23.2	18.9	18.1	0.8	52.7
24 Parganas	59.6	17.6	4.9	82.1	5.2	12.7	12.5	0.2	40.4
Hooghly	61.1	16.4	9.3	86.8	7.1	6.1	5.9	0.2	38.9
Howrah	62.4	16.7	6.5	85.6	10.2	4.2	3.9	0.3	37.6
Midnapore	69.6	25.5	2.0	97.1	1.9	1.0	1.9	0.1	30.4
Purulia	72.7	21.0	2.4	96.1	3.4	0.5	0.4	0.1	27.3
Birbhum	72.1	18.8	4.4	95.3	2.8	1.9	1.5	0.4	27.9
Burdwan	61.7	16.9	7.2	85.8	9.3	4.9	4.7	0.2	38.3
Bankure	71.0	23.3	4.1	98.4	0.6	1.0	0.9	0.1	29.0

B. 10 Industry classification of workers—1961

	Argiculture	Household Industry	Manufacturing Industries	Secondary Sector	Trade & Transport	Services	Tertiary Sector
Darjeeling	40.4	1.7	1.8	35.6	8.8	15.2	24.0
Jalpaiguri	46.5	1.1	1.5	37.3	7.2	9.0	16.2
Cooch Behar	81.2	2.4	1.6	5.2	5.7	7.9	13.6
West Dinajpur	82.9	2.3	1.6	4.8	4.9	7.4	12.3
Malda	64.3	12.8	2.0	17.4	4.6	13.7	18.3
Murshidabad	63.9	11.0	3.1	18.7	5.8	11.6	7.4
Nadia	59.6	9.0	5.4	19.2	19.2	11.5	21.2
Calcutta	0.0	8.0	25.2	29.4	35.6	35.0	70.6
24 Parganas	49.1	2.7	21.1	26.3	11.4	13.2	24.6
Hoogly	50.0	4.2	19.4	27.2	11.5	11.3	22.8
Howrah	23.8	3.2	36.1	43.0	18.6	14.6	33.2

B. 10 Industry classification of workers—1961 (contd.)

Midnapore	75.9	5.4	2.6	9.8	4.8	9.5	14.3
Purulia	83.6	3.1	1.9	7 8	3.9	4.7	8.6
Birbhum	74.3	4.7	2.9	10.8	4.5	10.4	14.9
Burdwan	46.2	3.0	11.1	31.7	9.5	12.6	22.1
Bankura	77.0	5.8	2.8	11,2	3.8	8.0	11.8

B. 11 Registered factories—No. of establishment and employment—1961

	No. of factories	District as % of the State	No. of workers	Workers in the district as % of the State	Average no. of workers per factory
Darjeeling	171	3.9	8,877	1.3	52
Jalpaiguri	226	5.2	20,488	2.9	91
Cooch Behar	13	0.3	525	0.1	40
West Dinajpur	33	0.8	1,695	0.2	51
Malda	6	0.1	106	—	18
Murshidabad	14	0.3	1,339	0.2	96
Nadia	25	0.6	3,249	0.5	130
Calcutta	1,700	38.8	134,207	19.1	79
24 Parganas	672	15.3	228,542	32.5	340
Hooghly	156	3.6	72,888	10.4	467
Howrah	864	19.7	143,417	20.4	166
Midnapore	103	2.4	16,972	2.4	165
Purulia	60	1.4	2,812	0.4	47
Birbhum	74	1.7	5,040	0 7	68
Burdwan	199	4.5	59,794	8.5	300
Bankura	61	1.4	2,870	0.4	47

Towns and Town-groups with population of 20,000 or more in different districts of West Bengal.

District	Town or town group	Population 1961	Function
Calcutta	Calcutta	2,927,289	Trading
24-Parganas	South Subarban Town group	341,712	Manufacturing
	Bhatpara	147,630	Manufacturing
	Kamarhati	125,457	Manufacturing
	South Dum Dum	111,284	Manufacturing
	Baranagar	107,837	Manufacturing

Towns and Town-groups with Population of 20,000 or more in different districts of West Bengal. (Contd.)

District	Town or town group	Population 1961	Function
	Panihati	93,749	Manufacturing
	Titagar	76,429	Manufacturing
	Kanchrapara	68,966	Manufacturing
	Ashoknagar-Habra town group	64,716	Trading
	Barrackpore	63,778	Manufacturing
	Kasba town group	62,935	Service
	Barasat-Nabapally town group	61,621	Service
	Naihati	58,457	Manufacturing
	North Barrackpore	56,683	Manufacturing
	Bashirhat	53,943	Service
	Halisahar	51,423	Manufacturing
	Bangaon	41,082	Trading
	Batanagar	40,656	Manufacturing
	Budge-Budge	39,824	Manufacturing
	North Dum Dum	38,140	Manufacturing
	Garulia	29,041	Manufacturing
	Khardaha	28'362	Manufacturing
	Rajpur	24,812	Manufacturing
	Baduria	23,573	Artisan
	New Barrackpore	20,871	Trading
	Dum Dum	20,041	Manufacturing
Howrah	Howrah	512,598	Manufacturing
	Bally	130,896	Manufacturing
	Uluberia town group	66,299	Manufacturing
	Sankrail town group	47,174	Manufacturing
	Domjur town group	30,843	Artisan
	Jagachha town group	20,094	Manufacturing
Hooghly	Serampore	91,521	Manufacturing
	Hooghly-Chinsura	83,104	Service
	Chandernagore	67,105	Manufacturing
	Bansberia	45,463	Manufacturing
	Baidyabati	44,312	Manufacturing
	Champdani	42,129	Manufacturing
	Rishra	38,535	Manufacturing
	Bhadreswar	35,489	Manufacturing
	Kotrung	31,031	Manufacturing
	Konnagar	29,443	Manufacturing
	Uttarpara	21,132	Manufacturing

Towns and Town-groups with population of 20,000 or more in different district of West Bengal. (Contd.)

District	Town or town group	Population 1961	Function
Burdwan	Asansol town group	168,689	Manufacturing
	Burdwan	108,224	Service
	Durgapur town group	41,696	Manufacturing
	Kulti	34,280	Manufacturing
	Raniganj	30,113	Manufacturing
	Chittaranjan	28,957	Manufacturing
	Kalna	22,603	Service
	Katwa	20,621	Trading
Birbhum	Bolpur	23,355	Service
	Suri	22,841	Service
Bankura	Bankura	62,833	Service
	Bishnupur	30,958	Artisan
Purulia	Purulia	48,134	Service
Midnapore	Kharagpur	147,253	Transport
	Midnapore	59,532	Service
	Contai	22,094	Service
	Ghatal	21,062	Trading
Malda	English bazar	45,900	Service
Nadia	Nabadwip	72,861	Artisan
	Krishnagar	70,440	Service
	Ranaghat town group	55,100	Trading
	Santipur	51,190	Artisan
	Chakdah	35,089	Trading
	Kalyani-Kataganj-Gokulpur coly. town group	22,317	Service
Murshidabad	Berhampore	62,370	Service
	Jangipur	24,201	Manufacturing
	Jiaganj-Azimganj	23,675	Service
West Dinajpur	Raiganj	32,290	Trading
	Balurghat	26,999	Service
Darjeeling	Siliguri	65,471	Trading
	Darjeeling	40,651	Service
	Kalimpong	21,105	Service
Jalpaiguri	Jalpaiguri	48,134	Service
	Alipur-Duar	28,927	Trading
	Maynaguri	29,014	Trading
Cooch Bihar	Cooch-Bihar	41,922	Service

SOME FEATURES OF THE GROWTH, DISTRIBUTION AND PRESSURE OF POPULATION IN WEST BENGAL

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Growth of population in West Bengal, 1901-61 : One of the smallest States in India forming only 2.9 per cent of the area of the Indian Union, West Bengal has about 8.0 per cent of the total population in 1961. During the period 1901-61, the population in West Bengal had almost doubled itself (106%) while the all-India population had shown an increase of 86% only. Within the State as one would have expected, there had been considerable inter-district variation in the population growth rate as shown in Table 1. For instance, the population of the district of Bankura had recorded an increase of only 49% while in Calcutta the increase was about 214% during the period under consideration. Of the 7 districts showing a rate of increase higher than that of the State as a whole 2 are in the extreme north and the remaining five forming a contiguous pocket are in the south-eastern part of the State.

Table 1 : Percentage increase in population during 1901-61 in the districts.

Calcutta— 213.5, 24-Parganas— 193.1, Jalpaiguri— 148.6, Howrah—139.7, Darjeeling— 135.0 Nadia—121.7, Hooghly— 107.4, Malda— 102.3, Burdwan— 101.7, Cooch Behar— 80.5, West Dinajpur— 78.3, Purulia—75.8. Murshidabad— 64.7, Birbhum— 59.5, Midnapore— 55.7, Bankura—49.1, WEST BENGAL—106.2

The inter-district variation in the growth rate may be attributed to the differential rate of natural increase (birth rate—death rate) and to the differential net migration rate. Of these two the latter apparently is more dominant wherever there had been substantial growth. The districts where the population had almost doubled are industrial or industrializing areas with perhaps the exception of the plantation districts of Darjeeling and Jalpaiguri. But here also it may be said that the pattern of production is industrial rather than agricultural. Obviously, employment opportunities offered by these areas have attracted persons not only from other predominantly agricultural districts but also from neighbouring states.

The growth of population examined above is for a span of 60 years and shows the net effect of several factors affecting the growth. In recent decades an important factor contributing to population increase seems to be in-migration. On the other hand, natural calamities like the influenza epidemic in 1918 and

famine in 1943 have tended to deplete the population of the districts in varying degrees in the earlier decades. Between 1911 and 1921 the population in most districts declined due to the influenza epidemic, the over-all percentage decline being of the order of 3% in West Bengal. Similarly, during 1941-51, the increase in population had slowed down considerably in some of the districts as a result of the Bengal famine of 1943. Deaths due to the influenza epidemic or the Bengal famine are not precisely known. The former estimated on the basis of an assumed growth rate during 1911-21 as the average of 1901-11 and 1921-31 is about 1.8 million. As regards famine deaths some estimates are available. For instance the Famine Inquiry Commission had put the figure at 1.5 million for Bengal (undivided) while Professor K. P. Chattopadhyaya's estimate based on a sample study of the worst effected areas was of the order of 3.5 million. It would appear from various considerations that the Commission's estimate was more reliable. Our estimate by graphical interpolation based on populations in 1921, 1931, 1941 (adjusted for inflation) and 1961 works out to nearly 5 lakhs in West Bengal which is in conformity with the figure (4.87 lakhs) given by the Census Superintendent, West Bengal (*).

A comparison of the growth of population between India and West Bengal during 1901-41 and 1941-61 would indicate the part played by political and economic factors in the growth of population in West Bengal since 1941. For instance, the increase in the Indian population during 1901-41 was 34% while it was only 27% in the case of West Bengal. During 1941-61, the population of India had increased by about 39% while that of West Bengal increased by 63%. The implication, therefore, is that in addition to the contribution of natural increase to the growth of West Bengal population which was subdued by heavy mortality due to famine and its effects during 1943-44, there had been substaintial addition to the population by migration of persons from neighbouring states as well as from East Pakistan during 1941-61. The contribution of migrants from other States in India and from Pakistan to the growth of population in West Bengal districts in 1951 may be assessed by referring to Statement 1.177 in the 1951 Census Report for West Bengal (*).

Table 2 : Percentage decennial variation in population in West Bengal by districts during 1901-61

District	Percentage decennial variation					
	1901-11	1911-21	1921-31	1931-41*	1941-51*	1951-61
Darjeeling	5.3	5.1	12.8	8.9	27.1	35.9
Jalpaiguri	21.3	4.9	6.5	5.8	17.9	48.3
Cooch Behar	4.6	-0.1	-0.3	0.3	13.2	52.4
West Dinajpur	6.8	-12.1	7.2	3.5	26.5	35.5

Table 2 ; Precentage decennial variation in population in West Bengal by districts during 1901-61 (contd.)

Malda	15.7	-1.8	5.0	8.4	20.1	30.3
Murshidabad	1.7	-9.0	12.0	10.7	13.1	33.5
Nadia	0.4	-8.3	1.4	7.7	47.3	49.6
24-Parganas	14.8	6.3	9.5	16.6	33.5	40.8
Calcutta	8.8	3.6	10.6	72.0	34.6	8.5
Howrah	10.9	5.7	10.2	25.5	16.9	26.5
Hooghly	3.7	-0.9	3.3	14.7	22.5	39.1
Burdwan	0.4	-6.4	9.8	11.0	25.3	40.7
Birbhum	4.1	-9.4	11.2	2.3	10.0	35.5
Bankura	2.0	-10.4	9.0	7.3	10.6	26.2
Midnapore	1.2	-5.8	5.0	5.4	13.8	29.2
Purulia	13.7	-6.0	16.9	3.6	16.1	16.3
West Bengal	6.2	-2.9	8.1	13.7	22.4	32.8

* adjusted for inflation in 1941 Census

Source : Census of India 1961 : West Bengal and Sikkim, Vol XVI, Part IIA-General Population Tables.

The 1941 Census enumeration in West Bengal was admittedly faulty as the major communities tried to inflate their numbers to gain political advantage. The inflation was estimated to be of the order of 17 lakhs (or roughly 7.5% of the population) for the State as a whole. In Table 2 adjustments have been made for the districts on a pro-rata basis. Without such an adjustment the trend in the growth of population during the two decades 1931-41 and 1941-51 would have been completely different. Adjustments with respect to all-India figures have also been done where the inflation in the 1941 Census enumeration was of the order of 20 lakhs including Punjab (?). The effect obviously is negligible.

Generally, the trend in the growth of population of West Bengal since the beginning of the century had been an increasing one except for the decade 1911-21 on account of heavy mortality caused by the influenza epidemic. During the first half of the period i.e. upto 1931, the population had been showing only a moderate rate of increase. Since then the growth of population in West Bengal had gained considerable momentum. This was, as stated earlier, due mainly to the inflow ~~of a steady~~ of jobseekers (and their families) from adjacent States and by the influx of displaced persons from East Pakistan since the partition of Bengal. Another factor that accelerated the growth of population particularly during 1951-61 was the general drop in mortality caused largely by public health measures. The consequent increase in the number of reproductive years lived by women in the married state due to decreasing female mortality and a decreased incidence of widowhood might have had a positive influence on fertility also.

The pressure of population : As consequence of population growth the density of population measured as a ratio of population to total land area has also increased over time in the State. West Bengal has the second highest density of population (1021 persons per square mile in 1961) among the States in India with Kerala occupying the first position (1127). There is, however, marked inter-district variation in the density within the State as shown in Table 3.

This concept of man-land ratio is obviously unsatisfactory for examining the pressure of population on agricultural resources, as factors affecting agricultural production vary from one area to another. A more satisfactory index in this context is perhaps obtained by taking into consideration the cultivated or cultivable area instead of the total area. It may, however. be remembered that cultivable area, though mostly utilized for the production of food grains is only a fair approximation to the food resources. Such man-land ratios have been estimated for the different districts in West Bengal. While in the State as a whole there are 1410 persons per square mile of cultivable land, the districts show variations from 768 (West Dinajpur) to 4745 (Howrah). The districts of West Dinajpur, Bankura, Cooch Behar, Jalpaiguri, Malda, Birbhum, Midnapore, Purulia, Darjeeling, Nadia, and Murshidabad comprising about 52.6 per cent of the total State population have a man-land ratio below the West Bengal average. Including Calcutta where there is no agricultural land, the population involved will be 61.0 per cent. The rest of the districts have a ratio above the State level. Assuming agricultural productivity to be the same all over the state (which assumption need not be true) it may probably be inferred that the latter group of districts are less self-sufficient than the former group, so far as food resources are concerned.

Table 3 : Density of population per square mile of total area and cultivable area by districts.

District	Population per sq.mile of total area	Population per sq. mile of cultivable area
Calcutta	73550	—
Howrah	3639	4745
Hooghly	1841	2256
Burdwan	1139	1444
Nadia	1135	1311
24 Parganas	1114	2048
Murshidabad	1051	1279
Malda	878	974
Birbhum	830	988
Midnapore	826	1040

Table 3 : Density of population per square mile of total area and cultivable area by district. (contd.)

Cooch Behar	776	896
West Dinajpur	642	768
Bankura	629	788
Jalpaiguri	570	973
Purulia	565	1046
Darjeeling	497	1291
West Bengal	1021	1410

Sources : I) Census of India 1961, West Bengal and Sikkim, Vol.XVI, Part IIA-General Population Tables.

II) Cultivable area estimated on the basis of figures given in S.N. Mukherjee : A brief agricultural geography of West Bengal, Directarate of Agriculture, Government of West Bengal 1956, p. 152.

Population distribution in relation to functional character of the districts.

In the 1961 Census the workers were classified into nine broad industrial categories as given below.

I) Cultivator
II) Agricultural labour
III) Forestry, fishing, plantations, mining and quarrying etc.
IV) Household industry
V) Manufacturing other than household industry
VI) Construction
VII) Trade and commerce
VIII) Transport, storage and communications
IX) Services

Table 4 : Percentage distribution of workers in different industrial categories by districts (1961 Census)

District	I	II	III	IV	V	VI	VII	VIII	IX	Total
Darjeeling	37.5	2.9	30 9	1.7	1.8	1.2	5.8	2.9	15.2	100
Jalpaiguri	43.5	3.0	33.7	1.1	1.5	0.9	5.2	2.0	9.0	100
Cooch Behar	74.1	7.1	0.8	2.4	1.6	0.4	4.9	0.9	7.9	100
West Dinajpur	61.8	21.1	0.5	2.3	1.6	0.5	4.2	0.7	6.9	100
Malda	49.8	14.4	2.0	12.8	2.0	0.6	3.5	1.0	13.8	100
Murshidabad	44.2	19.7	3.4	11.0	3.1	1.2	4.8	1.0	11.6	100
Nadia	42.9	16.7	3.4	9.0	5.4	1.3	7.4	2.3	11.5	100

Table 4 : Percentage distribution of workers in different industrial categories by districts (1961 Census) (contd.)

24 Parganas	31.4	17.6	1.4	2.7	21.1	1.1	8.3	3.2	13.2	100
Calcutta	—	—	0.2	0.8	25.2	3.2	23.9	11.7	35.0	100
Howrah	14.3	9.5	1.6	3.2	36.1	2.0	12.2	6.5	14 6	100
Hooghly	30.3	19.7	1.8	4.2	19.4	1.8	8.0	3.5	11.3	100
Burdwan	28.4	17.7	15.6	3.0	11.1	1.9	6.2	3.3	12.7	100
Birbhum	43.7	30 6	2.7	4.7	2.9	0.6	3.5	1.0	10.4	100
Bankura	52.4	24.6	1.9	5.8	2.8	0.6	3.0	0.8	8.0	100
Midnapore	55.6	20.3	0.9	5.4	2.6	0 8	2.6	2.1	9.5	100
Purulia	69.9	13.6	2.5	3.1	1.9	0.2	2.0	1.9	4.7	100
West Bengal	38.5	15.3	5.0	4.2	11.4	1 3	7.5	3.4	13.4	100

Source : Census of India 1961, West Bengal and Sikkim, Vol.XVI, Part IIA General Population Tables.

Being a predominantly agricultural State like the rest of India, West Bengal has over half the workers (54%) in the industrial categories I and II (agricultural workers). While in Calcutta these categories are absent, the percentage varies from 24 per cent in Howrah district to 84 per cent in the newly formed Purulia district. Of the industrial categories, Construction (VI) and Transport, Storage and Communications (VIII) by their nature and scope are unlikely to have any.wide representation and the category Services (IX) is necessarily restricted to big towns and cities. However, on the basis of the 1961 classification the districts could be classified into three or four broad groups according to their major functional affiliation.

It may, however be noted that barring a few districts with a high proportion of agricultural workers which could be classified as predominantly agricultural, the other districts except Calcutta are really of mixed character with agriculture as one of the activities. They may, therefore, be called agro-industrial districts. A rigid classification of these according to one or the other type is, therefore, less realistic.

The districts of Purulia, West Dinajpur, Cooch Behar, Bankura, Midnapore Birbhum, Malda, Murshidabad and Nadia in descending order show a high concentration of agricultural workers compared to the State average. These may, therefore, be classified as mainly agricultural districts. Similarly, Jalpaiguri and Darjeeling may be classified as predominantly plantation districts in as much as plantation areas of the State are concentrated in these districts. Further, Howrah, 24 Parganas and Hooghly, also mixed districts, may be termed primarily manufacturing since much of the manufacturing activities are concentra-

ted in them. Calcutta is a special category by itself with a majority of workers engaged in manufacturing (V), trade and commerce (VII) and service activities (IX). Though agricultural activities are also important in Burdwan district as in most other districts, it stands out clearly as a mining and quarrying (III) centre.

Following the general principles of population movement and distribution, there is greater concentration of population in the districts where the intensity of industrial activity is also higher. The classification of the districts according to their main functional character and the corresponding density of population is given in Table 5.

Table 5 : Classification of districts according to main functional character and the average density of population (1961).

District	Main functional character	Average density of population per sq.mile (1961)	Range in density of population	% pop. covered	% area covered
1. Purulia, West Dinajpur, Cooch Behar, Bankura, Midnapore, Birbhum, Nadia, Malda, Murshidabad	Argiculture	803	565-1135	46.9	59.7
2. Jalpaiguri, Darjeeling	Plantation	545	497-570	5.7	10.6
3. Burdwan	Mining and Quarrying	11,39	—	8.8	7.9
4. Howrah, 24 Parganas, Hooghly	Manufacture	1424	1114-3639	30.2	21.7
5. Calcutta	Manufacture; trade and commerce; service	73550	—	8.4	0.1
West Bengal		1021		100.0	100.0

Special features of the growth of population in 1951-61.

The decade 1951-61 requires special mention as it was a period of unprecedented growth rate. In the districts where the agricultural workers predominate the growth of population during 1951-61 had shown substantial variation ranging from 16.3 percent (Purulia) to 52.4 per cent (Cooch Behar) (Table 6). Considering all the districts under this category the average growth for the same period is 32.6 per cent which is lower compared to the other groups of districts except Calcutta. The plantation districts of Darjeeling and Jalpaiguri have shown the largest increase of 44.1 per cent. The mining and quarrying district of Burdwan has recorded an increase of 40.7 per cent which is greater than that of the manufacturing districts of Howrah, 24 Parganas and Hooghly (37.5%).

The higher rate of growth of population in the decade 1951-61 compared to the preceding one of 1941-51 in all the districts except Calcutta could not be ascribed to any increase in the marital fertility. On the other hand, it may be due to the migration component and also to the general improvement in the mortality situation. As the effect of the latter may be more or less uniform in the districts the chief component causing inter-district variation in population can only by differential migration.

Calcutta presents a totally different picture. A number of factors might have contributed to the fall in the rate of growth of population during this period. It is possible that the City has reached some sort of saturation level restricting its capacity to absorb persons as before. As a consequence, a process of deconcentration and suburbanization might have also set in. Besides, fertility possibly might have declined on account of a wider practice of family planning. However, further examination of relevant data is required to come to firm conclusions regarding the contribution of these and other factors in the observed trend.

Table 6: Percentage variation in population during 1951-61 in the groups of districts classified according to predominant function.

Functional character	Number of districts	Average percentage variation	Range in percentage variation
1. Agriculture	9	32·6	16·3—52·4
2. Plantation	2	44·1	35·8—48·3
3. Mining & quarrying	1	40·7	
4. Manufacture	3	37·5	26·5—40·8
5. Manufacture, Trade and Commerce, Service	1	8·5	
Total	16	32·8	

Agricultural situation in the districts.

In an area predominantly agricultural in character, the conditions of rural life largely depend on the man-land ratio, that is, on the relation between the number of persons subsisting directly or indirectly on agriculture and the agricultural potentialities of the land utilized. The two elements involved in the ratio are briefly considered in the following paragraphs.

(a) **Population occupied in agriculture** : From Table 4 it is clear that agriculture plays a significant role in the economic life of the State. More than half (54%) of the workers are in the agricultural sector. Even in those districts where the proportion falls below the State average agriculture occupies an important position in the economy of the district (except obviously Calcutta). Agriculture being a gamble in the rains, the economy of the districts depending mainly on agriculture is exposed to greater uncertainties than the rest.

(b) **Cultivable area** : The cultivable area here includes net area sown, current fallow and other uncultivated area, but excludes areas not available for cultivation and those occupied by forests. The agricultural potential of a region could then be roughly determined by the area that may be available for cultivation. Forest and certain other areas are normally not available for cultivation. The proportion of cultivable area to net land area of the districts given in Table 7 indicates the relative importance of the districts (The figures have been adapted from the data for 1954-55 given in 'A brief agricultural geography of West Bengal' (3) by S. N. Mukherjee).

(c) **Area actually utilized for cultivation** : The Area actually utilized includes the area cultivated and current fallow. The inclusion of the latter seems justified in as much as the land was usually cultivated but remained fallow (perhaps necessarily) during the period of reference. There may be areas which are sown more than once during the year (10% or so), but no additional weight has been given to much areas in this discussion.

The proportion of land actually utilized to total cultivable land indicates if there is scope for further extension of agricultural activity. At present this may be possible only with further improvement in irrigation and other facilities.

Table 7 : Percentage of cultivable area to total area and percentage utilization of cultivable area in the districts.

District	Percentage cultivable area to net land area	Percentage utilization of cultivable area
Malda	90	93
Cooch Behar	87	85
Nadia	87	84

Table 7 : Percentage of cultivable area to total area and percentage utilization of cultivable area in the districts. (contd.)

Murshidabad	86	91
Birbhum	84	95
West Dinajpur	84	94
Hooghly	82	95
Bankura	80	82
Midnapore	79	90
Burdwan	79	91
Howrah	77	94
Jalpaiguri	59	77
24 Parganas	54	86
Darjeeling	39	83
West Bengal*	74	89

* Purulia not included

Source : Figures have been adapted from the data for 1954—55 given in S. N. Mukherjee : A brief Agricultural geography of West Bengal, 1956

In the districts except Darjeeling, Jalpaiguri and 24-Parganas cultivable land covers more than three-fourths of the area and of this in almost all the districts of the State the land utilization is fairly high. However, in spite of the large area available for cultivation and the high utilization of the land the production of basic food materials falls short of demand due to very poor yield, With improvement in agricultural facilities and technology not only further extension in land-utilization could be affected but also yield per acre could be substantially stepped up which will help in achieving a more balanced man-land ratio.

Some features of agricultural over-population.

The existence of an excessive population in relation to agricultural resources in West Bengal is amply shown by the mounting trend in the import of principal food grains into the State in recent times. Some symptomatic features of agricultural over-population in the State are briefly examined here. They relate to low per capita arable land, low unit yields under-nutrition

(I) **Per Capita agricultural land** : Equating the estimated total cultivable area to the total cultivators in West Bengal in 1961, a cultivator has on an average 3·6 acres where as an agricultural worker (cultivator or agricultural labourer) has 2·6 acres. Broadly speaking low per capita cultivable land indicates the existence of agricultural over-population. Table 8 gives per capita cultivable land for a cultivator or an agricultural worker in the districts.

Table 8 : Cultivable area per cultivator or agricultural worker in the districts.

District	Cultivable area per cultivator (acres)	Cultivable area per agr. worker (acres)
Birbhum	4·8	2·8
Burdwan	4·6	2·8
Bankura	4·2	2·9
Nadia	4·2	3·0
West Dinajpur	4·1	3·1
Malda	4·0	3·1
Mushidabad	3·9	2·7
Midnapore	3·4	2·5
24 Parganas	3·4	2·2
Jalpaiguri*	3·4	3·1
Hooghly	3·1	1·9
Howrah	3·1	1·8
Cooch Behar*	2·9	2·6
Purulia	2·8	2·3
Darjeeling*	2·5	2·3
West Bengal	3·6	2·6

* For Darjeeling, Jalpaiguri and Cooch Behar cultivable area considered in this table does not include area under tea plantation.

Through per capita agricultural land by itself is an unsatisfactory index for making comparisons between different regions falling wide apart this may be taken as a useful indicator of the pressure of population on agricultural resources in areas within a State where factors affecting production are not expected to vary greatly. Not only are the holdings small, but they are also rendered more difficult for economic operation by fragmentation. The Land Revenue Commission, Bengal, 1940 estimated the average cultivated area per family including the families of agricultural labourers at about 4·5 acres. The Commission held that a minimum of 8 acres was required for an economic holding in West Bengal, but if 5 acres were to be stipulated, 2 or 3 acres must consist of 'wet' land (4).

(ii) **Agricultural yield** : The widely grown cereal in the State is rice, with nearly three-fourths of the cropped area under rice cultivation. In spite of the natural advantages the average yield or rice (Aman, Aus and Boro) in West Bengal was only about 11 maunds per acre (1950-51 to 1954-55) (3). The yield rates for Aman rice as estimated subsequently by the State Statistical Bureau for 1957-58 was 11·1 maunds per acre (4). The agricultural productivity (the most important component being rice) had since increased by nearly 2 per cent during 1954-54 to 1961-62 (5). The productivity is still undoubtedly low compared to other States and countries. For 1966, the yield rate estimated on the basis of figures appearing in the press is likely to lie between 8.5 and 10.5 maunds per acre (6).

It has been observed that unit yields of cereals are lower in purely agricultural countries than in more industrialized ones. This is mainly due to differences in agricultural practices. In this context it may be interesting to examine the inter-district variation in yield rates. In Table 9 are given the average yield of rice (Aman, Aus and Boro) per acre in the districts (1950-51 to 1954-55) and the proporton of agricultural workers (I & II) to total workers (I to IX) in 1961.

Table 9 : Average yield rates (in maunds per acre) of rice in the different districts (1950-51 to 1954-55) and percentage of agicultural workers to total workers (1961).

District	Yield per acre (maunds)	Percentage of agricultural workers
Birbhum	13.7	74.1
Burdwan	13.5	46.1
Darjeeling	13.1	40.4
Hooghly	12.6	50.0
Bankura	12.3	77.0
Howrah	11.6	23.8
Midnapore	10.9	75.9
Murshidabad	10.3	63.9
24 Parganas	10.3	49.0
Jalpaiguri	10.0	46·5
Malda	9.4	64.2
West Dinajpur	9·2	82.9
Nadia	8.8	59.6
Cooch Behar	8.6	81.2
West Bengal *	11.1	52.0

* Excluding Purulia

Sources : i) S. N. Mukherjee : A brief agricultural geography of West Bengal, Directorate of Agriculture, Government of West Bengal, 1956, p. 107, Table No. 9.3(a).

ii) Census of 1961, West Bengal and Sikkim, Vol. XVI, Part IIA—General Population Tables.

From a superficial examination of the data given in the above table, it would appear that there exists some inverse relationship between rice yield and population dependent on agriculture. Of the six districts where the yield of rice is above the State average, the proportions of workers in agriculture in four districts are below the State average. Similarly of the 8 districts with yields below the State level, six districts have higher proportions of agricultural workers.

While a more comprehensive examination is required to arrive at firm conclusions in this regard, the data given in the table are suggestive of a possible relationship.

iii) **Under-nutrition** : The symptoms such as the ones discussed above viz. the small size of agricultural holdings and the low unit yields are usually confronted in areas of apparent over-population. One of the reasons for the low yielding capacity of the soil may be sub-division and fragmentation of holdings and absence of scientific agricultural practices.

Our diet consists mainly of cereals and pulses and is grossly lacking in nutritious elements like, eggs, meat, fruits, etc. The existence of under-nutrition is really a reflection of the struggle for subsistence arising out of an incompatible ratio between population and the supply of nutrients.

The food problem today has come to be generally identified with shortage of food grains because cereals and pulses form the staple diet. Thus, while increase in domestic production of food grains can help in attaining self-sufficiency in food, from a nutritional point of view and as a long-term solution, the pressure of consumption on cereals need be reduced by the production of other foods especially vegetables and animal proteins.

Considering the size of the State the numerical strength of the cattle population is quite large. But the milk-yield is capriciously low resulting in high cost and low in-take. Assuming that there are about 140 cows and 10 buffaloes per 1000 population in the State and the approximate annual milk-yield to be 420 pounds per cow and 960 pounds per buffalo (3) the average quantity of milk available per head per day would work out to less than 3 oz. which by any reasonable standard of nutritional sufficiency is inordinately low.

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DEMOGRAPHIC DATA—AN IMPERATIVE NEED FOR THE WELFARE OF THE TRIBAL POPULATION IN INDIA

(A pilot study of the Totos in Totopara, West Bengal)

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India is one of those under-developed countries where the aboriginal tribes form a longstanding chronic problem. India's tribal population, though forms a negligible percentage of the total count had long been treated as sub-human population deprived of all natural human rights. The administrative officials so long felt no need to keep any statistics on a scientific basis nor any systematic official record of their vital events as imperative for the assessment of any population measurement or its progress.

After the independence, however, the India Government has shown to have taken special interests for the welfare of these scheduled tribes and has incorporated many intergrated projects and schemes for the upliftment of the mass in the third five year plan.

Elaborate census counts for varied measurements of the population, introduction of regular vital and other routine statistics of economic condition, time to time survey of the health and sickness condition, and study of the social and cultural behaviour in the population furnishes a prerequisite information as to the accurate knowledge regarding the general living condition of a community upon which the formulation of the policy of a plan ~~is promulgated~~ depends. For an overall assessment of these basic conditions of the people, a systematic and regular collection of data is therefore a fundamental necessity before implementation of any project at the present phase.

Inspite of the fact that many research workers and social investigators worked in the field a notion still ~~do~~ persists that many of the tribes in India are now-a-days being wiped out like the aboriginals in Australia and the Veddahs of Ceylon.

It is with this idea as to assess the dwindling population and its other important characteristics, recently an integrated multilateral survey was undertaken by the Indian Statistical Institute. This is a part of the study covering only the demographic aspects of the Totos and their economic, health and sickness conditions. As a pilot study and because of the special techeniques to be employed due to the inherent difficulty in collecting infomation from the tribes living in untrodden Himalayan tracts the present paper may be of some interest to the research workers and administrative officials connected with the

welfare of the tribes. The Totos are a special type of tribe living in a small tiny landscape under the foot of a hill on the Indo-Bhutan border, about 400 miles north of Calcutta. In appearance, they look like the Mongolians. They are a very active type of people of good temperament and painstaking in nature. They have got no industry, no land of their own. They live mainly on argiculture as share-croppers, and sometimes trade on fruits, and pigs. Save and except two souls who can write only in the script of their own, the rest are all illiterates. Practically no social stratification is possible among them. Devoid of all amenities of modern life, they live in a big den of darkness. Living in an atmosphere of misery, peril and total neglect form the so-called civilised society, they have naturally no hopes, no aspirations in life. They are neglected people born to work, suffer and at last surrender to the toll of death. They, however, from a compact group of people based on 14 clans and have got a composite social organisation of their own. Their religion is based on spirits, ancestor-worships and celestical dieties. Having maintained a relatively stable cultural condition, devoid of any outside contact, they naturally form an interesting group of study for the demographers.

No reliable and systematic vital statistics of the population is available even at the present day. There may be some scanty and vague official registration figures which are practically of no use. In the absence of the reliable registration data one has to look upon the census returns of the Totos for any demographic study of the population. Upto 1931, the census recorded a steady increase of population, though the population was growing with a diminishing rate and the growth rate ultimately fell down even to the negative side during the period 1931-51. After 1951, however, a tendency of slight rise began to be perceived as will be revealed from the present survey. An assessment of the actual cause of this depopulation after the 1st quarter of the 20th century, and collection of further demographic information to make an intensive analysis of the community have necessitated this study.

2. **General characteristics of the Population**—The Totos consist of 85 households occupied by 389 heads. Thus the average family size comes out to be 4.6, slightly higher than the figure 4.2 for Calcutta city. Though the people follow certain social sanction, there is no hard and fast rule prohibiting them from having more than one wife at a time. When the frequency of marriage relation is analysed it is observed that 82 percent are married once only, 17 percent twice while one husband is having three wives even. Thus while there is no wilful attempt to restrict family size, the increase is indirectly encouraged by not putting any restriction on the frequency of marriages.

The frequency of ultimate widowhood among the female population is also found to be low. Out of about 100 females in the child-bearing ages, only

2 were found to be widows on the date of survey. This is due to the fact that a woman becoming a widow in the reproductive period gets herself re-married reducing the proportion of widows to a low figure in the said age group. Five out of twenty women were found to be widowed when they had crossed the child-bearing age. However, it is to be noted that such widowhood in the older age groups has got no demographic effect on population growth.

The Toto households have been analysed and compared with those of 1951 census. The results are presented in table I below.

Table I—Analysis of Toto households—A. 1951 Census.

houses of	no. of houses	no of persons	males	fe-males	wives	sons	daughters	daughter in law	brothers	others
1-2 persons	12	21	10	11	6	—	—	—	—	3
3-4 persons	28	101	58	43	26	27	16	1	3	—
5-6 persons	21	115	56	59	21	33	25	2	5	8
above 6	10	77	33	44	12	21	18	5	—	11
Total	71	314	157	157	65	81	59	8	8	22
B : Present Survey										
1-2 persons	11	19	9	10	7	—	1	—	—	—
3-4 persons	32	111	56	55	31	20	16	2	2	8
5-6 persons	31	168	92	76	32	52	38	4	5	6
above 6	11	91	46	45	17	35	21	5	—	2
Total	85	389	203	186	87	107	76	11	7	16

It will be revealed from the above table that there has been an increase of 14 households, from 71 in 1951 to 85 in the present survey, i e. a significant addition of 20 percent new households within a decade or so, the main addition being in the 5-6 member households. Whereas in 1951 census, modal value of the family size was 3·5, it has shifted to 4.5, in the present study showing addition of 1 in the modal family size The average family size as well has risen from 4.4 to 4.6 in the large sized households (5 and above) there has been a significant increase in the proportion of male population from 46 percent of the total population in 1951 to 53 percent in the present survey. This means that the sex difference among the new additions is becoming higher and higher, leading to a sex imbalance. Whereas the sex ratio in the son-daughter relation in the 3-4 member households has come down to a significant extent, there has been an opposite trend in the still larger-sized households. The reason of such an uncommon behaviour and its repurcussion upon the population growth cannot however be explained.

In general, the Totos have got an individual family unit, rather than joint families. As soon as the sons become grown-up and become economically independent, they marry and form separate households of their own. Sometimes they live separately but use their farthers' houses as the common kitchen.

3. Sex Ratio and Sex preference

The sex-ratio of a populatian deserves no less importance in the study of reproduction and growth rate of a population. In a closed population, if the females in the childbearing ages are larger in number, it is expected that reproduction will be at a higher level by excessive net addition to the population through births. While general sex-ratio (female/male ratio) of the Totos was 1000 in 1951, it came down to 916 in the present study. The All India Tribal population in 1961, however, recorded a sex ratio of 951. This large fall in the female population, resulting in change in the sex ratio has given rise to a change in the sex-balance in a decade or so. This may be partly due to differential mortality among the females in the younger age groups and partly due to differential sex ratio among them. An imbalance which was noticed in 1951, having a sex ratio of 666 in the age-group 0-4 has got a considerable change with an addition of more females making it to be 905. This has made the ratio in the group closer too. In the next age group 5-9, on the other hand, there appears a huge sex difference, where sex ratio came down from 1300 to 700. This unusual change reflects an unusual turn of chance events sometimes observed in such small population aggregates. The sex ratio shows more or less a crest and through from census to census. In the present study it appears that the sex ratio in the reproductive age group is 972, indicating a stable sex balance and thus there is likely to be a positive growth of the population, if, of course, the proportion married in this age group is sufficiently high. Sex preference has got an underlying psychological effect which has its influence on family building motivation. According to cultural standard of the community, children have been highly valued. They lack no desire for children. They being argicultural labourers, it was likely that they would have a positive preference for sons and in fact it was found to be so. Whereas 53 percent of the parents preferred sons, only 7 percent preferred daughters, 40 percent had no option at all.

4. The major problem confronting us in this study is to indicate the possible reasons for the reversal in the secular trend of depopulation. Before this is answered it is necessary to describe the age distribution of the population and to probe into the factors responsible for the pattern of this depopulation before 1951.

4 Age Structure

In order to see whether there has been any shift in the age distribution of the survey population, the age table was constructed with comparable age grouping as that in 1951 census.

Table 2 — Age distribution of the Toto population

age-group	MALE 1951	MALE survey	FEMALE 1951	FEMALE survey	TOTAL 1951	TOTAL survey
0-4	27(17.2)	42(20.7)	18(11.5)	38(20.4)	45(14.3)	80(20.6)
5-9	20(12.7)	32(15.8)	26(16.5)	22(11.8)	46(14.6)	54(13.9)
10-44	97(61.8)	109(53.7)	97(61.8)	106(57.0)	194(61.8)	215(55.3)
45-64	13(8.3)	18(8.9)	14(8.9)	19(10.2)	27(8.9)	37(9.5)
65 above	—(.)	2(0.9)	2(1.3)	1(0.6)	2(0.6)	3(0.7)

* The figures in the parethesis denote percentages.

Comparing the 1951 census figures with those observed in the present survey it will be seen that there has been a significant increase (6.3 percent) in the size of the youngest age group, counterbalanced by a corresponding decrease in the reproductive age group 10 44. The rise in the earlier age group suggests that the population in the younger age group is growing at a higher rate as is usually observed in high birth rate areas. The median age dropped from 21.9 years in 1951 to 19.8 years in the present survey. There is thus a considerable evidence of the population being rejuvenated by the addition of the younger cohorts.

5. Fertility and Population growth

Fertility is the factor primarily contributing to the population growth. In order to conceive the impact of fertility upon the recent rise in population it is necessary to recapitulate foctors instrumental for the trend in depopulation. There are a number of factors affecting fertility and to study the different factors on their own merits, a rather comprehensive survey of a large population is necessary. We will, however, consider, some of the major important factors affecting fertility such as age at marriage, the proportion of the ever-married in the population and other indices relating to fertility.

A distinct characteristic of this tribal population is the early age at marriage and its universality. Both these factors are conducive to high fertility. The younger age at marriage constitutes a social sanction of the married couple to live together. Husbands and wives were analysed by age at marriage and the figures are given in table 3.

Table 3—Distribution of husbands and wives by age at marriage

age-group	wives		husbands	
	No.	percentage	No.	percentage
10-12	20	23.8	9	10.6
13-15	22	26,2	12	14.1
16-18	25	29.7	20	23.5
19-21	14	16.7	21	24.7
22-24	1	1.2	14	16.5
25-27	2	2.4	5	5.9
28-30	—	—	4	4.7
Total	84	100.0	85	100.0

The average age at marriage in the present survey was found out to be 18.8 for males and 15.6 for females, while the corresponding figures for females as was observed in the lower social group of the Calcutta Family Planning Survey (2) was only 14.5.

It will be noted from the above table that about one fourth of the wives marry even in the younger age group 10-12. The difference in average age at marriage between husbands and wives is 3.2 years, a very low figure compared to that observed even in highly urbanised areas.

Again the marital status of a population is indirectly related to population growth. The marital status of women aged 15-49 for All India Tribal Population, 1951 showed that 10 percent of the women remained unmarried, 80 per cent married and another 10 percent widowed. It will rather be interesting to study the marital status of the Toto population.

Table 4—Marital status of the Toto population by age and sex groups.

age-group	single		married		widowd		total	
	M	F	M	F	M	F	M	F
10-19	29(69)	20(48)	13(31)	22(52)	—	—	42(100)	42(100)
20-29	1(3)	—	32(97)	37(100)	—	—	33(100)	37(100)
30-39	—	—	22(100)	18(95)	—	1(5)	22(100)	19(100)
40-49	—	—	15(94)	14(93)	1(6)	1(7)	16(100)	15(100)
50 & above	—	—	10(62)	8(62)	6(38)	5(38)	16(100)	13(100)

* (figures in parenthesis denote percentages)

The above table shows that while about 80 per cent of the female population in the child bearing ages are married, it is more than 95 per cent in the age-group 20-49. On the other hand, nobody is widowed in the age group 10-29.

In the age group 50 and above, however, 60 per cent are leading married lives, the remaining 40 per cent being widowed. All these findings are indicators of the fact that the frequency of marriage is very high among the Totos. If one of the partners dies while in the age group 20-49, the other partner remarries raising thus the proportion of married in the said age group.

The proportion of ever-married among the population has also been analysed and the figures are given in table 5 below.

Table 5—Proportion of ever-married in the population

age group	Males			Females		
	no. of persons	no. ever married	percentage ever married	no. of persons	no. ever married	percentage ever married
10-14	28	4	14.3	23	7	30.4
15-19	14	9	64.3	19	15	78.9
20-24	12	11	91.7	17	17	100.0
25-29	21	21	100.0	20	20	100.0
30-34	20	20	100.0	17	17	100.0
35 & above	34	34	100.0	30	30	100.0
total	129	99	76.7	126	106	84.1

It is interesting to note that by age 30, cent per cent of the male population are married, the females however, marry even 5 years earlier. The trend towards early marriages is also evident from the age specific proportions of ever married shown in the above table.

In order to assess the ageing condition of the population the woman were classified by different marriage duration. From the table below it will be seen that 26.1 percent and 27.1 percent of the female population have got a married duration of 0-4 and 5-9 years respectively.

Table 6—Distribution of women by different marriage duration

duration group in years	number & percentages
0-4	24 (26.1)
5-9	25 (27.1)
10-14	19 (20.7)
15-19	1 7.7)
20 and above	17 (18.4)

Thus a sizeable majority of the females (more than 50 per cent) had a married duration of less than 10 years i.e. majority of women are enjoying married life of shorter periods only. The average marriage duration of the population

as calculated was found to be 10.7 years, exactly what was found in the Calcutta city population.(3) The generation have thus got a larger span of reproductive period yet to cover.

In a community characterised by early marriage, non-use of contraception on the one hand and high emphasis on fertility on the other, the proportion of childlessness would significantly involve a close measures of the inability of women to conceive. Dr. Lorimer has suggested that in a population characterised by early marriage and in the absence of deliberate limitation only about 5 per cent could be expected to be sterile. When the percentage of childlessness among the couples in the present survey was calculated by different number of years after marriage, it looked that 16 per cent was childless at 5-14 years of married life. Only 4 percent of the women remained childless even after 20 years of married life with little hope to conceive in future. This percentage of sterility is quite normal in any community.

As stated earlier, there appears to have taken place a drastic shift in the gradual trend of depopulation characteristics of the Toto community in recent years. The-then depopulation cannot be explained in any context from this study due to paucity of data. The kind of information ideal for study of fertility is the total fertility. Though it is available here, the data being very scanty, no reliable inference can be drawn. However, some of the indices of fertility were derived for the population which may throw some light on the reproductive pattern of the Totos.

The general fertility rate worked out from this study was found out to be 180 and a crude birth rate of 41.1 per 1000. Hence, rate of growth which is nothing but natural increase ± net migration comes out to be 2 31 per cent per annum, migration being effectively zero in this closed community, and crude death rate being 18·0

Another index on fertility is the chid-woman ratio, which measures the proportion of children 0-4 years to married women in the reproductive period. This ratio was found out to be 899 per 1000 among the Totos while the corresponding figure for the married women for All India Tribal population was 1023. The reason for such huge difference in the ratio at the present circumstances cannot be ascertained.

Again total fertility for the population was also calculated by age at marriage and duration of married life. It appears that there is a consistent trend both in the horizontal and vertical directions. Average fertility of the community was observed as 3.29, comparable to the figure 3.5 obtained for the lower social groups of the Calcutta Family Planning Survey. The standardised fertility of the population was found to be 3.8. The standard population was taken as the population in the

lower social group of Calcutta city as it seems the present Toto population is comparable to the city population. The results of the analysis of fertility are presented in table 7.

Table : 7 Average number of children born per married woman by age at married age and duration of married life.

Age at marriage (in years)	Duration of married life (in years) 0 — 4	5 — 9	10 — 14	15 — 19	20 and above	Total
10-14	.13	1.25	4.00	4.67	7.00	2.38
	(8)	(8)	(3)	(3)	(5)	(27)
15-19	0.40	2.55	4.60	7.00	8.17	3.68
	(10)	(9)	(10)	(2)	(6)	(37)
20-24	1.33	2.20	3.20	—	7.50	3.07
	(3)	(5)	(5)	—	(2)	(15)
25 and above	—	4.67	—	5.00	4.50	3.23
	(3)	(3)	(1)	(2)	(4)	(13)
Total	.41	2.32	3.89	5.43	6 88	3.29
	(24)	(25)	(19)	(7)	(17)	(92)

(Figures in parenthesis denote the no. of women)

One striking feature that can be noticed from the above table is that those who married in the age group 15-19 and crossed 10 years of married life had their fertility always higher than those who married in any other age groups. This is probably because the age group 15-19 is the most suitable one for the fertility performance of the population. The highest fertility observed was 8.17 in the group when they have already passed 20 years of married life. This may be taken as the total fertility of the group. The average fertility of the population who have enjoyed more than 20 years of their married life was calculated as 6.88 which is comparatively higher than the figure 6.3 obtained in the Calcutta Survey.

A table was constructed classifying the total no. of pregnancy terminations into live births, still births and infant deaths.

Table 8—Fertility history (children born and dead by number of terminations) of women.

Termination group	No. of couples	Live births	Death	Still births	Percentage death among live births	Percentage of still births amongst total births
1	8	8	1	—	12.5	—
2-5	47	139	26	8	18.7	5.4
6 and above	19	139	49	19	39.8	12.0

Table 8 above shows that among the women who had one termination, 8 were live births of which only one was dead, all the rest being alive. In higher termination groups, (6 and above), however, out of 139 live births a sizeable porportion namely 49 were dead. To work out the index of living among the live births, the proportion of deaths among the live births were calculated. It will be seen that there is a systematic upward trend in the proportion dead along the higher termination group. About 40 per cent of the terminations (considering live briths only) amongst the live births with highest number of terminations were found dead as against 12.5 per cent in the one-termination group. This is probably due to the fact that those in the lowest termination group are exposed to the risk of dying on the average, for shorter period only compared to those in the highst termination groups. The proportion of still births amongst the total no. of births also shows an increasing trend, a result which can be corroborated from other studies as well.

Another approach to study the changes in fertility history is the generation fertility. In order to ascertain any change in the fertility pattern in the course of a generation, the generation fertility is of interest to the demographers. Here the study has been made by comparing the fertility performances of the father with those of grand-fathers. Fertility has been calculated from the father's side only. The total average fertility of previous generation was found to be 2.6 as against that of 2.3 in the father's case. Because the total fertility could not be compared with that of the present generation, the main interesting part of the study had to be left. From the figures it appears that the fertility has declined to a considerable extent in the course of grandfather—father generation. This substantiates indirectly the census growth rate which fell down to the negative side during 1931—51.

A study of the growth of the population from table 9 below shows that after 1901 there had been a gradual decline in the growth of the population. This decline continued upto 1931, followed even by a negative rate of growth during the period 1931—51.

Table 9—Population by different census years.

Census year	Population Male	Female	Total	Rate of growth (per cent per annum)
1901	72	99	171	3.15
1911	125	110	235	1.74
1921	n.a	n.a	n.a	
1931	130	204	334	
1941	—	—	—	—0.31
1951	157	157	314	
Present survey	203	186	389	2.13

The population in the present survey comes out to be 389, an increase of 75 persons from 1951.

It seems that the rate of growth of the population was gradually changing, beginning from 1901, and during 1931-51 it became negative. After 1951, however, the population growth began to attain an increasing trend and during 1951-61 the growth rate comes out to be 2.13 per cent per annum, similar to that of 2.14 per cent per annum during 1951-61 obtained from the National Sample Survey 7th Round (Rural). It is expected that at the present levels of fertility, the population will continue to increase at even greater pace than it had been during the intercensal period.

6. Morbidity and mortality

Certainly an important factor bearing on mortality is disease. It has already been said that the Totos are one of the most neglected species among the tribals in India. With no public health measures, no medical facilities, no literary and industrial activities the people become pessimistic and show apathy towards any progressive outlook. They cry for medical relief but no such help is written to their lot. About 6 per cent of the population are suffering from gastro-intestinal diseases, acute in nature, 24 per cent from a special kind of disease called 'yaws' and 4 per cent from hydroceles. Peculiarly enough, there is so much social contacts among the different members of the population that all the cases of hydroceles were also reported separately by the head of the community. There is a traditional idea that most of the tribal population have a high prevalence of veneral disease, a characteristic of the population in many underdeveloped countries. Whether this 'yaws' is the outcome of this infectious disease or not is an interesting study for medical research. But prevalence of veneral infection may cause sterility and thus cut down fertility which is not observed in the population. Only 7 deaths were noticed to have occurred during the period of last one year thus giving a crude death rate of 18 per thousand compatible with that of all India figure.

7. Recomendations

The Totos have been perpetual sufferers. Living under inimical atmosphere, the people are ever uncared and depend solely on their lot. They are badly in need of medical relief. No public health care or medical facilities are available to them. An overwhelming percentage of the population have been suffering from be a peculiar disease called 'yaws'. The root cause of this community curse should be spotted out with all seriousness and a bold policy of action should be adopted to ameliorate this evil with the help of modern drugs and health techniques. With intensive public health programmes, child health and ante-natal care and atleast few monthly visits by qualified nurses, We may expect reduction in morbidity and infant mortality and to have some important progress in general in a short period. With the present foctors of fertility operating and still lower expected mortality, the population seems to continue to increase at even greater pace than it had been during the last intercensal period

This compact community bears in general the normal demographic characteristics experienced by many underdeveloped countries of the world.

ECONOMIC IMPACT OF IMMIGRATION ON THE POPULATION OF WEST BENGAL

by

S. Banerjee*

The 1961 Census revealed an unprecedented increase in the population of West Bengal from 26.30 millions in 1951 to 34.93 millions in 1961 or by 32.8 per cent as against an all-India increase of 21.1 per cent, though during the previous 50 years (1901-1951) the population of West Bengal increased by about 58 per cent, against the all-India increase of about 53 per cent. The exponential growth rate during 1951-61 was about 22 per cent in West Bengal against the all-India rate of about 19 per cent. Thus the phenomenal increase can not be explained by the natural rate of growth. The main reasons for the excessive increase are growing flow of immigrants from other States of India in search of livelihood and influx of refugees from Pakistan. Excluding such persons, the indigenous population of West Bengal, that is, who were born within the State whether of parentage immigrating from other States or not numbered 29.4 million, which is in accordance with the natural growth rate.

Since the partition of the country, there was a large influx of refugees from Pakistan. The 1951 Census revealed that the refugees from East Pakistan accounted for nearly 8.5 per cent of the total population. Another 2.1 million persons were estimated to have migrated from East Pakistan during the decade 1951-1961. Migration into West Bengal from other States of India in search of their livelihood was quite substantial. According to the 1951 Census, immigrants from other States formed nearly 7.6 per cent of the total population. The following table shows the increasing proportion of immigrants since 1881.

Table - 1

Year	Percentage of immigrant males to total males.	Parcentage of immigrant females to total females.	Percentage of all immigrants to total population	Year	Percentage of immigrant males to total males.	Percentage of immigrant females to total females.	Percentage of all immigrants to total ~~immigrant~~ population
1881	3.0	1.3	2.2	1921	11.8	5.7	8.9
1891	6.5	2.8	4.7	1931	11.2	5.2	8.4
1901	8.0	4.2	6.6	1941	13.1	5.3	9.5
1911	11.4	5.4	8.5	1951	21.1*	6.9+	18.5++

N.B. Only persons born outside the State were regarded as immigrants.

* Consists of 9.4 percent of displaced persons from East Pakistan.

\+ Consists of 3.4 ,, ,, ,,

++ Consists of 8.5 ,, ,, ,,

* Labour Bureau, Simla. The views expressed are of the author's alone.

The above figures consists not only of immigrants from other States, but also from foreign countries other than East Pakistan. But such immigrants were nominal having no significant effect on the percentage figure.

Though the percentage of immigrants from other States showed a decline during the decade 1951-1961 by nearly 3.7 per cent, there was an actual increase in the number of the immigrants by nearly 20.6 per cent from 1,881 thousand in 1951 to 2,272 thousands in 1961. The apparent decrease in the percentage figure was on account of larger influx of the diplaced persons from East Pakistan.

The bulk of the immigrants, as is well-known, dose not settle in the State for good, but earn their livelihood in West Bengal and maintain families in their States of origin. This has resulted not only in an economic drain to the State (as they take away bulk of their earnings to their native States), but also has distorted the age and sex distribution of the people. According to the 1961 Census, while the number of females per 1000 males was 903 among the indigenous population, this proportion was 885 among the immigrants from Pakistan, 425 among the immigrants from the States adjacent to West Bengal and 458 among immigrants from other States. This is in sharp contrast to the practice adopted by the emigrants from West Bengal. Not only the number of emigrants was incomparably smaller (6.06 lakhs only in 1961) the sex ratio was also considerably higher (1056 females per 1000 males among emigrants to adjacent States and 771 females per 1000 males among emigrants to other states according to the 1951 Census).

The future of the immigrants to settle down in West Bengal has introduced an element of instability which has an adverse effect on the emergence of a committed industrial labour force. The great disparity of the sexes among the immigrants has introduced an element of unhealthiness in the social fabric.

The sharp increase in population (inclusive of immigrants) has resulted in considerable increase in the density of the population which reached the staggering figure of 1,032 per square mile (742 in the rural areas and 12,972 in the urban areas) by 1961. An interesting feature is that though there had been a sharp increase in the overall density from 799 per square mile in 1951 to 1,032 in 1961, the urban density has come down from 13,632 per square mile in 1951 to 12,972 in 1961. This is mainly on account of reduction in density of the urban population in Calcutta and the districts of Howrah, Burdwan, Nadia, Darjeeling, Jalpaiguri and Cooch Behar, though there had been considerable increase in the density in the industrial urban areas of the districts of Hooghly and 24-Parganas. Increases were, however, noticed in the proportion of the indigenous persons in all the districts including Calcutta except Birbhum, Bankura and Midnapore. This may be seen from the following table.

Table – 2

District	Proportion of urban persons to total population				District	Proportion of urban person to total population			
	Born in West Bengal		All persons			Born in West Bengal		All persons	
	1951	1961	1951	1961		1951	1961	1951	1961
West Bengal	13.4	15.1	24 6	24.5	24-Parganas	14.9	19.2	29.6	31.8
Darjeeling	12.5	13.1	21.2	23.2	Calcutta	45.5	57.9	100.0	100.0
Jalpaiguri	2.1	4.9	7.2	9.1	Howrah	23.4	27.7	32.4	40.5
Cooch Behar	3.3	3.5	7.5	7.0	Hooghly	14.2	16.4	22.2	26.0
West Dinajpur	2.1	3.2	5.8	7.5	Burdwan	8.6	12.8	14.8	18 2
Malda	2.6	3.0	3.2	4.2	Birbhum	5.4	5.7	6.5	7.0
Murshidabad	6.3	7.4	7.9	8.5	Bankura	6.5	6.9	7.2	7.3
Nadia	9.5	10.6	18.2	18.4	Midnapore	5.5	5.3	7.5	7.7

This shows that while a greater proportion of the non-indigenous persons were finding their way into rural areas the indigenous persons were finding it difficult to continue in their village homes and were gravitating towards urban areas in search of livelihood.

Examination of the variation in the age and sex structure of the population might be useful at this stage. During the period 1901 to 1961, the proportion of persons in the working age-group came down to 54.1 per cent from 57.2 per cent in 1901 and is estimated to have reached the figure of 52.6 per cent in 1966. This is mainly on account of reduction of the death rate, especially among the children. as may be seen from the following table.

Table – 3

Age group	Proportion of persons in different age groups											
	1901			1931			1951			1961		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
0-14	37.7	38.1	37.4	37.2	36.6	38.0	37.5	36.0	39.5	40.9	39.2	43.0
15-59	57.2	57.4	56.8	59.3	60.2	58.3	58.5	60.2	56.2	54.1	56.0	51.6
60 and above	5.1	4 5	5.8	4.8	3.2	3.7	7.0	3.8	4.3	4.0	3.8	5.4

1966		
Estimated		
Total	Male	Female
42.7	40 8	45.8
52.6	54.7	49.4
4.7	4.5	4.8

The economic effect of the above changes is, however, quite serious. It means that comparatively lower proportion of earners has to carry on the burden of maintaining the population.

Table—~~3~~ 4

	Type of work	1951			1961		
		Person	Male	Female	Person	Male	Female
I.	Cultivation	12.3	19.7	3.6	12.8	20.9	3.5
II.	Agricultural Labourers	5.3	8.0	2.2	5.1	7.8	2.0
III.	Mining, Quarrying, Live Stock, Forestry, Fishing, Hunting & Plantations, Orchards and allied activities	2.1	2.4	1.6	1.7	2.4	0.9
IV.	Household industry	+	+	+	1.4	1.6	1.1
V.	Manufacturing other than household industry	5.1	8.0	1.8	3.8	6.7	0.5
VI.	Construction	0.4	0.8	0.1	0.4	0.8	(a)
VII.	Trade & Commerce	3.3	4.5	0.6	2.5	4.5	0.2
VIII.	Transport, Storage & Communication	1.4	2.6	0.1	1.1	2.1	(a)
IX.	Other services	4.6	7.2	1.6	4.4	7.2	1.2
	Total workers	34.5	54.2	11.6	33.2	54.0	9.4
	Total non-workers	65.5	45.8	88.4	66.8	46.0	90.6
	Grand Total	100.0	100.0	100.0	100.0	100.0	100.0

+ Included in the industry class V during the 1951 census (a) Less than 0.05.

During the decennium 1951 to 1961, the overall proportion of workers came down from 34.5 percent to 33.2 percent. During the same period, consequently, the pressure on land has gone up, not only in terms of the population depending on land, but also in the proportion of persons depending on cultivation of land. A consequence of this increase in dependence on land is not only greater fragmentation of the available cultivable land, but also lowering of employment opportunities in cultivation. When the owners of land feel increasing pressure themselves, they try to dispense with hired help for cultivating the land. Hence, there is a reduction in the proportion of agricultural labourers. It is concievable that reduction of demand for hired help in cultivation is, to a considerable extent, concealed by increasing under-employment of this class of workers.

Among the other categories of economic activity, expansion of opportunities in the remaining primary economic activities of Mining, Quarrying, Live-stock, Forestry, Fishing Hunting, Plantation, Orchards etc., and in tertiary

classes of Construction, Trade & Commerce, Transport and Communication and Services could not keep pace with the increase in population. Only in the case of secondary production (Manufacturing including Household Industries), there has been a marginal increase in the proportion of workers engaged.

A portent of greater concern is the squeezing out of women from all spheres of economic activity. The overall position is that while in 1951 nearly 12 percent of the women were found to be economically active, during 1961 such women were found to be slightly more than 9 percent. They were practically squeezed out of the category of activities Construction and Transport, Storage and Communication, while maintaining a slight foothold in the category Trade and Commerce. Thus, the families in West Bengal are becoming more vulnerable to the vicissitudes of life.

As compared to other States of India, the participation rate in economic activities was the lowest in West Bengal. As against an all-India average participation rate of 57.1% per males and 28.0% for females in 1961, the corresponding figures for West Bengal were 54.0% and 9.4%.

The position was still worse for the indigenous population of West Bengal. The following table shows percentage of workers and non-workers by sex among the indigenous population, and the migrants whether from Pakistan or from other States of India.

Table — 6 5

	Indigeneous population			Displaced persons from Pakistan			Migrants from other States in India		
	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female
Workers	30 4	50.1	9.1	38.0	64.8	5.8	61.8	79.2	20.1
Non-workers	60.6	49.9	90.9	62.0	35.2	94.2	38.2	20.8	79.9
Total	100.0	100.0	100.0	100.0	100.0	100 0	100.0	100.0	100 0

Only about 30 percent of the indigenous population was economically active, while the position was slightly better among the displaced persons from Pakistan. Among the migrants from other States, however, the proportion of economically active persons was more than double that of the indigenous population. The same disparity between the indigenous population and migrants from other States are noticeable in the participation rate of women, While among the former, only 9 percent of the women were found to be workers, the percentage was found to be 20 among the women the who migrated from other States. The position was still worse among the displaced persons from Pakistan. Even less than 6 percent of the women among this group of population were found to be workers.

The distribution of the workers among these groups of population between the different industrial categories are also of interest. The table below shows the Percentage distribution of workers by sex among the groups of population between the different industrial categories :

Table—7.6

Industrial Categories	Indigenous population		Displaced persons from Pakistan		Migrants from other States of India	
	Male	Female	Male	Female	Male	Female
1. Cultivation	46.7	40.2	25.1	16.0	2.7	20.0
2. Agricultural Labourers	17.5	23.2	6.7	6.2	3.0	12.9
	64.2	63.4	31.8	22.2	5.7	32.9
3. Mining, Quarrying, Live Stock, Forestry, Fishing Hunting & Plantation, Orchards and Allied Activities	3.6	6.6	2.4	2.5	10.0	27.8
4. House-hold Industry	3.1	12.7	3.9	23.5	1.3	2.9
5. Manufacturing other than House-hold Industry	8.7	3.5	16.8	7.4	31.5	17.1
6. Construction	1.1	0.3	1.8	@	3.3	0.7
7. Trade & Commerce	6.0	2.2	15.8	2.5	16.4	2.9
8. Transport & Communication	2.5	0.2	6.2	1.2	10.0	0.7
9. Other Services	10.8	11.1	21.3	40.7	21.8	15.0
All Workers	100.0	100.0	100.0	100.0	100.0	100.0

Major portion of the workers among the indigenous population, both male and female, was employed in agriculture. Except for the category "other services" —in none other, the percentage of workers among the indigenous population reached 10 percent. Only in Household Industries, the proportion of female workers exceeded 10 percent. Thus, it will be seen that most of the workers among the indigenous population were engaged in the subsistence sector of the economy with low marginal output.

In sharp contrast, it will be seen that bulk of the workers among the migrants from other States were engaged in sectors of the economy where marginal productivity was higher. The displaced persons from Pakistan were found to hold on intermediate position. The point will be clearer from the following table which shows the percentage of the indigenous population, the displaced persons from Pakistan and the migrants from other States among the workers employed in different industrial categories.

Table—# 7

Industrial categories	Percentage of Male workers			Percentage of Female workers		
	Indigenous population	Displaced persons from Pakistan	Migrant from other States	Indigenous Population	Displaced persons from Pakistan.	Migrants from other States
1. Cultivators	92·1	7·0	0·9	92·8	2·3	4·9
2. Agricultural Labourers	92·3	5·1	2·6	92·9	1·5	5·6
3. Mining, Quarrying Live-Stock, Forestry, Fishing, Hunting and Plantation, Orchards and other activities.	64·4	6·2	29·4	67·5	1·6	30·9
4. House-hold Industry	80.5	14·1	5·4	87·7	10·2	2·1
5. Manufacturing other than house-hold industry	58·5	14·8	31·7	60·0	8·0	32·0
6. Construction	58.6	13·1	28 3	80·0	@	30·0
7. Trade and Commerce	54·9	20·6	24·5	82·0	5·7	11·4
8. Transport & Storage & Communication	50·0	17·5	32·5	00·0	20·0	30·0
9. Other Services	62·1	17·4	20·5	72·7	16·7	10·6
All Industries	76·6	10·9	12.5	85.5	9.2	5.3

@ Less than 0·05

The migrants from other States constituted only 12·5 percent of all the male workers, but they constituted a proportion much higher than household industries and the tertiary industries. In the primary industries they constituted a similarly larger proportion among the workers in Mining, Quarrying, etc. This is true of the migrants among the female workers also.

The pressure exerted by increase of population was also having its effect on the food front. While during the decade 1951-61, Population increased by 32·8 percent, the increase during 1949-50 to 1959-60 in the production of food grains was by 4·3 percent only. As a result, the food position in West Bengal deteriorated considerably. While the population of West Bengal in 1951 was 7·3 percent of the all-India population and the State produced 8·2 percent of the total food-grains produced in the country during 1949-50, the corresponding figures for 1961 and 1959-60 were 8·0 percent and 6·2 percent respectively. The net availability of food grains per capita decreased by 34 percent during the decade. Unless effective measures are taken for checking growth of population, and means explored for raising the opportunities, the future of the State seems gloomy.

AN IMPACT OF POPULATION GROWTH ON HEALTH PROBLEMS IN WEST BENGAL

STATE BUREAU OF HEALTH INTELLIGENCE
Directorate of Health Services, Government of West Bengal.

Since man first appeared on earth, human arithmatic has moved from a relatively simple exercise in addition to a complicated one of geometrical progression. It took all the vast reaches of time to build today's population of nearly 3 billions. But it will take only 40 more years for population to reach 6 billions in 2000 A. D. If the present growth rate remains unchanged as will be seen from the table below :

World Population—Millions

Year	1000	1600	1800	1900	1960	2000
Asia & Oceania :	165	279	599	921	1700	3900
Europe, including Russia	47	102	192	423	641	947
Africa :	50	90	90	120	244	517
America :	13	15	25	144	407	904
Total ;	275	486	906	1608	2992	6268

It will be revealed from the table that the increase of population of the world during 60 years between 1900 and 1960 is a little more than the increase in 900 years prior to 1900, thus showing the dynamic increase in population in the present century.

The picture of India does not differ very much from that of the world in respect of growth of population. It will be seen from the table below that the increase of population during the period 1891 to 1931 and 1931 to 1961 was about 43 millions and 160 millions respectively, thus showing that the increase of population during 1931 to 1961 was about four times of that during 1891 to 1931.

Growth of population of India and West Bengal during 1891-1961

Census years	India		West Bengal	
	Census population (in millions)	Annual growth in percentage	Census population (in millions)	Annual growth in percentage
1891	235.9	—	16.94 (1901)	—
1931	279.0	1.10	18.90	0.81
1951	361.1	1.33	26.30	1.32
1961	439.2	2.15	34.93	3.28

The position of West Bengal is still worse. A comparative study of the growth of population in India and West Bengal will reveal that during the last decade the rate of increase in West Bengal is higher than that in India.

It may be noted that about 4,000 babies are born alive per day in West Bengal at present. What amount of health care needed for these new-born babies can well be imagined. The excessive growth of population is affecting the load of health problems every day. The facilities which are sufficient for today, become inadequate tomorrow, resulting in obvious consequences.

Apart from the physical load relating to excessive population on the existing health facilities, there is also a change in the pattern of diseases. Communicable and other preventible diseases which were the leading causes of death in the past, are now becoming less important due to different health development plans undertaken in the country. Their places are, however, being taken by diseases like Cardiovascular diseases, Neoplasms, Mental diseases and Injuries etc. as in other developed countries of the world, with the simultaneous increase in the expectation of life in this region. The above diseases are constitutional in character and exert enormous pressure on the existing hospital facilities as bed-days required by these diseases are many more times greater than those of the diseases of the past.

In the wake of the apprehended population explosion, it is of real significance that methods of birth control and family planning are vastly gaining grounds and it is felt that such methods can be regarded as the best to reduce the population pressure by preventing pregnancies to occur and thereby enabling to solve the overall problem of the country.

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A BRIEF NOTE ON FERTILITY SURVEY OF STILL-MARRIED FEMALES IN THE ADJOINING VILLAGES OF CHAKDAH, DISTRICT NADIA.

State Bureau of Health Intelligence,
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Objective & method of survey :

The most important single problem in the country today is population control. For this purpose, with the initiative of the Government, the Family Planning Programme is being pursued intensively to make an impact on the growth of population of the country and thereby to reduce the population pressure within manageable limit. Side by side with this, the need for periodical assessment and evaluation of such programmes as to their effectiveness in controlling fertility or reducing birth rate is obvious. With this objective in view a retrospective method of survey to compare the fertility of those who adopted family planning methods with that of those who did not, was taken up in the adjoining villages of Chakdah, District Nadia, where the family planning programme was reported to have made considerable progress. The actual house to house survey was conducted by three assistants deputed by the State Bureau of Health Intelligence with the assistance of a few Lady Health Visitors under the direct guidance of the Medical Officer-in-Charge of Chakdah Primary Health Centre.

A detailed instruction as to the procedure of operation of the survey was prepared for the purpose, and the staff concerned were imparted necessary training in the office of the State Bureau of Health Intelligence. The field operation was also periodically supervised by the Senior Officers of the Bureau at regular intervals. A card for recording the fertility of still-married couples was also designed for this purpose. The cards were to be filled up in respect of every women of the area who lived with her husband and came within the age-group 15-49 years on the Ist January, 1967.

During the survey, the staff visited every household of the area, prepared a register for the couples concerned, and with the help of the Lady workers, enquired about the necessary particulars as per the card. The complete particulars of children born alive were noted down in the cards in respect of all women, while particulars relating to family planning were recorded for only those who adopted the method.

The cards thus duly filled in were then processed and analysed from different view points, and important findings of the survey are summarised in the following paragraphs :

Adoption of Family Planning Methods :

The selected area comprised a total population of 6903, of whom 1016 still-married females came under the age-group 15-49 years and they were studied under the survey. It was found that only 222 i.e. about 22% of

them either adopted family planning methods or were found to be still adopting them at the time of the survey. The use of such methods was started in the area only in recent years, so that out of this 22% still-married females as many as 20% adopted the method during the last five years.

Motivation towards Family Planning Programme :

To note actually who were the persons to have recourse to family planning methods, the still-married females under the two groups, "adopted" and "not adopted," were compared in respect of age-group, average spacing interval between marriage and first live birth and between two successive live births, as also average number of children born to them. It was found that the females in the age-group 25-39 years were more keen to adopt family planning methods than those in lower or higher age-groups, presumably because of greater fertility during this period and at the same time of being more cautious about the effect of uncontrolled fertility having a number of children already born to them. The effect of family planning on average spacing interval was 3.2 years before adoption and 3.7 years after adoption, while it was 3.4 years for those who never adopted. So the spacing intervals increased by only 0.5 years or six months after adoption of family planning methods and the spacing interval was smaller by only 0.2 years before adoption for those who adopted the method in comparison with those who never adopted such methods. But these figures are too small to record any marked effect of family planning on spacing interval or to conclude definitely that those who adopted the method were actually having children more frequently before adoption of such methods than those who never adopted. These observations are also subject to the limitations that number of observations in some age-groups was too small and the use of family planning methods being a fairly recent phenomenon there was no scope of comparison over longer period of time.

The fact that it is larger family size which pursuaded them to adopt family planning methods was, however, evident when it was found that the number of children born to a hundred mothers per unit duration of married life was 29 for those adopted as against 22 for those, who never adopted. Also, when the cases of mothers 'adopted' and 'not adopted' family planning methods under the same age group and equal duration of married life was compared, average number of children born to them was found to be higher in almost all the cases for those, who adopted the method, thus pointing to the definite role of prevention of further increase in family size as an important factor for motivation towards family planning devices.

It may, however, be borne in mind in this connection that other important socio-economic factors contributing to such motivation like educational, employment status of the couples were outside the consideration of the present survey.

Impact of Family Planning Programme in the area :

The effect of family planning upon the occurrence of total number of births, fertility and consequently the birth rate was also studied from the findings of the survey. Taking only the cases of 222 mothers who adopted family planning methods it was found that only 17% of them adopted the method in 1962 and the further increase of 83% of them during the course of the proceeding five years was associated with 55% reduction in total number of births occurred to them as observed by the end of 1966. The corresponding change in fertility rate per 100 still-married females was that it came down from 25.1 in 1962 to 23.4 in 1966 taking both the mothers adopted or not adopted together. Birth order statistics revealed that about 23% of total number of births could be reduced per year if the number of live births could be restricted to five only for each mother.

To note the effect on fertility as also to make the comparison valid it was necessary to consider a sample of equal number of still-married females in the child bearing period 15-44 years with same age group composition under the two groups viz. those adopted and those who did not adopt family planning methods. It was observed that there was reduction in fertility rate per 100 still-married females in both the cases during the course of the years 1962 to 1966. It came down from 33.5 to 15.4 for those adopted and 24.4 to 21.1 for those who never adopted family planning methods during the period. Higher fertility for mothers in the adopted group in the year 1962 when however, most of them had not adopted such methods again established the fact that they were having comparatively more children at that time. This however, came down sharply in, 1966 with the adoption of family planning methods to record a decline of 18.1 while the corresponding reduction for those never adopted was only 3.3 during the years 1962 to 1966. Assuming that all the couples considered were under identical conditions but for their attitude towards family planning, the programme by itself effected a fall of 18.1—3·3=14.8 in the fertility rate per 100 still-married female in the area during the course of the years 1962 to 1966.

Considering that our main concern is with birth rate which in its turn will effect the growth rate—the overall fertility rates for 1962 and 1966 as obtained from the survey were operated upon the estimated rural population of still-married females for West Bengal in the corresponding years. The birth rates were then calculated for these 2 years on the basis of estimated mid-year population for rural West Bengal with the help of expected number of births thus obtained. It was observed that a reduction of about 7% in the birth rate was made possible during this 5 years with 22% of still-married females adopting family planning methods. To put a more reasonable point to it, it was also observed that out of the 22% adopted 18% was still continuing with such devices at the time of survey of whom again 16% practised with really effective measures like loop and steri-

lization while the remaining 2% using other methods with greater chance of failure. This small margin of 4% between those adopted and those still pursuing the method was, however, due to the special efforts of the Medical Officer of the Chakdah Primary Health Centre which may be lacking in other normal areas.

Use of Loop as a Family Planning device :

Loop, which came in use in the area in the year 1964, was predominant among all the methods used so that it accounted for 77.5% of the total number adopted family planning methods. 14% of those who adopted loop, however, rejected the method subsequently once for all and another 2% although rejected it at some time again adopted the same afterwards. The principal reasons for rejection were found to be "excessive bleeding and pain" as well as "automatic rejection". There was 4.1% cases of failure after once adopting the method and its relative efficacy could not be ascertained with reliability because of the smallness of the sample in respect of other methods.

Reasons of non-adoption of family planning methods :

Why a great many number of persons still did not adopt family planning methods? The study revealed that about 49% of those not adopted was not willing to use family planning methods although they were conversant about the programme. They may either be antipathetic or ignorant about the beneficial aspect of the Family planning Programme which emphasises the need for effective pursuation and spread of necessary education in this respect. About 36% was simply desirous of having children while 1.5% complained of want of facilities. The percentages "not conversant not willing" came out to be very small which may be due to the fact that this was a specially selected area where much endeavour was made to popularise the programme and, therefore, this percentage is believed to be normally higher in other areas.

Marriage :

When there is much talk about restricting the age at marriage for Indian girls, the study from the persent survey as to how did it change in the normal course during the last twenty years showed that average age at marriage increased to nineteen years in 1966 from fourteen years in 1946 in the area. The analysis also revealed that about 8% and 35% of total births are contributed per year by females in the age-groups 15-19 years and 20-24 years respectively—a fact that may be considered while fixing up such lower limit for age at marriage.

The marriage rate per 1000 population worked out to 4.2 which is much lower in comparison to other developed and Western countries and is, therefore, subject to further verification.

Source : Report on Pilot Survey on Fertility of Still-married female population in the adjoining villages of Chakdah Primary Health Centre, Dist. Nadia. Published by State Bureau of Health Intelligence, Directorate of Health Services, Government of West Bengal.

Summary discussions of papers of the seminar on Population Growth and related social problems under the Chairmanship of Dr. A. Ghosh, Professor of Applied Economics, Jadavpur University, Calcutta.

The following papers on "population growth and related social problems" were read and discussed.

1. "Some features of the Growth, distribution and preassure of population in West Bengal"-by Sri M. V. Raman.

2. "Demographic data - an imperative need for the welfare of the tribal population in India" - by Shri B. Chakraborty and C.R. Malakar.

3. "The growth of Fopulation, immigration and certain related economic problems" — by Shri S. Banerjee.

4. "Developments of West Bengal : Some considerations for regional planning" — by Shri P.B. Dasai.

5. "An impact of population growth on health problems in West Bengal" — by State Bureau of Health Intelligence, West Bengal.

6. "A brief note on Fertility survey of still-married females in the adjoining villages of Chakdah, District—Nadia"—by State Bureau of Health Intelligence, West Bengal.

Discussions on paper by Shri Raman :- Dr. Mathen observed that from Table —2 we see that Calcutta occupies the bottom place in growth of population in 1951-61. In the previous decade it was occupying a high place.

The reason of Lower Growth rate may be that people who come to Calcutta go back after retirement. This cou d be examined by comparing age composition of Calcutta population with that of other districts.

Mr. Behara said that our present rate of increase in output of food items is not sufficient to maintain our people and we may not be in a position to give any consideration to nutritionally adequate food items at this stage. Mr. Dutta Roy gave an explanation for lower growth rate in Calcutta. According to him birth rate here is less than death rate and growth rate is expected to be low if migration is limited.

Mr. S.P. Jain said that our agricultural production is very low and intensive cultivation may be tried as already suggested by Shri Jyoti Basu, Hon'ble Deputy Chief Minister of West Bengal in his inaugural speech.

Mr. Chairman said that a curious feature of study made by the author is that there exists an inverse relationship between rice yield and population dependent on agriculture including cultivators.

In reply Mr. Raman said that low growth of Calcutta population during 1951-61 may be due to decrease in fertility etc. but to what extent the various aspects have contributed he has not studied. He also said that there may not have any inverse relationship between the increase in production and increase in nuritionally adequate foods. While elaborating the points raised by the Chairman he said that less argicultural individuals might be using better implements. These are striking reasons. He does not know whether there are other reasons.

Mr. Jain said that production is low specially in West Bengal and there is no alternative to a call back on argiculture. Chairman winded up the discussion with the comment that there exists overcrowding in agriculture and there may not be any technical superiority in one region or other. The point is open.

Discussion on paper by Shri S. Banerjee :- Shri D. Chatterji said that at page-4 author has said that density of urban population has decreased and at page-5 he has said that the indigenous population was finding it difficult to continue in their village homes and was gravitating towards the urban areas— these two contentions are contradictory. The decrease in density of urban population may be due to the increase in number of towns.

Shri M V. Raman said that Mr. Banerjee is an indigenous person and he has done injustice to non-indigenous persons. He questioned whether by squeezing out in-migrants the economy of the State will improve since the working population will not increase considerably and also there are persons from this state to other states and they will come back. In migrant population working here causes some economic strain and there is also definite economic gain. He also said that all remittances do not necessarily go out. According to him the picture is not going to be rosier by humiliating the in-migrants.

Chairman intervened and said that Mr. Raman is seeing only the negative aspect and elaborating the matter beyond what Mr. Banerjee wanted to say. Partition and consequent influx of refugees is a grave problem for the state. There is overcrowding here and Mr. Banerjee has discussed its adverse effect. Refugee population definitely hardly press West Bengal's economy and one cannot deny that if no additional scope for them can be opened it is difficult to solve the problem.Secondly West Bengal has got a very big floating population without families. Probably their income here is not sufficient for maintaining their

families. The state of affairs is bound to have adverse social and economic effects and the remedy does not lie in squeezing them out but in encouraging them to live here with their families.

Discussion on Mr. Malakar's paper :- Chairman said that the material is small and it is of the nature of a pilot-study, not mature enough. Some type of more serious study may be necessary to be of any use.

Dr. Chandrasekharan wanted to know how it is possible to study the fertility and mortality and numerous other factors, for tribal population who live in very small groups. These are bound to be erratic due to smallness of sample. He said that it is interesting to know how far this affects, and of course, there is the difficulty of obtaining data from them.

Chairman remarked that this seems to be a case study and may have value not from the standpoint of estimation but from the stand point of social change.

Dr. Das suggested that the study could have been accompanied by a parallel study on diet etc. since very few of them get nutritionally adequate food and death rate is very high. In reply Shri Malakar said that the study is a complete ennumeration and not a sample survey. Population is small and the idea was to observe whether the tribe was going to be wiped out.

Discussion on the paper entitled—"Impact of population growth on health problems of West Bengal" by state Bureau of Health Intelligence :—Mr. S. Das Gupta observed that the author has presented death rates for the years 1962 to 1966 as 12.9, 13.2, 10.8, 10.6 and 11.1 respectively.

Investigation may be necessary whether low death rate is likely to be followed by high death rates after a few years. Chairman observed that unless sampling details are available it is very difficult to say anything about the representativeness and reliability of the figures presented.

Discussion on the paper entitled—"A brief note on fertility survey of still-married females in the adjoining villages of Chakdah, district—Nadia"—by State Bureau of Health Intelligence, West Bengal.

Sri P.B. Gupta pointed out that "still-married women" may not be a happy nomenclature.

Mr. Saxena said the married females' may include widowed etc. Mr. Chairman requested Dr. Chandrasekharan for giving some idea about the usual practice.

Dr. Chandrasekharan said that the information actually used matters. There are two terms viz. (1) Currently married
and (2) Ever married

Shri S. Dutta Roy said that in a survey conducted in 1962 by the State Statistical Bureau for rural areas of West Bengal similar figures were obtained and this is a corroborating point.

Discussing on the motivation behind adoption of family planning measures he observed that as the information on age at marriage is available it could not be studied whether the cause behind the motivation is age or large number of children already born.

Dr. Das wanted to know the population which may be represented by the information i.e. whether it will include the urban population of Chakdah or also the refugees concentrated in the outskrits ; because in that case the sample may be a typical one since the refugees are economically handicapped.

Shri B. Chakraborty gave the information that marriage age for city population has gone up by 4 years as revealed by a survey conducted in 1956.

Chairman wound up the discussion with a comment that it would be better if instead of such general topics we could deal with more pointed topics so that some effective and pointed conclusion could be arrived at. As a matter of fact there may not be any point in re-establishing some well known facts and that also with no greater stress. Some studies e.g. the family planning survey seems to be of operationed nature. Designs may be drawn more purposefully so that discussions may be more fruitful.

He added that fruitful points raised during the discussions are (i) Overcrowdedness in agriculture (ii) Female participation in labour force and these may be the points for some pin pointed studies.

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A NEW METHOD OF CALCULATING THE EXPECTATION OF LIFE AT BIRTH AND MEAN AGE AT DEATH UNDER STABLE CONDITIONS

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~~Expectation of Life at Birth~~

A closed population exposed to a constant age schedule of fertility and mortality will in due course attain a fixed age distribution with constant rate of birth, death and growth. Such a population is called a 'Stable Population' and the age distribution and birth rate at any time is given by the following equations :

$$C(a) = be^{-ra}p(a) \qquad \text{-(1)}$$

$$1/b = \int_{\alpha}^{\omega} e^{-ra}p(a)da \qquad \text{(2)}$$

where C(a) is the proportion of population at age a, 'b' is the birth rate per person per annum, 'r' is the annual rate of natural increase per person and 'p(a)' is the probability at birth of an individual reaching age 'a'.

For calculating the expectation of life at birth (e°), let us consider the plane area in the figure below bounded by the curve $y = e^{-ra}$ and the axes of x and y.

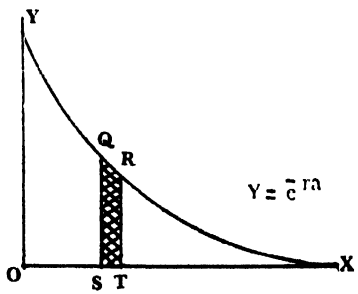

Fig. 1

x axis denotes age 'a'

y axis denotes e^{-ra}

In this figure let the area of the strip QRTS be ydx where dx is the width being infinitesimally small and y the length. Also let p(x) be the mass per unit of area. Then the total mass of the strip is yp(x)dx and the coordinates of its centre of gravity with sufficient accuracy are $(x, \frac{1}{2}y)$. The coordinates $(\bar{X}, \bar{Y})$ of the centre of gravity of the whole area bounded by the curve $y = e^{-ra}$ and the two axes are as follows :

$$\bar{X} = \int_{o}^{\omega} xy\, p(x)\, dx \,/ \int_{o}^{\omega} y\, p(x)\, dx \qquad \text{---(3)}$$

$$\bar{Y} = \int_{\alpha}^{\omega} \tfrac{1}{2}y^{2}\, p(x)\, dx \,/ \int_{\alpha}^{\omega} yp(x)\, dx \qquad \text{--- (4)}$$

Substituting the value of x and y we get:

$$\bar{X}=\int_0^\infty ae^{-ra}\,p(a)\,da/\int_0^\infty e^{-ra}\,p(a)da \qquad (5)$$

$$\bar{Y}=\int_0^\infty e^{-2ra}\,p(a)\,da/\,2\int_0^\infty e^{-ra}\,p(a)da \qquad (6)$$

or $\bar{X}=M$ (Mean age in the stable population).

It can be proved that $\bar{Y}$ (equation 6) is very approximately equal to

$$\int_0^\infty e^{-ra}p(a)\,da/\,2\int_0^\infty p(a)da=\frac{1}{2be^\circ} \quad (\text{See equation } 2) \qquad (7)$$

where 'b' as defined above is the birth rate per person per annum and e° is the expectation of life at birth:

PROOF:

Let us assume that

$$\int_0^\infty e^{-2ra}\,p(a)\,da/\int_0^\infty e^{-ra}p(a)da=\int_0^\infty e^{-ra}p(a)da/\int_0^\infty p(a)da$$

$$\int_0^\infty e^{-2ra}\,p(a)da/\int_0^\infty p(a)\,da=\left(\int_0^\infty e^{-ra}p(a)da/\int_0^\infty p(a)da\right)^2$$

Expanding e^{-ra} by Taylor's theorem and writing for brevity

$$Kn=\int_0^\infty a^n p(a)da \qquad (10)$$

Equation (9) is

$$\frac{K_0-2rK_1+2r^2K_2-\frac{8}{6}r^3K_3+\cdots}{K_0}=\frac{1}{K_0^2}\left(K_0-rk_1+\frac{r^2K_2}{2}-\frac{r^3K_3}{6}+\cdots\right)^2 \qquad (11)$$

$$\text{or } 1-2r\frac{K_1}{K_0}+2r^2\frac{K_2}{K_0}-\frac{8}{6}r^3\frac{K_3}{K_0}+\cdots=\left(1-r\frac{K_1}{K_0}+\frac{r^2}{2}\frac{K_2}{K_0}-\frac{r^3}{6}\frac{K_3}{K_0}+\cdots\right)^2 \qquad (12)$$

The terms beyond the second power of r in the above equation are negligible and $\frac{K_1}{K_0}$, $\frac{K_2}{K_0}$ etc. are respectively the first and second moment of the distribution about zero in the population and which can respectively be denoted as $\bar{U}_1$, $\bar{U}_2$ etc.

Thus, finally we have :

$$1-2r\bar{U}_1+2r^2\bar{U}_2=(1-r\bar{U}_1+\frac{r^2}{2}\bar{U}_2)^2 \qquad (13)$$

$$=1+r^2\bar{U}_1^2+\frac{r^4}{4}\bar{U}_2^2-2r\bar{U}_1+r^2\bar{U}_2-r^3\bar{U}_1\bar{U}_2 \qquad (14)$$

$$=1-2r\bar{U}_1+2r^2\bar{U}_2-r^2\bar{U}_2+r^2\bar{U}_1^2+\frac{r^4}{4}\bar{U}_2^2-r^3\bar{U}_1\bar{U}_2 \qquad (15)$$

$$=(1-2r\bar{U}_1+2r^2\bar{U}_2)-r^2(\bar{U}_2-\bar{U}_1^2)+\frac{r^4}{4}\bar{U}_2^2-r^3\bar{U}_1\bar{U}_2 \ldots \qquad (16)$$

The terms underlined are negligible in value and can be dropped.

So that we have :

$$1-2r\bar{U}_1+2r^2\bar{U}_2=1-2r\bar{U}_1+2r^2\bar{U}_2-r^2\ddot{U}_2 \quad \text{---------- (17)}$$

where U_2 is the second moment of the distribution about the mean in the population and is equal to $\bar{U}_2-\bar{U}_1^2$

Thus, the relation $\int_0^\infty e^{-2ra}p(a)da/2 \int_0^\infty e^{-ra}p(a)\,da=\frac{1}{2be^0}$ involves an error of $-\frac{1}{2}U_2r^2$ which is very small and can be ignored.

Hence we get :

$$\bar{Y}=\frac{1}{2be^0} \text{ (see equations 6 and 7)} \quad \text{.... (18)}$$

When $x=\bar{X}$, $y=e^{-rM}$ (see equation 5) .... (19)

but $y=2\bar{Y}=\frac{1}{be^0}$ (20)

or $be^0=e^{rM}$ (21)

It may be pointed out that the same formula (1) can be applied to read the expectation of life at birth in a quasistable population—a population where fertility is fixed but mortality is declinnig—as the quasi-stable population resembles the particular stable population defined in equations 1 and 2 by the mortality function p(a) and the growth rate (r) prevailing at the time the quasi-stable population was observed.[2]

Mean Age at Death

An argument similar to that developed above with respect to the derivation of equation (21) may also be applied to the calculation of the Mean Age at Death.

Let us consider a surface where x axis denotes age (a), y axis denotes the growth function (e^{-ra}) and Z axis denotes M(a), age specific mortality. Also, let p(a) be the mass per unit of volume of the solid bounded by this surface and (x,y) plane. The x and y coordinates of the centre of gravity of the solid covered by this surface and the (x,y) plane are then given by the equations :

$$\bar{X}=\int_0^\infty ae^{-ra}p(a)\ M(a)\ da/\int_0^\infty e^{-ra}\,p(a)\ M(a)da \quad \text{---------- (22)}$$

$$= V \text{ (Mean age at death in the stable population)} \quad \text{--(23)}$$

$$\bar{Y} = \int_{o}^{\infty} e^{-2ra}\, p(a)\, M(a)\, da/2 \int_{o}^{\infty} e^{-ra} p(a)\, M(a)\, da \qquad -- (24)$$

$$= \int_{o}^{\infty} e^{-ra} p(a)\, M(a)\, da/2 \int_{o}^{\infty} p(a) M(a) da \text{ (See equations 8-17)} \quad -(25)$$

$$= \frac{d}{2b} \text{ (See equations 30 and 35 in the alternative proof)} -(26)$$

where d denotes the annual death rate

$$\text{or } e'' = \frac{r}{d} \qquad \ldots \qquad \ldots \qquad \ldots \quad -(27)$$

$$= 1 + \frac{r}{d} \qquad \ldots \qquad \ldots \qquad \ldots \quad -(28)$$

Alternative Proof :

At age 'a' since M(a) denotes the age specific mortality

$$\int_{o}^{\infty} e^{-ra} p(a)\, M(a)\, da / \int_{o}^{\infty} e^{-ra} p(a)\, da = d \qquad (29)$$

$$\text{or} \quad \int_{o}^{\infty} e^{-ra} p(a) M(a) da = \frac{d}{b} \qquad (30)$$

Let the integral in (30) be denoted by y so that, p(a) and M(a) being given, y is a function of r. Differentiating with respect to 'r' we have,

$$dy/dr = -\int_{o}^{\infty} a e^{-ra} p(a) M(a) da \qquad -- (31)$$

$$= -Vy \qquad (32)$$

$$\text{where} \quad V = \int_{o}^{\infty} a e^{-ra} p(a) M(a) da / \int_{o}^{\infty} e^{-ra} p(a) M(a)\, da \qquad (33)$$

Integrating (32) we have

$$Y = Te^{-\int Vdr} \text{ (T being a constant)} \qquad (34)$$

when $r = o$

$$Y = T = \int_{o}^{\infty} p(a) M(a) da = 1 \qquad (35)$$

$$\text{hence } y = e^{-\int Vdr} \qquad (36)$$

We seek a value of r such that $y = \frac{d}{b}$. This value, then, is given by

$$\frac{d}{b} = e^{-\int Vdr} \qquad (37)$$

Expanding e^{-ra} in equation (33) by Taylor's Theorem and writing for brevity

$$Kn = \int_{\alpha}^{\infty} a^n \, p(a)M(a)\,da \qquad (38)$$

we find

$$V = \frac{K_1 - r\frac{K_2}{K_0} + \frac{r^2}{2}\frac{K_3}{K_0} - \frac{r^3}{6}\frac{K^4}{K_0} + \cdots}{K_0 - rK_1 + \frac{r^2}{2}\frac{K_2}{K_0} - \frac{r^3}{6}\frac{K_3}{K_0} + \cdots} \qquad (39)$$

$$= A + Br + Cr^2 + Dr^3 + \cdots \qquad \cdots \qquad (40)$$

where $A = \frac{K_1}{K_0}$ .. .. (41)

$$B = A^2 - \frac{K_2}{K_0} \quad \ldots \qquad \ldots \qquad \ldots \quad (42)$$

$$C = A^3 - \frac{3A}{2}\frac{K_2}{K_0} + \frac{1}{2}\frac{K_3}{K_0} - \ldots \qquad \ldots \quad (43)$$

$$D = A^4 - 2A^2\frac{K_2}{K_0} + \frac{2A}{3}\frac{K_3}{K_0} + \tfrac{1}{8}\frac{K_2^2}{K_0^2} - \tfrac{1}{8}\frac{K^4}{K_0} \quad \ldots \quad (44)$$

The series (40) converges very rapidly and the terms beyond Br are negligible. It can also be shown that A and B are the first and second moments of the variate p(a) M(a) in a stationary population: ($A = U_1$, and $B = U_1^2 - U_2 = -U_2$) So that we have :

$$V = U_1 - U_2 r \text{ (after neglecting the higher powers of r)} \qquad (45)$$

$$\text{or } \int V dr = U_1 r - U_2 \frac{r^2}{2} \qquad (46)$$

$$= Vr \text{ (approximately) :} \qquad (47)$$

Going back to equation (37) we get

$$b/d = e^{Vr} \qquad (48)$$

$$\text{or } 1 + \frac{r}{d} = e^{Vr} \qquad (49)$$

The table gives the expectation of life at birth and the mean age at death in India during 1951-1961.

Table I

Expectation of life at birth and mean age at death 1911-1961

Year	Expectation of life at birth $e^0 = \frac{1}{be}Mr$		Census Figures		Mean age at death $\frac{b}{d} = \frac{V^r}{e}$	
	Male	Female	Male	Female	Male	Female
1911	23·8	23·5	22·6	23·3	21·9	21·8
1921	20·9	20·5	19·4	20·9	20·0	19·4
1931	28·5	28·0	26·9	26·6	24·9	24·5
1941	33·0	32·5	32·1	31·4	28·2	28·0
1951	33·7	33·3	32 5	31·7	29·5	29·2
1961	40·9	39·6	41·9	40·6	34·8	33·9

1. It is to be remarked here that formula (21) should be applied to either sex separately.
2. See Coale A.J. "Estimate of various Demographic Measures Through the Quasi-Stable Age Distribution". **Emerging Techniques in Population Research.** Proceedings of the 1962. Annual Conference of the Milbank Memorial fund, 40 Wale Street, New York, 5.
3. In equation (45) $Vr = U_1 r - U_2 r^2$, after neglecting the terms of higher powers of r as these are very small; the relation $\int Vdr = Vr$ involves a very minor error of $-\frac{1}{2} U_2 r^2$ which can be ignored,
4. It is to be remarked that the formula (49) should be applied to either sex separately.
5. Mean age (M) has been calculated for the unsmoothed age data. In 1931 as the unsmoothed age data are not available, mean age has been taken as the average of the mean ages of 1941 and 1951. The birth rates and death rates are taken from **Country Statement for India,** Asian Population Conference, New Delhi, December 10-20, 1963. Govt. of India, Deptt. of Statistics, Central Statistical Organisation, New Delhi. p.15. Table 40.

SUMMARY

In this paper an attempt has been made to work out certain relations for calculating the expectation of life at birth and mean age at death under stable conditions. The relations are :—

$$e^0 = \frac{e^{Mr}}{b} \qquad \text{(i)}$$

$$e^{Vr} = 1 + \frac{r}{d} \qquad \text{(ii)}$$

where e^0 is the expectation of life at birth, M is the mean age of the population, b the birth rate per person per year, r the annual growth rate per person and V and d are the mean age at death and the death rate per person per year.

These relations may have some value for the developing countries where population is following a 'stable' or 'quasistable' pattern and the basic data, i. e., age specific death statistics, for calculating these indices are not available.

The values of the expectation of life at birth worked out according to this formula for India (1911-1961) are very close to those given by the census figures.

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ESTIMATION OF NET INFLATION IN WEST BENGAL CENSUS, 1941

by Sex and age-groups

By

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Indian Statistical Institute

1. Introduction :

It is well-known that at the 1941 Census, the major communities in West Bengal and the Punjab made a definite move to inflate their numbers in the census enumerations. Although steps were taken to counter-act this move as far as practicable, the published figures were not entirely free from an artificial inflation of the populations. Estimates of the inflation were therefore made by the authorities and in the case of West Bengal, the over-enumeration was found to be of the order of 17 lakhs (1, P.5). While this enables us to know the correct total population of West Bengal in 1941 and also the actual rates of growth in the decades 1931-40 and 1941-50 (against the higher and lower ones respectively on the basis of published figures), further work on the basis of the 1941 population is obviously hampered in the absence of the correct population figures by sex and age-groups. It is the purpose of this paper to suggest a method by which the inflation can be assessed separately for each sex and also in age-groups, and since again the estimated total inflation represents the excess of the abnormal over-enumeration over the possible undercount (especially at the young ages), it is the net inflation that is considered in this paper.

2. Theory of the method.

If P and P^1 are respectively the enumerated and true total populations and I the net inflation, $I = P - P^1$.

Further, if π_x = proportion of P, at age x last birthday, π^1_x = corresponding proportion of P^1, and I_x = net inflation at age x last birthday,

we have
$$I_x = P.\pi_x - P^1.\pi^1_x \qquad \ldots\ldots\ldots \quad (2.1)$$
$$= P.\pi_x - (P - I).\pi^1_x$$
$$= P.(\pi_x - \pi^1_x) + (I\ \pi^1_x) \qquad \ldots\ldots\ldots\ldots \quad (2.2)$$

and $\Sigma I_x = I$, where the summation extends over all ages,

since $\Sigma \pi_x = \Sigma \pi^1_x = 1$.

Equation (2.2) expresses I_x directly in terms of I and the change in the age-distribution, $\pi_x - \pi^1_x$, caused by the inflation and is preferred to equation (2.1). A further advantage of the expression will be seen later.

3. Application of the method to West Bengal Census data.

To apply equation (2. 2), it will be noticed that P is given by the census figures, 1941, π_x by the corrected Age-tables, 1941 (2), so that we have to obtain an exact value of I, and to assess the true distribution of the population, π_{x}^{1} if the inflation had not occurred.

3. 1. Estimation of I (1941 census).

From the total population figures of West Bengal for 1931, 1941 and 1951 on the basis of the 1961 lay out of the State, the decennial growth rates percent are 22.93 and 13.23 respectively for the decades 1931-40 and 1941-50 (3, pp 8-9), but in the paper 'State Growth Rates and their Components' (4), the Census Actuary gives revised figures corrected for inflation, viz., 13.4 and 22.4 respectively. Calculations on the revised figures give the estimated correct population of West Bengal in 1941 and hence also the total net inflation. Reducing it to apply to the population under the 1951 lay-out (which is less than under the 1961 lay-out, caused by the reorganisation of states, 1956-60), and on the assumption of a uniform incidence of inflation over the bigger area, the total net inflation in West Bengal at the 1941 census comes to be 1,638,595 and the decennial growth rate (1941-50) to be 22.8 per cent, which figures agree fairly well with those mentioned above. Apportioning the total net inflation between the sexes by the relative sizes of the male and female populations in 1941 (2), in the absence of any information about the inflation being sex-selective, we have figures for West Bengal given in the table below.

Table—1.

Enumerated and Correct Population of West Bengal in 1941 (on the 1951 lay-out of the State), by sex.

Sex	Enumerated population P	Net Inflation I	Correct population P^1
(1)	(2)	(3)	(4)
Male	11,841,066	888,513	10,952,553
Female	9,996,229	750,082	9,246,147
Total	21,837,295 (5)	1,638,595	20,198,700

3. 2 Estimation of π_x^1 (1941 Census).

The age-distribution of a population is the product of its past fertility, mortality and migration experiences. The fertility of the Indian population as also that of the population of West Bengal have remained practically at the same level through the past decades. Mortality rates however declined during the past decades in West Bengal (as also in the rest of India), but the improvement was substantial only in the decade, 1951-60 and thereafter, and it may be noted also that a small change in the mortality experience would leave the age-structure practically unaltered. On the other hand, migration which is a factor of some importance for West Bengal, would make an outright change in the age-structure, depending on its nature and extent. Thus, following the method of Sec. 2, if.....

If, at a given time, M=total net migrant population, p^n=total natural population (subject to no migration), and P^{11}=total population including migrants, then, $P^{11}=P^n+M$.

Further, if π^m_x, π^n_x and π^{11}_x are the proportions of populations at age x last birth day in M, P^n and P^{11} respectively, and M_x=number of migrants at age x last birthday, we have

$$M_x = P^{11}(\pi^{11}_x - \pi^n_x) + M.\pi^n_x$$

Or $$P^{11}(\pi^{11}_x - \pi^n_x) = M - M.\pi^n_x = M(\pi^m_x - \pi^n_x)$$

$$\therefore \pi^{11}_x - \pi^n_x = M/P^{11}(\pi^m_x - \pi^n_x) \qquad \ldots\ldots\ldots\ldots (3.1)$$

From equation (3.1), we may deduce the following results, which may however be obtained from general considerations.

(i) The distribution at any age will remain unaffected, if the distributions in the migrant and natural popluations are identical $\left(\pi^m_x = \pi^n_x\right)$, which is otherwise obvious.

(ii) The change in the distribution from the natural at any age is larger as the migrant population differs more from the natural population in this respect, and for a given difference, it will be smaller (larger) as the proportion of the migrant population to the total population is smaller (larger).

(iii) If both the difference between the age-distributions of the migrant and natural populations, and the proportion of the migrant population to the total population remain stable, the difference between the distributions of the total and natural populations will also remain stable.

3.21. The broad facts about migration in West Bengal (6) are :

(i) Immigration from other states of India have far exceeded emigration to the other states and international migration (excluding Pakistan) is negligible (6, Statement 1.128, p. 315 and Statement 1.129, p.321).

(ii) The percentage of net inter-state migration to the total population may be considered to have been fairly stable, being 7 per cent in 1921 and 6.3 per cent in 1951 (6, Statement 1.128, p. 315).

(iii) The percentage of immigrants from outside West Bengal remained fairly stable from 1911 to 1931, being 8.5, 8.9 and 8.4 in 1911, 1921 and 1931 respectively (6, Statement 1 118, p. 307)

(iv) The immigrants are predominantly male, but the percentages of male immigrants to the male population, and of the female immigrants to the female population show the same stability as in (iii) above, being for males, 11.4, 11.8 and 11.2 and for females, 5.4, 5.7 and 5.2 in 1911, 1921 and 1931 respectively (6, Statement 1.118, p. 307).

(v) The percentages for 1941 are somewhat in excess of those for 1931, but they may not be considered equally reliable, for after all tabulations of birth place statistics were not made in 1941, and the figures for 1941 had to be estimated from the information relating to migrants available at the 1931 and 1951 censuses. Further, there were many special difficulties in arriving at these estimates (7, pp. 12-15).

Thus, it may be considered reasonable to assume that the stability referred to above continued to 1941. From earlier decades to 1911, however, the percentages show a steady increase, and they have therefore to be given correspondingly less weights when the series is considered as a whole to estimate the position in 1941.

(vi) The immigrant population has always been heavily concentrated in the working ages, and in 1951, the percentage of the immigrant population (from other states) in the age-group, 15-55 was 79 and that in the total population only 57.4 (6, Statement, 1.127, p.314). Even with this disparity, calculation by equation (3.1), with the percentage of the immigrant population to the total population as 7.5 (from the Statement mentioned above), shows the percentage in the age-group in the natural population to be 55.7, so that the change in the natural distribution caused by the immigration is only of the order of 3 per cent.

(vii) The excessive preponderance of males over females in the immigrant population in successive decades, as shown in (iv) above, gives rise to the presumption that immigarnts, concentrated as they are in the working ages, come to West Bengal mostly for earning a living and not for settling there permanently, and so keep their families at their places of origin. The presumption is confirmed by a comparison of the sex-ratios (females per 1000 Females) in the actual population of West Bengal, immigrants from adjacent states, from states other than adjacent states, emigrants to adjacent states, to states other than adjacent states, and natural population of West Bengal, which (in 1951) are respectively 859, 426, 452, 1,056, 771 and 920. Thus it may be said that emigrants generally move with their families to settle at their place of adoption and so the effect of emigration on the age-distribution of the population should not be material. On the other hand, immigration is to a large extent impermanent, and correspondingly non-cumulative in the sense that the outstanding balance of such immigration could ultimately remain at about the same proportion of the whole population, through the decades (6, pp. 307-319, and Statement 1.119, p.308).

Excluding emigration in the present context, we may say from the above that the age-distribution of the natural population of West Bengal (dependent on fertility and mortility rates alone) would be a nearly stable one, that

the change caused by immigration would be small, and that from the comparative stability of the proportion of the immigrant population to the total population and of the age-distribution of the migrant population, the actual age-distributions up to 1931 could be expected to throw up a more less stable series, except for some fluctuations, from which an assessment of the age-distribution as in 1941 might be possible.

3.22 We have the percentages of population in age-groups to the total population of West Bengal, 1901-1951 from census figures (6, Statement I.148, p.358), but considering the deficiencies in the census enumeration which would need correction before any detailed comparisons could be made, we compare the values only in two broad age-groups, 0-15 and 15-55 from the statement mentioned above and those also for persons. For the age-group, 0-15, the percentages are 37.7, 37.6, 36.6, 37.2 and 36.4 and for the age-group, 15-55, they are 53.1, 53.3, 54.2, 54.0 and 54.6 respectively for the years 1901, 1911, 1921, 1931 and 1941. The values for 1951 excluded, because the period 1941-50 experienced abnormal migrantion following Partition. The 1941 values also are vitiated by the net inflation in the census enumerations, but they have been included, remembering however that the value for the age-group 0-15 is understated and that for the age-group 15-55 overstated in view of the opposite nature of the net inflation in these age-groups, as will be seen later. It will be seen that both the series present a stable picture, with small fluctuations in either direction, confirming the view taken earlier from general considerations (See 3.21).

3.23 To obtain a clearer picture, however, it is necessary to work with graduated age-distribtions of the West Bengal population in the past decades, which are available (except for 1931) in 'Actuarial Reports for the Census, 1881-1931' 1951' (8). In the first place, the boundaries of Bengal in the decades prior to 1951 were different from and inclusive of those of West Bengal in the 1951 lay-out of states but the age-distribution is assumed to have been uniform within the former and so to be applicable to the latter. Secondly, in what follows, comparisons will be made in terms of proportions of the population aged x and over to the total population, where x varies from 0 to 60, in quinquennial steps (i. e., with the help of the curve of the ogive in preference to the frequency curve). The curve of the ogive is smoother and easier to draw, facilitates comparison by the graphical method and also by progressively increasing (or diminishing) age-groups, but the main advantage is that extrapolation (or interpolation) from the proportions at a given value of x is independent of that from those at any other value or values of x, the proportion at age 0 being always equal to unity.

Table—2

Age x	Graduated percentages of population age x and over to total population of West Bengal (Males) 1881-1941					
	1881-91-1901 (1891)	1901-1911 (1906)	1921	1931	1941	1941 (estimated)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	100.0	100.0	100.0	100.0	100.0	100.0
5	83.0	82.6	84.5	83.5	88.6	83.6
10	69.9	69.4	71.5	70.1	76.4	70.3
15	58.2	57.7	59.5	58.1	66.0	58.4
20	47·8	47.3	48.6	47.5	56.7	47.8
25	38.5	38.2	38.9	38.2	47.2	38.4
30	30.4	30.3	30.4	30.3	37.4	30.3
35	23.5	23.5	23.1	23.6	28.4	23.4
40	17.7	17.8	17.0	17.8	20.9	17.6
45	12.9	13.0	12.1	12.9	14.9	12.7
50	9.0	9.1	8.3	8.9	10.2	8.8
55	5.9	6.0	5.5	5.6	6.7	5.7
60	3.6	3.7	3.4	3.0	4.2	3.3

Notes on Table 2

Column (2)—Source : (8), p. 140. The mean population of the period is assumed applicable to 1891.

Column (3)—Source : (8), p. 198. The mean population of the period is assumed applicable to 1960.

Column (4)—Sources : (8), p. 291 and Census of India, 1921, Report, Vol. I. Part II (9), In the Actuarial Report, the correct age-distributions are given for Hindus and Mohamedans separately. The joint age-distribution has been obtained from the respective population from the 1921 Census Report, and is assumed to hold for the whole population of Bengal.

Column (5)—Source : Census of India, 1931, Vol. I, Part II (10). The census figures for the ogive have been graduated by the graphic method and finally adjusted by inspection of the third differences. An inspection of the third differences of the graduated ogive values for 1891, 1906 and 1921 reveals that each series is smooth except for the value I at 0_4 which exceeds the one that would fit in smoothly with the rest of the series by 2.6 per cent, 2.8 per cent, and 1.5 per cent

respectively. This would appear to be an essential feature of the age-distributions and for 1931, the last (and the nearest) value is adopted, raising the value 1 at age 0 (of the fully graduated series) to 1.015 and finally reducing all values of the series in the same proportion to start again with 1 at age 0.

Column (6)—Source : (2, p. 150). The population in the age-group, 0-5 is uncorrected.

Column (7)—Details in Sec. 3.24.

Table-3

Age x	Graduated percentages of population, aged x and over to the total population of West Bengal (Females), 1881-1941					
	1881-91-1901 (1891)	1901-1911 (1906)	1921	1931	1941	1941 (estimated)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	100.0	100.0	100.0	100.0	100.0	100.0
5	82.7	82.7	83.2	82.8	87.5	82.9
10	69.2	69.4	69.5	69.0	74.2	69.2
15	57.4	57.7	57.5	57.1	63.4	57.3
20	47.0	47.3	47.0	46.4	53.6	46.7
25	37.9	38.2	37.8	36.8	44.0	37.4
30	30.2	30.4	29.8	28.6	34.8	29.3
35	23.7	23.7	23.0	21.9	26.8	22.6
40	18.2	18.0	17 3	16.5	20.5	17.1
45	13.7	13.2	12.6	12.0	15.4	12.5
50	9.8	9.3	8.9	8.4	11.3	8.8
55	6.7	6.2	6.0	5.4	8.0	5.8
60	4.2	3.8	3.8	3.2	5.5	3.5

Notes on Table 3

Same as those on Table 2, except that in column (5), the adjusting factor at age 0 is taken as 1.4 per cent, the corresponding values for 1891, 1906 and 1921 being 2.2 per cent, 2.5 per cent and 1.4 per cent respectively.

The ogive curves for the different periods up to 1931 (separately for males and females (drawn together are very close to one another, sometimes overlapping and sometimes intersecting to meet again and thus show a remarkable stability of distribution through the years. The area under the ogive gives the mean age of the distribution, the near-constancy of which, as an over-all index of

the nature of the distribution confirms the above point. On the other hand, the departure of the 1941 ogive from the group of the other curves is large and significant at all ages and clearly shows how the 1941 distribution which in normal circumstances may reasonably be expected to conform to the family of the other curves, was distorted by the net inflation in the 1941 census enumerations. Further the want of smoothness in the distorted curve indicates the differential incidence of net inflation at the various ages.

3.24. In conformity with the stability of the age-distribution through the years as mentioned above, the cumulative proportionate frequencies in Table 2 (Males) up to 1931 at any age do not show any secular trend. On the other hand, the small fluctuations are alternately positive and negative at all ages (except of course at age. 0). There seems to be a central tendency or a tendency towards an average value, which, in the absence of any drastic change in the demographic situation in the decade following 1931, might be assumed to have been in operation onward for 10 years, as it had been in the preceeding period of 40 years. Thus for estimating the value for 1941, it could be taken to be a short of weighted average of the previous values, (the weights being suitably related to the year 1941), which would prevent it from running away from the general level of values. In accordance with the principle that the more remote value should be given less weight, since each might be taken as representative of the then appropriate factors influencing the age-structure, the impact of which on a later date would lessen with time, the weight for the cumulative proportionate frequency in a previous year is taken as the reciprocal of the time-interval (in years) between that year and 1941. This also gives comparatively much less weight to the 1891 or 1906, value as is necessary from other considerations (see, 3.21) (v). The resulting estimates of the 1941 cumulative frequencies are tabulated in column (7) of Table 2.

The cumulative proportionate frequences in Table 3 (Females) appear to show a diminishing trend at age 40 and above, which is difficult to explain in the absence of sufficient grounds that the progression of the female age-distribution should be materially different from that of the male age-distribution. Unfortunately, the 1951 age structure on account of its being affected by abnormal migration following Partition, does not help up in the matter, but the 1961 age-distribution (11), when the effects of abnormal migration might have smoothened out to some extent, gives us values for cumulative proportionate frequencies, which at all ages above 20, are in excess of those for 1931 and are in line with those for 1891. The method of estimating the 1941 cumulative proportinate frequenceles for females is therefore taken to be the same as that for males, and the estimated values are tabulated in column (7) of Table 3.

3 3 The distributions of the inflated population and the true population being obtainable in age-groups by successive differencing from columns (6) and

(7) respectively of Tables 2 and 3, we apply equation (2.2) as in the following table. π_x and π_x^1 will now represent the proportionate frequencies in the age-group, x to $x+4$, and δx the net inflation in the same age-group.

Table—4 : **Distribution of total net inflation by age-groups West Bengal (Males), 1941**

Age-group x—x+4	π_x from col. 6 Table 2	π_x^1 from col. 7 Table 2	(2)-(3) $\pi_x-\pi_x^1$	(4). P (P=11, 841, 066)	(3). I (I=888, 513)	δx (5)+(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—4	.114	.164	—.050	—592,053	145,717	—446,336
5—9	.122	.133	—.011	—130,252	118,172	—12, 080
10—14	.104	.119	—.015	—177,616	105,733	— 71,883
15—19	.093	.106	—.013	—153,934	94,182	— 59,752
20—24	.095	.094	+.001	+ 11,841	83,520	+ 95,361
25—29	.098	.081	+.017	+ 201,298	71,970	+273,268
30—34	.090	.069	+.021	+ 248,662	61.307	+309,969
35—39	.075	.058	+.017	+ 201,298	51,534	+252,832
40—44	.060	.049	+.011	+ 130,252	43,537	+173,789
45—49	.047	.039	+.008	+ 94,729	34,652	+129,381
50—54	.035	.031	+.004	+ 47,364	27,544	+ 74,908
55—59	.025	.024	+.001	+ 11,841	21,324	+ 33,165
60—	.042	.033	+.009	+106.570	29,321	+135,891
Total	1.000	1.000	—.089	—1,053,855	888,513	—590,051
			+.089	+1,053,855		+1,478,564
						888,513

Table—5 : **Distribution of total net inflation by age-groups West Bengal (Females), 1941**

Age-group x—x+4	π_x from col. 6. Table 3	π_x^1 from col. 7 Table 3	(2)-(3) $\pi_x-\pi x^1$ $\overline{\pi_x-\pi_x}$	(4). P (P=9, 996, 229)	(3). I (I=750, 082)	δx =(5)+(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—4	.125	.171	—.046	—459,827	128.263	—331,564
5—9	.133	.137	—.004	— 39,985	102,761	+ 62,776

Table—5 (Continued)

10—14	.108	.119	—.011	—109,959	89,260	— 20,699
15—19	.097	.106	—.009	— 89,966	79,509	— 10,457
20—24	.096	.093	+.003	— 29,989	69,758	+ 99,947
25—29	.092	.081	+.011	+109,959	60,757	+170, 716
30—34	.080	.067	+.013	+129,951	50,255	+180,206
35—39	.064	.055	+.009	+ 89,966	41,255	+131,221
40—44	.051	.046	+.005	+ 49,981	34,504	+ 84,485
45—49	.041	.037	+.004	+ 39,985	27,753	+ 67,738
50—54	.C03	.030	+.003	+ 29,989	22,502	+ 52,491
55—59	.025	.023	+.002	+. 19,992	17,252	+ 37,244
60—	.055	.035	+.020	+ 199,925	26,253	+226,178
Total	1.000	1.000	—.070	—699,737	750,082	—362,720
			+.070	+699,737		+1, 112,802
						750,082

Column (7) of the above tables gives the net inflation in the 1941 census enumerations by sex and age-groups. It will be seen that in both tables, the net inflation is positive in all age-groups from and above age 20, increasing to age-group, 30-34 and then diminishing. But while in the male table, the net inflation is negative in all-age-groups up to age 20, in the female table, the position is different in that in the age group, 5-9 it is positive (though negative in the other age-groups), a feature, which must appear to be unusual, While it can be appreciated that the numbers at the adult ages were forced up with the purpose of gaining political advantage and those at the young ages suffered at least the usual under-enumerations an overcount at the early age-group, 5-9 in the female table would be anomalous and need explanation. On scrutiny, however, this feature will be found to be implicit in the male table also, because the nature of the variation of net inflation in age-gronps up to age 20 is the same in both tables, viz , that it starts with a very high negative value at age group, 0-4, attains a low negative (or a small positive) value at age-group, 5-9, then a higher negative value at age-group, 10-14 and finally a smaller negative value at age-group, 15.19. That is, the variation in both cases is a rise, then a fall and finally a rise, as would appear from a graph drawn with the values.

If we assume that the values of π^1_x, obtained as they have been by extrapolation from the stable age-distributions of earlier periods, are substantially correct, we have to look for the cause of the anomaly not in the component of net inflation represented by I. π^1_x in equation (2.2) but in the other component P $(\pi_x - \pi^1_x)$, i. e., in the value of π_x at the appropriate ages. It will be noticed that in the corrected age-distributions of the West Bengal population (both male and female) in all periods up to 1931 (and also in 1961), the proportionate frequency is the largest in the age-group, 0-4, gradually diminishing in the higher age-groups. In column (2) of Tables 4 and 5, however, the proportionate frequency in age-group, 0-4 is substantially less than in the next age-group, 5-9. It might be thought that this anomaly had been the result of the abnormal circumstances prevailing at the 1941 census but the same feature appears also in the corrected 1951 age-distribution of West Bengal population of either sex (2, pp. 48-51). Hence, the reason for the anomaly has to be sought for in the fact that in both the corrected age-distributions of 1941 and 1951, the population in the age-group, 0-4 (both male and female) was left unadjusted. It may be presumed that on account of the usual over-statement of ages of young children, a number of children in the age-group, 0-4 was enumerated in the age-group, 5-9, causiug a reversal of the normal relative magnitudes of the proportionate frequencies in these two age-groups. It is not possible to make an adjustment without a knowledge of the extent of the transference between the two age-groups, as mentioned above, but the ogive curves for 1941 would help us to make an estimate. These curves show a distinct upward kink at age 5, and a smooth curve drawn (which avoids the kink) gives the cumulative frequency at age to be 88 per cent for males and 86.5 per cent for females, as against 88.6 per cent and 87.5 per cent respectively (column (6), Table 2 and 3). The adjusted proportionate frequencies are therefore .120 (age-group, 0-4) and .116 (age-group 5-9) in the male table, and .135 and .123 respectively in the female table and thus are in agreement with the usual run of values.

It will be seen that with the adjusted values of π_x replacing the corresponding original values in column (2) of Tables 4 and 5, the altered distribution of Δx through ages up to 20, in both tables, is corrected for the anomaly which existed before, Δx being negative in all age-groups and diminishing in absolute magnitude through the advancing ages (col.4 of Table 6). A graph drawn through the values of Δx will show a continuous rise, and if positive values from age 20 onwards are also included, the rise will continue to age-group, 30-34, to be succeeded by a fall thereafter.

Further, from column (6) of Table 6, the proportion of the total inflation to the whole population was 7.5 per cent for both males and females and

so for the whole population, and while it was negative at ages up to 20 and positive at ages 20 and above, for both males and females, the proportions were respectively 5 per cent and 12.5 per cent for males and 3 per cent and 10.5 per cent for females.

4. We now obtain the true population of West Bengal in 1941 by sex and age-groups, which is given in the following table.

Table—6

Distribution of true population of West Bengal, 1941 by age-groups

(Males)

Age-group x—x+4	π_x	P x =P.(2)	I_x	(3)—(4) $P^1 = P - I$ x x	$\Sigma I/P/100$ x
(1)	(2)	(3)	(4)	(5)	(6)
0—4	.120	1,420,928	—375,290	1,796,218	
5—9	.116	1,373,564	— 83,126	1,456,690	
10—14	.104	1,231,471	— 71,883	1,303,354	—5
15—19	.093	1,101,219	— 59,752	1,160,971	
20—24	.095	1,124,901	— 95.361	1 029,540	
25—29	.098	1,160,424	+273,268	887,156	
30—34	.090	1,065,696	+309,969	755,727	
35—39	.075	888,080	+252,832	635,248	+12.5
40—44	.060	710,464	+173,789	536,675	
45—49	.047	556,530	+129,381	427,149	
50—54	.035	414,437	+174,908	339,529	
55—59	.025	296,027	+ 33.165	262,862	
60—	.042	497,325	+135,891	36361,434	
Total	1.000	11,841,066 (P)	+888,513 (I)	10,952,553 (P^1)	+7.5

(Females)

(1)	(2)	(3)	(4)	(5)	(6)
0—4	.135	1,349,491	—231,601	1,581,092	
5—9	.123	1,229,536	— 37,187	1,266,723	—3
10—14	.108	1,079,593	— 20,699	1,100,292	
15—19	.097	969,634	— 10,457	980,091	
20—24	.096	959,635	+ 99,747	859,891	
25—29	.092	919,653	+170,716	748,937	
30—34	.080	799,698	+180,206	619,492	
35—39	.064	639.759	+131,221	508,538	
40—44	.051	509,808	+ 84,485	425,323	+10.5
45—49	.041	409,845	+ 67,738	342,107	
50—54	.033	329,876	+ 52,491	277,385	
55—59	.025	249,906	+ 37,244	212,662	
60—	.055	549,792	+226,178	323,614	
Total	1,000	9,996,229 (P)	+750,082 (I)	9,246,147 (P^1)	+7.5

5. Discussion of results.

We have noticed that the net inflation in West Bengal 1941 census enumerations followed a definite pattern, and it is significant that it was the same for males and females. The pattern was no doubt the product of the psychological factors motivating the major communities of West Bengal at the time to behave in this abnormal way, and they were in their turn influenced by the current political situation and the prospects of change in that situation in the more or less immediate future. It is difficult and even unsafe to delve into the realm of human psychology but in this case, it is reasonable to say that the overcounts at all ages, 20 and above, were due to an attempt to achieve greater political advantage in a democratic set-up with propects of expanding on the basis of adult franchise for both sexes. It is also understandable that the incidence of inflation should have been greatest in the age-group, 30-34, when persons may be said to be at the prime of their lives. The total negative net inflation of persons in the age-group, 0-19, where possibly no conscious over-statement of numbers existed and which might thus represent the extent of under-reporting comes to 4.4 per cent of the true population of persons (Table 6). This would appear to be reasonable is as much as in a recent study by the present author based on stable population analysis, the undercount as estimated for All-India at the 1951 Census was of the order of 3%, and the undercount for West Bengal which might be similar to that for All-India, would, if anything, be larger in 1941 than is 1951.

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ON WORKER PARTICIPATION RATES IN ORISSA DURING 1951-61

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1. A significant phenomenon that has been observed as a result of the data furnished by the 1961 Census and which has been agitating the minds of Indian demographers is the steep and unprecedented increase in the number and proportion of workers in 1961 Census as compared with that revealed by the 1951 Census. On a closer study, it was noticed that this abnormal rise in the worker-participation rate in the country during 1951-61 was mainly due to sharp rise in the worker-participation rates during this decade in a few Southern States like, Andhra Pradesh, Madras and Mysore and one of the Eastern States, namely, Orissa. It has been suspected by some demographers that this abnormal rise in the worker-participation rates in certain States is not real, and is probably due to difference in concepts used in the last two censuses. The purpose of this paper is to examine this question in detail with a view to analyse the correct trend in the working force during the decade 1951-61 in the State of Orissa and locate possible under and over enumeration of workers in the categories where they are considered to exist and also to provide some alternative estimates of working force which appear to be more plausible than what has been observed at the two Censuses. The main objective of these estimates is to provide a more reliable growth rate of the working force during the decade as compared with what has been revealed by the Censuses of 1951 and 1961. It has been generally acknowledged that the change in worker participation rates during 1951-61 was incorrect due to a variety of factors which are also discussed in the paper.

2. First of all, let us consider the facts as revealed by the two Censuses. Continuous decennial census are the only source of data on the 'working population' and hence before we discuss the trends in the worker participation rates from census to census, it is worth-while to briefly examine the concept of 'worker' from census to census. A clear distinction between 'workers' and 'dependents' was introduced for the first time in 1901 census. The 'workers,' as in earlier censuses, were not those who actually worked for their living but also those subsisting on rent, pension, etc. 'Dependents' were those whose occupation, if any, was not sufficiently important to augment family income. The workers in the sense of gainfully employed were the **actual workers having productive occupations.** With some minor changes in the instructions these concepts remained unchanged in the censuses of 1911 and

Note : Views expressed in this article are personal and not those of the Government of India.

1921. In the 1931 census, classification of population by economic status was made for the first time, into 'earners' (wage receiver or subsistance obtainer), 'working dependent' (who, though dependent, nevertheless work and have an occupation) and others (who have no occupation i.e. non-earning dependents). Only those women and children were shown as 'earners' who helped to augment the family income by permanent and regular work for which a return was obtained in cash or kind. Dependents who assisted in the work of the family and contributed to its support without actually earning wages were shown as 'working dependents. Thus workers (gainfully occupied persons) of the 1931 census were the aggregate of (i) all earners and (ii) all working dependents, following productive occupations. In the 1941 census 'occupation' referred only to gainful 'occupation'. The concept of 'working dependent' was further classified by introducing two terms 'wholly' and 'partly' dependent. A person was 'wholly dependent' if he had 'no income in cash or kind'. A person who contributed in cash or kind towards the support of the household without being definitely capable of supporting himself/herself was considered as 'partly dependent'. The classification of persons followed in 1941 census was continued in the 1951 census with different nomenclature. In the 1961 census classification of persons as 'worker' and 'non-worker' was made for the first time on the basis of a direct question on the gainful activity of the person concerned. The concepts followed at the 1951 and 1961 censuses are discussed in some detail elsewhere in this paper. An examination of Table I where the worker participation rates for the Censuses 1911 to 1961 are furnished, brings out the fact that there has been a gradual decline in these rates with the exception of the 1921 census where there has been a slight increase in these rates. This declining trend was noticed upto 1951 though the decline from 1931 Census to 1951 Census was a steep which is mainly due to sharp decline in the participation rates for women which has recorded a fall from 30.0 in 1931 to 18 8 in 1951. It would have been helpful to analyse the trends more effectively had the 1941 data been available. Unfortunately detailed tabulations of 1941 data were not undertaken due to war time economy. During the decade 1951 to 1961 earlier downward trend was reversed. As can be seen from Table II, the worker participation rate for all persons has increased from 37.4 to 43 7. The increase for males was from 56.4 to 60.8 and for females was from 18.8 to 26 6. Again, it can be seen that this increase in the worker participation rate during the decade 1951-61 was mainly because of increase in the rural areas and here also the increase among females was more marked. From Table III it will be seen that the percentage increase among workers during the decade 1951-1961 was 40.0 as compared to the percentage increase of 19.8 in the total population. The peacentage increase among women workers was as high as 68.0 as compared to an increase of 18.6 per cent among women population. Table III also brings

out that while the rate of increase in Primary sector (Category I and Category II) is very high ; the rates of increase in Secondary and Tertiary sectors may be considered as more or less normal. In fact, out of a total increase of 21.88 lakhs of workers, 18.1 lakhs or 82.6 per cent has been accounted for by the workers in the primary sector. In other words, the percentage of additional working force absorbed by the Primary Sector alone was 82.6. The increase among agricultural workers during the decade was 46 9 percent (the increase among males was 31.9 per cent and among females 102.4 percent). The percentage increase during the decade among cultivators was 53.3 (males 34.6 and females 146.5)- Thus it is seen that the increase in the number of workers in the primary sector was more marked in the case of females than male workers. A significant factor is that the percentage of female cultivators to total population has more than doubled during the decade. The working population incremental ratio, that is, the proportion of additional workers to additional population during the decade 1951-61 was 75.4 per cent (the corresponding ratios for men and women being respectively 81.4 and 68.7). In other words, for every increase of 100 persons in the total population, the increase in the number of workers has been of the order of 75 of which 62 has been accounted for by agricultural workers (52 cultivators and 10 agricultural labourers).

3. In relative terms, taking the year 1911 as 100, the index number of female cultivators in 1951 was 83. In one decade alone that is by 1961 this index has risen very steeply to 204. The increase in the index of male cultivators was from 127 to 171. The indices of agricultural labourers on the same base rose from 106 for males and 66 for females in 1951 to 129 and 95 respectively in 196'. The sex ratio among the different category of workers which has been showing a somewhat declining trend has suddenly and steeply increased during the decade 1951 to 1961. The percentage of agricultural labourers to cultivators has fallen from 36 in 1951 to 30 in 1961. The percentage fall among females was rather steep being from 74 to 43.

4. Thus, from the foregoing analysis, it will be seen that the most striking phenomenon that has been observed during the decade 1951 to1961 has been the enormous increase in the number and proportion of cultivators specially among the females. The various factors that might have affected the number and proportion of the working force during the decade 1951-61 are the following :—

i) Conceptual differences and their operation in the field under Census conditions.

ii) Demographic factors such as (a) decline in mortality rates

(b) age structure of the 1951 population which might be heavily in favour of the age group 5 to 15 who would enter the working ages in 1961.

(c) better survival rates in the age-group 5 to 15, and

(d) increase in literacy and migration of workers from rural to urban areas.

iii) the real effect of economic progress, and

iv) Structural and institutional factors.

5. In countries with high mortality and fertility rates, rapid increase in the population as a result of declines in mortality rates is not likely to affect significantly the age structure of the population.* Therefore, there is no reason to believe that the age structure of the population of the State will be significantly different in 1951 as compared to 1961. In fact the age structure of 1961 census population and that of 1951 census population (10 percent sample) are more or less similar. Moreover, even if the increase in the absolute number of workers is ascribed to decline in mortality, there is no reason why the proportion of workers to total population should also significantly increase unless the decline in mortality is specially favourable to the workers. Again it is also not clear why these demogrophic factors should specially favour cultivators and amongst them females in particular. Changes such as increase in literacy would retard rather than promote worker participation rates and migration of persons from rural to urban areas would reduce rather than increase worker participation rates in rural areas as in many cases it is workers that migrate leaving the dependants behind. Even assuming that the economic development that has taken place during the decade may account for the abnormally heavy increase in the working force, it is not clear why this should favour specially the rural areas and also the category of cultivators, specially the females amongst them. This leads to the consideration whether the steep rise in the number of cultivators during the decade could be due to structural and other institutional factors. It is a fact that the pressure of population on land has been increasing which in turn leads to (a) subdivision of holdings through partition by the operation of law of inheritance and (b) replacement of hired labour by family labour on the reduced holdings. Land tenancy reforms and land ceiling legislation might, to some extent, have accounted for large increase in the category of cultivators. With a view to evade ceiling law on land holdings, there might have been transfer of land on a mass scale to those who had no land or who had less land than the prescribed ceiling acreage. Under tenancy legislation, provision was made in most of the States to allow the landlords to resume land for personal cultivation within a prescribed period after leaving a certain minimum area with their tenants Under this legislation non-cultivating land lords became cultivators. All these factors would increase the number of cultivators who would include owner cultivators, tenant-cultivators, share croppers and lessees. According to the report of the Panel on Land Reforms 1961, 1,40,000 acres of waste land has been distributed to the land-

less during the period 1941 to 1957 in Orissa*. Also the gross area sown has increased by about seven percent during the decade 1951-61 in the State. These changes in land holdings, etc. reduce the demand for agricultural labour because with smaller holdings, the need and the capacity to employ hired labour might have deminished leading to the replacing of hired labour by family labour and hence the justification for the very slight increase in the proportion of agricultural labour during the decade 1951-61. According to the results of farm management studies, the smaller the size of farm higher the contribution of family labour to total labour. But as supply of agricultural labour is more or less inelastic they have no other alternative but to compete with family labour. Also it is likely that some of the male agricultural labour might have migrated to urban areas as a result of depression in agricultural wages due to reduction of demand for them in rural areas. However, it may be stated that these structural changes outlined above alone could not have accounted for such a large increase in the number and proportion of cultivators. Hence one is tempted to conclude that a proportion of the growth in the working population is not real and they have arisen due conceptual differences at the Censuses and their operational effect under Census conditions, which might have introduced an element of (i) under enumeration of workers in 1951 (ii) over-enumeration of workers in 1961, or (iii) both (i) and (ii) (iv) misclassification of workers by categories at either of the Censuses.

6. The basis of enumerating a person as a 'worker' was 'income' (in cash or kind) in the 1951 Census, whereas it was 'work' in the 1961 Census. Another point of difference was that while a uniform definition was adopted for workers in seasonal and non-seasonal sectors of economic activity in 1951 Census (the 'usual status' approach), different definitions were adopted in the 1961 Census for workers in these two sectors of activity (for persons working in seasonal occupations 'usual status' approach was used and for others 'current status' approach was used). The 1951 Census adopted a tripartite economic classification of all persons into self supporting persons (S.S.P.), earning dependent (E.D.) and non-earning dependants (N.E.D.). All persons who earned a regular income (in cash or kind) were classified either as self-supporting persons or as earning dependents, the criterion for classifying a person as between the two categories being based on the 'adequacy of income for self-maintenance or otherwise'. Unpaid family workers were considered by definition as earning dependents. All others who had no claim to regular income were considered as non-earning dependents. The principal means of livelihood was defined as the one which accounted for the largest income when there were more than one means of livelihood for a person. The principal means of livelihood of earning dependents and non-earning

*Report of the Panel on Land Reforms—1961'.

dependents was the principal means of livelihood of the person on whom he/she is partly and wholly dependent. Accordingly, workers (gainfully occupied persons) of the 1951 Census would be the aggregating of (i) all self-supporting persons with productive principal means of livelihood, (ii) self-supporting persons with unproductive principal means of livelihood, but with productive subsidiary means of livelihood and (iii) all earning dependents with their own (secondary) means of livelihood from productive occupations. Due to the adoption of 'income' concept in the 1951 Census it is quite likely that some 'unpaid family workers' might have been returned as non-earning dependents, because of non-receipt of cash and kind income. In the case of female workers absolute rather than earning dependency might have been reported on social status and prestige considerations. Hence it is likely that under-enumeration was more marked in the case of female workers then male workers in the category of unpaid family workers. When the 1951 Census showed a decline in the participation rates in agricultural and increase in non-earning dependency, the reason attributed for this was decline in land population ratio unaccompanied by a proportionate increase in non-agricultural employment, an argument not substantiated by 1961 Census results Usually, the rural worker is seldom totally unemployed but shares work available with other members of the family. In fact, it has been acknowledged that one of the reasons for discarding the 'usual status' approach and the 'income criterion in 1961 Census was because of the wide feeling that concepts such as 'self supporting', and 'earning dependent' tend to minimise the role of unpaid family workers who make substantial contribution by working in family farms or family enterprises. The following elements of underestimation in 1951 might have also influenced the worker participation rates :

(i) Many self-supporting persons in livelihood Class IV (non-cultivating owners of land, agricultural rent receivers and their dependents) having productive secondary means of livelihood may not have reported it for prestige considerations.

(ii) Some earning-dependents in livelihood Class IV may also have productive secondary means but their figures were not collected at the Census.

(iii) Some self-supporting persons with non-productive principal occupation in livelihood category VIII (other services and miscellaneous sources) may have productive secondary means of livelihood but their figures are not available separately.

7. An independent check on the accuracy of the 1951 Census worker participation rates for various States and all India is provided by the first Argicultural Labour Enquiry—1950-51 (A.L.E.) Fortunately, the concepts used

in the First Argicultural Labour Enquiry were similar to those adopted in the 1961 Census. Hence it is proposed to discuss at some length the concepts and results of this enquiry. The A.L.E. defined Agricultural Labourer as one who reports that he or she was engaged in agicultural operations as hired labourer for wages for 50 per cent or more of the total number of days worked by him/her during the previous year' and an Agricultural labour family in turn was defind as one in which either the head of the family or 50 per cent or more of the **earners** report agricultural labour as their **main occupation**—the occupation in which he or she was engaged for 50 percent or more of total number of days worked by him/her, during the previous year. "A person contributing to family income through his/her ernings was considered as an earner however meagre the contribution may be". A helper according to the definition adopted in the survey was one 'who helped the earner of the family in his **work** without getting any separate remuneration for himself or herself'. A member of the family who was earning as also helping was considered as earner. Thus it will be seen that the First Agricultural Labour Enquiry adopted the 'work' rather than 'income' as the basis of classification of the person either as an 'earner' or a 'helper'. Although the three-way classification of 'economic status' followed in the first Agricultural Labour Enquiry differ from the one used in the 1951 census, a certain rough equivalence in the actual returns might resonably be expected. According to a study on 'Working Force Size and Occupational Distribution in India 1950-55' by Alice Therner it has been fairly established that there has been an under-enumeration of workers, especially the earning dependents, in the 1951 census. The Table A below brings out the facts clearly.

Table A

Percentage distribution of rural population of Orissa by 'Economic status' according to census of 1951 and Agricultural Labour Enquiry, 1950-51.

Economic Status	Persons	Males	Females
1951 Census S.S.P.	28.41	47.76	9.60
A.L.E. (earners)	30.65	48.08	12.81
1951 Census E.D.	9.48	7.48	10.18
A.L.E. (helpers)	13.36	14 81	11.89
1951 (S.S.P.+ED)	38.25	57.24	19.78
ALE (Earners+helpers)	44.01	62.89	24.70
1951 Census (N.E.D.)	61.75	42.76	80.22
ALE (N.E.D.)	55.99	37.11	75.30
Percentage in working ages 15-64 (1951 Census)	59.34	58.92	59.75
All persons	100	100	100

8. According to First A.L.E. the worker participation rate in rural Orissa comes to 44.0 per cent as compared to 37.4 revealed by the 1951 Census for rural Orissa. Again according to the same Enquiry there were 1.2 million Agricultural Labour households in Orissa and the average number of wage earners per household was 1.8 which gives an estimated number of wage earners in agricultural Labour households of about 2.16 million. Of course not all these wage earners are agricultural labourers. Also there may be some Agricultural Labourers in households other than 'Agricultural Labour'. In any case it can be easily seen that one million agricultural labourers recorded at the 1951 Census is on the low side, thus establishing under enumeration of agricultural labourers at the 1951 Census. Moreover, considering the present state of Country's economic development, the worker participation rate for Orissa of 37.4 revealed by 1951 Census is very low. On the basis of the trend revealed at the various censuses, it would appear that this rate should not be below 42. Thus it seems that at the 1951 Census there has been a significant under-enumeration of workers in the rural areas both in the categories of cultivators and agricultural labourers and specially among females for reasons already explained earlier.

9. The 1961 Census classified persons between the two categories namely (1) worker, and (2) non-worker on the basis of a direct question on the gainful activity of the person. The instructions in the 1961 Census were as follows :—

> "The basis of work will be satisfied in the case of seasonal work like cultiviation, livestock, dairying, household industry etc. if the person had some regular work of more than one hour a day throughout the greater part of the working season. In the case of regular employment in any trade, profession, service, business or commerce the basis of work will be satisfied if the person was employed during any of the fifteen days preceding the day on which you visited the household. A person who is working but was absent from his work during the fifteen days preceding the day on which enumerated or even exceeding the period of fifteen days due to illness or other cause should be treated as worker. Work includes not only actual work out effective supervision and direction of work."

The 'one hour criterion' in the 1961 Census instructions is likely to have inflated the figures of workers engaged in agriculture. It is likely that women on the border case with hardly significant role in the field of economic activity may be liberally given the 'worker status'. But the emphasis 'regular work' in the instructions and the more precise 'work' concept might have acted as a safeguard against over enumeration of workers. Moreover there is no extraneous and independent evidence to suspect over-enumeration at the 1961 Census. However, it is likely that some of the agricultural labourers might have been enumerated wrongly in category I-cultivators. According to the instructions of the 1961 Census,

a person's participation in the economic activity depends on his answers to questions 8 to 11*. He had to reply questions 8 to 11 put to him in the serial order. This might have introduced an element of priority which might have influenced participation rates in different economic categories. It is likely that some workers in households possessing land might have returned themselves as cultivators even though they rightly belong to the agricultural labour category by the nature of their gainful activity either due to ignorance or on considerations of social prestige. This tendency was also noted in 1951 Census. Or the wrong classification may be due to lack of clear understanding of the instructions by enumerators. In this connection it may be noted that in Orissa as many as 46.5 per cent of the agricultural labour households were in possession of some land according to the Second Agricultural Labour Enquiry (1956-57). Some of the workers in these households who, on the basis of their major activity strictly belong to Category II—agricultural labour—might have been enumerated in Category I—cultivators. Table B gives the number of persons working principally as (I) cultivators and (ii) agricultural labourers classified by sex and by secondary work as (i) agricultural labourer and (ii) cultivator according to 1951 census.

Table B

(In lakhs)

Primary Work	Secondary Work			
	As Agricultural labourer		As Cultivator	
	Males	Females	Males	Females
i) Cultivator	4.68	1.52	—	—
ii) Agricultural labour	—	—	1.34	0.55

* Questions 8 to 11 apply only to workers. These questions as given in the individual Census slips, are as follows :-

8.	Working as Cultivator	9. Working as Agricultural Labour.
10.	Working at Household Industry	(a) Nature of work (c) If employee (b) Nature of Household Industry
11.	Doing work other than 8, 9 or 10	(a) Nature of work (c) Class of worker (b) Nature of Industry, Profession, Trade or Service (d) Name of Establishment.

In view of the fact that agricultural labour is wage paid employment and also in view of the fact that demand for agricultural labour and also requirements of work on one's own land are more or less simultaneus, it is likely most of the cultivators reporting agricultural labour as secondary activity might have reported

themselves so because of the fact that they have helped the other family members on the farm regularly for more than one hour during the greater part of the working season. In addition it is also likely that some agricultural labourers wrongly enumerated as cultivators might not have given agricultural labour even as secondary work. This may be particularly true of women workers.

10. However, according to the Registrar General the order in which the quesions were put at the 1961 Census could not have influenced the answers by any implied priority since all the four questions were required to be severally asked of every person and every person was required to answer each of the four questions which were arranged in order of their importance in the Census slip. Purely on theoretical considerations there may not be differences in identifying a worker and placing him in the correct category of economic activity at either of the two Censuses. In fact, elaborate identity equations setting out who are to be considered as workers (economically active) out of the tri-partite classification adopted at the 1951 Census have been evolved. Sufficient care has also been taken in the instructions given to the enumerators at the time of the 1951 Census to see that family helpers working on the family farm or enterprise are not omitted to be included in the categories of either self-supporting or earning dependents merely because of non-receipt of income in cash or kind. But, it has now been generally acknowledged that instructions were not properly followed in some of the States during 1951 Census and that there has been significant under enumeration of workers specially the unpaid family enterprise worker in some of the Southern States. Similarly, even though clear instructions were given at the time of 1961 Census to avoid implied priority due to the order in arranging the questions 8 to 11 in the Census slip, the operational difficulties and the employment of large number of enumerators who could not be provided with sufficient training and the field work under Census conditions might have easily resulted in mis-interpretation and faulty implementation of the Census instructions. Moreover, the attitudes of the respondents and also the skill and the understanding of the enumerators count very much in the identification of a worker in the population and assigning him the correct economic activity category.

11. Thus, it will be seen from the foregoing discussions that :

i) It is likely that there has been some under-enumeration of workers in both the sexes in the rural areas in the 1951 Census and this under-enumeration is mainly confined to the categories I—'Cultivators' and II—'Agricultural Labour'.

ii) Over-enumeration of workers at the 1961 Census is rather unlikely but there might have been some mis-classification of workers and it is possible that some of the workers who should belong to Category II—Agricultural labour were enumerated or got themselves enumerated in Category I—Cultivators.

12. The 1951 Census figure of 'workers' have been revised after eliminating the discrepency pointed out at para 11 (i) above, on the lines indicated below :-

12.1. According to the First Agricultural Labour Enquiry (General Family Survey) results published in 'Rural Man-Power and Occupational Structure in India' the percentage distribution of Earners, Helpers and Dependents to total population by Age and Sex in Rural Orissa* is given in the table C below :-

Table C

	Earners	Helpers	Dependents
Men	23·4	6·2	1·5
Women	6·1	5·4	19·7
Boys	0 9	1·3	17·3
Girls	0·2	0·5	17·5
Total	30·6	13·4	56·0

Earners and helpers together constitute the working force. The worker participation rates calculated on the basis of the above data is furnished in the table D below along with those according to 1951 Census.

Table D

Worker Participation Rates for Rural Orissa.

	Persons	Males	Females
Estimated on the basis of A. L. E. data (1950-51)	44·0	62·8	24·7
1951 Census	37·4	56 4	18·9

12.2. The worker participation rates on the basis of first Agricultural Labour Enquiry are expected to be more reliable than those revealed by the 1951 Census in which 'income' criterion was used for identifying an earner. However, the A. L. E. rates are subject to certain errors for which some corrections would be necessary. Since the First A. L. E. was a sample survey, it covered only a small proportion of the total rural population and the worker-participation rates revealed by the First A. L. E. will be subject to some sampling error. These rates will also be somewhat different from those in the 1951 Census, in view of the fact that the period of the Survey was not identical with that of the 1951

* The General Family Survey which was the second stage of the All India Agricultural Labour Enquiry was conducted in 812 villages selected on the principle of statistical random sampling. Of these 45 villages are in the State of Orissa. A schedule called 'General Family Schedule' was canvassed from each and every household of the selected sample villages. The schedule was designed to provide information on the age and sex compositions, size and earning strength and main and subsidiary occupations, etc., of all families living in the sample villages.

Census. As such, alternative estimates of worker-participation rates in rural Orissa for the 1951 Census are worked out below in an indirect manner.

12.3 From the above discussions it is clear that although various characteristics such as, sex-ratio, percentage of population in various age-groups and so-forth, which are not related to the concept of 'worker' used in the 1951 Census, might have been correctly brought out in the 1951 Census, the estimates of the working force and other related concepts like the worker-participation rate in rural Orissa, etc., may not have been quite correct. Since a close relationship between the strength of working force and the population belonging to the working age group 15-54 can be reasonably expected in any population, an alternative estimate of the strength of the rural working force in the 1951 Census for Orissa, might be derived from the actual rural population in the working age group 15-54 recorded at 1951 Census by applying certain suitable adjustment factor to it. More specifically, if y and x denote respectively the worker-participation rate and the percentage of population in the working age group 15-54, it may be assumed that a simple relationship between y and x, viz.,—

$$Y = Bx,$$

holds good both for the entire population as well as for the male population in rural Orissa. This simple relationship may not be quite good for the total female population in view of the fact that the number of females on the working age group 15-54 joining the rural working force is dependent on various other social and economic factors. For getting an unbiased estimate of the unknown factor B, it is necessary that none of the variables, y and x, are biased. Since value of y, as observed in the 1951 Census is suspected to be somewhat biased, although the value of x revealed by the same source is expected to be reasonably good, estimation of B from the 1951 Census data on y and x would not be desirable. However, a reasonably good estimate of B may be obtained from the data collected during the First A.L.E., in which both y and x are not expected to suffer from any bias. Thus, an alternative estimate of y at the 1951 census may be derived by the ratio-method, using estimates of x according to the 1951 Census as an auxiliary variate. Values of x and y for all rural persons and total male population in rural Orissa, as revealed by the First A.L.E., as well as estimates of B from the First A.L.E. data are given in table E.

Table E

Estimates of B from First A.L.E. Data.

Rural Population in Orissa	Worker participation rate for rural Orissa (y)	Percentage of rural population in the 15-54 (x)	Estimate of B (y/x)
All persons	44.0	55.2	0.797
Males	62.8	54.7	1.15

Using the above estimates of B and the percentage of rural population in the working age group 15-54, as revealed by the 1951 Census, the ratio estimate of y for all rural persons and the total male population in rural Orissa can be readily obtained. Worker participation rates of female population in rural Orissa can then be derived from those of the total and male rural population. These figures are presented in table F.

Table F

Corrected worker-participation rates for rural Orissa in 1951 Census

Rural population of Orissa	Percentage of persons in age group 15-54 in 1951 Census	Estimates of B from First A.L.E.	Worker Participation Rates		
			1951 Census Corrected	1951 Census Uncorrected	First A.L E.
All persons	54.1	0.797	43.1	37.4	44.0
Males	53.9	1.15	62.0	56.4	62.8
Females	—	—	24.7	18.9	24.7

The above table reveals, as would be normally expected, that worker-participation rates obtained by the ratio method are quite close to those obtained from the First A.L.E., but these rates are appreciably different from those obtained from the 1951 Census.

13. On the basis of the estimated worker participation rates for the year 1951 given in the table above, the number of workers separately for males and females who are likely to have been omitted from enumeration at the 1951 Census have been estimated. The estimated additional number of workers (males and females) so obtained, have been distributed to the two categories, namely, I—Cultivators and II—Agricultural Labour in the same proportion as was observed according to the 1951 Census.

14. The 1961 Census figure of workers have been corrected for the discrepancy pointed out at para 11(ii) by redistributing the total number of workers (males and females) in the agricultural sector (categories I and II taken together) observed in 1961 Census to the Categories I and II according to the 1951 ratio as estimated above for these categories. The table G below gives for 1951 and 1961 the revised estimated figures of workers, in the categories affected by the revision outlined above. The corresponding revisions of percentage of workers to total population and also the percentage of workers in various categories to total workers, ratios, etc. for the years 1951 and 1961 are given in brackets in tables III to VI wherever they stand affected by the revision.

Table—G

Category according to 1961 Census		Workers in lakhs according to 1951 Census	1951 Census Corrected	1961 Census	1961 Census Corrected
Total Workers	P	54.73	60.57	76.61	76.61
	M	40.85	42.95	53.28	53.28
	F	13.88	17.62	23.33	23.33
I—Cultivators	P	28.39	32.19	43.53	40.78
	M	23 65	25.30	31.85	31.19
	F	4.74	6.89	11.68	9.59
II—Agricultural Labour	P	10.10	12.15	13.03	15.78
	M	6.61	7.06	8.05	8.71
	F	3.49	5.08	4.98	7.07
Agricultural Sector (I+II)	P	38.49	44.33	56.56	56.56
	M	30.26	32.36	39.90	39.90
	F	8.23	11.97	16.66	16.66

15. It will be seen from table III that the revised rates of increase among the total workers as well as among the cultivators and agricultural labour separately for males, and females do not show any abnormal variation during the decade 1951-61. The wide differences in the percentage of workers to total population as well as the percentage of workers in different categories to total workers noted in certain cases as between the two censuses when no correction was applied to the Census figures have been eliminated on the basis of the revised figures. Also certain abnormally low and high proportion of workers noticed in the original census data are no longer present as a result of revision of workers in different categories.

16. However, it should be emphasised that the various corrections outlined above are somewhat arbitrary and the magnitude of the corrections indicated should only be considered as dimensional in nature and it aims at providing more reliable estimates of growth in the total number of workers as well as workers in the agricultural sector for the years 1951 and 1961. As indicated earlier in the paper the number of workers in certain other sectors are also expected to be subject to some bias ; but as their magnitudes are not considered to be significant, no attempt has been made in this paper to provide alternative estimates of workers for these sectors. The estimates of workers for 1951 and1961 furnished in this paper can at best be taken as a first approximation to the 'true' values.

Table I

Worker Participation Rates according to Various Censuses 1911-1961 (Orissa)

	Persons	Men	Women
1911	45.1	60.6	30.4
1921	46.9	61.8	33.2
1931	44.4	59.7	30.0
1951	37.4	56.4	18.8
1961	43.7	60.8	26.6

Table II

Worker Participation Rates (percent) by sex and area according to 1951 and 1961 Censuses (Orissa)

	1951			1961		
	Persons	Males	Females	Persons	Males	Females
All State	37.4	56.4	18.8	43.7	60.8	26.6
	(43.0)	(61.8)	(24.7)			
Rural	37.4	56.39	18.93	44.1	61.0	27.4
	(43.1)	(62.0)	(24.7)			
Urban	36.9	56.6	14.4	37.5	57.2	13.1

Note :— Figures in brackets are those estimated from the Agricultural Labour Enquiry data (1950-51) by the method outlined in the paper.

Table IV

Indices on the corresponding 1911 figures as 100 (Orissa)

(I) Total Population

Year	Persons	Males	Females
1921	98	97	99
1931	110	109	110
1951	129	131	127
1961	154	158	150

(Contd. to Page 176)

Table III

Some Demographic Trends During 1951-61 (Orissa)

Category according to 1961 census		Percentage of population of specified category with total population equal to 100		Percentage of workers of specified category with total workers as 100		Percentage increase during 1951-61
		1951	1961	1951	1961	
Total Population	P	100	100	—	—	19.82
	M	100	100	—	—	21.09
	W	100	100	—	—	18.58
Total Workers	P	37.37(41.36)	43.66	100	100	39.98(26.49)
	M	56.40(59 30)	60.75	100	100	30.45(24.07)
	W	18.76(23.81)	26 58	100	100	68.02(32.39)
Cultivators (Category I)	P	19.39(21.98)	24.80(23.24)	51.88(53.14)	56.82(53.23)	53.30(26.70)
	M	32.66(34.93)	36.32(35.56)	57.92(58.90)	59.78(58.54)	34.64(23.30)
	W	6.40(9.31)	13.30(10.92)	34.12(39.09)	50.06(41.10)	146.47(39.21)
Agriculture Labour (Category II)	P	6.90(8.29)	7.43(8.99)	18.45(20.05)	17.01(20.60)	29 06(29.96)
	M	9.12(9 75)	9.18(9 93)	16.17(16.45)	15.11(16.35)	21.87(23.30)
	W	4.72(6.86)	5.68(8.06)	25.17(28.83)	21.37(30.32)	42.65(39.21)
Primary Sector (Category—I plus II) Workers	P	26.29(30.27)	32.23	70.33(73.19)	73.83	46.94(27.59)
	M	41.78(44.68)	45.50	74.09(75.35)	74.89	31.85(23.30)
	W	11.12(16.17)	18.98	59.29(67.92)	71.43	102.40(39.21)
Secondary Sector (Category III plus IV plus V plus VI) Workers	P	4.15	4.45	11.11	10.17	12.84
	M	5.23	5.51	9.28	9.08	12.76
	W	3.09	3.37	16.44	12.68	12.96
Tertiary Sector (Category VII plus VIII plus IX) Workers	P	6.93	6.98	18.56	16.00	20.56
	M	9.39	9.74	16.63	16.03	25.78
	W	4.55	4.23	24.27	15.89	10.02

Note : Revised figures are given for the years 1951 and 1961 within brackets wherever they stand affected by the revision of number of workers for the years 1951 and 1961 by the method outlined in the paper.

(Contd. from Page 174)

(ii) All Workers			
1921	102	98	108
1931	108	108	109
1951	107(118)	122(128)	78(99)
1961	149	159	131
(iii) Cultivators			
1921	106	100	123
1931	99	107	73
1951	117(132)	127(136)	83(120)
1961	179(168)	171(168)	204(167)
(iv) Agricultural Labourers			
1921	96	93	100
1931	105	111	69
1951	88(105)	106(113)	66(96)
1961	113(137)	129(139)	95(134)

N. B. :—Revised figures are given for the years 1951 and 1961 within brackets wherever they stand affected by the revision of number of workers for the years 1951 and 1961 by the method outlined in the paper.

Table V

Sex Ratio—Number of female workers per 1000 male workers (Orissa) according to various Censuses (1911-1961)

Years	All Workers	Cultivators	Agricutural Labour
1911	530	308	843
1921	584	377	901
1931	537	211	730
1951	340 (410)	200 (272)	529 (719)
1961	438	367 (307)	619 (812)

Table VI

Percentage of Agricultural Labourers to Cultivators (Orissa) according to various Censuses (1911-1961).

	1911	1921	1931	1951	1961
Persons	47	43	50	36 (38)	30 (39)
Males	34	31	35	28 (28)	25 (28)
Females	92	75	121	74 (74)	43 (74)

N.B.— Revised figures are given for the years 1951 and 1961 within brackets wherever they stand affected by the revision of number of workers for the years 1951 and 1961 by the method outlined in the paper.

EXTENT OF MIGRATION INTO ASSAM DURING THE DECADE 1951-61.

By

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INTRODUCTION

The paper is divided into five parts. In part I, we discuss mostly the reliability of census data in respect of migrants. Part II deals with rate of population growth in Assam during the decade 1951-61. Part III deals with the problem of natural increase of population. In part IV the estimation of migrants from the available census data has been shown and part V contains the conclusion of the paper.

1. Reliability of census data in respect of migration

Estimation of migrants is not a very difficult thing if reliable census or some other data are available. But it must be made clear that dealing with these problems in Assam is extremely difficult because of lack of data in this aspect. Migration, which has become a special problem to Assam has drawn the attention of many students interested in Demography. In India, we don't have much study on the subject. However, of late, some authors on migration have estimated the possible quantum of migration to the Estern Zone of India. But really it is not an easy job to estimate the extent of migration to this eastern zone basing upon the information collected in our census papers. The information collected in our census papers suffer from various defects. In general, data on place of birth are roughly correct. Sometimes the place of birth of children are shown arbitrarily and sometimes questions relating to place of birth are not asked intelligibly. Of course, Assam is not the only State to suffer from these defects. However, these defects are not so serious defects as they are susceptible to correction. But major defect arises only when people deliberately mis-state their places of birth. This kind of defect has been observed with the census of 1961. In 1951 census persons born in East Pakistan and enumerated in Assam numbered 831,872 but in 1961 census the corresponding figure stood at 774,869 only. It is a well known fact that after 1951 quite a good number of people came over to Assam from East Pakistan and quite a good percentage of them were children and youngmen and not too many elderly persons. It is generally observed that inflow of such migrants is still continuing. This being the position, the people born in East Pakistan and enumerated in Assam in 1961 cannot be less than the figure of 1951 census. But the census

of 1961 has shown quite a reverse position. From this fact we can easily infer that for political or some other reasons the Pakistani nationals have misstated their place of birth in 1961 census. Now what we see is that the "place of birth" data are very unreliable. Persons born in other parts of India would not definitely misstate their place of birth because of the constitutional guarantee for freedom of movement to any place they like within India and this makes easy to calculate the net migration to Assam from other parts of India. Then again our census table D-III-"Migrants classified *by place of birth data and duration of Residence in place of Enumeration*" *also suffers from the same defect.* However, an attempt will be made later on to show the reliability of these tables by giving a possible quantitative estimate of migration in Assam.

We have stated earlier that the estimation of migration is not an easy thing if census data are not reliable and we have also shown that census data in respect of migration suffer from a serious defect and hence we cannot expect to get the possible quantum of migration to Assam during the period 1951-61. **The purpose of this paper is to bring out the possible quantum of migration into this State during the decade 1951-61.**

II. Population growth rate in Assam 1951-61

Assam has shown the highest rate of increase during the decade 1951-61 among all the major States of India. The census of 1961 enumerated 11.87 million persons in the State. In 1951 census the population for the corresponding area was only 8.83 million. Thus between 1951 and 1961, population increased by 3.04 million or 34.45 percent. During the same decade the population of India increased by 21.50 percent. This rate of increase is really alarming and it has drawn the attention of many people to find out the reason behind this kind of high increase. The next highest rate is observed with our neighbouring State, West Bengal. In a sense, we can say that the States which are nearer to East Pakistan have shown higher growth rates. But it is strange that East Pakistan in respect of growth rate does not go in line either with West Bengal or with Assam. The rate of growth observed in East Pakistan is very low. East Pakistan cannot claim any special advantage in respect of social and economic factors which affect fertility to favour them with such a low rate of growth. Some of the districts of East Pakistan have shown high growth rates and these rates are similar to the rates observed in most of the districts of Assam. The districts of Assam which have shown very high growth rates do not seem to be the result of birth or deaths alone because of heterogeneity of growth (observed) in these States.

The following table I shows the population of Assam for 1951 and 1961 by religion group. In every district, excepting the Mizo District, the

growth rate of Muslims is higher than that of Hindus and in some of the districts the growth rate of Christians is also higher but population involved is not much.

TABLE : 1

Increase of Population by broad Community Groups during the period 1951-61.

	HINDUS			MUSLIMS		
	1961	1951	P.C. increase over 1951	1961	1951	P.C.increase over 1951
1	2	3	4	5	6	7
1. Goalpara	736597	571080	37.7	668748	475825	40.5
2. Kamrup	1427008	1039462	37.3	605524	436495	38.7
3. Darrang	976563	726369	34.4	249585	157262	58.7
4. Lakhimpur	1407035	1019765	40.1	68242	52482	68.1
5. Nowgong	701506	517953	35.4	499320	359519	38.9
6. Sibsagar	1383187	1115662	23.9	87911	70543	24.6
7. Cachar	822600	676640	21.4	539457	429457	25.6
8. Garo Hills	51876	40189	29.0	17163	10778	59.2
9. United Mikir & N.C.Hills	227202	116607	94.8	3500	328	967.1
10. Mizo District	13778	6470	113.0	203	131	55.0
11. United Khasi-Jaintia Hills	83569	55866	58.6	5856	3116	88.0

	CHRISTIANS			*OTHERS		
	1961	1951	P. C. increase over 1951	1961	1951	P. C. increase over 1951
1	8	9	10	11	12	13
1. Goalpara	51594	31009	66.4	36953	30210	22.3
2. Kamrup	18419	11015	67.2	11621	3420	239.8
3. Darrang	59861	36396	64.4	3661	3541	3.4
4. Lakhimpur	54309	34186	63.9	14256	19861	28 2
5. Nowgong	7143	4789	49 2	2792	4694	40.5
6. Sibsagar	29080	21213	37.0	8212	4806	70.9
7. Cachar	15178	8422	80.2	2241	1346	66.5
8. Garo Hills	87311	39292	213.8	150872	151816	0.9
9. United Mikir & N. C. Hills	27548	11024	149.9	21476	37481	42.7
10. Mizo District	230509	177575	29.8	21573	12026	79.4
11. United Khasi-Jaintia Hills	183601	110086	66.8	184126	194531	5.3

* Comprise Buddhists, Jains, Sikhs and others.

Source : Census of Indian Paper No. 1, 1961 Census and Census of India, Vol. XII, 1951.

Table—2

Annual Average growth rate of Muslims and Non-muslims.

Year	Population	Muslims	Non-muslims
1951	88,30,732	19,95,936	68,34,796
1961	1,18,72,772	27,65,509	91,07,263
Annual Average growth rate		3.2325	2.8509

The table 2 shows the annual average growth rates of Muslims and Non-muslims comprising Hindus, Christians, Buddhists, Jains and others and from the table it is observed that the growth rate of Muslims is nearly 0.38 percent point higher than that of the growth rate of non-muslims and this point is very important for our analysis purpose.

III. Natural Increase

We know that population growth is the net result of births over deaths and movement from and to countries outside the national boundary. We also know that reliable vital statistics are essential for the good foundation on which the field of Demogrphy is based. But it is a matter of regret that vital statistics of Assam are also most inaccurate and hence no reliance can be made on them.

The following table shows the recorded birth and death rates from 1959 to 1961.

Table—3

Recorded birth and death rates in Assam.

Year	Birth rate	Death rate
1959	8.01	4.01
1960	7 35	3.15
1961	7.83	2.98

The Urban Registration data of 1960 for births and deaths give us only 21.1 and 8.0 for births and deaths per thousand respectively and they are obviously far from reality. The Fertility Survey conducted by the census authority of Assam, 1961 shows 41.5 as birth rates. The following table shows the birth and death rates of sample census conducted by the Department of Economics and Statistics, Assam, Shillong.

Table—4

Birth and death rates in Assam from sample Census

Year	Birth rate	Death rate
1960	32.20	14.70
1963	42.50	24.83

The census of 1961 reveals 49.3 and 26.9 as birth and death rates respectively for Assam.

The Reverse Survival method (assuming e_0^0=41 for males and 42 for females) gives us birth rates as follows.

Table 5

Birth rates by Reverse Survival method.

Age group (year)	Birth rates
0-4	47.95
5-9	58.64
0-9	52.91

Birth rate of age group 0-4 years falls more or less in the line of birth rate shown by the Census, 1961. Estimated birth rate (by Reverse Survival method) is more or less independent of migration and hence we can assume birth rate to be in between 50 to 48 (per thousand). But the case is different in case of calculating death rates. The child women ratio for 1961 census is higher than the ratio observed in 1951 census. Moreover, other indices of fertility indicate high fertility in Assam. But death rate is also quite high due to prevalence of high mortality conditions in Assam. Death at maternity is quite high due to absence of proper medical facilities to the expected mother in time of need. Although in recent years medical sciences have made remarkable progress in arresting diseases yet the major killers are not unknown to the people of Assam. Such being the position, Assam cannot claim any special advantage to show a very high rate of natural increase during the decade 1951-61.

IV. Estimate of Migration from Available Census Data.

From the long history of migration it is known to all that Assam is an immigrating area. Migration to Assam was quite substantial in the past. Various factors encouraged migrants to come over to Assam. The virgin soils and the tea gardens were the main objects of attraction of those migrants. After partition of India, quite a large number of refugees came to Assam, West Bengal and some other parts of India and besides this many

muslims entered Assam illegally. Such flow of migrants into Assam is still continuing. Kingsley Davis remarked "Assam having been the centre of two kinds of immigration, has been from a demographic point of view the fastest growing province in the Indian Sub-Continent". He could perceive well the trend that would follow in near future and his saying did not take much time to assert itself.

Table (6) below shows the life time in, out and net migration in Assam for the year 1951-61.

Table -6

Life time In, Out and Net migration in Assam.

Year	Immigration	Outmigration	Net migration
1951	13,43,497	2,37,445	11,06,052
1961	13,53,581	2,93,925	10,59,656

The above table shows that during the year 1961 life time in and out migration have increased. The life time in migrants during the period 1951-61 have increased by nearly 10,000 only. Even if we allow for mortality, taking into consideration the survival ratio of 0.9, the net immigrants during the decade does not appear to be more than 1,45,000. The life time outmigrants have also increased nearly by 80,000 during the same period. This gives us life time netmigrants of 0.06 million for the same decade. Besides this from the place of birth data we get duration of residence stay in Assam and estimated netmigrants from this source come 0.4 million (approximately estimated value). Now taking into consideration these figures as authentic, we get an intercensal population increase of 34 P.C. or 30 P.C. and these percentages seem to be quite high. Moreover, the growth rate of Assam born population enumerated in Assam and elsewhere appears to be more than 42 P.C. which is seemingly impossible. All these clearly indicate that the place of birth data, so far as Assam is concerned, are of doubtful validity and hence serve no useful purpose in estimating migrants coming over to Assam during the decade 1951-61.

V. Conclusion

Now we have seen that unless and until we take some other technique for estimating migration into Assam neither birth and death statistics nor place of birth data can offer us reliable information of Migration into this State. We have shown earlier that the annual average rate of increase of muslim population of Assam during the decade is nearly 0.38 percent higher than that of non-muslim population. Now for our estimation purpose we take Assam, West Bengal, East Pakistan, Bihar, Tripura and Manipur as one

unit and assume that this area has more or less similar population. We also assume that the growth of non-muslims of this region is similar to the growth rate of non-muslims of Assam (because of Hindu majority in Assam as well as in the region). We also assume that the growth rate of muslims is nearly 0.38 P.C. higher than that of non-muslims (as observed in the census of 1961). From table 7 below the annual average growth rate of non-muslims in the region is found to be 1.9681. And applying this growth rate of 1.9681 to the non-muslim population of Assam we get the national increase of non-muslims for the decade 1951-61 and applying the annual average rates of growth of 2.3497 (i.e 1.9681 for non-muslim ~~and~~ +0.3816 as observed in 1961 census) we get the natural increase of muslims in Assam for the same period and the components of population growth thus arrived at have been shown in table 8. This table shows the natural increase of 21,75,434 of which 5,59,398 belong to the muslim community and the rest 15,68,778 belong to the non-muslim community. Now by subtracting 21,28,176 from the total growth of 30,42,040, we get 9,13,864 as in-migrants and immigrants coming over to Assam during the decade 1951-61. The estimated immigrants (people coming to Assam from other parts of India) and Nepalies from Nepal stand at 22,000 and 31,000 respectively. And after deducting 22,000 from 9,13,866 we get net immigration of 8,91,864 of which 8,60,864 (8,91,864—31,000) immigrants are mainly from our neighbouring country, East Pakistan. This migration estimate gives us 20.56 as the rate of natural increase which seems to be a quite reliable rate for Assam.

Table 7

Growth rate of Non-muslim population in the States of Indian Sub-Continent, and the neighbouring East Pakistan 1951-61.

State	1951 Non muslims	1961 Non-muslims
1. Assam	68,34,796	91,07,263
2. West Bengal	2,11,84,117	2,79,40,992
3. East Pakistan	98,36,361	99,49,754
4. Bihar	3,44,10,418	4,06,69,979
5. Tripura	5,02,089	9,12,003
6. Manipur	5,40,438	7,31,419
Total	7,33,08,219	8,93,11,440
Annual average growth rate for 1951-61	1.9681	

Table 8

Components of Population growth by Religion for Assam 1951-61.

	Total Population	Muslims	Non-muslims
Population in 1961	1,18,72,772	27,65,509	91,07,263
Population in 1951	88,30,732	19,95,936	68,34,796
Total growth, 1951-61	30,42,040	7,69,573	22,72,467
National increase	21,28,176	5,59,398	15,68,778
Annual average growth rate		(2.3497)	(1.9681)
Net migration	9,13,864	2,10,175	7,03,689

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INFANT MORTALITY IN INDIA

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The True Infant Mortality Rate of a community defined as the number of infant deaths that occur per thousand live births is to be found by follow-up method and is hardly realised in practice due to administrative and other difficulties. Since such rates for India are not available with us we have in this paper worked with the conventional index of infant deaths per 1000 live births during some specified period, generally, one year.

1. The figure (on Page—187) shows, for the period 1921-1961, the movements of the infant mortality and general mortality (deaths at all ages per 1000 living) in India. A very cursory inspection of the diagram shows that the two varied together in the same direction, —when the infant mortality rose from one year to the next the general mortality did the same, with only ten exceptions during the period under review. The correlation between the annual values of the two may be expected to be positive, because the infant death rate forms part of the general death rate.

To exhibit the closeness of the relation between infant and general mortality for such causes as show marked changes from one year to the next we correlate the annual changes.

Table—1. General Mortality and Infant Mortality for India, 1921-1961.

Year	Inf. Mort. Rate	Genl. Mort. Rate	Year	Inf. mort. Rate	Genl. Mort. Rate
1921	198	31.0	1941	158	21.8
22	175	23.9	42	163	21.3
23	176	24.7	43	165	23.6
24	187	28.0	44	169	24.1
25	174	24.1	45	151	21.5
26	189	25 8	46	136	18.7
27	167	23.7	47	146	19.7
28	173	24.1	48	130	17.1
29	178	24.2	49	123	15.8
30	181	24.9	50	127	16.0
31	179	25.3	51	130	14.4
32	169	21.8	52	123	13.8
33	171	22.5	53	125	13.0

(:contd. Table 1)

34	181	25.0	54	114	12.5
35	164	23.6	55	103	11.7
36	162	22.5	56	109	10.9
37	162	22.1	57	107	11.4
38	167	23.9	58	101	12.9
39	156	21.7	59	90	11.4
40	160	21.3	60	86	11.0
			61	83	11.4

Source : Upto 1950, "Population and Planned Parenthood in India". S. Chandrasekhar, pp-92-93. From 1951, Statistical Abstracts, India.

The following constants are found :

Infant Mortality ;	mean annual change	—2.707
	standard deviation	9.363
General Mortality ;	mean annual change	—.454
	Standard deviation	1.828
	Coefficient of correlation	.940

This is a much higher correlation than would arise from the mere fact that the deaths of infants from part of the general mortality, and consequently there must be a higher correlation between the annual changes in the mrotatlity of those who are over and under 1 year of age, respectively.

Now general mortality per 1000 of population = Infant mortality per 1000 Births $\times \frac{\text{Births}}{\text{Population}}$ + Deaths over one year per 1000 of population and to estimate, very roughly, the correlation that would be found between annual movements in infant mortality and general mortality if the mortality of those under and over one year of age were uncorrelated treat the ratio of births to population as if it were a constant at a rough average value, say, ·036. The s.d. of annual movements in infant mortality is 9.363 and that of annual movements in mortality other than the infantile may be taken as sensibly the same as that of general mortality, say, 1.828 units. The correlation then comes out as ·181. The difference between ·940 and ·181 is, perhaps, ascribable to causes which show marked changes from one year to the next and which may not add to infant mortality but may bear some effect on the post-infiantile period of life.

2. We may take three variables,—birth rate (X_1), average number of persons per 1000 of population* who have any kind of education—general

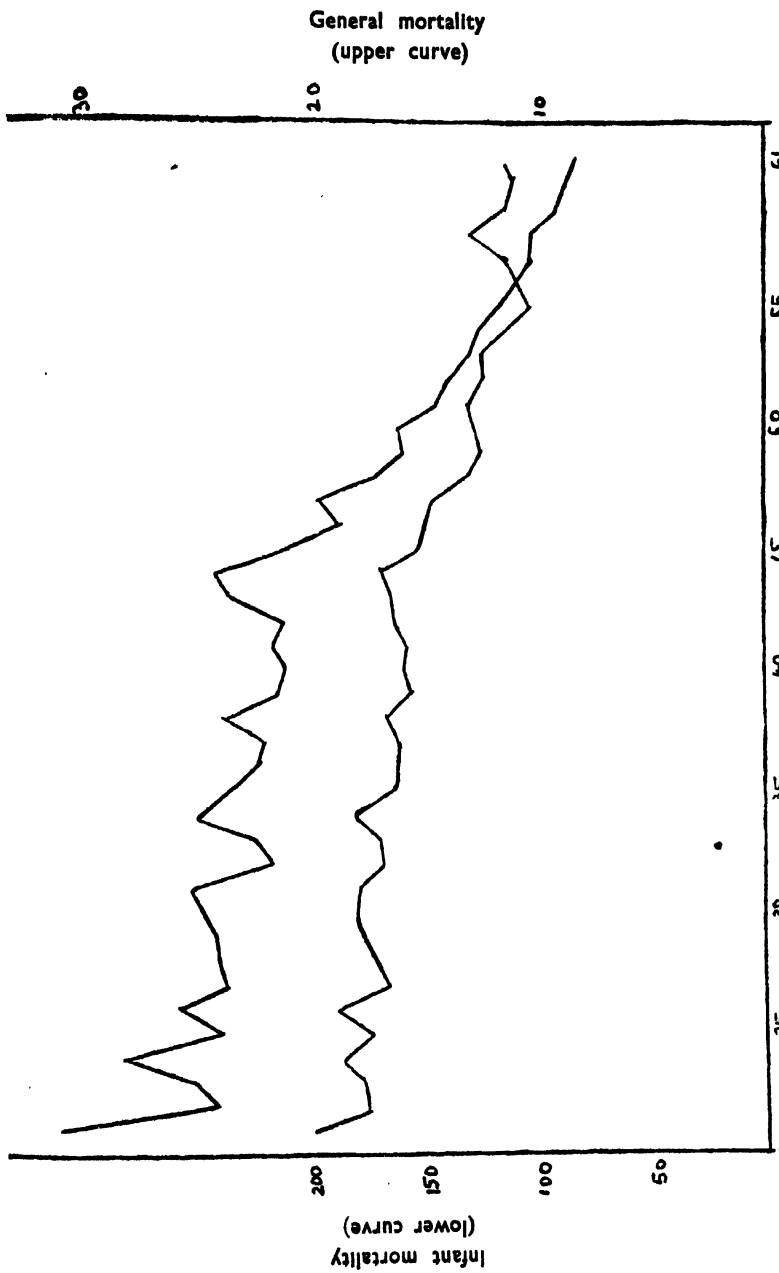

Figure showing the infant mortality and general mortality in India for the period 1921-61

or technical (X_2) and average number of persons* in thousand for whom a hospital exists (X_3) and study the dependence of infant mortality (y) on these.

Table 2

Year	Y	X_1	X_2	X_3
51	130	24.9	71.6	127.7
52	123	25.4	72.8	169.8
53	125	24 8	73.7	137.1
54	114	24 4	76.4	130 5
55	103	27.0	80.2	131.4
56	109	23.3	85.2	120.4
57	107	21.9	88.6	144.3
58	101	25.9	91.6	114.1
59	90	27.8	98.1	111.3
60	86	26.7	103.3	107.4
61	83	27.7	109.2	75.8

Source : Statistical Abstracts, India.

R^2 is ·974 and the relevant F ratio is significant at 1% level. $\beta y3.12$ however comes insignificant. b_1, b_2 are 1.0576 and — 1.2380 respectively the signs of the regression co-efficients confirming the general belief about the association of infant mortality with these two factors. The regression equation is

$$Y = 106.5 + 1.0576\ (X_1 - 25.4) - 1.2380\ (X_2 - 86)$$

Table 3

Year	Infant mortality	
	Observed	Expected
1951	130	124.3
52	123	123.3
53	125	121.6
54	114	117.8
55	103	115.9
56	109	107.2
57	107	100.1
58	101	100.6
59	90	94.6
60	86	86.9
61	83	80.7

* Population at each year has been estimated by assuming linearity of the curve between 1951 and 1961.

3. In this last section we shall compare India's performance in reducing infant mortality over the last several decades with other countries. Infant mortality rate may apparently seem an adequate measure of comparison but one should at the same time take account of factors upon which infant death rate depends. One such factor is birth rate. Generally a high birth rate is accompanied by a high rate of infant mortality and a low birth rate by a low proportion of infant deaths.

Taking two communities C_0 and C_1 with birth figures B_0 and B_1 and infant death rates D_0 and D_1 respectively we have $B_1 D_1$ as the total amount of loss in terms of infant deaths of community C_1. But if the infant death rate D_0 of the standard community C_0 operated on C_1 then only $B_1 D_0$ children would be victimised. Generally standard population is chosen such that its infant mortality rate D_0 is less than that for the community C_1. Then B_1D_1-B_1D_0 is the amount of gain of lives that the community C_1 would have if the death rate D_0 of the standard population operated on it having no effect however on its birth figures. This quantity divided by B_1D_0 viz. $\frac{D_1}{D_0} - 1 = I$ (say) may be taken as a weight attachable to every expected infant death in community C_1 giving a measure of the gain in lives that would occur if the death rate D_0 of the standard community C_0 would operate on it. I therefore may be looked upon as an index for comparison of various populations with respect to their perfromance in preventing infant deaths and hence reducing the infant mortality rate. Clearly $-1 \leq I \leq \infty$. A positive value of I depicts that C_1 is worse than C_0 and a negative value gives a reverse picture.

The following table shows the values of I for the years 1921-25, 1926-30, 1931-35, 1936-38, 1946-50 in respect of selected countries of the world with the U.S.A. population as standard. The values have been calculated on the basis of infant mortality rates for the above countries and above periods taken from Epidemological and vital Statistics Report (Geneva, World Health Organisation, 1954) Vol.7, No. 1

Table 4 showing values of I for the years 1921-25, 1926-30, 1931-35, 1936-38, 1946-50, 1951 and 1952 in respect of some selected countries of the World taking U.S.A. Population as standard.

Countries	Values of I for the years						
	1921-25	1926-30	1931-35	1936-38	1946-50	1951	1952
Africa							
Egypt	—	—	2.525	2.797	4.469	4.928	4.620
Mauritius	·919	1.073	1.559	1.834	2.750	2.000	1.793
Union of S.Africa (European population only)	—.014	—.015	.068	.037	.125	.214	.207

(Contd. Table—4

Countries	1921-25	1926-30	1931-35	1936-38	1946-50	1951	1952
America							
Canada (excluding Yukon and N.W. territory)	.324	.368	.271	.259	.375*	.357	—
Chile	2.581	2.367	3.203 (1928-38)	3.500	5.031	4.321	3.620
Mexico	—	—	.941	—	—	2 571	2.103
U.S.A.	0	0	0	0	0	0	0
Asia							
Ceylon	1.568	1.574	2.085	1.982	2.093	1.928	1.689
India (registration area)	1.459	1.603	1.932	2.019	3.094	3.142	—
Israel (prior 1948 Palestine)							
Jewish population	.703	.397	.288	.148	.281	.393	.345
Moslems	1.581	1.838	1.814	1.741	—	—	—
Japan	—	—	(1928-38) 1.058	—	—	1.035	.724
Europe							
Germany X	.649	.382	.254	.167	1.219	.893	.655
Belgium	.432	.485	.508	.574	.769	.786	.552
Denmark	.108	+.206	.203	.185	.188	.036	0
Spain	1.014	.926	1.000	1.296	1.406	1.428	—
Finland	.297	.294	.220	.241	.625	.250	.103
France	—	.382	.322	.315	938	.821	.586
Ireland	—.541	—.029	.153	.315	.781	.607	.413
Iceland	—.284	—.221	—.136	—.333	—.250	—.072	—
Italy	.716	.750	.780	.945	1.406	1.393	—
Malta	2.649	3.088	3.695	3.056	2.375	2.571	1.483
Norway	—.298	—.279	—.237	—.260	—.032	—.072	—
Netherlands	—.284	—.176	—.237	—.296	—.032	—.107	—.207
United Kingdom							
England & Wales	027	0	.051	.037	.125	.071	—.070
Scotland	.243	.250	.373	.426	.469	.321	.207
Sweden	—.189	—.147	.153	—.195	—.250	—.250	—.310
Switzerland	—.122	—.206	—.186	—.167	.125	.071	0
Yugoslavia	—	1 220	1.593	1.574	2.656	3.999	3.310
Oceania							
Australia	—.230	—.236	—.305	—.278	—.157	—.107	—.173
New zealand (excluding Maoris)	—.419	—.456	—.458	—.489	—.250	—.179	—.241
Maoris	—	.588	.661	1 .185	1.375	1.428	1.896

* as from 1946 including Newfoundland

\+ upto 1932 British Registration Area

X as from 1956 Federal Republic of Germany

—:o:—

POPULATION PROJECTION : A REGIONAL STUDY

By

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1.0 Introductions : In order to make satisfactory long-range policy decisions, the knowledge of the size to which the decision variables will grow over the time horizon considered is a sine qua non. In the context of long-range planning of a State's economy one of the most important things we require is the size to which the present population will grow at the end of the plan period.

In forecasting the population in open areas, such as a relgon or State, major elements of population growth which should be taken into account are : (i) the rates of natural increase or decrease, (ii) in-migration, and (iii) out-migration. The relationship may be written in general form as follow :— $P_{t+\theta}=P_t + (b-d) + (m-n)$ ... .. (1) where P_t and $P_t + \theta$ denote respectively the base year (t) and projected population (at $t+\theta$) figures, b and d represent respectively the total number of births and deaths, while m and n represent respectively the extent of in-migration and out-migration during the period θ. As it is essential to incorporate in-migartion and out-migration in the natural increase of population, the problem of forecasting the population in open areas for a long period, such as, a decade becomes all the more difficu't owing to non availability of satisfactory data on migration in respect of individual States.

2.0 Projection by Extrapolation using Mathematical Functions : In the absence of even vague information about migration and a suitably constructed life table based on the most recent data, one may be forced to use a suitably formulated mathematical function on the basis of the time-series data on population for the purpose of forecasting. If the interest is mainly on the aggregate population figures, and not the break-up of its differential components at a future date, such methods of extrapolation may come in quite handy. Although the assumption of future population growth following a pattern predictable from past relationship involved in such a method of forecasting somewhat restricts its uses. the projections arrived at from such functions for a short period, say 5 years, may in certain cases be used as a satisfactory indicator.

2.1 One finds in the literature a large variety of such mathematical functions (such as, polynomial, exponential, modified exponential etc.,) and a discussion of the merits and demerits of the different forms used is beyond

the scope of this paper. For our purposes we have used an exponential of second degree. This particular form has also been favoured by some researchers in the field recently.

2.2 The form of the function tried in this case may be explictly written as. $P_t = a+bt+ct^2$ - - - - - - - - - - - - - - - - - - (2) where 'P' stands for 'population', t for 'time-points' and a, b and c are constants to be estimated from the time series data of population census. The table below gives population figures for each of the census decades from 1901 to 1961 for West Bengal (considering the present boundaries of the State) and the last column of the table shows the estimated values of population as obtained from an exponential curve of second degree which was fitted, employing the usual regression techniques, to the population figures of seven time-points. The fitted equation is

$$\text{Log } P_t = \underset{(0.03630)}{16.73199-0.08900\,t}+\underset{(0.00443)}{0.02547\,t^2} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

where the figures in parentheses denote the standard errors

Population of West Bengal (in thousands)

Census Year	observed	estimated
1901	16942	17336
1911	18001	17119
1921	17476	17788
1931	18899	19450
1941	23232	22378
1951	26302	27093
1961	34926	34515
1966		39708*
1971		46268*

* Indicates extrapolated values with percentage variation of the order of 4%

It may be noted that if an exponential curve were fitted to the first six time-points, the extrapolated value in 1961 would be about 5% below the actual. One of the reasons of such under estimation of the actual value in this case may be due to our failure to take into account the huge influx of migrants into this State from Pakistan during the 1951-1961 census decade.

2.3 Although it may be possible to fit certain mathematical functions to time-series data of population estimates, cases are not rare when one ends up with rather discouraging results if such fits are tried to the components

of the aggregate population figures[1]. But stable estimates of the differential components of the population at a future date are very often required for planning purposes. Besides, even for projecting the population total for a long period (say, 10 to 20 years) in a country undergoing rapid changes in the economic and social spheres extrapolation by mathematical functions may, owing to its severe limitation (vide section 2.1 above), give quite misleading results.

3.0 **Cohort Survival Method** : In order to reflect changes in the population structure (such as distribution by region, age, sex etc.,) more accurately the pattern of variations in the differential components over the period of projection should be taken into account. If we confine our attention to the natural increase (i.e., the first two components of the right hand side of eqn 1) we might expect an improvement if differences in birth and death rates for various age and sex groups are also considered. This is what the 'cohort survival' method precisely does. Briefly speaking, according to this method the natural increase in population is projected with the help of (i) expected number of births, (ii) the number of survivors of these births on the basis of the infant mortality rates and (iii) estimated number of survivors over one year of age obtainable from the relevent survivorship ratios. The expected number of births is estimated by multiplying the age-specific birth rates by the average number of women in each of the age-groups. The number of survivors in the lowest age-group is then added to the number of survivors in the other groups already calculated The procedure is then repeated for each time interval upto the forecast date. Thus the success of this method would largely depend on the accurate estimation of vital rates like birth and death rates and survivorship ratios by age, sex and region. In the present study we have estimated the birth and death rates and related characters from the results thrown up by a survey conducted in 1963 by the Bureau of Applied Economics & Statistics Govt. of West Bengal, while the survivorship ratios have been derived from the set of life tables which were prepared with the help of the estimated vital rates.

3.1 In constructing life tables the normal practice has been to use data covering a long period of reference, such as a decade, so that observed death rates can be smoothed by averaging over years of severe epidemics and those of relatively good health and the related life tables may reflect the average conditions. With the rapid improvement in mortality during the last few

1. In this connexion the paper by V.S. Swamy (vide Census Paper No 1, 1962) may be referred to. In his case a second degree exponential provided a good fit in the case of general population indices but yielded quite discouraging results when this was extended to its components, such as, workers in the Primary and Secondary sectors.

decades it is now being increasingly felt that the life tables should be based on shorter reference periods so that they may portray the current conditions. Many countries now have their life tables on the basis of death records for a three year period centred at the reference year. In the present study we have been forced to use a still shorter reference period—almost a year—for the simple reason that in the absence of any other dependable source we had (in order to calculate the vital rates) to fall back upon the results of a survey (already referred to) the length of whose reference period was one year.

3.2 At the stage a brief description of the survey may be in order. The sample count of population conducted during April—July, 1963 was designed mainly to collect quantitative details regarding migration and details of deaths were recovered as ancillary information. In this survey, covering one percent of the population of the State, a multi-stage stratified sampling design was followed. The first stage sampling units were mouzas in the rural areas and census blocks or towns or wards in the urban areas. The ultimate sampling unit was a household. Details of resident members on the dates of survey and on the last Festival day i.e. 31st Chaitra 1368 B.S. (14th April, 1962) along with details of births, deaths and migration in the sampled household during the reference year were recorded. These provided relevant materials for estimation of the infant mortality rates and other age and sex specific death rates. While the entire data of urban areas were used in the present construction of life tables only one half-sample of the rural area was utilised to reduce the computational work without much loss in precision.

3.3 **Estimation of Death Rates**: The age-sex specific death rate for any particular sex-age groups has been estimated as the ratio of the estimated total number of deaths in the sex-age group and the estimated total population exposed to risk under the same category. Unbiased estimates of the totals have been obtained by multiplying the total of sample values by the reciprocal of the sampling fractions in a stratum and then pooling over the strata.

3.4 Since all the sampling units were not surveyed at the same time it required derivation of the total population exposed to risk separately for each of the muzas and towns. This was done by multiplying the total of the survey day and Festival day population in the specific group $\frac{t}{2} \times \frac{1}{365}$ where 't' was the length of the relevant reference period in days.

3.5 The estimated population by single age-group as well as deaths by single age-group showed marked preference for digits ending with 0 and 5. To avoid this digital preference and to smooth out the irregularities in the observed death rates the construction of abridged life tables with broad age intervals was preferred to complete life tables in the present case. The

age groups in the tables were (in yrs.) 0—1, 1—5, 5—15, 15—25, 25—35 .....75—85 and 85 and above.

3.6 **Estimation of Mortality Rates and Expectation of Life etc :** After derivation of specific death rates the mortality rates n^q_x, ^L_x etc., were derived by using standard formulae and tables. The formulae used in the construction of present tables were all due to Reed & Merrell.[2]

3.7 The different formulae are as follows :—

(i) $Q_0 = 1 - e^{-mo(.9539 - .5509 m_0)}$

(ii) $_4q_1 = 1 - e^{-4 {}^m1 (.9806 - 2.079\ 4 {}^m1)}$

(iii) $_{10}q_x = 1 - e^{-10 {}_{10}m_x - .008 (10)^3\ {}_{10}m_x^2}$ for $x \geq 4$

(iv) $L_0 = .276 l_0 - .724 l_1$

(v) $_4L_1 = .034 l_0 + 1.181 l_1 + 2.782 l_5$

(vi) $_nL_x = \frac{n^d x}{n^m x}$ where $n^d x = l_x \cdot n^q x$

(vii) For the terminal age group $_\infty L_x = \frac{l_x}{\infty^m x} = T_x$

(viii) $T_x = T_{x+n} + n \sum L_x$

(ix) $e_x^o = \frac{T_x}{l_x}$

The above symbols carry the usual significance.

3.8 Six abridged life tables one each for males and females in the urban and rural areas and also in the State as a whole have been prepared. These tables are appended to the paper (Tables 1 to 6).

3.9 It will be seen from these tables that expectation of life is higher in urban areas than that in the rural areas and that the rural picture has been mainly reflected in the life tables for the state as a whole. It is also interesting to note that in the rural areas women have higher expectation of life.

3.10 In using the above life tables the following limitations in their construction may be borne in mind.

(i) The specific death rates ($n^m x$) are estimates based on sample survey and are not actuals based on total count. The percentage variations of these rates are round about four and the related functions of the life tables are also subject to similar variation,

2. A reference in this connection may be made to the paper entitled "A short Method for Constructing An Abridged Life Table" by Lowell J. Reed and Margaret Merrell in American Journal of Hygiene Vol. 30, No. 2, September, 1939.

(ii) The reference period on which the death rates and hence other functions of the tables are based is short.

(iii) The death rates are based on "resident members" of the household and hence the survey might have excluded deaths in single member households and hence slight underestimation in the death rates and over estimation in the expectation of life, specially in the higher age groups cannot be ruled out.

4.0 Population Projection with the help of life tables: Several attempts have been made by various research workers in this country to arrive at population projections with the help of life tables (published in the reports by the Government Actuaries) and some postulated changes in the rates of mortality and fertility. In almost every case the interest has been mainly in projecting the population of the country as a whole and, to the best of our knowledge, few attempts have been made in projecting population of different regions within India.

4.1 Following the method described briefly in para. 3.0 above the post-censal population of the State has been estimated with the help of abridged life tables for males and females in the urban and rural areas of the State constructed by us. As has already been described in para. 3.1 ancillary information on age-specific fertility rates for male and female births derived from the sample census, 1963 were used in order to estimate the natural increase in population upto 1971.

4.2 Although we have indicated briefly the method of estimating the future population in para. 3.1 it may be worthwhile here to describe certain computational details of our estimation procedure. From the values of $n{}_nL_x$ i.e. $\sum_{x}^{x+n} {}_nL_x$, the values ${}_1L_x$ were derived with the help of standard life tables (United States life tables for males and females, 1939-1941). This was done by multiplying ${}_nL_x$ of the standard tables by a factor "f" which equals the $n{}_nL_x$ of the abridged life table for rural/urban, male/female of the State of West Bengal divided by the $n{}_nL_x$ of the relevant standard life table. An estimate of the proportion of the population aged x years in 1961 who would remain alive y years later was taken as ${}_{x+y}L_x$. It should be noted that this estimate is valid only under the assumption that the mortality rate for persons in the different age-groups of the abridged life table remained stationary at the rate observed in 1962-63 for a period of y years after 1961 census. There is also an implicit assumption that within a particular age-group the variation in mortality rate with age is typically the same as that in the standard life table population. Starting with the male/female population tabulated according to single-year

ages in the rural/urban areas of the State as per census 1961 and applying the survival factor $({}^{l}x+1)/{}^{l}x$ the corresponding population in the year 1962 for ages one year and above were obtained. The estimate of male/female babies born in the rural/urban area of the State during the year 1961-62 was obtained by applying the age-specific fertility rates to the average female population in the relevant age-group in the rural/urban area of the State. These fertility rates were derived from the sample census, 1963. Utilising infant mortality rates (derived from the same survey data) the population below one year of age of 1962 was then estimated. Starting again with the derived population of 1962 and proceeding in the same manner and applying the same rates the population in 1963 was then estimated and this procedure was repeated year after year until 1971. Thus it will be clear that we have made no attempts to postulate any changes in the rates of mortality and fertility throughout the period of projection.

4.3 The increase in 1971 thus estimated indicates only the size to which the population will grow if the effect of net in-migration can be considered as in-significant. But in open areas, such as regions or States, the effect of net in-migration can seldom be insignificant. Areas which are prosperous or undergoing rapid development, attract population from the less developed adjoining areas. In the case of West Bengal it is well-known that substantial in-migration takes place from East Pakistan due to political reasons and also from adjoining States of our country because of the greater employment opportunities, and ample scopes in commercial and various other fields offered by this State. Hence the consideration of migration factor is a must in the preparation of population forecasts for West Bengal.

4.4 **Correction for Migration** : In forecasting future migration pattern, as in the case of projection of general population, various techniques, such as, extrapolation of past trends, relating migration to some aspects of population growth (through a constant or changing ratio or certain other determinants of migration, such as, economic opportunity) etc. are found in the literature. Unfortunately, data on inter-State migration even with the barest minimum of details, which might permit the application of sophisticated techniques, were not available until recently. It is only in 1961 Census some systematic efforts were made to this and but even now we do not find enough data, time series or spatial, on the subject. Naturally, we had to be satisfied with a crude adjustment which could be made with the help of existing data. It has already mentioned that in our 1963 survey certain information relating to in-migration into the State and out-migration from the State were collected. From this data rates of net in-migration into the State by sex and regions (that is, rural and urban) were estimated. In tables 8, 9, 10 appended to this paper these rates have been applied

for the purpose of our adjustment. It may be noted in this connection that we have refrained from applying any correction for intra-State migration in projecting rural and urban population of the state because the estimated rates of such migration from the aforesaid survey were not quite stable.

5·0 It may be of interest at this stage to compare the estimated projection figures of West Bengal's population arrived at with the help of two different techniques. The relevant figures have been given in the table below :—

Projected Population of West Bengal

[(in millions)

Year	Extrapolation by mathematical function	Cohort survival method	Difference of (3)—(2) expressed as percentage of (3)
(1)	(2)	(3)	(4)
1966	39.71	40.03	+0.80
1971	46.27	44.75	—3.39

5.1 It may be seen that the method of projection with the help of mathematical curve has given estimates consistently lower than those by the cohort survival method for the first few years but with the extension of the period of projection the position has reversed. Thus, although in 1966 the former method yielded an estimate which is a little (less than 1%) below that obtained by the latter, in 1971, however, the former method pushed the estimate three percent above the forecast done by the cohort survival method.

5·2 Having reached our journey's end certain remarks may now be made in the light of our findings. We have already explained that the two techniques discussed here are to be applied in two different situations. It has not been our intention to judge which one is better than the other.

5.3 It has been made sufficiently clear that in order to succeed in making satisfactory forecasts about the structure of population in open areas to years ahead more reliable data on the pattern of migration should be sought. As such data do not exist in sufficient quantity the need for migration surveys during the inter-censal period can hardly be over-emphasised. A pioneering effort to this end was made once few years back by our Registrar General, but unfortunately this does not appear to have been repeated. In order to have an accurate idea about the pattern of changes in the vital rates and migration such surveys should be conducted at least once every three years during the inter-censal periods.

TABLE—1 ABRIDGED LIFE TABLE FOR MALES IN THE STATE OF WEST BENGAL, 1963

Years of age	Age specific death rate	Mortality rate	Of 100,000 born alive		Stationary population		Average future life time
Period of life between two exact ages stated	Number dying per 1000 in the age-group	Number dying per 1000 alive at beginning within n years after attaining age x	Number living at beginning of years of age	Number dying in the age interval	In the age interval	In the age interval and all later years	Average number of years of life remaining at beginning of years of age
x—x+n	1,000 $_nm_x$	1000 $_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e°_x
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0—1	92	79.74	100000	7974	94227	5843907	58
1—5	18	65.65	92026	6042	351566	5749680	62
5—15	3	29.62	85984	2547	849000	5398114	63
15—25	3	29.62	83437	2471	823667	4549114	55
25—35	3	29.62	80966	2398	799333	3725447	46
35—45	4	39.33	78568	3090	772500	2926114	37
45—55	9	86.66	75478	6541	726778	2153614	29
55—65	20	183.89	68937	12677	633850	1426836	21
65—75	45	372.62	56260	20964	465867	792986	14
75—85	82	582.63	35296	20565	250793	327119	9
85—	193	1000.00	14731	14731	76326	76326	5

TABLE—2 ABRIDGED LIFE TABLE FOR FEMALES IN THE STATE OF WEST BENGAL, 1963

0—1	70	62.06	100000	6206	95507	6044669	60
1—5	16	58.83	93794	5518	360036	5949162	63
5—15	3	29.62	88276	2615	871667	5589126	63
15—25	4	39.33	85661	3369	842250	4717459	55
25—35	4	39.33	82292	3237	809250	3875209	47
35—45	5	48.96	79055	3871	774200	3065959	39
45—55	8	77.36	75184	5816	727000	2291759	30
55—65	14	132.00	69368	9157	654071	1564759	23
65—75	35	302.18	60211	18195	519857	910688	15
75—85	78	563.37	42016	23671	303474	390831	9
85—	210	1000.00	18345	18345	87357	87357	5

TABLE—3 ABRIDGED LIFE TABLE FOR RURAL MALES IN THE STATE OF WEST BENGAL, 1963

0—1	103	88.27	100000	8827	93609	5612402	56
1—5	20	72.37	91173	6598	346636	5518793	61
5—15	3	29.62	84575	2505	835000	5172157	61
15—25	4	39.33	82070	3228	807000	4337157	53
25—35	4	39.33	78842	3101	775250	3530157	45
35—45	6	58.51	75741	4432	738667	2754907	36
45—55	10	95.89	71309	6838	683800	2016240	28
55—65	23	208.82	64471	13463	585348	1332440	21
65—75	45	372.62	51008	19007	422378	747092	15
75—85	70	522.50	32001	16721	238871	324714	10
85—	178	1000.00	15280	15280	85843	85843	6

TABLE—4 ABRIDGED LIFE TABLE FOR RURAL FEMALES IN THE STATE OF WEST BENGAL, 1963

0—1	77	67.78	100000	6778	95093	6002564	60
1—5	17	62.25	93222	5803	356975	5907471	63
5—15	3	29.62	87419	2589	863000	5550496	63
15—25	4	39.33	84830	3336	834000	4687496	55
25—35	5	48.96	81494	3990	798000	3853496	47
35—45	5	48.96	77504	3795	759000	3055496	39
45—55	7	67.97	73709	5010	715714	2296496	31
55—65	14	132.00	68699	9068	647714	1580782	23
65—75	30	264.50	59631	15772	525733	933068	16
75—85	77	558.44	43859	24493	318091	407335	9
85—	217	1000.00	19366	19366	89244	89244	5

TABLE—5 ABRIDGED LIFE TABLE FOR URBAN MALES IN THE STATE OF WEST BENGAL, 1963

0—1	61	54.59	100000	5459	96048	6410544	64
1—5	11	41.26	94541	3901	367497	6314496	67
5—15	3	29.62	90640	2685	895C00	5946999	66
15—25	1	9.96	87955	876	876000	5051999	57
25—35	2	19.83	87079	1727	863500	4175999	48
35—45	2	19.83	85352	1693	846500	3312499	39
45—55	6	58.51	83659	4895	815833	2465999	29
55—65	14	132.00	78764	10397	742643	1650166	21
65—75	46	379.31	68367	25932	563739	907523	13
75—85	102	668.20	42435	28355	277990	343784	8
85—	214	1000.00	14080	14080	65794	65794	5

TABLE—6 ABRIDGED LIFE TABLE FOR URBAN FEMALES IN THE STATE OF WEST BENGAL, 1963

0—1	48	43.54	100000	4354	96848	6245465	62
1—5	14	51.89	95646	4963	368925	6148617	64
5—15	2	19.83	90683	1798	899000	5779692	64
15—25	3	29.62	88885	2633	877667	4880692	55
25—35	3	29 62	86252	2555	851667	4003025	46
35—45	4	39.33	83697	3292	823000	3151358	38
45—55	8	77.36	80405	6220	775000	2328358	29
55—65	16	149.60	74185	11098	693625	1553358	21
65—75	40	338.20	63087	21336	533400	859733	14
75—85	104	675.84	41751	28217	271317	326333	8
85—	246	1000.00	13534	13534	55016	55016	4

Table—7 AGE SPECIFIC FERTILITY RATES (FOR MALE AND FEMALE BIRTHS) IN RURAL AND URBAN AREAS OF WEST BENGAL, DURING 1962—63

Age-group of women	below 18	18—22	23—27	28—32	33—37	38—42	43—47	48 years & above
In rural area (per woman per year)								
male child—	0.0042	0.1269	0.1226	0.1053	0.0808	0.0383	0.0148	0.0009
female child—	0.0044	0.1261	0.1179	0.0987	0.0801	0.0408	0.0150	0.0016
In urban area (per woman per year)								
male child—	0.0021	0.0849	0.0955	0 0884	0.0641	0.0239	0.0084	0.0011
female child—	0.0015	0.0825	0.0931	0.0803	0.0526	0.0254	0.0067	0.0007

Source : Sample Census 1963

TABLE—8 Estimated Population In The State Of West Bengal In 1966 And 1971 As Per Projection Using Abridged Life Table 1963.

Age—group in years.	Population as per 1961 census.			Estimated Population, 1966			Estimated Population, 1971		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0—1	437436	443453	880889	597530	591829	1189359	664545	660625	1325170
1—5	2157292	2211177	4368469	2158166	2161275	4319441	2322513	2326021	4648534
5—15	4697862	4343352	9041214	5191533	5222212	10413745	5098307	5176874	10275181
15—25	3107763	2880298	5988061	3411908	2994177	6406085	4556497	4210068	8766565
25—35	3148783	2493693	5642476	3218811	2810815	6029626	3010154	2765100	5775254
35—45	2259399	1596002	3855401	2626361	1899500	4525861	3033292	2384261	5417553
45—55	1469641	1119015	2588656	1760347	1284581	3044928	2130867	1510209	3641076
55—65	851213	741579	1592792	1062271	858878	1921149	1295815	1019268	2315083
65—75	330773	344098	674871	506106	525882	1031988	665295	607363	1272658
75—85	102437	115656	218093	150863	175345	326208	194923	215576	410499
85—	31085	34406	65491	39222	36636	75858	37487	33932	71419
Ages not specified	5460	4406	9866	6135	5020	11155	6866	5660	12526
Excess of in-migrants over out-migrants since 1961 (all ages)	x	x	x	574234	156814	731048	643810	176894	820704
Total	18599144	16327135	34926279	21303487	18722954	40026441	23660371	21091851	44752222

Table—9 Estimated Population In Rural Areas Of West Bengal In 1966 And 1971 As Per Projection Using Abridged Life Table, 1963.

0—1	351967	363151	715118	484729	485979	970708	538692	542353	1081045
1—5	1758729	1820508	3579237	1746777	1775775	3522552	1867661	1901093	3768754
5—15	3639353	3383120	7022473	4155135	4230765	8385900	4124413	4248396	8372809
15—25	2125546	2211751	4337297	2502835	2259542	4762377	3520077	3272249	6792326

(Contd. Table—9)

25—35	2121618	1917957	4039575	2135460	2162136	4297596	2042124	2116318	4158442
35—45	1527462	1243204	2770666	1757634	1460104	3217738	2025071	1827215	3852286
45—55	1055169	886052	1941221	1210160	1007626	2217786	1422561	1176945	2599506
55—65	627779	583693	1211472	753456	682440	1435896	915160	809259	1724419
65—75	256646	271194	527840	382205	412594	794799	491675	484391	976066
75—85	83941	94412	178353	123999	146100	270099	155791	175853	331644
85—	25639	27234	52873	34023	31033	65056	32826	29198	62024
Ages not specified	5195	4117	9312	5848	4704	10551	6556	5309	11865
Excess of in-migrants over out-migrants since 1961 (allages)	x	x	x	243421	44226	287647	275519	50388	325907
Total	13579044	12806393	26385437	15535682	14703023	30238705	17418126	16638967	34057093

TABLE—10 Estimated Population In Urban Areas Of West Bengal In 1966 And 1971 As Per Projection Using Abridged Life Table, 1963.

0—1	85469	80302	165771	112801	105850	218651	125853	118272	244125
1—5	398563	390669	789232	411389	385500	796889	454852	424928	879780
5—15	1058509	960232	2018741	1036398	991447	2027845	973894	928478	1902372
15—25	982217	668547	1650764	909073	734635	1643708	1036420	937819	1974239
25—35	1027165	575736	1602901	1083351	648679	1732030	968030	648782	1616812
35—45	731937	352798	1084735	868727	439396	1308123	1008221	557046	1565267
45—55	414472	232963	647435	550187	276955	827142	708306	333264	1041570
55—65	223434	157886	381320	308815	176438	485253	380655	210009	590664
65—75	74127	72904	147031	123901	113288	237189	173620	122972	296592
75—85	18496	21244	39740	26864	29245	56109	39132	39723	78855
85—	5446	7172	12618	5199	5603	10802	4661	4734	9395
Age not specified	265	289	554	287	317	604	310	351	661
Excess of in-migrants over out-migrants since 1961 (all ages)	x	x	x	330813	112588	443401	365291	126506	494797
Total	5020100	3520742	8540842	5767805	4019931	9787736	6242245	4452884	10695129

Estimation of vital rates to measure population Changes in developing countries with special reference to West Bengal.

By

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The problem of rapid and uncontrolled population growth in the developing countries emerges as one of the most critical issues of the present time. The current population of the world now somewhat in excess of three billion, is expected to be doubled in the next 35 years, providing a population of about six billion by the year 2000 A.D. Such a tremendous population growth, which is out of proportion to the present rate of increase in economic development, imposes a heavy burden on all efforts to augment human welfare and happiness. Study of dynamics of population growth, especially in the developed or underdeveloped countries, is now, therefore, attracting greater attention than ever before. The administrators of action programmes now feel that all their efforts to raise the living standard of the people are being hampered by the rapid growth of population and for this reason the problem of population explosion commands the highest attention of the planners and the administrators of the developing countries.

Changes in population size and structure of a country mainly depend on three variables viz. birth, death and migration. Accurate and reliable birth and death rates of an area provide essential information for many purposes, including the analysis of factors affecting population growth and the estimation of future population trends. But accurate vital rates cannot be obtained from the registration statistics in our country because a large number of births and deaths usually escape registration.

In the developed countries where censuses and registration of birth, death and migration statistics are dependable, study of population growth on a year to year basis can be made directly from the date on the components of population. In most countries of the world such a study of population changes from national censuses and registration statistics is not fessible for lack of reliability.

It is generally agreed that the best technique for providing information on vital statistics is an official registration system which is designed to maintain a continuous statistical record of events as and when they occur. But these systems in the developing countries are generally incomplete and are not, therefore, capable of producing reliable vital statistics for the measurement of components of population growth. The administrators and research workers

must, therefore, turn to other sources of data such as censuses and sample surveys to have reliable estimates of statistics on population growth.

The complete population census is one of the two fundamental instruments for measuring population distribution and change. Although it gives detailed data for a number of demographic variables for small as well as large geographic units, it is not adequate for all measurement purposes and has several potential and actual limitations. A census provides data to compute an average rate of population growth but the rate of growth is an average for the intercensal period and may sometimes be substantially different from the current rate of growth. Due to improvement in public health practices and modern treatment facilities, mortality is declining in almost all the developing countries, though fertility remains constant without any effective family planning programme. In such a situation the average rate of growth derived from decennial census may not depict the current picture for the purpose of evaluating and appraising the current programmes in the country.

Experts, however, strongly recommend the use of sampling method for the registration or enumeration of vital events in the countries where registration systems are either non-existent or are only beginning to develop. Reliable estimates of birth and death rates can be obtained by means of a National Sample Survey till the official registration system is in a position to provide such information correctly. The use of sampling technique in obtaining reliable estimates of vital rates either by means of household sample surveys or sample registration is, therefore, now becoming common in some countries.

2. Sampling in the field of vital statistics :

The experience of western countries has shown that the development of a system in maintaining adequate vital statistics takes a considerable time. In our country, the Bengal Birth and Death Registration Act was promulgated in 1873. In other words, West Bengal has had a tradition of registration of vital events for about a century but the official statistics still suffer from major defects in quality and quantity for any effective use in national planning and international comparibility.

In the "Principles for a Vital Statistics System" the United Nations made the following recommendation for the use of sampling for obtaining vital statistics :

"Where a complete registration system is not practicable or sufficiently reliable the possibility of applying sampling methods to the reporting collection and compilation phases should be explored keeping in mind its limitations in providing the desired detail and the requirement that sampling be carried out only under rigorous scientific specifications".

Hauser rightly pointed out that the use of sampling for registration of vital events in the underdeveloped countries, where there is hardly any registration system can ultimately lead the development of a complete and well-organised system of registration.

In recent years the use of sampling technique in obtaining vital statistics has become very common. In "The Mysore Population Study" under the auspices of the United Nations and the Govt. of India an experiment was carried out in the use of a sample survey of households to measure the trends and characteristics of the population of the area. Under the study, the survey data on births and deaths for the past year were matched with the official Registers of vital statistics in rural areas and omissions were corrected to arrive at reliable vital rates. In 1964 a continuous survey of population change was undertaken in Thailand on a national sample of rural and urban areas. The main objective of the survey was to estimate birth and death rates and to measure under registration of births and deaths in the Official Registration System.

In 1965 Turkey also started a continuous annual household sampling programme designed mainly to provide estimates of birth, death and population movements separately for rural and urban populations in each of the five major geographic areas.

The population Growth Experiment Study in Pakistan which is similar to the Thai Study also deserves mention in this connection. The population Growth Experiment Study which was started in 1962 in twentyfour Population Growth Experiment areas of both East and West Pakistan gave very satisfactory results for estimating the rates of population growth in the country. Sample surveys have also been adopted to derive estimates of vital rates in many other countries like India (National Sample Survey), U. A. R., and also in some South American Countries where a system of adequate vital registration is lacking.

3. Official Registration System :

It is well known that the present system of registration in the country is quite defective in both quality and quantity and is not yet in a position to provide any useful vital rates undertaking any scientific research or any effective health planning. The official vital rates are much lower than what one would expect for West Bengal, as revealed from the Pilot Survey conducted on incompleteness of birth and death registration in urban and rural areas in the State during 1948 and as corroborated by the results of the special projects since undertaken in this State.

The development plans should not, however, wait for an indefinite period till the official registration system develops and produces acceptable vital rates of the country. Sample registration and other household surveys seem, therefore, to be the only promising source of action, which provides vital rates on current basis and also proves helpful towards development of official registration system in the State.

4. Estimation of accurate vital rates in West Bengal.

As stated, previously, the vital statistics of West Bengal like those of many other developing countries, are deficient to meet the growing needs of the social, economic and family planning programmes of the State. In order to overcome these difficulties, special projects which could estimate population size and other demographic characteristics on a current basis, were undertaken by the State Bureau of Health Intelligence, as given below :

i) Half-yearly Census of Births and Deaths,

ii) Pilot Sample Census on population as well as births and deaths (subsequently renamed Model Health and Ideal Registration Unit Projects),

iii) Sample Registration Scheme (Pilot).

The procedures together with the results of operation in respect of each of the above-mentioned three projects in the State have been set forth in the following paragraphs :

i) Half-yearly Census of Births and Deaths :

This project is being carried out by the existing local Registrars of Births and Deaths under the official Registration system in the State since 1962 without any financial involvement. Under the scheme a village or a group of villages comprising a total population of about 1000 has been selected by the Registrars of Births and Deaths near their Headquarters to suit operational convenience. Vital events in the selected areas are collected by house to house survey at half yearly intervals each year and the findings are matched with official registration records of those specified areas with a view to ensuring complete registration of vital events as well as deriving estimates of vital indices for the rural areas of the State.

As the object of this study is purely experimental and to train the local Registrars of Births and Deaths, the selection of Sample Units under this project is not based on probability sampling. The following gives annual estimates of rates of vital events as detected and registered in the rural areas of West Bengal during 1966 :

TABLE—I

Birth and death rates as detected and registered under the Half-yearly Census Project.

Estimated rural population of West Bengal, 1966=31,457,041							
Birth				Death			
Detected events		Registered events		Detected events		Registered events	
Rate per 1000 population	S.E. as percent of estimated birth rate	Rate per 1000 population	Percentage omission	Rate per 1000 population	S.E. as percent of estimated death rate	Rate per 1000 population	Percentage omission
37.0	0.1	27.2	27.6	12.2	0.2	9.4	22.9

ii) **Model Health and Ideal Registration Unit Project**

The survey under this project covered only 5 districts of the State. One union from each of these districts were selected for the survey. The unions provided with Health Centre were purposively chosen for the pilot study. The area of the Union was further subdivided into several Basic Public Health Units comprising about 5000 people and a whole-time trained investigator was appointed as Official Registrar of Births and Deaths for each of the Basic Public Health Units.

The working procedure comprises (a) normal registration, (b) survey and (c) assessment of health care activities in respect of each Basic public Health Unit under the scheme.

(a) Birth and death registers for each Basic Public Health Unit are maintained after collection of information from Village Health Reports and verification of the events personally by visiting the houses concerned during first three days of the week for registering the events.

(b) Household schedules are made upto-date in respect of houses under the Basic Public Health Unit by Visiting the houses during the last three days of the week. Each Basic Public Health Unit has again been subdivided into three groups so that the houses under Group A' of the Basic Public Health Unit are covered during one month and groups 'B' & 'C' are covered during subsequent two months so that the houses under the area are visited four times a year. The survey work under (b) for one Basic Public Health Unit is done by the investigator of another Basic Public Health Unit so that the records maintained under normal registration by one investigator is checked independently by another during the survey. This process of operation is carried out in a cyclic order for testing completeness in the normal registration as a routine procedure.

(c) Information regarding the presence of any unprotected person relating to Smallpox, expectant mother requiring antenatal care and bed-ridden cases requiring domiciliary treatment is collected during house to house survey and reported to the Medical Officer-in-charge of the Health Centre concerned in especially designed requisition slips for prompt action.

The following gives the crude birth and death rates and their standard errors and rates of natural increase for different units under the project during 1965.

TABLE II

Birth and death rates with their Standard Errors for different Units under 'Model Health & Ideal Registration Units' Project, 1965, West Bengal.

Unit	Esti-mated mid-year Popln., 1965	Birth rate per 1000 Popuin.	Standard errors as percent of esti-mated birth rate	Death rate per 1000 Popuin.	Standard error as percent of esti-mated death rate	Rate of natural increase per 1000 Popu a-tion
Mathurapur	18439	36.5	3.8	9.8	7.1	26.7
Duttapulia	9238	47.4	4.6	12.8	9 2	34.6
Bandipur	15345	36 1	4.1	9.4	8.1	26.7
Balarampur	12748	36.9	4.6	11.1	8.3	25.8
Barsul	12184	38.2	4.5	11.3	8.9	26.9
Total :	67954	38.3	1.9	10.6	3.8	27.7

iii) **Sample Registration Scheme (Pilot)**

The sample registration scheme was implemented in rural areas of West Bengal as a pilot study in July 1966 in collaboration with the Registrar General Govt. of India. The objective of the scheme is to obtain quick and reliable estimates of components of population growth at State as well as national level. The method of stratified random sampling was adopted in selecting 150 units from rural areas of the State which was divided into two geographical subdivisions viz. Stratum I (Himalayan) and Stratum II (Plains) for the purpose. Each of the above natural divisions was further subdivided into sub-strata based on four population groups viz below 500, 500-999, 1000-1999, 2000 and above. The sampling unit was a village for each of the first three sub-strata and the segment of a village in the fourth sub-stratum. The procedure of operation of the scheme may be summarised as (i) Concentration of effort in a representative sample of relatively small area such that a high level of quality in the collection of information on vital events and population can be maintained, (ii) Preparation of houselists and household schedules in respect of sample areas at the onset of operation by a part-time local resident enumerator and active search for information about vital events by personally contacting a fixed set of local informants regularly at prefixed intervals.

iii) Supervision of the work of the enumerators as well as half-yearly revision by house to house survey to detect the vital events occurring during the past six months and to note any changes in the household composition by part-time Supervisor of the Units independently,

iv) Matching the discrepancies between the enumerator's records and results of half-yearly survey operations of Supervisors by actual verification in the field and

v) Systematic supervision, inspection and control over the above operations for obtaining satisfactory estimates of vital events in the country.

The sample registration scheme is now being carried out in this State as a pilot study to find out practical problems in organising it on a full scale basis when the rural units will be raised from 20 to 150. The project has also been under operation in 10 urban blocks since January 1967. The results of operation of the scheme after satisfactory completion of the first half-yearly survey in the rural areas of the State are shown hereunder :

The following table gives the estimated annual rates of vital events by different strata under the Sample Registration Scheme (Pilot) on the basis of the results upto the first half-yearly survey operations.

TABLE—III

Annual rates of vital events under Sample Registration Scheme (Pilot) West Bengal (July 1966 to Dec. '66)

Stratum	Birth rate per 1000 population	Death rate per 1000 population
I. (Himalayan)	44.8	15.8
II. (Plains)	37.5	14.4
State	38.9	14.6

5. Population and rates of natural increase :

The schemes discussed above not only help to study the structure of population but also give an idea as to how much of the growth rate was accounted for by the rate of natural increase. The age and sex composition of the population as obtained under the different projects are given below :

TABLE—IV

Percentage distribution of population by age and sex for rural West Bengal, 1965

Age group	Percent distribution					
	** Rural West Bengal		Model Health & Ideal Registration Unit Project		Sample Registration scheme (1966)	
	Male	Female	Male	Female	Male	Female
Under 1 year	2.6	2.8	3.4	3.5	3.7	2.9
1—4 yrs.	12.9	14.2	11.8	11.1	10.2	10.7
5—14 yrs.	26.8	26.4	29.5	28.5	30.9	31.4
15—44 yrs	42.5	42.0	40.3	42.1	40.8	40.1
45 & above	15.1	14.5	15.0	14.8	15.4	14.9
Age not stated	0.1	0.1				
Total :	100.0	100.0	100.0	100.0	100.0	100.0

** Estimates based on 1961 Census figures,

The age and sex distribution of population under the special projects seems to be fairly in accordance with that for rural West Bengal, estimated on the basis of 1961 census figures. The natural increase measured by the excess of birth rate over the death rate, as revealed under the different operations in the rural areas of this State, was found to be very high, which gives an idea of the rate of growth of population in the country as shown in the table below :

TABLE V

Annual rate of natural increase per 1000 population under different projects in rural areas of West Bengal

Project	Year	Annual rate of natural increase per 1000 population
Model Health & Ideal Registration Unit Project	1965	27.7
Half-yearly Census of Birth and Deaths	1965	25.2
Sample Registration Scheme (Pilot)	1966 (Jul.-Dec.)	24.3

It has been observed that the rates agree well with the average annual rate of growth of population of rural West Bengal as obtained from the census during 1951-1961.

6. Conclusion

Achievements of the national plans including effective evaluation of family planning programme in the country must be measured quantitatively on the basis of reliable and accurate birth and death rates and rates of population growth on a current basis. The existing official registration system is hardly capable of producing any reliable data for measurement of rates of population growth. The sampling technique has, therefore, been advocated by the experts for arriving at reliable estimates of components of population growth at relatively low cost as also for exploring ways and means for improving the official registration system.

ON FERTILITY DIFFERENTIALS IN WEST BENGAL

By

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&

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The Bureau of Applied Economics & Statistics, West Bengal has conducted a fertility survey in the State in 1961. Some results of this survey regarding the factors which may influence the fertility rates have been discussed in this paper. Due to paucity of time it has not been possible to present a vigorous mathematical analysis. Some results that may be relevant in connection with the scheme for family planning methods have also been discussed. Table I below shows the percentage distribution of births during the reference year by birth order.

Table—I : Percentage distribution of births during reference year.

	Birth Order										
	1	2	3	4	5	6	7	8	9	10& above	Total
Rural—	19.2	17.6	16.8	15.2	11.0	8.1	5.1	2.9	2.0	2.1	100.0
Urban—	20.6	18.4	17.5	14.0	10.4	7.3	5.3	3.0	2.3	1.2	100.0

We shall first consider the case of controlling births in rural areas. If it is decided that the number of children will be controlled after the third birth, the birth rate in the rural areas will be reduced to 19.3 per thousand, assuming the normal birth rate to be 36 ; and asuming the death rate to be 11 per thousand, the natural growth rate reduces from 2.5% to 0.8% per year. If it is decided to control births after the 4th issue, the reduction in birth rate is 11.2 with the corresponding reduction in growth rate from 2.5% to 1.4%. In other words the former reduces the growth rate by 2/3 and the latter by 1/2 of the present figures. The respective percentages of births upto the 3rd and 4th orders are 56.5 and 70.5 in urban areas as against 53.6 and 68.8 in rural areas.

The effects of growth-rate by controlling births in rural areas after the third issue and the 4th issue have been discussed in the previous para on the basis of births of a particular year. Here we shall discuss what will happen if the same thing is examined on the basis of total births. By this technique the comparison is made on the basis of a fiducial population of mothers of completed

fertility. Table 2 shows the average number of children contributed in different birth-orders by mothers who have completed the period of fertility ; this has been obtained by dividing the number of children of a particular birth order contributed by the still-married women, who have completed their fertility period, by the total number of such mothers.

Table—2 : Average number of children contributed by mothers of completed fertility, in different birth orders.

	Birth Order										
	1	2	3	4	5	6	7	8	9	10 & above	All
Rural—	0.94	0.88	0.82	0.75	0.64	0.53	0.43	0.30	0.20	0 25	5.74
Urban—	0.94	0.87	0.80	0.72	0.62	0.53	0.43	0.33	0.24	0.40	5.88

Here we find that in the rural areas a control after the third issue will in the long run reduce the births of complete fertility to 46 p.c. as against the figure of about 54 p.c. as obtained in the previous para from the figures of the reference year. Similarly, retention up to the 4th issue will reduce rural birth rates in the long run by about 41 p c. as against 31 p.c. in case of the births of the reference year. Urban births on the basis of completed fertility are 44 & 57 percents respectively upto the 3rd and 4th orders of issue ; the corresponding figures on the basis of current year's births being 56 and 70. Current years' proportions are higher due to incomplete fertility.

Table 3.1 shows the percentage distribution of all women by age at marriage for each marriage duration, Table 4 the average number of children contributed by each birth order to the average size of the family by mothers of completed fertility and Table 5 the average number of children born to all still-married women (of incomplete fertility) for different ages of marriage and different marriage durations. The figures in Table 4 have been obtained by dividing the total number of children of the corresponding cell contributed by mothers who have completed their fertility period, by the total number of all such mothers ; those in Table 5 have similarly been calculated on the basis of all still-married women.

Table—3 1 : Percentage distribution of women by age at marriage for each marriage duration (in years)

Age at marriage (yrs)		Marriage duration (years)							
	0	1-4	5-9	10-14	15-19	20-24	25-29	Above 29	All
Less than 18	Rural	90.6	86.8	88.6	89.9	91.7	91.2	91.6	92.1	89.8
	Urban	74.9	62.4	71.5	76.0	77.9	76.2	84.4	82.8	74.8

(Contd. Table—3.1)

18-22	Rural	5.7	10.1	9.7	7.6	6.9	7.6	6.4	7.0	8.2
	Urban	20.1	31.3	24.9	19.8	20.4	21.1	12.2	14.9	21.5
Above	Rural	3.7	3.1	1.7	2.5	1.4	1.2	2.0	0.9	2.0
22	Urban	5.0	6.3	3 6	4.2	2.6	2.7	3.4	2.3	3.7
All	Rural	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Urban	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0	100.0

Table—3.2 : Percentage distribution of women of completed fertility by age at marriage

Age at marriage (yrs.)	Percentage	
	Rural	Urban
Less than 18	90.54	79.57
18-22	6.94	14.34
23 & above	2.52	6.09
Total :	100.00	100.0

Table—4 : Average number of children contributed in different birth orders by mothers of completed fertility distributed by age at marriage.

		Birth Order										
Age at marriage (yrs)		1	2	3	4	5	6	7	8	9	10 & above	All
Less than 18	Rural	0.94	0.89	0.84	0.76	0.67	0.56	0.45	0.32	0.21	0.28	5.92
	Urban	0 94	0 88	0.83	0.75	0.69	0.58	0.49	0.38	0.28	0.48	6.30
18-22	Rural	0.89	0.70	0.64	0.60	0.50	0.37	0.20	0.15	0.13	0.06	4.24
	Urban	0.97	0.86	0.77	0.69	0.48	0 37	0.25	0.19	0.13	0.07	4.78
Above 22	Rural	0.92	0.87	0.67	0.59	0.21	0.10	0.09	—	—	—	3.45
	Urban	0.87	0.64	0.51	0.40	0.14	0.13	0.10	0.02	0.01	0.04	2.86

TABLE—5

Average number of children born per women (Considering all still-married women)

Age at marriage (years)		Marriage duration (years)							
		1-4	5 9	10-14	15-19	20-24	25-29	30 and above	All
Less than 18	Rural	0.43	1.86	3.38	4.63	5.40	5.70	5.92	3.27
	Urban	0.63	2.03	4.22	4.77	5.73	6.06	6.30	4.03

(Contd. Table—5)

18-22	Rural	0.66	1.94	3.22	4.14	4.29	4.70	4.24	2.67
	Urban	0.69	1.77	2.62	3.91	4.59	3.63	4.78	2.63
Above	Rural	0.44	1.60	2.49	2.87	2.83	3.52	3.89	1.84
22	Urban	0.46	1.38	2.38	2.88	1.64	2.25	4.29	1.83
All	Rural	0.46	1.86	3.34	4.57	5.28	5.59	5.79	3.19
	Urban	0.64	1.94	3.82	4 54	5.38	5.63	6.03	3.65

Applying the distribution of Table 3.2 to the data of Table 4, it is found that in rural areas the average number of children born to rural mothers, who were married after 18 years of age and have since completed their fertility period, is 4.03. The average is 3.45 for such mothers who were married after they have attained the 23rd year. Hence if the minimum age of marriage is increased to 18 years, there will be an ultimate reduction in birth rate by about 30%. Marriage after 22 years of age will similarly reduce the rural birth rate to 60% which is equivalent to controlling the birth of children after the fourth issue. In the urban areas also raising the age of marriage to 18 years will reduce the birth almost to the same extent (by 28%), but interestingly enough, increase of marriagable age to 23 years, it appears, will reduce the birth rate to as low a figure as 49%. Results on the basis of all still-married women (Table 5) also show that marriage after the 22nd year will reduce the birth-rate to 58% in rural areas and 50% in urban areas ; if on the other hand the minimum age of marriage is fixed at 18 years the corresponding figures will be 79 and 69 per cents respectively.

Table 6 shows the birth rates per thousand mothers having different educational qualifications during the reference years :

Table 6 : Births per thousand mothers during reference year.

Zone	Elementary School Examination		passed High	Gradu- ates	Overall
	With low social class.	With High social class	school		
Calcutta	231	156	290	*	155
Calcutta Industrial area	200	155	242	135	142
Other urban areas	199	215	43	133	172
All urban	207	175	203	281	158
Rural	—	—	—	—	181
West Bengal	—	—	—	—	177

Sample size small.

It is not possible to arrive at a definite conclusion regarding the effect of educational qualification mainly due to smallness of sample-size, but it seems that education has perhaps no effect on birth rate. On the other hand, it is clear from the figures relating to the mothers passing the elementary school examinations that the social class has got a more significant effect on fertility. Birth rate in mothers belonging to high social class is quite low in comparison with those belonging to low social class. We may then conclude that the cultural environment has got stronger influence on fertility than education and those belonging to the higher society have lesser number of children which may perhaps be partly due to their desire for a higher standard of living and partly due to their consciousness regarding family-planning methods. In this connection, the data of Table 7 obtained from the employment and unemployment survey conducted in the industrial areas of West Bengal during 1959 may be examined :—

Table—7 : Employed persons expressed as percentage of total persons in each age-group and sex in manual and non-manual classes of families of Calcutta and industrial areas including Asansol.

Age-group	Manual Class		Non-manual Class	
(years)	Male	Female	Male	Female
6—10	0.46	0 11	0.26	0.16
11—15	7 67	0.32	2.68	0.82
16—20	58.59	3.29	18.84	1.57
21—25	83.67	5.61	54.20	4.55
26—30	94.39	13.07	84.41	8.30
31—40	96.44	14.75	92.03	10.44
41—50	94.47	21.56	91.13	10 93
51—55	88 53	15.49	85.13	6.74
56—58	84.39	11.86	73.51	2.33
59—60	81.97	11.34	66.14	6.64
61— & above	46.18	4.62	26.28	2.31
Total	67.70	7.19	46.11	4.46

Table 7 reveals that the percentage of employed females in the manual class of families is 7.19 as against 4.46 in the non-manual class. In fact employed persons are proportionally more numerous in almost all age-groups of manual class people, males as well as females. The manual class may be taken to be equivalent to the class of families having comparatively low social status, and the fertility rate in this class of families have been obtained to be higher. This therefore, suggests that in comparison with social status the labour-force participation rate is less effective in reducing fertility. A more rigorous type of analysis would be to consider the employed and the unemployed mothers of

the same class of families; but this could not be done for want of data. On the basis of the figures of the reference year (vide Table 8) the fertility rate per thousand mothers has been obtained as 174 in rural areas and 148 in urban areas, showing a lower rate in the latter. Similar situation is also observed in different groups of marriage durations exceeding 9 years and for all ages at marriage; but fertility rates for lower durations are higher in urban areas, which may be partly due to lower proportion of newly married women and higher proportion of married women attaining the child bearing age in these areas (vide Table 9). But the figures relating to all births under complete as well as incomplete fertility rates (Table 2, 4 and 5) show that there is practically no difference between the behaviour of urban and rural mothers.

Table—8: Fertility rates by marriage duration and age at marriage on the basis of births of all still married women during the reference year.

Age at marriage (years)		Marriage duration (years)							
		1-4	5-9	10-14	15-19	20-24	25-29	30 & above	All
Less than 18	Rural	175.3	229.6	233.2	214.8	151.2	93.9	27.7	175.3
	Urban	199.7	232.9	188.5	183.2	95.7	64.8	8.9	150.3
18-22	Rural	222.4	202.5	229.2	166.2	129.1	62.7	2 8	172.5
	Urban	234.7	208.6	149.3	93 3	54.5	12.9	2.6	143.1
Above 22	Rural	167.7	210.3	79.3	164.7	30.6	50.3	0 0	121.7
	Urban	281.8	145.9	69.9	51.9	50.8	21.4	0.0	122.8
All	Rural	179.9	226 6	229.0	210.7	148.1	91.0	25.7	174.0
	Urban	215.8	223.8	175.8	161.5	85.7	57.0	7.7	147.8

Table—9: Percentage distribution of still-married women by marriage-duration.

Marriage duration (years)	Percentage	
	Rural	Urban
0	3.0	1.0
1—4	16.6	13.9
5—9	20.4	19.6
10—14	21.1	21.1
15—19	13.0	13.6
20—24	9.5	11.7
25—29	5.8	6.7
30 & above	10.6	12.4
All	100.0	100.0

In any case, education and urbanisation may raise the age at marriage and lead to higher cultural attainment and may thus help in reducing the fertility rate.

APPLICATION OF OSCULATORY INTERPOLATION METHOD TO ANNUAL POPULATION ESTIMATION*

By

DR. PRAKASH CHANDRA MATHUR

Planning of developmental needs requires annual population estimates. Developmental needs such as housing, education, medical and health services etc., are provided for in relation to the size of population which varies from year to year. Other direct uses of annual population estimates are (a) computation of the annual per capita national income estimates and (b) computation of the annual birth and death rates statistics.

More important, however, from the point of view of planning are the annual changes in population. Consideration of the net increase in population rather than population in absolute terms arises while planning for construction of the new schools, hospitals, or for food requirements.

Although the decennial Indian population Censuses have been held since 1872 and do provide data of accuracy to the order of one to two per cent in total population count, there are as yet no reliable annual population estimates prepared through annual sample population censuses. Also as the registration of Indian Vital events is highly deficient the Indian Vital Stastistics do not yield satisfactory annual population estimates. And yet we must somehow make reasonable annual estimates of population for purposes of planning.

The only satisfactory way under these circumstances for computing annual population estimates for India appears to be that of using data from the decennial population censuses held upto 1961 and the quinquennial population estimates for the years 1966, 1971, 1976 and 1981 prepared by the Expert Working Group on Population Projections of the Planning Commission. These data would be sufficient to yield annual estimates for the period 1951 to 1971, which is of concern to the first four Indian Five Years Plans. In these Projections the Working Group has assumed that (a) the mortality would decline each year so that the expectation of life would improve by 0.9 year per year until 1970 and 0.75 year per year until 1981, (b) the fertility would decline by 5% during 1966-71, 10% during 1971-76 and 20% during 1976-81 and (c) the international migration is negligible.

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*The observations and opinions expressed in the paper, are the personal ones of the author and do not constitute those of the organisation to which the author belongs. When this paper was presented he was the Assistant Director, Central Statistical Organisation, Cabinet Secretariat, Government of India, New Delhi, India. Currently, he is serving as the United Nations Population Census Adviser to the Royal Government of Afghanistan.

In this paper, firstly and mainly, I propose to examine various methods of yielding annual population estimates from decennial population census data and to demonstrate that the osculatory interpolation is the best method. Secondly and incidently, I propose to establish that the set of multipliers for distributing 5-years age group population into those for each successive single-year age in the age group, derived from the general equal interval fourth degree osculatory formula is similar to those developed by Sprague and Kozakelwicz.

A good set of annual population estimates derived from decennial population census data should fulfil the following conditions :—

(a) The estimates over years when plotted should have a smooth curve i.e. the annual changes should be gradual.

(b) There should be continuity in transition between the curves before and after the years for which data have been provided.

(c) The total of the annual state population estimates for all-India should be equal to the All-India population figure yielded directly by using all India data and

(d) The formulæ used for interpolation of annual population estimates between any two years for which data are given should be able to reproduce the data for those years.

There are three methods of interpolation, which may be used :—

1. Geometric growth method.
2. Polynomial curve method and
3. Osculatory interpolation method which I suggest in this paper.

1. **The geometric growth method** requires data from only two population figures between which intepolation is desired. The formula used is $P^t = P^o(1+r)^t$ where

P^t is the population in the 't' th year

P^o is the initial population in the first census

p^{10} is census population in the 10th year.

t is the number of year and

r is the annual rate of growth during the decade and is calculated from $r = \sqrt[10]{P^{10}/P^0}$

This method has been used by the Office of the Registrar General India in providing annual population estimates for the intervening periods 1951-61. and 1961-66. The method is an expedient device for quick estimation.

Although the geometric growth method satisfies the criteria (a) and (d) i.e. smoothness and faithfulness, it does not satisfy the other two conditions, (b) and (c) i.e. continuity and conformity. Discontinuity in the population increase appears around the year 1951, where the rate of growth for the periods 1941-51 and 1951-61 differ. Another disadvantage of the method is that the state population figures require to be adjusted in order to conform to the computed all-India population and the magnitude of these manipulations cannot be predicted. The method may be considered suitable for some purposes, but for purposes where trends are involved the use of this methods may gives rise to difficulties.

2. **The method of fitting a Polynomial curve**, of say third degree, by the method of least squares has an advantage over the geometric growth method in that there is no discontinuity in growth rate at the census data years. The growth rate itself changes gradually over the entire period, whereas by using the geometric growth method such changes take place in jerks.

The disadvantages in using a polynomial curve fitted by statistical methods, perhaps, far outweigh its merits. In this case smoothness is ensured at the expense of exactness. The population estimation yielded by this method would not reproduce the actual enumerated population for any data year. Also, if the method of least squares has been used in fitting the polynomial curve, the standard error at the last year would be higher than that of the middle of the range for which data are used. Consequently the accuracy for the near period would be much less.

Again by using this method as similar to the geometric growth method, the total of the States population estimates would not be equal to the all India population estimate and undefinable adjustments in the state population estimate would become necessary.

3. **The osculatory method of interpolation**, which I suggest, is of particular significance in the estimation of annual population of state and of all-India because the various criteria for good estimates mentioned earlier are all satisfied. Smoothness, continuity, conformity and faithfulness are built in features of osculatory curves.

The osculatory curve is so called because it touches two other similar polynomial curves, one at either end of the portion for which interpolation is to be done. Suppose a fourth degree polynomial curve passes through the points say A, B, C, D & E and another such curve passes through the points B, C, D, E & F. The fourth degree osculatory curve ~~which~~ passes through the points B, C & D ~~but~~ and also has the same tangent at C and D as the other two above mentioned polynomials, respectively. The fourth degree osculatory curve therefore has also five constraints, in order to be of the fourth degree.

The osculatory method is that of fitting a polynomial curve which moves from one stage to the next as similar to moving averages. The interpolated values are calculated from the mathematical equation of the curve for any year at any date,

I propose that the osculatory method be used for obtaining population for each of the intervening years when population is known at quinquennial or decennial or intervals partly both. In this case the actual osculatory curve is used for interpolating population values at different times.

The osculatory method has overwhelming advantages over either the geometric method or the method of fitting a polynomial curve. Apart from the above mentioned theoretical advantages the method offers practical advantage of computational facility by means of a set of multipliers. However, when for a given period population estimates are required the period over which the population data are available may either limit the choice of the method or osculatory formulae may have to be devised using the given data.

As an illustration, I have devised osculatory interpolation formulae to be used for Indian data in the period 1951 to 1971. But, in order to suit realistic conditions regarding family planning policy of the Government of India, two sets of formulae are devised. Ordinarily one set of formulae, taking the population data from the Censuses of India, 1931, 1941, 1951 and 1961 and the projection estimates for 1971 and 1981 could yield the interpolated figures for the entire Period from 1951 to 1971. However, beginning from the year 1966 the population policy has been much invigorated and the future years may not reflect the past trends. The population for the period 1971-1981 depends increasingly upon the implementation of family planning programmes of the Government of India. In view of this, one set of formulae is devised to interpolate for the period 1951-61 using the population data only for the years 1931, 1941, 1951, 1961, 1966 and 1971 and another for the period 1961-71 using population data for the years 1951, 1956, 1961, 1966, 1971, 1976 and 1981. Each of these formulae has been translated into two sets of panel of multipliers for yielding population estimates as on Ist March and as on Ist July of each calender year.

The following equations of osculatory curve have been developed :

1. Interpolation for the period 1951 to 1961, using population data for the years 1931, 1941, 1951, 1961, 1966 and 1971 standing as 0, 10, 20, 30, 35 and 40 in the formula.

$$P^x = P^{10} + (x-10)\frac{(P^{20}-P^{10})}{10} + \frac{(x-10)(x-20)}{2!}\frac{(P^{30}-2P^{20}+P^{10})}{10^2}$$
$$+ \frac{(x-10)(x-20)(x-30)}{3!}\frac{(0.5P^{0}-3.8P^{10}+10P^{20}-17P^{30}+12.8P^{35}-2.5P^{40})}{10^3}$$
$$+ \frac{(x-10)(x-20)(x-30)(x-40)}{4!}\frac{(2P^{0}-9.6P^{10}+20P^{20}-32P^{30}+25.6P^{35}-6P^{40}}{10^4}$$

where P^x is the estimated population in the Xth year

2. Interpolation for the period (i) 1961 to 1966 (ii) 1966 to 1971 using population data for the years (i) 1951, 1956, 1961, 1966, 1971 and 1976 (ii) 1956, 1961, 1966, 1971 and 1976 and 1981 standing as 0, 5, 10, 15, 20 and 25 in the formula.

$$Px = P^5 + (x-5)\frac{(P^{10}-P^5)}{5} + \frac{(x-5)(x-10)}{2!}\cdot\frac{(P^{15}-2P^{10}+P^5)}{5^2}$$
$$+\frac{(x-5)(x-10)(x-15)}{3!}\cdot\frac{(P^0-7P^5+16P^{10}-16P^{15}+7P^{20}-P^{25})}{2.5^3}$$
$$+\frac{(x-5)(x-10)(x-15)(x-20)}{4!}\cdot\frac{(2P^0-9P^5+16P^{10}+14P^{15}-6P^{20}-P^{25})}{5^4}$$

Where P^x is the interpolated population in the Xth year.

By putting suitable values for X in the above equations two panels of multipliers for each equation have been computed for the population as on 1st March which is the usual census date in India and as on 1st July (mid-year) of every calender year during the interpolated period. These panels are shown in Annex I. Equation 1 is represented in panels I & II and the equation 2 in panels III & IV. In Annex II results of an exercise in using osculatory interpolation method with all-India population Census data and population projections data for obtaining all-India population estimates as on 1st July of each year, 1951 to 1970, are shown and compared with those using geometric growth method prepared by the Office of the Register General, India.

The second method of using osculatory interpolation formula is that of deriving a difference formula. The difference formula has been widely used hitherto for yielding single year age population from quinquennial age group data. The substitution of values in the difference formula results in a set of multipliers which can be used easily in machine computation to yield the population in each successive age as the algebraic total of products of total population in successive age groups with corresponding multipliers. KOZAKEIWICZ multipliers are used in the Census of Canada, 1941 and the Census of India, 1941 & 1951 and SPRAGUE multipliers in the Census of U. S. A.

The fourth degree osculatory curve which passes through the points x=5, 10 & 15 and having the same tangents at x=10 & 15 as the fourth degree curves which pass through x=0, 5, 10, 15 & 20 and x=5, 10, 15, 20 & 25, respectively is

$$Tx = T5 + \frac{(x-5)(T_{10}-T_5)}{5} + \frac{(x-5)(x-10)}{2!}\cdot\frac{(T_{15}-2T_{10}+T_5)}{5^2}$$
$$+\frac{(x-5)(x-10)(x-15)}{3!}\cdot\frac{T_0-7T_5+16T_{10}-16T_{25}+7T_{20}-T_{25}}{2.5^3}$$
$$+\frac{(x-5)(x-10)(x-15)(x-20)}{4!}\cdot\frac{2T_0-9T_5-16T_{10}-14T_{15}+6T_{20}-T_{25}}{5^4}$$

Now population in a 5-year age group may be considered as the difference of successive quinquennial values of T's e g. ~~$P_{0-4}=T_5-T_0$~~ etc. $P_{0-4}=T_5-T_0$, $P_{5-9}=T_{10}-T_5$; etc. $P_{20}=T_{21}-T_{20}$ $P_{21}=T_{22}-T_{21}$; etc. By putting for X successive values of 10, 11, 12, 13, 14 either in the above formula or its difference formula the interpolated population values for successive ages can be obtained in the form of multipliers with population age groups.

As a matter of interest, using the difference formula obtained from the fourth degree osculatory formula for equal intervals I have also derived the corresponding set of multipliers to be used for obtaining single year age population from quinquennial age group population. These are presented in Annex III.

Sprague, who is the originator of the osculatory formulae, had used a fifth degree osculatory curve passing through the points x=10 & 15 and having the same tangents and radius of curvature at X=10 & 15 as the fourth degree curves which pass through x=0, 5, 10, 15 & 20 and x=5, 10, 15, 20 & 25 respectively.

Kozakeiwicz, on the otherhand, has used two osculatory curves for interpolation. He uses the fourth degree osculatory curve passing through x=5, 10 & 15 and having the same tangents at x=10 & 15 as the fourth degree curves passing from the points x=0, 5, 10, 15, & 20 and x=5, 10, 15, 20 & 25 respectively, as given above But he uses the interpolated values for Tx at x=11 & 14 and the condition of same tangency at these points to fit a third degree parabola Using the interpolated values for x=12 & 13 he obtains the multiplier panel.

The difference between the fifth degree Sprague fromula and the above mentioned fourth degree osculatory fotmula lies in that the Sprague formula has also a second degree smoothness in transition but not as much reproduction as in the fourth degree osculatory formula, The switching to another curve for interpolating the mid-values in the interval in the Kozakeiwicz multipliers may result in aberration in first differences of mid-values in the groups when series of groups is considered. This may be avoided by using the same curve to yield all the required interpolated values within any quinquennial period.

In conclusion it may be said that in actual practice the difference between the results obtained by using any of the three formulae will be minor as compared to the size of population. However, where refinement is required it may be worthwhile testing all the three sets of multipliers to find out which one gives the best results according to given criteria as to smoothness, continuity, conformity, faithfulness and overall reasonableness.

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ANNEX I

Osculatory Interpolation Panel of Multipliers

MULTIPLIER PANEL I

GIVEN : Population for 1931, 1941, 1951, 1961, 1966 & 1971 (on 1st March)

REQUIRED : Population for 1952 to 1960 (on 1st March)

10, 000Interpolated population for the year	Multipliers for Population in the years					
	1931	1941	1951	1961	1966	1971
1952	74	— 575	+9818	+ 847	— 106	— 58
1953	128	— 966	+9280	+ 2032	— 410	— 64
1954	159	— 1177	+8418	+ 3497	— 874	— 23
1955	168	— 1272	+7280	+ 5152	—1434	— 56
1956	156	— 1125	+5938	+ 6875	—2000	— 156
1957	128	— 918	+4480	+ 8512	—2458	+ 256
1958	89	— 645	+3018	+ 9877	—2666	+ 327
1959	48	— 358	+1680	+10752	—2458	+ 336
1960	14	— 119	+ 618	+10887	—1642	+ 242

MULTIPLIER PANEL II

GIVEN : Population as in Panel I for 1931 to 1971 (on 1st March)

REQUIRED : Population for 1951 to 1961 (on 1st July)

10,000 x Interpolated population in for the year	Multipliers for Population in the years					
	1931	1941	1951	1961	1966	1971
1951	27	— 212	+9980	242	— 12	— 25
1952	94	— 726	+9677	1207	— 186	— 66
1953	141	—1056	+9026	2493	— 549	— 55
1954	165	—1210	+8066	4033	—1054	— 0
1955	166	—1204	+6851	5726	—1627	— 88
1956	148	—1066	+5459	7439	—2171	—191
1957	116	— 832	+3987	9007	—2562	—284
1958	75	— 549	+2551	10235	—2651	—339
1959	35	— 270	+1267	10893	—2263	—318
1960	7	— 62	+ 353	10720	—1198	+180

MULTIPLIER PANEL III

GIVEN : Population for (i) 1951, 1956, 1961, 1966, 1971 & 1976
(ii) 1956, 1961, 1966, 1971, 1976, 1981 (on 1st March)

REQUIRED : Population for (i) 1962 to 1965 (on 1st March)
(ii) 1967 to 1970 (on 1st March)

10,000 x Interpolated Population for the year		Multipliers for Population in the years					
	(i)	1951	1956	1961	1966	1971	1976
	(ii)	1956	1961	1966	1971	1976	1981
i 1962							
ii 1967		128	— 976	9344	1744	—256	16
i 1963							
ii 1968		168	— 1256	7504	4144	—616	56
i 1964							
ii 1969		128	— 976	4864	6784	—896	96
i 1965							
ii 1970		48	— 416	2064	9024	—816	96

MULTIPLIER PANEL IV

GIVEN : Population for (i) 1951, 1956, 1961, 1966, 1971 & 1976 (on 1st March)
(ii) 1956, 1961, 1966, 1971, 1976 & 1981 (on 1st March)

REQUIRED : Population for (i) 1961, 1962, 1963, 1964, 1965 (on 1st July)
(ii) 1966, 1967, 1968, 1969, 1970 (on 1st July)

10,000 x Interpolated Population for the year		Multipliers for population in the years					
	(i)	1951	1956	1961	1966	1971	1976
	(ii)	1956	1961	1966	1971	1976	1981
i) 1961							
ii) 1966		51	— 405	9926	492	— 66	2
i) 1962							
ii) 1967		151	— 1143	8849	2487	— 372	28
i) 1963							
ii) 1968		162	— 1214	6687	5024	— 730	71
i) 1964							
ii) 1969		103	— 802	3909	7613	— 926	103
i) 1965							
ii) 1970		24	— 236	1242	9539	— 647	78

ANNEX II

All-India Population Estimates as on Ist July prepared by using the Osculatory Method in comparison with those prepared by the Office of the Registrar General using the method of Geometric Growth.

In thousands

Year	Osculatory Method			Geometric Growth Method		
	Popula-tion	annual increase	Δ	Popula-tion	Annual increase	Δ
1951	363,040			363,439		
1952	369,069	6,029		369,589	6,150	
1953	375,495	6,426	397	376,080	6,491	341
1954	382,322	6,827	401	382,924	6,844	353
1955	389,600	7,278	451	390,151	7,227	383
1956	397,315	7,715	437	397,774	7,623	396
1957	405,452	8,137	422	405,824	8,050	427
1958	414,081	8,629	492	414,316	8,492	442
1959	423,134	9,053	424	423,276	8,960	468
1960	432,625	9,491	438	432,719	9,443	483
1961	442,617	9,992	501	442,736	10,017	574
1962	453,018	10,401	409	453,407	10,671	654
1963	463,852	10,834	433	464,335	10,928	257
1964	475,110	11,258	424	475,526	11,191	263
1965	486,785	11,675	417	486,987	11,461	270
1966	496,857	12,072	397	498,860	11,873	412
1967	511,267	12,410	338	511,298	12,438	565
1968	524,014	12,747	337	524,048	12,750	312
1969	537,089	13,075	328	537,115	13,067	317
1970	550,502	13,413	338	550,509	13,394	327

ANNEX III

Multipliers used for obtaining Single year age from Quinquennial age Group Population

End-Panel Multipliers (Sprague, Kozakeiwicz & Mathur)

10,000 x		Population in the age-group			
Population in the single year age		(I) 0 — 4	5 — 9	10 — 14	15 — 19
(I)	(II)	(II) 95 — 99	90 — 94	85 — 89	80 — 84
0	99	+3616	−2768	+1488	−336
1	98	+2640	— 960	+ 400	— 80
2	97	+1840	+ 400	— 320	+ 80
3	96	+1200	+1360	— 720	+160
4	95	+ 704	+1968	— 848	+176

II. Next-To-End Panel Multipliers (Sprague, Kozakeiwicz & Mathur)

10,000 x Population in the single year age		Population in the age-group			
	i) 0—4	5—9	10—14	15—19	
	ii) 95—99	90—94	85—89	80—84	
i)	ii)				
5	94	+ 336	+2272	— 752	+ 144
6	93	+ 80	+2320	— 480	+ 80
7	92	— 80	+2160	— 80	0
8	91	— 160	+1840	+ 400	+ 80
9	90	— 176	+1408	+ 912	— 144

MID-PANEL

III. Sprague Multipliers

10,000 x Population in the single year age	Population in the age-group				
	0—4	5—9	10—14	15—19	20—24
10	— 128	+ 848	+ 1504	— 240	16
11	— 16	+ 144	+ 2224	— 416	64
12	+ 64	— 336	+ 2544	— 336	64
13	+ 64	— 416	+ 2224	+ 144	16
14	+ 16	— 240	+ 1504	+ 848	—128

IV. Kozakeiwicz's Multipliers

10	— 128	+ 848	+ 1504	— 240	+ 16
11	— 16	+ 145	+ 2218	— 409	+ 62
12	66	— 344	+ 2556	— 344	+ 66
13	62	— 409	+ 2218	— 145	— 16
14	16	— 240	+ 1504	+ 848	—128

V Mathur Multipliers

10	— 128	+ 848	+ 1504	— 240	+ 16
11	— 40	+ 240	+ 2080	— 320	+ 40
12	+ 40	— 240	+ 2400	— 240	+ 40
13	+ 40	— 320	+ 2080	+ 240	— 40
14	+ 16	— 240	+ 1504	+ 848	—128

Summary discussions of papers on "Technique of Population Analysis

Under the Chairmanship of Shri S. P. Jain, F. I. A.

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1. Paper by Dr. G. B. Saxena

Shri P. B. Gupta, from Indian Statistical Institute observed that the expectation of life at birth and the mean age at death are equal. If we put X=O then the mean age at death of persons who start their lives at age O would be equal to e_0° which is the expectation of life at birth. But he pointed out that this equality does not hold good in the estimates arrived at by Dr. Saxena on the basis of his formulae for census years presented in table I in his paper.

Shri B.B. Biswas from Bureau of Applied Economics & Statistics, West Bengal considered the work done by Dr. Saxena as interesting. He, however, pointed out some defects in the derivation of the approximate formula. He stated that the equations $C(a) = be^{-ra} p(a)$ and $\frac{1}{b} = \int_0^\infty e^{-ra} p(a)\, da$ would hold good if the birth rate (b), growth rate (r) and age-specific fertility and mortality rates relate to the same sex so that the new born may experience the same fixed sets of rates. New fertility rates are attributed to females only. Hence all the notations connected with the above two equations should relate to females i.e in defining birth rates only daughters must be counted and rated to female population and so on. It is not that the equations can not be applicable in case of males in any circumstances. But then the assumptions would sound rather absurd. For in that case we have to assume that the number of sons born to fathers at age X to X+dx will bear a fixed ratio to the population of men aged between X and x+dx at any time t. Shri Biswas pointed out that the rates mentioned in the paper of Dr. Saxena should be instantaneous per capita annual rates and not the crude per captia annual rates. He wondered whether Dr. Saxena has used these instantaneous per capita annual rates of birth and death in his computation of e_0° and the mean age at death. Next Shri Biswas pointed out that in deriving his results Dr. Saxena had employed the concept of centre of gravity (C.G.). He did not understand how Dr. Saxena took the relation $y = 2\bar{Y}$ to be exact in his (20). He doubted whether the co-ordinates $(\bar{X}\ \bar{Y})$ of the C. G. of the lamina bounded by the curve $y = e^{-rx}$ and the two axes with mass per unit area in the neighbourhood of the point (X, Y) denoted as p(x) are connected by the relation $\bar{Y} = \frac{1}{2}e^{-r\bar{x}}$ Shri Biswas also stated that

the relations $y=2\bar{Y}$ would hold good only in the case when y is a linear function of x. Finally he gave an alternative method for arriving at the approximate relation $e_0^0 \simeq \frac{e^{rM}}{b}$ in the following manner :

Following Dr. Saxena's notations :—

$$M = \frac{\int_0^\infty ae^{-ra}\, p(a)\, da}{\int_0^\infty e^{-ra} p(a)\, da} \quad \text{and} \quad \frac{1}{b} = \int_0^\infty e^{-ra} p(a)\, da \text{ and } e_0^0 = \int_0^\infty p(a)\, da$$

Now $\int_0^\infty e^{-ra} p(a)\, da$ is a function of r only and let $\phi(r)$ denote this function

$$\therefore \quad \frac{d\phi}{dr} \int_0^\infty -ae^{-ra} p(a)\, da,$$

since the differentiation within the sign of integration is permissible in the present case.

$$\text{Hence} \quad \frac{1}{\phi} \frac{d\phi}{dr} = -M$$

$$\therefore \quad \phi(r) = c.e^{-\int M dr}$$

Assuming that M which is a function of r, does not change appreciably for small change in the value of r we may take $\int M dr \simeq rM$

$$\therefore \quad \phi(r) \simeq c\, e^{-rM}$$

$$\text{Now } \phi(0) = e_0^0 \qquad \therefore \quad c = e_0^0$$

$$\text{Hence} \quad \frac{1}{b} = \phi(r) \simeq e_0^0 \quad e^{-rM}$$

$$\text{i.e} \quad e_0^0 \simeq e^{rM}$$

Shri S.P. Mukherjee from Calcutta University commented that the expansion of e^{-ra} by Taylor's theoram, used by Dr. Saxena, would be valid only when $ra < 1$ which perhaps could not be assumed in the whole span of life.

The chairman, Shri S.P. Jain observed that the author had made use of the unsmoothed age data for calculating the mean age. He suggested that the author might have calculated the mean age by using the smoothed age data. He also pointed out that the two sides of the equation 17 are identical except for the last term $-r^2 U_2$ on the right hand side which is extra. The relationship is difficult to accept.

In reply to the above criticisms and suggestions regarding his paper Dr. Saxena pointed out that the expectation of life at birth and the mean age at death could be equal only in case of a stationary population i.e. when the rate of growth is nil. But to derive his formulae he assumed a stable or a quasi stable population in which case the above two estimates would not be the same. He also stated that the relationship $y=\lambda\bar{Y}$ must hold whether y is a linear or non-linear function of X.

In favour of the use of unsmoothed age data he argued that different methods had been applied for smoothing the age data in different census years.

He admitted that the census age data used by him are defective but the mean age at death (M), he pointed out, is a very insensitive index and will not be easily effected by the inaccuracy in age data. He also stated that the alternative proof given in his paper to arriving at the formulae $e^{vr} = 1 + \frac{r}{d}$ could be used to derive the relation $e^{\circ}_{\circ} \simeq \frac{e^{rm}}{b}$

2. Paper by Sri A. C. Sharma

Shri S. Dutta Roy, from S.S.B., West Bengal wanted to know whether the growth rate of muslims and non-muslims in the region (Assam, West Bengal, East Pakistan, Bihar, Tripura and Monipur) were studied by the author on the basis of the census figure. Shri A. C. Sharma replied that no such calculations had been made by him.

The chairman, Shri S.P. Jain observed that in the region comprising of West Bengal, Assam and part of Bihar the growth rate of Hindus were found to be more or less equal to that in other parts of this country. But the growth rate of Muslims were found to be much higher, possibly due to migration of muslims from East Pakistan, who settled themselves in this region surreptitiously. He mentioned that he had calculated the surreptitious migration of Muslim in Assam during 1951-61 on the basis of the excess of growth rate of Muslims in Assam over the corresponding rate in Pakistan.

3. Paper by Sri P. B. Gupta

Dr. G. B. Saxena observed that the net inflation figures calculated by Sri Gupta showed that while the net inflation of male population was negative in all the age groups upto age 19, in the female table the position was different in that in the age group 5-9 it was positive. Dr Saxena stated that this excess in the female group may be due to (1) over counting in the age group of (2) misreporting of ages. In reply Sri Gupta pointed out that he made use of graduated age-distributions of West Bengal population in the past decades which are given in 'Actuarial Reports for the Census, 1881-1931, 1951'.

The Chairman Sri S. P. Jain stated that he had also estimated population of 1941 separately for male and female by fitting free-hand curves to census data of the previous decades, that the result are published in the Census Report of West Bengal for 1941.

4. Paper by Mrs. C. Bose and Dr. A. C. Das.

Shri S. Dutta Roy pointed out that in table 2 the average number of children contributed by mothers of completed fertility was found to be higher in urban areas than in rural areas, while on the basis of the reference year the fertility rate per thousand mothers (vide table 8) was found to be lower in urban areas. It had been stated in the paper, Shri Dutta Roy, observed, that people belonging to higher society have lesser number of children than those belonging to lower society. So in future there might be shortage of manpower in that part of the employment market when personnel with high professional and technical education are referred. His contention was that the people belonging to higher education to their children.

Shri S. B. Mukherjee from CMPO commented that in page 2 of their paper, where the authors had discussed the effect of a control after the third or fourth issue on the fertility-rates, the birth rates should be adjusted to the extent the population in younger ages would decline if births of higher order were stopped. Shri Mukherjee also observed that since the results were based on fertility survey there might be recall lapse for which some corrections were to be applied. Dr. G. B. Saxena observed that in table 5 the figures of average number of children born per women with age at marriage above 22 and marriage duration group (i) 25-29 years and (ii) 30 years and above seemed to be inconsistent. It showed that while the women after completing age 50 (say) had contributed 2.25 children on an average per woman, after crossing the age 50 their contributions had increased on an average by 2 children per woman, an observation which called for scrutiny of data.

The Chairman, Shri S.P.Jain observed that the figures presented in table 5 showed that among women of age 47 (say) years in rural ages those married at an age above 22 appeared to have contributed more children than those married earlier i.e. between 18 to 22 years. He suggested for checking of these figures as well as of the figure shown in under marriage duration 20-24 years for age at marriage above 22 years. The Chairman also pointed out that considering the size of population the adjustment in calculating the birth rates as suggested by Shri S. B. Mukherjee, would be negligible. Further, he did not agree with Shri Dutta Roy regarding the latter's contention of man-power shortage in certain vacancies due to low fertility rates in the higher social class.

In reply Dr.A.C.Das said that the discrepancy in rural and urban fertility rates as shown in different tables, as pointed out by Shri S. Dutta Roy, had been explained in the paper where it has been stated "which may be partly due to lower proportion of newly married women and higher proportion of married women attaining the child bearing age in these areas". Regarding recall lapse, Dr. Das continued, the investigators were properly instructed at the time of the survey to see that the recall lapse were minimum. Some suitable questions were framed for this purpose. However, no mathematical corrections were applied on the figures for recall lapse, if any. He also admitted that some of the figures shown in table 5 might be inconsistent possibly due to small sample size.

5. **Paper by Dr. S. Chakraborty and Sri B B. Biswas.**

Shri S.P. Mukherjee from Calcutta University observed that the relationship between ${}_nq_x$ and ${}_nm_x$ given by Reed and Merrell formulae might not be applicable to West Bengal population.

Shri S. Dutta Roy wanted to know whether the 1921 and 1941 Census figures had been used by the authors as such in population projection of West Bengal using mathematical functions. Shri Dutta Roy also wanted to know if the percentage variations of the specific death rates (${}_nm_x$) are about four in all the cases or there is some range of errors. He suggested that on the basis of the survey data, used by the authors, the crude birth and death rates might be calculated and compared with these based on census data.

Shri S.B. Mukherjee from CMPO observed that the growth of urban population might be caused by the following factors :—

1) Natural increase of population
2) migration of population from rural to urban areas
3) declaration of new areas as urban areas.

But mainly natural increase had been taken into account by the authors in projecting the urban population by the cohort survival method. He also objected to the use of vital rates like birth and death rates from a particular survey in life table construction, which, according to him, should not be done due to high sampling error. He mentioned that projections based on such life table would be of no use. He also questioned the reliability of the estimates of expectation of life at birth in West Bengal, which, according to the calculations of the authors, came out as 60 or 63. Finally, Sri Mukherjee suggested that the voluminious Census data available in India should be utilised more usefully and intensively. Shri Ajit Dasgupta stated that few years ago he used the mathematical function used by the present authors in projecting

regional population. He wanted to know the names of other research workers who used this function. He also expressed his opinion in favour of using the huge vital registration data that are available in our country.

In reply to the comments made Dr. S. Chakrabarty assured Shri S. P. Mukherjee that the estimates given by Grevilles method were close to those given by Reed and Merrell method in the present case. As regards the use of 1921 and 1941 census data, Dr. Chakrabarty stated that the figures as given by Shri Asoke Mitra, the former Registrar General of India, were used as such. However, the irregularities, if any, in one or two observations out of seven were likely to be smoothed out by such mathematical function as had been considered in their paper. As regards the percentage variation of specific death rates, Dr. Chakrabarti said that these variation were found to be around four in most of the cases He also pointed out that in projection of urban population by the Cohort survival method the growth due to natural increase of population and migration into urban areas had been taken into consideration. However, he admitted that the growth of urban population due to new areas being declared as urban areas had not been considered in this study as their endeavour was confined to direct factors only, and drew the attention of Shri Mukherjee to the introductory section of his paper in this connection.

In support of his estimates of expectation of life at birth Dr. Chakrabarty quoted the Planning Commission's estimate which was about 50. Commenting on Sri Mukherjee's advocacy for use of census data Dr. Chakravarti remarked that inspite of his best efforts he could not find any life table for West Bengal prepared by the Census authority. In reply to Shri Dasgupta's enquiry Dr. Chakrabarty informed that among others, Sri V.S. Swami of R.G.'s office also had made use of this sort of function (vide census of India, Report I.)

No material comments were made on the remaining papers presented in this session. The Chairman commended the quality of the papers and the high academic level at which the various commentators made their observations. He thanked all the participants for making the session a lively one.

THE END

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