MONOGRAPH OF THE DEPARTMENT OF ANCIENT INDIAN HISTORY, CULTURE AND ARCHAEOLOGY
No. 12

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**PROF. LALLANJI GOPAL**

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# Archaeology of Population

(A Study of Population Change in the Ganga-Yamuna Doab from 2nd Millennium B. C. to the Present)

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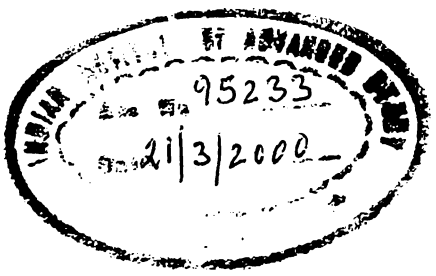


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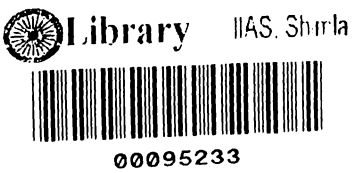


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# FOREWORD

The extra mouths to be fed, whose number is constantly multiplying in different parts of the world, are a nightmarish concern alike for the countries concerned and all thinking people all over the world. They have violently shaken all calculations of the alert experts of social and economic planning. They have often affected the course of history and have provided indications of a new direction for shape of things to emerge.

Population, its density, and its pressure have often been a compelling factor in determining the course of historical events. Demographic considerations are relevant for diverse aspects of society and culture and are not to be sought for in the narrow sphere of political events alone. Theoreticians, philosophers, historians, jurists and sociologists alike, admit the possibility of population assuming the dominent role among factors moulding a society or a country. There are some very interesting instances of their role in many countries of the world. Somehow there has been no serious and sustained effort to study their working in the Indian context. Scholars, who have attempted an analysis of the geographical factors in Indian history and culture, have seldom been appreciative of the significance of the demographic elements. The demographic factors have not been able to assert themselves because of a paucity of relevant data.

A student of ancient Indian history, conscious of the new trends in historical studies, would do any thing to find answers to many meaningful questions concerning the distribution, composition, pressure and movement of population in different parts of the country and its expansion down the centuries. An analysis of the factors that have governed the

number and nature of population will be fascinating indeed and will open new dimensions and impart new meaning to the study of history.

Modern attempts at calculation of Indian population in earlier periods are often highly speculative and are so few that they can be easily counted. The evidence is nebulous and the method used does not have a scientific basis, pattern or model. In a scholarly article published in the *Journal of the Bihar Research Society*, Prof. G. C. Pande has utilised many useful clues for calculating Indian population in different periods. But his study has not received the response and reaction it deserves.

Archaeological studies have been enriched through the use of new disciplines and devices of a scientific and sophisticated nature. The recent trend in archaeological research is to pose new meaningful questions and, through the application of purposive models, to derive significant inferences. In last two decades the reconstruction of the population pattern has been attempted by archaeologists for their respective regions with a proper recognition of its importance in the study of the connected cultural phenomena. On the Indian map these studies have been confined to the two famous sites of Mohenjodaro and Harappa.

In the present monograph Dr. Makkhan Lal has chosen to subject the archaeological data of the Kanpur district to a searching analysis for determining the population statistics. He submits his estimates for different settlements in the region. He goes on to offer the changing pattern of population distribution over a span of two thousand years correlating it with the present pattern. This has given his findings a new meaning and relevance for calculations and speculations about the growth of population in different parts of the country in different periods of their history.

Dr. Makkhan Lal has blazed a new trail of glory in the present monograph. It shows that by posing significant questions, by training the eye for the relevant material, and by adopting a keen and careful analysis and interpretation of the evidence one may hope to find fresh information and inferences and to present the stereotyped details of the past in a new perspective. I have pleasure in offering the present study as a monograph in the Departmental series.

*Anantacaturdaśī* **Lallanji Gopal**
the 9th of September, 1984

## ACKNOWLEDGEMENT

Figs. 12 and 13 have been reproduced from the articles by Fekri A. Hassan published in *Current Anthropology*. Vol 14, No. 15, Dec. 1973 and *Advances in Method and Theory in Archaeology*, Vol. 1. Academic Press, 1977.

## PREFACE

The present monograph is the outcome of the intensive village-to-village survey in district Kanpur carried out between 1977 and 1980 in the connection of my Ph. D. dissertation submitted to the University of Poona in 1982. This intensive village-to-village survey was carried out to understand the settlement patterns and systems in the Ganga-Yamuna doab during the second and first millennium B. C. and its bearing on the present settlement patterns and systems in the same area. Kanpur district was taken as a model for it forms an integral part of the doab. In my view the importance of the present work lies not in estimating the settlement-wise population and or its exactness, which is just a step towards the main goal, but throwing light on the general pattern of population distribution and the change during the different cultural periods and its relation to the present pattern of population distribution in the same area.

Arnold Toynbee said that after the publication a book or an article no longer remains the personal property of a writer. However, it is with this feeling I now place this modest work in the hands of readers with a small note that this is the first work of its kind in Indian archaeology and thus many shortcomings may have crept in which could have been avoided had there been any other parallel work of this kind.

It is my pleasant duty to acknowledge the help I received from various scholars to complete this work. The work was done under the guidance of Prof. V. N. Misra, Deccan College, Pune. I shall always be grateful to him for his help in various ways. Throughout my association with him as a student, which continues even today, he has been not only my guide but friend and philosopher as well. He went through the manuscript with his usual thoroughness and great understanding.

However, I, alone, am responsible for any shortcoming that still remains the book.

I would like to thank Prof. H. D. Sankalia and Dr. M. L. K. Murty of Deccan College, Pune and Prof. Philip E. L. Smith for their discussions on various aspects of this work and going through the original draft and suggesting several improvements.

In the Department here in Banaras Hindu University I am extremely thankful to Prof. Lallanji Gopal, Head of the Department for kindly considering the present work to publish in the form of monograph and giving editorial advices. Prof. Purushottam Singh has been very kind to go through the press copy of the manuscript and encouraged me to publish the work as monograph. I am thankful to Prof. V. C. Srivastava and Dr. T. P. Verma for their help in various ways.

3.9.1984 **Makkhan Lal**

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# INTRODUCTION

Archaeologists in the past have shown interest in demographic factors in the interpretation of archaeological data, but it is only during the last two decades that a definite shift from an obsession with material remains to a healthier concern with the past people and behaviour has taken place. One facet of this shift in interest is the growing emphasis on estimating the size, density and the growth rates of past populations. Accurate population estimates for individual settlements are of great interest but the factors affecting population size within a given area are so numerous that accurate estimates of populations and the densities are, if not impossible, difficult. Size of settlements, structures found in excavations, demographic observations on contemporary settlements and mathemetical models given by demographers are some of the methods for estimating the past populations.

Some demographers have criticised archaeologists and the archaeological methods of estimating the prehistoric populations. Peterson (1975) criticises archaeologists for over-analysing their data and the use of methods that are crude. At the same time he admits that even in modern times "no nation has ever made a complete and accurate account of its inhabitants and their characteristics so that even in the best cases what is eventually published invariably includes emendation by the central establishment office. The demographic data of most of the world, more over, are full of holes and often quite unreliable" (Peterson 1975 : 227).

In spite of methodological shortcomings several attempts have been made to estimate the populations of the

past in different areas of the world. The methods employed in these attempts are human skeletal remains (Vallois 1960; Angel 1969, 1972; Browthwell 1971, 1972; Acsadi and Nemeskeri 1970; Weiss 1973), artifacts used by past people (Cook 1972; Clark 1954, 1972; Muller-Beck 1961; Shawcrass 1967; Parkins and Daly 1968; Evans and Renfrew 1968), ecological potential of human habitat (Birdsell 1953, 1975; Cowgill 1962; Baumhoff 1963, Allen 1965; Casteel 1972; Martin and Reed 1973; Hassan 1974) and settlement area (Narrol 1962; Adams 1965; Cook and Heizer 1965, 1968; Leblanc 1971; Blanton 1972; Renfrew 1972; Casselberry 1974; Plog 1975; Longacre 1976).

My interest in palaeodemography lead me to study the pattern of population distribution in the Ganga-Yamuna doab during the second and first millennium B. C. and to compare it with the present pattern of population distribution in the same area. To my surprise I discovered that in the study area the change in the pattern of population distribution since second millennium B. C. has been only quantitative and not qualitative. Qualitatively the pattern remains almost the same even today as it was during early times. The data for the early periods comes from my own archaeological fieldwork in the study area and for modern period from the decennial *Census Reports*.

The book is divided into three parts. Part I describes the area of the research and the method of data collection. In Part II the present pattern of population distribution has been dealt with. In Part III the distribution pattern of population during the first and second millennium B. C. has been discussed and it has been shown that how it is reflected in the present pattern of population distribution.

## STUDY AREA

Area taken for study and the collection of archaeological and census data for the population estimates is Kanpur District in the Ganga-Yamuna doab. The extremities of the district are marked by the parallels of 25° 26′ and 26° 28′ N. latitude and 79° 31′ and 80° 43′ E. longitude. The total area measures 6167 km.

The reason for the choice of Kanpur district was that it forms an integral part of the Ganga-Yamuna doab and in regional sub-divisions it falls in the central doab. The greatest advantage that this district provided was that it is flanked by both the major rivers i. e. the Ganga and the Yamuna that form the doab. Also at micro-level there are some ecological variations. Thus it was expected that with the study of this area it will be possible to understand the influence of the two great rivers of India and micro-level ecological conditions on the distribution pattern of the human population.

In topography this district resembles rest of the doab. It slopes gently from northwest to southeast, the gradient following the line of main rivers. The interior surface is rendered undulating by numerous minor drainage lines. The sectional contour is practically the same throughout the district. The level rises sharply from the Ganga bed to the crest of high cliff and then slopes gently towards the centre beyond which it again ascends to the ridge overlooking the valley of the Yamuna. The same thing occurs on a miniature scale in the case of smaller rivers, though where the stream has small volume and low velocity, the change is hardly noticeable. The centre of the district is slightly lower than the banks of the Yamuna and the Ganga.

Beside the Ganga and the Yamuna there are six tributaries—Isan, Northern Non, Pandu, Rind, Sengur and Southern Non—which flow through the district. All the rivers follow a course from northwest to southeast direction. The Ganga and the Yamuna are the only rivers which rise from the Himalayas. Other rivers rise from the marshy plains of the upper doab. The rivers N. Non, Pandu and S. Non carry very little or no water during summer. The land along the Yamuna and the Sengur is badly dissected and this bad land topography extends upto 5 km. away from the river banks.

The river Rind can be taken as the main water parting line. The water of east to the Rind goes in the Ganga and of west to the Rind (including Rind) goes to the Yamuna.

On the basis of the physical and chemical characteristics, soils of Kanpur district can be divided into six categories (Fig.1). Each of these include several soils of similar nature with only minor variations (Agrawal and Malhotra 1952). Kanpur type I (Recent Alluvium), type II (Ganga Upland) and type III (Ganga Lowland) occupy the whole area between the Ganga and the Rind. These are light brown to dark brown in colour. The soils are slighty alkaline in reaction and rich in organic matters. The $p^H$ value ranges between 7 and 8. These are good for agricultural purpose and easily manageable. Kanpur type IV (Central Lowland), type V (Yamuna Flats) and type VI (Yamuna uplands) occupy the area between the Yamuna and the Rind. These soils are yellow to dark grey in colour. Because of poor drainage, especially in the type IV and V at places water logging takes place. Consequently a large portion of tract has become alkaline. The $p^H$ value ranges from 7 to 11. Along the rivers Yamuna and Rind due to excessive drainage extensive ravines have been formed. These soils contain very little alluvium and are calcareous. For agricultureal purposes these soils are not as good as Kanpur types I, II and III.

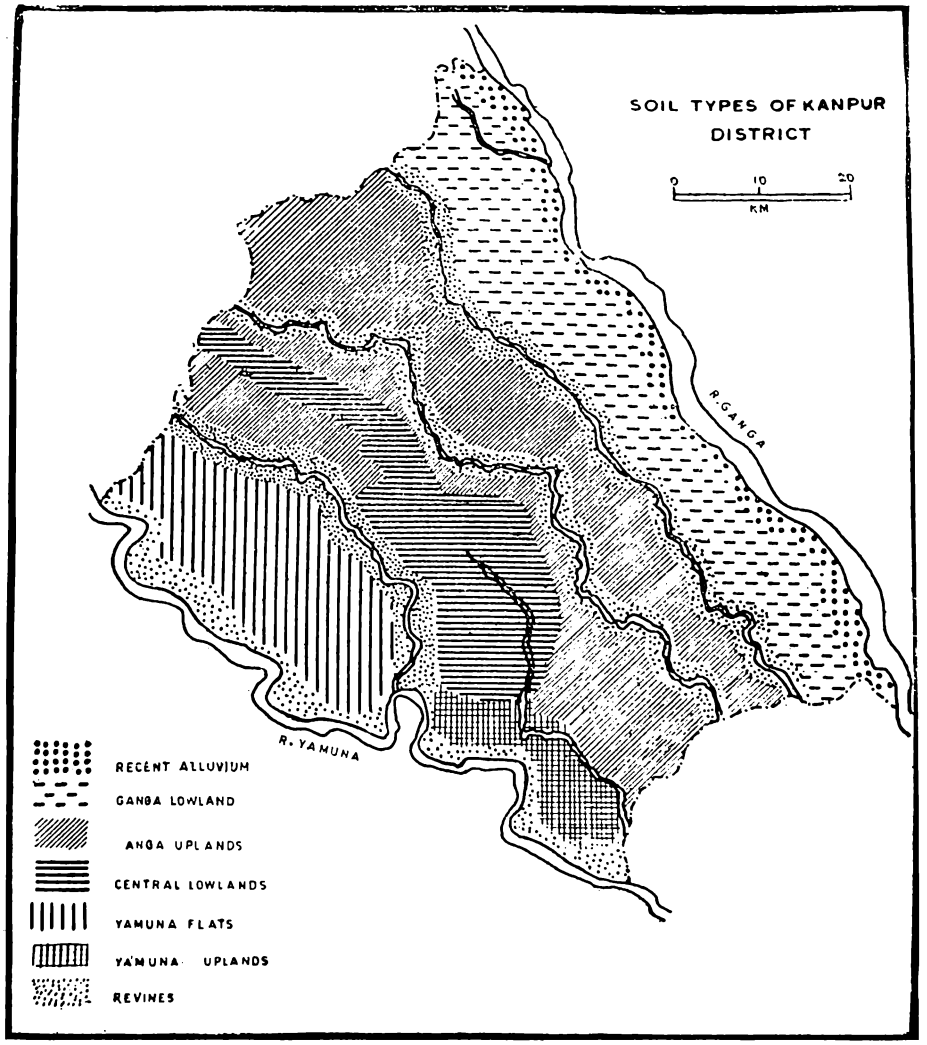



Fig. 1

The district contains a large number of small depressions in which water accumulates during rainy season and shallow lakes are formed. These are found in south of Bilhor, central portion of Derapur, eastern part of Narwal and northern part of Ghatampur tahsil. The most important ones are at Jahangirabad in Ghatampur, Harnu, Itali and Naila in Bilhor, Rasulpur and Gogamau in Akbarpur and Rahnas in Narwal.

The climate of district is same as that of the doab from Agra to Allahabad. From March to June it is characterised

by extreme heat (temp. 40-48° C) and dryness, intensified by strong westerly wind (speed 10-14 km. per hour), occasionally accompanied by violent dust storms. With the approach of mansoon temperature starts coming down but weather by and large remains oppresive. The temperature during rainy season ranges between 25 and 34° C. The cold weather starts by the end of October and temperature falls gradually until it reaches its minimum in January (6-10° C). Frost are common but are seldom of much intensity.

The average annual rainfall in the district is nearly 80 cm. The variation from tahsil to tahsil is slight but quite significant. The tahsils in the west namely Derapur and Bhoganipur receive less rainfall by about 6-10 cm. than the tahsils in the east namely Bilhor and Kanpur. The average difference in the annual precipitation for the last 100 years (1864-1964) is low, the variation that occurs from year to year are very striking. Treating an excess or deficit of more than 25% as abnormal there have been 19 occasions during the past one hundred years on which the rainfall has been exceptionally heavy and on 19 occassions deficiency was equally marked. In other words in every five years we may expect both a famine and a flood. These floods which in most cases occur in September are not necessarily the result of heavy rainfall in Kanpur district. The heavy rains in the Himalayan region and in the upper doab are more responsible for these floods.

## DATA COLLECTION

For the late 19th and 20th centuries the data for the pattern of population distribution comes from *Census Reports* of Government of India.

For the data for the second and first millennium B. C. it was decided to explore the whole district and locate all the ancient settlements. An intensive village-to-village survey was carried out during the three summer field seasons (March-June 1977-79) and one winter season (November 1977-January 1978), overall for about 14 months. Though the high temperatures (40-48°C) during the summer make fieldwork a trying task, yet is the best season for locating archaeological sites, examining their cultural content and measuring their size because the site is then totally free from standing crops (in the case of mounds under cultivation) and wild vegetation.

During the course of explorations greatest emphasis was laid on locating the ancient sites and observing the distribution pattern of the cultural content on them and the sites themselves on the landscape. The sites were examined from observable surface remains and from the exposures in the erosion gullies and the artificial cuts in the mound to obtain information about the thickness of deposit, stratigraphy, cultural sequence etc. without excavation. My status as a doctoral fellow then and consequent limitations on the facilities available to me precluded the possibility of conducting excavations of any site.

The antiquity and chronology of cultural remains found on them have been decided on the basis of occurrence of well known and securely dated ceramic industries associated with

different cultures in the doab. The estimation of total size of a settlement and its size during different cultural periods have been decided on the basis of area represented by the distribution of representative ceramic types.[1]

For locating the sites I have relied upon the Survey of India map of 1 : 63,360 (1918 edition) and local informants. Since exploration proceeded from one village to the next adjoining village the possibility of any site remaining unexplored was considerably reduced. Further, since the survey was done during summer months the sites which are rendered flat by erosion or cultivation could also be located with precision.

The total area explored measures about 5100 sq. km. An area of nearly 1,000 sq. km. could not be explored except along the bank of the Ganga as it is now occupied by the city of Kanpur and its suburbs.

During the explorations 150 sites were discovered. On the basis of distinctive ceramic type following cultural sequence emerges from the area of intensive explorations (Lal 1984) :

A = Black and Red Ware culture (BRW)
B = Painted Grey Ware Culture (PGW)
C = Northern Black Polished Ware culture (NBPW)
D = Early Historic Culture (represented by post NBPW Red slipped Ware)

The number of settlements of each cultures is as follows :

| | | |
|---|---|---|
| BRW | = | 9 |
| PGW | = | 46 |
| NBPW | = | 99 |
| Early Historic | = | 141 |

The chronology of these cultures is as follows (Lal 1980, n. d.) :

| | | |
|---|---|---|
| BRW | = | 1400-1200 B. C. |
| PGW | = | 1300-600 B. C. |
| NBPW | = | 700-100 B. C. |
| Early Historic | = | 200 B. C.-300 A. D. |

It is important to mention here that the above date brackets are for the total duration period of different cultures. The total time period of a culture is not relevant here in the estimation of the area occupied or the population of that period. This is so because we are estimating the area and population on the basis of the total number of sites known for a culture. This number would naturally have reached quite some time after the initial appearence of the culture. It is assumed here that the maximum area occupied during a cultural period and the peak of population of that culture must have occurred towards the very end of that period. This assumption will not be valid where there is definite evidence of the decline of a culture and desertion of its settlements as for example in the case of Harappan culture. But in the case of protohistoric and early historic cultures of the Ganga valley there is no evidence that during any cultural period any appreciable number of sites were deserted. In fact we find newer culture slowly replacing the older at almost all the sites.

The period suggested for maximum occupation and population during successive cultures is as follows :

1. For the BRW culture 1350 B. C. has been considered because 1300 B. C. is the lower date limit of the PGW.

2. In the case of the PGW culture climax period has been considered to be between 800 and 750 B. C. because the upper date limit of PGW culture is 600 B. C. and around 700 B. C. NBPW is introduced in the area. Also it is in the late levels that we find maximum use of iron and prevalence of architectural activities.

3. For NBPW culture the period between 300 and 200 B.C. has been considered as the climax period because it is during this period that we find use of coins on a large scale, massive architectural activities and the development in the fields of art and other cultural aspects.

4. For the Early Historic culture the period between 150-200 A. D. has been considered as the climax period because the historical evidence clearly show that at this time the culture was at its peak and started declining often the fall of Kushanas.

**Note :** For the details about exploration and methodology employed in determing the size of settlements, their location and their size (in sq. m.) see Lal 1982, 1984a, 1984b.

# PRESENT PATTERN OF POPULATION DISTRIBUTION

Athough the external boundaries of the district have remained intact since the separation of Fatehpur in 1825, the extensive internal changes that have taken place in the matter of tahsils arrangements, especially in 1860, 1894 and 1911 render it impossible to establish a satisfactory comparion of the results obtained at successive enumerations in the various tracts before 1901. In the census report of 1853 figures are given for no less that 12 tahsils the total of which in 1860 becomes 9 and subsequently 8 in 1894 and finally 6 in 1911. Consequently the existing tahsils of Bilhor, Derapur, Bhoganipur and Kanpur no longer represent the same area as at the time of 1901 census and previous enumerations. It is, therefore, necessary to keep in mind that earlier statistics of these tahsils refer to them as they were prior to the reconstitution of their present area. Because of the availability of better data the figures of 1891 have been adjusted according to 1894 adjustment and of 1901 have been adjusted according to 1906 adjustment of the areas.

Table 1 gives the detail breakup of the population per sq. km. in different tahsils of Kanpur from 1881 to 1961. The tahsils of Bilhor, Kanpur and Sheorajpur are along the Ganga and occupy the area of Ganga-Rind doab. The tahsils of Derapur, Bhoganipur and Ghatampur are in the Yamuna-Rind doab. The tahsils of Akbarpur is spread both in the Ganga-Rind doab and Yamuna-Rind doab. Only a small part of Derapur tahsils is in the Ganga-Rind doab.

Table 1

Variation in Population Density per sq. km. in Different Tahsils of Kanpur District

| Tahsil | Census Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1881 | 1891 | 1901 | 1911 | 1921 | 1931 | 1941 | 1961 |
| Bilhor | 212 | 211 | 177 | 162 | 160 | 177 | 190 | 241 |
| Kanpur | 399 | 448 | 467 | 419 | 421 | 419 | 673 | 1142 |
| Sheorajpur | 213 | 209 | 209 | 184 | — | — | — | — |
| Narwal | 182 | 177 | 166 | 168 | — | — | — | — |
| Akbarpur | 175 | 163 | 172 | 156 | 158 | 155 | 174 | 239 |
| Derapur | 151 | 148 | 190 | 169 | 168 | 159 | 177 | 238 |
| Bhoganipur | 122 | 1[illegible]5 | 150 | 139 | 137 | 146 | 173 | 228 |
| Ghatampur | 130 | 135 | 143 | 138 | 140 | 143 | 171 | 233 |
| Rasulabad | 176 | 171 | — | — | — | — | — | — |

(Tahsils 1-4 (from top) are in the Ganga-Rind doab, 5 is spread both in the Ganga-Rind and Yamuna-Rind doab and 6-9 are in the Yamuna-Rind doab. Tahsils 3, 4 and 9 were broken in subsequent years and merged in various Tahsils).

The distribution pattern of population in different tahsils of the district shows that the density per sq. km. in the tahsils in the Ganga-Rind doab is greater than those in the Yamuna-Rind doab. When we estimate an approximate density pattern in the two areas taking Akbarpur tahsil common for both we find that right from 1881 to 1961 the density in the Ganga-Rind doab has been much more than in the Yamuna-Rind doab (Table 2). The density per sq. km. ranged from 218 to 541 persons in the Ganga-Rind doab while it was only 150 to 235 in the Yamuna-Rind doab. This shows that Ganga-Rind doab is more attractive for the human settlements than Yamuna-Rind doab. This is mainly due to the availability of good agricultural land.

The distribution pattern of the villages in different categories (Table 3) shows that from 1901 to 1941 it was fluctuating. But there remained a consistency in the size and the number of settlements. Smaller villages were highest in number. They constituted more than 60% of the total and

the population living in these villages varied from 28.28% to 35.5%. But after 1941 with the increase in population the size of villages also increased to the extent that in 1971 census there were only 36.7% of the total villages which had the population less than 500 persons and the population living in in them constituted only 12.2% of the total. There has been a steady increase in the size of settlements with the increase in the population due to health care and timely relief at the time of famine, drought etc. Beside the population increase since 1941 the reason for the increase in the size of settlements is also the non-availability of the hinter land for the growth of new settlements.

Table 2
Average Population Density in the Ganga-Rind doad and Yamuna-Rind doab

| Year | Ganga-Rind Doab | Yamuna-Rind Doab |
|---|---|---|
| 1881 | 236 | 151 |
| 1891 | 242 | 150 |
| 1901 | 238 | 163 |
| 1911 | 218 | 151 |
| 1921 | 246 | 151 |
| 1931 | 251 | 152 |
| 1941 | 346 | 174 |
| 1961 | 541 | 235 |

Now it would be interesting to have a look at the pattern of spacing among these population units i. e. the villages. The formula for determing the spacing pattern of settlements is based on the density of settlements.[1]

In the spacing pattern if the rank size rule—the number of settlements of a given type continue to increase as the size decreases—has to operate then we should expect the spacing of settlements to be governed mainly by their size (Brush and Bracy 1955).[2] Large settlements would be widely spaced and small settlements closely spaced. Christaller (1933) and Losch (1954) put forward the evidence that this proposition is valid at least for some areas.

Table 3

Percentage of villages and Population in different size categories

| Year | Less than 500 | | 500-999 | | 1000-1999 | | 2000-4999 | | 5000-9999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 1901 | 63.80 | 30.00 | 23.00 | 30·20 | 10.70 | 26.90 | 2.40 | 12.40 | 0.10 | 0.50 |
| 1911 | 67.25 | 28.28 | 20.99 | 25.16 | 9.89 | 22.44 | 1.82 | 8.45 | — | — |
| 1921 | 68.60 | 35.50 | 21.50 | 32.40 | 8.40 | 23.90 | 1.40 | 7.50 | 0.10 | 0.70 |
| 1931 | 67.05 | 26.92 | 21.85 | 24.99 | 8.13 | 19.12 | 2.01 | 8.40 | 0.05 | 0.54 |
| 1941 | 61.41 | 20.14 | 25.35 | 21.97 | 10.45 | 17.63 | 2.72 | 8.90 | 0.10 | 0.67 |
| 1951 | 55.60 | 24.30 | 27.40 | 30.80 | 13.40 | 27.60 | 3.60 | 17.30 | — | — |
| 1961 | 46.30 | 18.10 | 30.90 | 29.50 | 17.90 | 32.90 | 4.5 | 16.70 | 0.40 | 2.80 |
| 1971 | 36.70 | 12.20 | 33.00 | 25.90 | 22.00 | 33.80 | 7.50 | 22.90 | 0.80 | 5.20 |

1. Percentage of villages in this class to the total number of villages.
2. Percentage of population in this class to the total population.

In the district the total number of settlements is 1898 which are classified in different categories and distributed in all the six tahsils (Table 4 ). The spacing pattern of settlements shows that the spacing of small villages (1. 78 km.), big villages (2. 45 km.) and regional centres (6. 73 km.) was minimum in Kanpur tahsil which is in the Ganga-Rind doab while the maximum spacing of small villages (2. 32 km.) and big villages (2. 83 km.) is in Ghatampur tahsil and the regional centre (10. 67 km.) in Bhoganipur tahsil which are in the Yamuna-Rind doab (Table 5). When we compare the average spacing pattern in the Ganga-Rind doab and the Yamuna-Rind doab (by taking Akabarpur tahsil common for both the regions) we find that in the Ganga-Rind doab the average spacing of small villages, is 1. 80 km., big villages 2. 66 km. and regional centres 8. 31 km. while in the Yamuna-Rind doab the average spacing of small villages is 2. 2 km., big villages 2. 73 km. and regional centres 9. 53 km. (Lal 1984a).

Table 4

Number of Villages in Different Categories in Kanpur District
(Based on Census of India 1971, Series 21, Part II-A)

| Tahsil | Small village below 500 | Big village 500-1999 | Regional centre 2000-4999 |
|---|---|---|---|
| Bilhor | 240 | 159 | 15 |
| Kanpur | 119 | 117 | 16 |
| Akbarpur | 128 | 146 | 14 |
| Derapur | 135 | 181 | 13 |
| Bhoganipur | 134 | 164 | 10 |
| Ghatampur | 125 | 157 | 18 |

Table 5

Average Spacing (in km.) of settlements in Kanpur District
(Based on Table 4)

| Tahsil | Small village | Big village | Regional centre |
|---|---|---|---|
| Bilhor | 1.80 | 2.78 | 9.20 |
| Kanpur | 1.78 | 2.45 | 6.73 |
| Akbarpur | 2.05 | 2.75 | 9.00 |
| Derapur | 2.03 | 2.63 | 9.82 |
| Bhoganipur | 2.02 | 2.67 | 10.67 |
| Ghatampur | 2.32 | 2.83 | 8.60 |

Thus we see that the spacing of settlements in the Ganga-Rind doab is comparatively less than in the Yamuna-Rind doab.

**Notes :**

1. The theoretical basis of the transformation of density into spacing is provided by an ultimate development of polygon into circles. A polygon is a geometrical figure that fits perfectly with another polygon without leaving any empty space. Thus the entire area can be conceived as spatial structure built of a series of polygons and the distance between the centers of the adjascent would be the spacing of settlements which are assumed to be located at the centers themselves. To make the polygons fit with each other increasingly better, their sides would have to become more and more numerous. Ultimately, theoretically the polygons would have an infinite number of sides and the gradually decreasing length of their sides will be the chords of the circles fitting in exactly with their circumferences. It is this way a polygon is transformed into circle. Haggett (1965: 48) also argues that in the continum of regular polygons the limiting case is clearly the circle which we may regard as a regular polygon with an infinite number of sides and vertices.

The formula used for the computation of spacing (S in km.) of settlements is as follows :

$$S = 2\sqrt{\frac{A}{N\pi}}$$

where A is the area in square km. and N is the number of settlements.

The derivation of the formula is as follows :

The area around a settlement is assumed to be a circle. The area of the circle is the area covered by it from the total area of the district, hence,

$$\pi r^2 = \frac{A}{N} \text{ km.}$$

$$r^2 = \frac{A}{N\pi} \text{ km.}$$

$$r = \sqrt{\frac{A}{N\pi}} \text{ km.}$$

Since the spacing between adjascent centres of the circles is the sum of their radii, hence, it is equal to 2r; therefore, spacing is equal to 2r, and is equal to

$$2\sqrt{\frac{A}{N\pi}}$$

2. The rank size rule in the spacing of settlements operates only in the case of settlements of same size (Hagget *et. al.* 1977 : 128). However, as Thomas (1961) points out, this does not necessarily mean that the population of the sample settlement and the neighbour settlements are exactly of the same size; rather they are "approximately of same size". This would mean that if we want to estimate the spacing pattern of settlement according to their size we have to evolve a site typology, a classification that reflects the differences in size, function strucutre and other attributes of the site of same period.

# POPULATION ESTIMATES FOR THE PROTOHISTORIC AND EARLY HISTORIC PERIODS[1]

In the present study estimation of population has been made on the basis of settlement size on the principle that there is some relationship between the number of people and the area they occupy. The formula is as follows :

Number of people = Constant x Site area

Where constant is the number of persons per unit of site area determined from a modest modern village or town in the area which is thought to be comparable to the archaeological settlements under consideration. The per unit population here is applied for the whole site area which includes both dwelling and inter-dwelling space[2].

There are, however, several shortcomings in this method. Flatcher (1977 : 102) points out that area and the population estimates are merely a device to aid the comparison that a researcher wishes to make. Defining the exact limit of a settlement and specifying precisely how many people lived on that is certainly a difficult task.

The estimates in the present paper are obviously tentative due to various limitations.[3] A better population estimate can be made where the total settlement has been laid bare to show the layout of structures and the relationship of different structures within it[4]. Unfortunately in whole of the Ganga-Yamuna doab not a single site has been excavated horizontally so as to reveal the settlement layout and which could have been used as an index for the protohistoric and early historic population estimates. In the absence of any such evidence I have relied on

the intensive and careful explorations of the archaeological sites and the use of present day settlement data and family size. To avoid regional biasness whole of the Uttar Pradesh (of which Kanpur district is a part) has been considered for the present-day settlement data and the family size.

The average size of household in Uttar Pradesh (U. P.) for 50 years was 4.82 and for the rural household the average was 4.9 (Table 6). The total variation during the period ranged upto 0.58 persons in general and 0.60 in the case of rural household. About the variations in the average household size *Census of India* (1961, Vol. XI, Part IV A: 105-6) says :

Table 6

Average Household size in Uttar Pradesh from 1911 to 1961

| Year | Rural Average | Urban Average | Total Average |
|---|---|---|---|
| 1911 | 4.64 | 4.54 | 4.59 |
| 1921 | 4.57 | 4.54 | 4.55 |
| 1931 | 4.82 | 4.40 | 4.61 |
| 1941 | 5.01 | 5.25 | 5.13 |
| 1951 | 5.17 | 4.87 | 4.97 |
| 1961 | 5.17 | 5.03 | 5.10 |

"There was a fall in the size of average household in 1911 owing to an artificial increase in their number due to the prevalence of the plague, on account of which a large number of temporary structures had to be put up. The actual size in 1911 was slightly larger than what the figures indicate. In 1921 there was a fall, but it was insignificant taking into consideration that a large number of empty houses had been counted as occupied. The population fell during the decade 1911-22 by 3.1 percent and the number of household by 1.7 percent, thereby causing a decrease in the size of household. In 1931 the population, the number of households and the size of households, all showed an increase. About half of the increase

in the decade 1921-31 was due to the increase in the size of average household, and half due to the increase in the number of households. The latter was caused by labourers migrating to town as a result of the abnormal fall in agricultural prices at the end of the decade, leaving the families in villages, and partly due to the continued breaking of the joint family system. In 1941 the population, the number of households and the size of households again showed an increase. The population in the decade rose by 13.6 percent while the number of households increased by 7.6 percent only, resulting in an increase in the size of average household. More than half of the increase in population in the decade 1931-41 was due to increase in the number of households, and remaining due to increase in the size of average household. The causes of increase in the number of household were the same as in the previous decades. In the rural areas owing to favourable agricultural conditions, the tendency towards the breaking of joint family system was resumed. The increase in the size of urban household on the other hand was remarkable. During 1941-51 decade the increase in population and number of households was 12.2 percent and 11.7 percent respectively. The size of average household remained practically the same....

"In 1951-61 the population has increased by 16.6 percent but the number of households has increased by 12.5 percent resulting in an increase in the size of average household. Three-fourth of population has increased on account of the increase in the number of households and one-fourth owing to the increase in the size of average household" (*Census of India* 1961, Vol. XV, Part IV A: 105-6).

Thus we see that the average size of household is affected not only by the actual increase in the population but also by the migration of the people, construction of new houses, disease and several other factors.

My investigations and the study of revenue records showed that in the Ganga-Yamuna doab in a modest village

the total number of houses ranges between 50 and 60 and the total population between 230 and 300 persons per hectare. This includes non residential areas like threshing floors, wells, paths and public buildings also. In the present estimate I have taken 4.9 persons per house[5] (the rural average for 50 years in U. P.) and 55 houses per hectare (mean of minimum and maximum average of houses per hectare) and this gives 270 persons per hectare. The figures of population estimates for protohistoric and early historic sites given may seem a bit too exact (Table 18). This is due to the fact that instead of rounding off the figures I have put them as they were obtained from calculations.

**Pattern of Population Distribution**

During the BRW period total population of Kanpur was 4,646 of which 3,224 (69.04%) persons were living on six sites in the Ganga-Rind doab (G-R doab) and 1,422 (30.96%) on three sites in the Yamuna-Rind doab (Y-R doab). The break-up of settlements according to population size shows that of less than 250 persons there was one settlement in each doab, and in the category of 251-500 there were three settlements in the G-R doab while only one in the Y-R doab. In the class of 501-750 population there was one settlement in each doab and with the population over 1,000 there was only one settlement and it was in the G-R doab. (Fig. 2, Table 7-8). The average population per sq. km. was 1.06 persons in the G-R doab and 0.45 persons in the Y-R doab. In the district, when taken as a whole the density was 0.75 persons per sq. km. (Table 10).

During the PGW period the total population was 14,509 of which 10,155 (70%) was distributed on 31 sites in the G-R doab and 4,354 (30%) was distributed on 15 sites in the Y-R doab. A large part of population was living in small villages (total 38) with the population less than 500 people. In the category of above 500 persons there were only eight settlements of which six were in the G-R doab and two in the Y-R

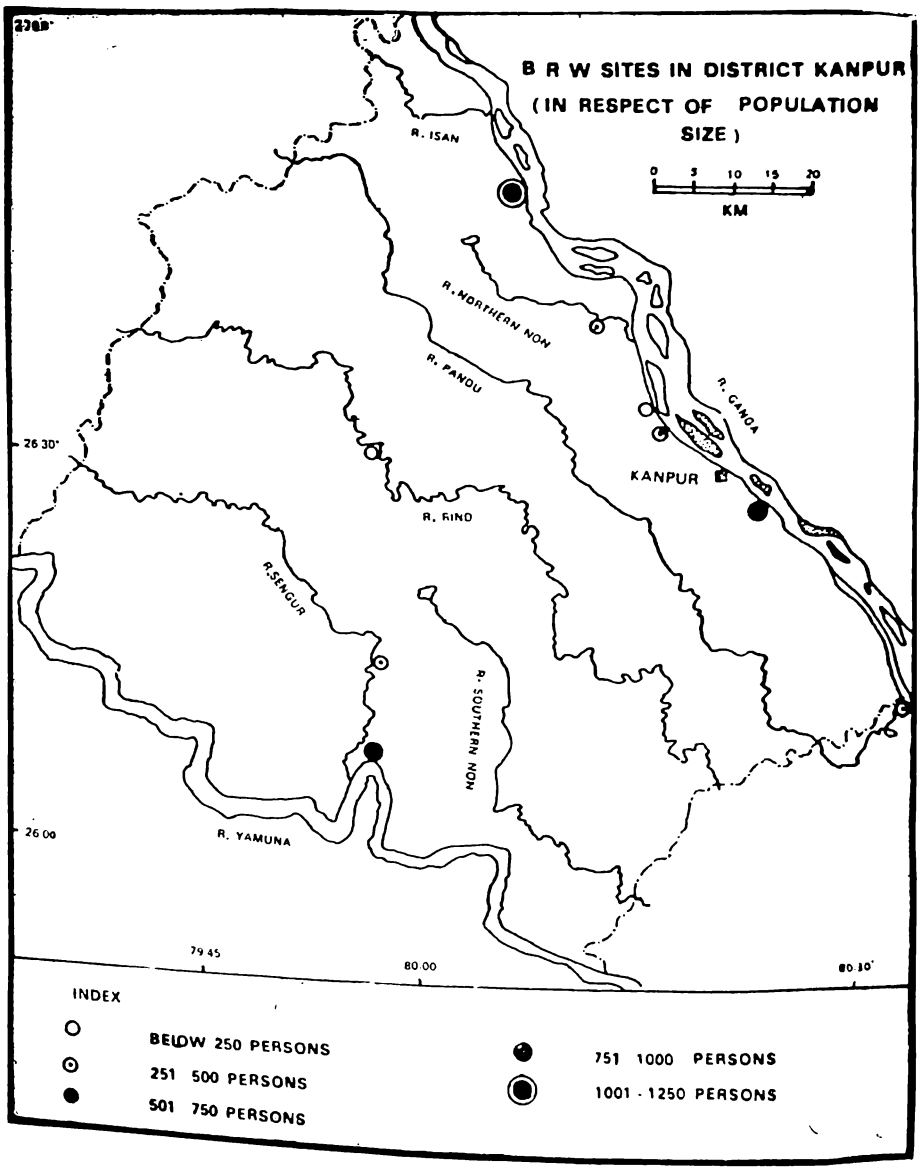



Fig. 2

Table 7

Estimate of Population in Kanpur During different Cultural Periods

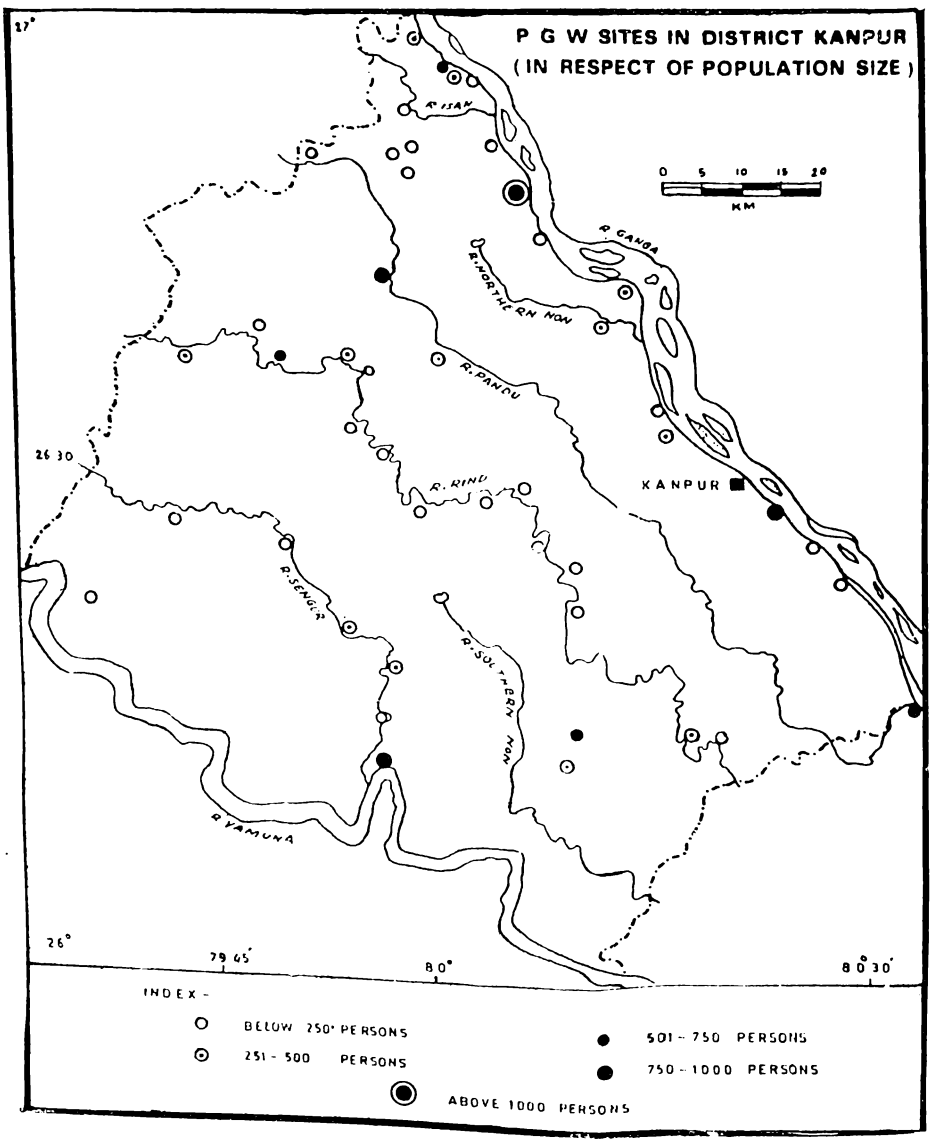
| Cultural Periods | Population in G-R doab | Percentage | Population in Y-R doab | Percentage | Total Population |
|---|---|---|---|---|---|
| BRW | 3224 | 69.4 | 1422 | 30.6 | 4646 |
| PGW | 10155 | 70.0 | 4354 | 30.0 | 14509 |
| NBPW | 23968 | 66.0 | 13941 | 34.0 | 37909 |
| Early Historic | 49045 | 62.0 | 30032 | 38.0 | 79077 |

Table 8

Number of sites in Respect of Population Size During Different Cultural Period

| Cultural Periods | Population size in persons | No. of Sites in G–R Doab | Y–R Doab | Total |
|---|---|---|---|---|
| BRW | Below 250 | 1 | 1 | 2 |
| | 251–500 | 3 | 1 | 4 |
| | 501–750 | – | – | – |
| | 751–1000 | 1 | 1 | 2 |
| | Above 1000 | 1 | – | 1 |
| | Total | 6 | 3 | 9 |
| PGW | Below 250 | 17 | 9 | 26 |
| | 251–500 | 8 | 4 | 12 |
| | 501–750 | 3 | 1 | 4 |
| | 751–1000 | 2 | 1 | 3 |
| | Above 1000 | 1 | – | 1 |
| | Total | 31 | 15 | 46 |
| NBPW | Below 250 | 22 | 19 | 41 |
| | 251–500 | 18 | 19 | 37 |
| | 501–750 | 7 | 4 | 11 |
| | 751–1000 | 5 | – | 5 |
| | 1001–1250 | 1 | – | 1 |
| | 1251–1500 | 2 | 1 | 3 |
| | 1501–2000 | – | – | – |
| | Above 2000 | 1 | – | 1 |
| | Total | 56 | 43 | 99 |
| Early Historic | Below 250 | 19 | 16 | 35 |
| | 251–500 | 27 | 22 | 49 |
| | 501–750 | 11 | 11 | 22 |
| | 751–1000 | 9 | 7 | 16 |
| | 1001–1250 | 5 | 1 | 6 |
| | 1251–1500 | 3 | 1 | 4 |
| | 1501–2000 | 4 | 3 | 7 |
| | 2001–3000 | 1 | – | 1 |
| | Above 3000 | 1 | – | 1 |
| | Total | 80 | 61 | 141 |

doab (Table 8, Fig. 3). Mean population per settlement during this period was 315 (Table 9) and the average population per sq. km. was 2.35 persons. The average population per sq. km. in the G-R doab was 3.34 and in the Y-R doab it was 1.39 (Table 10).




Fig, 3

During the NBPW period total population of the district was 37,909. The number of inhabitants in the G-R doab was 23,968 (66%) and in the Y-R doab 13,941 (34%). During this

Table 9
Mean Population per Settlement During Different Cultural Periods

| Cultural Periods | G–R Doab | Y–R Doab | Tatal Mean |
|---|---|---|---|
| BRW | 537 | 474 | 516 |
| PGW | 328 | 290 | 315 |
| NBPW | 428 | 342 | 383 |
| Early Historic | 615 | 491 | 561 |

Table 10
Average Population per sq. km. During Different Cultural Periods

| Cultural Periods | G–R Doab | Y–R Doab | Mean Average |
|---|---|---|---|
| BRW | 1.06 | 0.45 | 0.75 |
| PGW | 3.34 | 1.39 | 2.35 |
| NBPW | 7.88 | 4.46 | 6.15 |
| Early Historic | 16.13 | 9.60 | 12.82 |

period also we find that a large portion of population (21,968 i. e. 56.5%) was living in the small villages having less than 500 persons. In the category of above 500 population there were 21 settlements of which 16 were in the G-R doab and 5 in the Y-R doab. In the G-R doab there were four settlements with the population more than 1,000 (Table 8, Fig. 4). The pattern of population distribution shows that on 13 sites (site Nos. 6,39,61,68,71,74,88,124,129,136,139,140 and 143) population remained at the level of PGW period. Most of these sites are on the tributaries or away from the rivers. Settlements on the bank of the Ganga show a remarkable increase in size. The total increase in some cases was more than 250 percent.

The mean population per settlement during the NBPW period was 383 persons (Table 9). The population per sq. km. in the district was 6.15. It was 7.88 persons per sq. km. in the G-R doab and 4.46 persons in the Y-R doab.

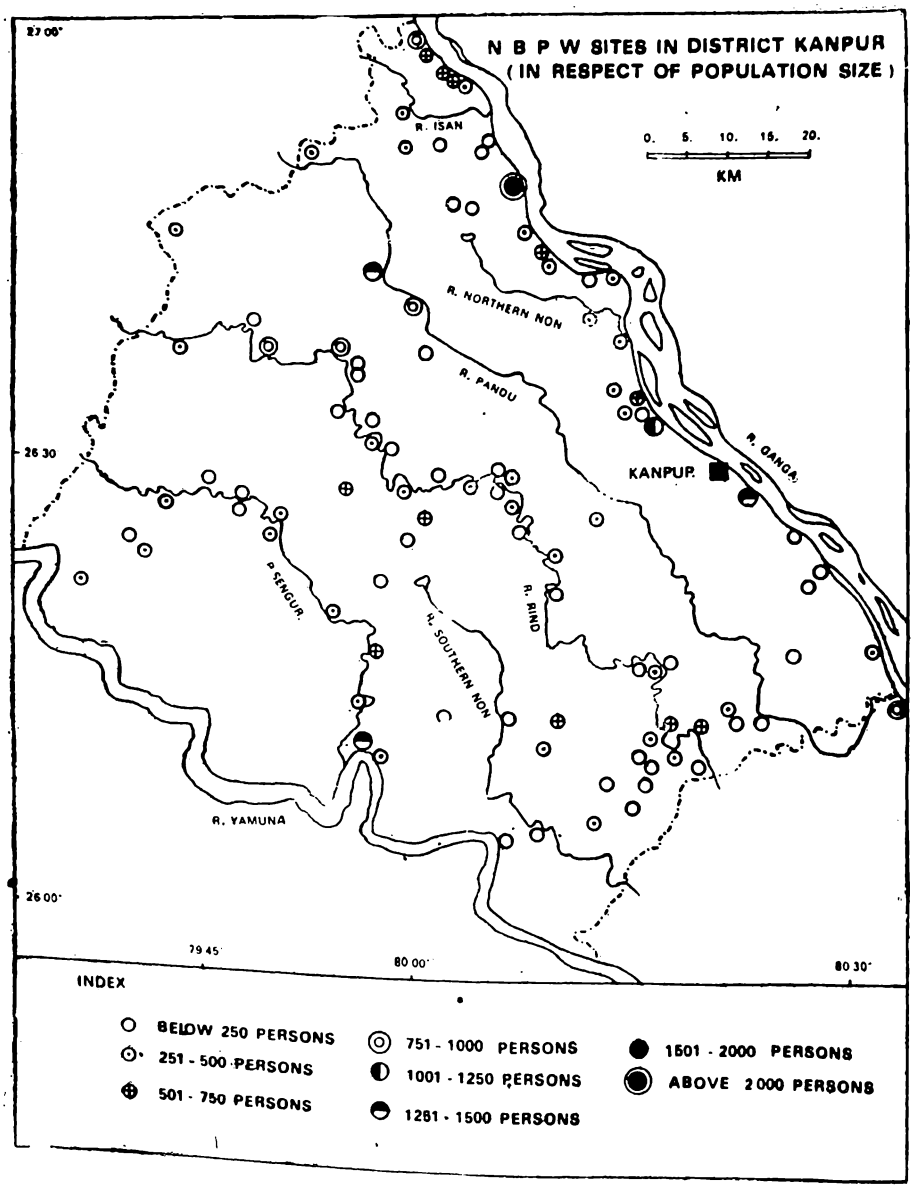



Fig. 4

During the Early Historic period total population was 79,077 and was much widely distributed in comparison to the previous periods. The population in the G-R doab was 49,095 (62% of the total as against 66% during the NBPW and 70% during the PGW and BRW periods) and in the Y-R doab it was 32,032 (38% of the total as against 34% during the NBPW and 30% during the PGW and BRW periods). It is important

to note that of the 88 sites where habitation continued from earlier period, population remained at NBPW level atleast on 38 sites (site Nos. 3,5,8,10,15,17,28,31,32,34,35,48,50,53,55,66, 69,72,74,76,82,91,101,106, 110,114,118, 122,127,128, 132,133, 135,137,138,142,144 and 150; Table 18).

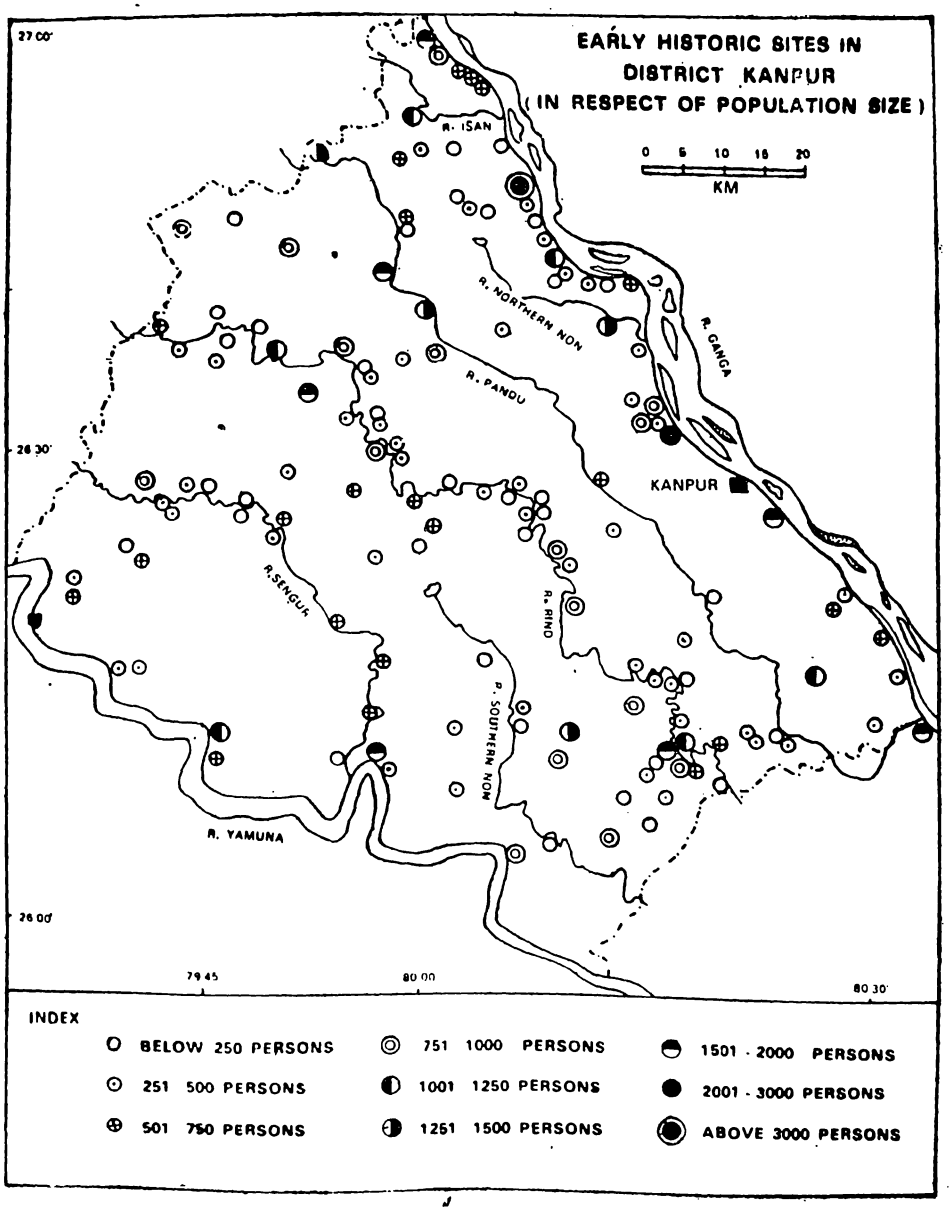



Fig. 5

During the Early Historic period also villages were predominantly small. The total number of settlements having less than 500 persons numbered 84 (59.57%) and in the category of 501-750 persons 22 and in the category of 751-1,000 persons 16. The settlements with the population more than 1,000 were 19. Among these, population of 9 settlements was more than 1500. Of the 57 settlements with the population more than 500, 34 were in the G-R doab and 23 in the Y-R doab (Table 8, Fig. 5).

The mean population per settlement during this period was 561 (Table 9). The density per sq. km. in Kanpur district was 12.82. The density per sq. km. in the G-R doab was 16.13 and in the Y-R doab it was 9.6 (Table 10).

On the basis of analysis presented above, some general observations can now be made.

During the BRW and PGW periods population was mainly confined along the river banks. Only six PGW sites are located away from the rivers but they are near the large low-lying swampy areas which take the shape of lakes during the rainy season. These swampy areas must have been regular lakes during the early periods. The settlements in general were small but in the G-R doab and especially along the bank of the Ganga settlements were comparatively bigger in size (Fig. 3). The settlements along the tributaries show a tendency of fission after reaching maximum to a size of 500 people. They could not grow bigger in size as the settlements along the Ganga. This fission of settlements along the tributaries must have been due to the non-availability of sufficient good agricultural land near the settlements. Further, the soils along the tributaries are not as fertile as the soils along the Ganga. This must have put the limit on the size of local units. The sparseness of popoulation along the rivers Yamuna and the Sengur can be partially explained by the presence of Kankary ravines which extend up to six to eight km. from the banks. Soils along the rivers are most unpromising. Only at some places along the bank of Sengur we find narrow strips of fresh alluvial land and near its confluence with the Yamuna there is

a wide area of fresh alluvial deposit of high agricultural value. This factor explains the location of a few settlements along the Sengur and the site of Musanagar on the bank of the Yamuna.

Table 11

Number of Settlements and Populatian in different categories (in respect of population size) During Different Cultural Periods

| Cultural Periods | Population size | No. of Sites | Percentage | Population | Percentage |
|---|---|---|---|---|---|
| BRW | Below 250 | 2 | 22.22 | 447 | 9.62 |
| | 251–500 | 4 | 44.44 | 1489 | 32.05 |
| | 501–750 | – | — | — | — |
| | 751–1000 | 2 | 22.22 | 1626 | 35.00 |
| | Above 1000 | 1 | 11.11 | 1084 | 23.33 |
| | Total | 9 | 99.99 | 4646 | 100.00 |
| PGW | Below 250 | 26 | 56.52 | 4426 | 30.50 |
| | 251–500 | 12 | 26.08 | 4222 | 29.10 |
| | 501–750 | 4 | 8.70 | 2338 | 16.11 |
| | 751–1000 | 3 | 6.52 | 2439 | 16.81 |
| | Above 1000 | 1 | 2.17 | 1084 | 7.47 |
| | Total | 46 | 99.99 | 14509 | 99.99 |
| NBPW | Below 250 | 41 | 41.41 | 6667 | 17.59 |
| | 251–500 | 37 | 37.37 | 13237 | 34.92 |
| | 501–750 | 11 | 11.11 | 6466 | 17.06 |
| | 751–1000 | 5 | 5.05 | 4014 | 10.59 |
| | 1001–1500 | 4 | 4.04 | 5152 | 13.59 |
| | Above 1500 | 1 | 1.01 | 2373 | 6.26 |
| | Total | 99 | 99.99 | 37909 | 100.01 |
| Early Historic | Below 250 | 35 | 24.83 | 5898 | 7.46 |
| | 251–500 | 49 | 34.75 | 16634 | 21.03 |
| | 501–750 | 22 | 15.60 | 13216 | 16.71 |
| | 751–1000 | 16 | 11.35 | 13941 | 17.63 |
| | 1001–1500 | 10 | 7.09 | 12487 | 15.79 |
| | 1501–2000 | 7 | 4.96 | 11819 | 14.95 |
| | Above 2000 | 2 | 1.41 | 5082 | 6.43 |
| | Total | 141 | 99.99 | 79077 | 100.00 |

A significant change took place in the pattern of population distribution during the succeeding periods i. e. during the NBPW and Early Historic periods. The population extended beyond the range of the distribution of previous periods (Figs. 4,5). A good percentage of population was now living away from the rivers and not necessarily along the lake shore. This could be possible only because of the better technology available to people in the form of cheap and plentiful iron implements. An adequate availability of iron axes was helpful in clearing the then dense mansoonal forests which could not have been cleared with copper or early stage of iron technology during the preceding cultural periods. Further, the increasing population pressure along the river bank and lake shores must have been another factor for the movement of population away from the rivers. The tendency towards the splitting of settlements on the tributaries continued but the limit was now raised to nearly 750 persons. Only a very few settlements could grow beyond this level. Again, on the Ganga the settlements were much larger than those on the tributaries or away from the rivers.

In general, with increase in population from BRW to Early Historic period there has been increase not only in the number of settlements (Table 8) but also in the size of settlements (Table 9). But the most distinct thing is that in the G-R doab not only the settlements are more in number than in the Y-R doab but also bigger in size. Thus, the average density of population per sq. km. is more in the G-R doab than in the Y-R doab confirming the present pattern of population density in the same area (Tables 2, 10).

After the above analysis of size and distribution of population in the area we shall now turn towards a comparison of the past and present pattern of the settlement and population distribution in the different categories (according to size). Table 12 which is combined and slightly rearranged version of Tables 3 and 11 gives the percentage of settlements and population on them in different categories right from BRW

to the present. The analysis clearly shows that from PGW to Early Historic period there has been a gradual increase in the size of settlements and the population living on them. The number of settlements in small category and the population living on them had gradually declined while the number of settlements in the higher categories have increased and so the population living on them. After the Early Historic period's distribution pattern when we look at the *Census Reports* of this century we find that from Early Historic period to 1941 the pattern of population and settlement distribution did not change much. The stabilization in the ratio of settlements and population that came in the beginning of the Christain era continued up to the first half of this century. This suggests that althrough the nearly two thausand years the population on the settlements was forced to split after reaching to a certain limit and from a new settlement. A rough idea of the settlements of medieval period also proves this. But it was after the second World War due to the health care, and relief provided by the government and other organisations at the time of famine, flood, drought and epidemics there has been rapid growth in the population. The unavailability of the land for new settlements is resulting in the increase in the size of settlements.

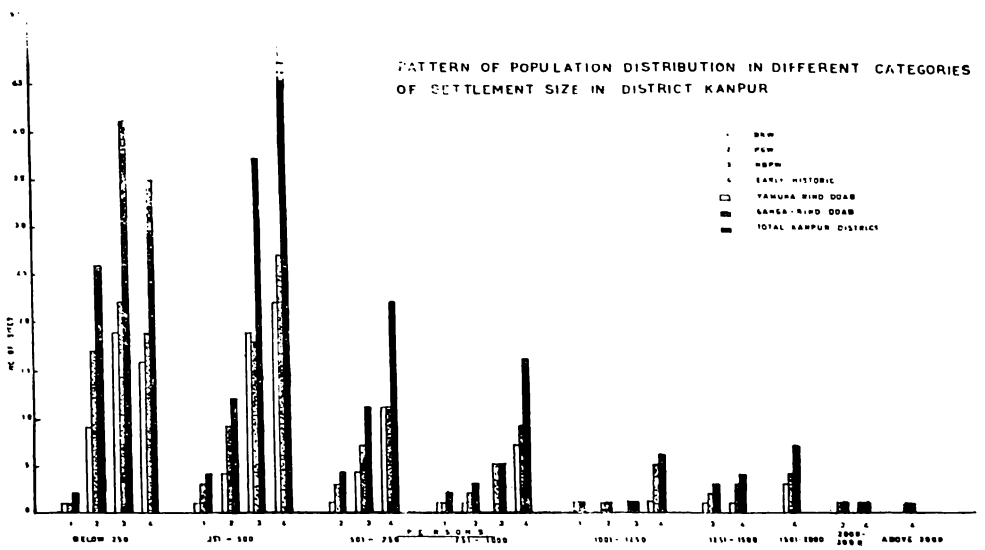



Fig. 6

Table 12

Percentage of villlages and population in different size categories from second millennium B. C. to the present

| Cultural Periods/Year | Less than 500 | | 500-999 | | 1000-1999 | | 2000-4999 | | 5000-9999 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| P G W | 82.60 | 59.60 | 15.22 | 32.92 | 2.17 | 7.47 | — | — | — | — |
| NBPW | 78.78 | 52.51 | 16.66 | 27.65 | 4.44 | 13.59 | 1.11 | 6.26 | — | — |
| Early historic | 59.57 | 28.49 | 26.49 | 34.34 | 12.05 | 30.74 | 1.41 | 6.43 | — | — |
| 1901 | 63.80 | 30.00 | 23.00 | 30.20 | 10.70 | 26.90 | 2.40 | 12.40 | 0.10 | 0.50 |
| 1911 | 67.25 | 28.28 | 20.99 | 25.16 | 9.89 | 22.44 | 1.82 | 8.45 | — | — |
| 1921 | 68.60 | 35.50 | 21.50 | 32.40 | 8.40 | 23.90 | 1.40 | 7.50 | 0.10 | 0.70 |
| 1931 | 67.05 | 26.92 | 21.85 | 24.99 | 8.13 | 19.12 | 2.01 | 8.40 | 0.05 | 0.54 |
| 1941 | 61.41 | 20.14 | 25.35 | 21.97 | 10.45 | 17.63 | 2.72 | 8.90 | 0.10 | 0.67 |
| 1951 | 55.60 | 24.30 | 27.40 | 30.80 | 13.40 | 27.60 | 3.60 | 17.30 | — | — |
| 1961 | 46.30 | 18.10 | 30.90 | 29.50 | 17.90 | 32.90 | 4.50 | 16.70 | 0.40 | 2.80 |
| 1971 | 36.70 | 12.20 | 33.00 | 25.90 | 22.00 | 33.80 | 7.50 | 22.90 | 0.80 | 5.20 |

1. Percentage of villages in this class to the total number of villages.
2. Percentage of population in this class to the total population.

**Population Densities**

While dealing with the distribution pattern of population in Kanpur district we have seen that during the earlier periods (BRW and PGW) population was mainly confined to the river banks and lake shores during the NBPW and Early Historic periods due to increasing pressure on the river banks and lake shores and newly acquired technology of agriculture population started moving away from the rivers and lakes. But largely population was confined to the good land areas except in the case of Y-R doab where we find sometimes the settlement of Early Historic period located in not very promising areas.

The size and density of population in the two doabs are significantly different. It is much more apparent in the case of rivers. What may have been the factors governing the size and density ? Technology ? Environment ? Social factors ? Social factors seems to have been same for the whole area and so was the available technology to exploit the environment. Therefore, environmental factors and the resource availability appear to be the main factors in the population size and density. With a given population of plants and animals in an area there is a theoretical maximum of human population that can be supported. One thing is certain that man can not and may never may be able to use the total food potential in the environment. In the first place if he did so, nothing will be left for future but at the general level what is important here is the relative availablity of food resources and the land exploitation. The land potentials must be the one reason which limited the size and density of population.

Another factor which seems to have affected the size and density of population is the rainfall. Birdsell (1953, 1975) has studied the relationship between the rainfall and population densities. He investigated the relationship of 165 tribes with 65 environmental variables and found that among all the variables rainfall was one of the best indicators for population density. Areas with higher rainfall have greater density of

population. Martin and Reed (1973) while working with data on African hunter-gatherers obtained the similer results. Vidal de la Blache (n. d.) in his work *Le peuple de l' Inde* traces a causal connection between population density and rainfall. He concludes that in the greater rainfall areas the population density will be more than in lesser rainfall areas.[6] This correlation fits well with Kanpur data. The G-R doab with higher rainfall had and even today has greater population density than the Y-R doab which has less rainfall.

One factor that will be interesting to investigate is the spacing of settlements in study area keeping in the mind the relationship between population size in response to the aggregated and the scattered economic resources. Scattered, sedentary resources are exploited by small dispersed groups. If the yield of resources in an area is low we should expect the regional density of settlements to be small and the catchment territory to be large. In other words the spacing between the settlements will be wide.

From the changing pattern of population size and density (Table 7, Fig. 7) during the second and first millennium B. C. in Kanpur and so in the G-R and Y-R doabs we can have some idea of population movement from one area to another.

During the BRW and PGW periods nearly 70% of the total population was living in the G-R doab and only 30% in the Y-R doab. But during the NBPW and Early Historic periods the difference is reduced. The difference which was 40% during the BRW and PGW comes down to 32% during the NBPW period and 24% during Early Historic period. The narrowing gap between the two areas can be attributed to the peoples' migration to Y-R doab from G-R doab. During the recent periods also with the increasing population in the G-R doab people migrated in the sparsely populated areas of the Y-R doab. However, this does not exclude the possibility of people coming from other areas.

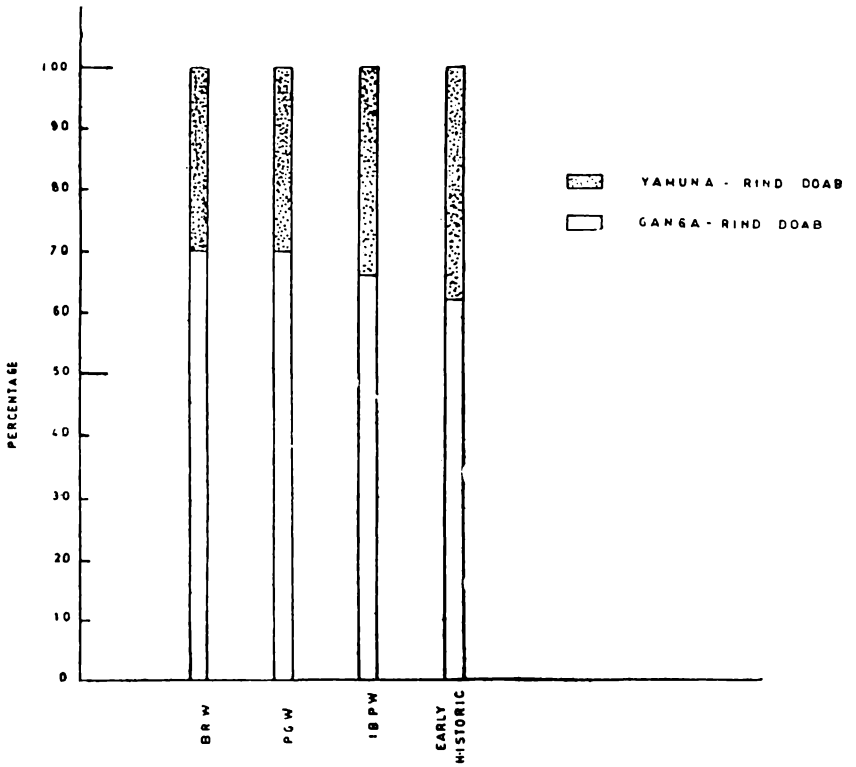



Fig. 7 Distribution Pattern of Population in District Kanpur

## Spacing Pattern of Settlements

Now we turn to the spacing pattern of the populations during the protohistoric and the early historic periods. We would see this pattern both in the context of size of settlements and the economic potentialities of the area.

During the BRW period there were only 9 settlements in the district. The average spacing was 29 km. Because of the limited number of settlements ranking has not been done for this period.

During the PGW period, of the 46 settlements, 38 were small villages, four big villages and four regional centres (Table 13). The average spacing of the small villages was 13 km., big villages 31 km. and regional centres 45 km. (Table 14).

Table 13

Number of Settlements in Different Categories During Prothistoric and Early Historic periods in Kanpur District.

| Cultural Periods | Regional Centre | Big Village | Small Village |
|---|---|---|---|
| PGW | 4 | 4 | 38 |
| NBPW | 5 | 16 | 78 |
| Early Historic | 19 | 38 | 84 |

Table 14

Average Spacing of Settlements in Different categories during the Protohistoric and Early Historic periods in Kanpur District

| Cultural Periods | Regional Centre | Big Village | Small Village |
|---|---|---|---|
| PGW | 45 | 31 | 13 |
| NBPW | 40 | 19 | 9 |
| Early Historic | 20 | 12 | 7 |

During the NBPW period, of the 99 settlements 78 were small villages, 16 big villages and five regional centres. The average spacing of small village, big villages and regional centres was 9 km., 19 km. and 40 km. respectively during this period as against 13, 31 and 45 km. during the PGW period (Table 14, Fig. 8). Thus, there was a positive reduction in the spacing distances among the settlements of all types.

During the Early Historic period, of 141 settlements 84 were small villages, 38 big villages and 19 regional centres. The average spacing of the villages was 7.5 km., big villages 12 km. and of regional centres 20 km. (Table 14, Fig. 8). The spacing pattern of this period shows that there is only slight reduction in the spacing of small village in comparison to the previous period but the growth of small villages into big villages and big village into regional centres seems to have been very rapid. This growth considerably reduced the spacing of big villages and regional centres (Lal 1984a : 193).

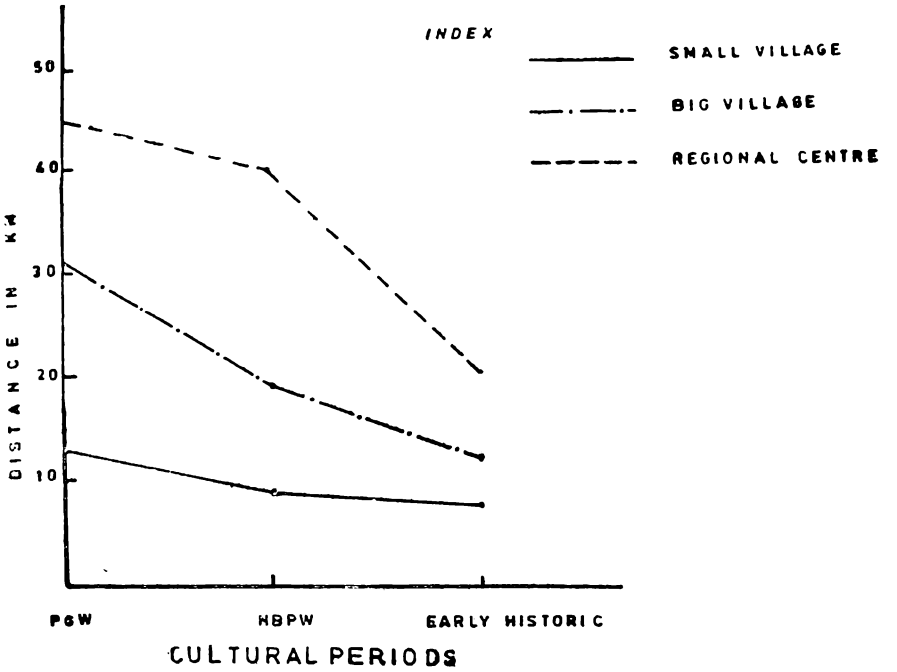



Fig. 8 Average spacing between two settlements of a given category during different cultural periods in Kanpur district.

It would be interesting to see if factors other than size, affected the spacing of settlements. King (1961) carried out a multivariate regression analysis of several alternative hypotheses in the spacing pattern of towns in Washington state. In his study spacing was seen as a function of a settlement, its occupational structure and characteristies of the zone in which it was located. His study showed that the spacing of settlements was governed not only by the size of population but also by the economic potentialities of the area. He concluded that settlements of a given type were likely to be widely spaced where (i) rural population density is low, (ii) farming is extensive, (iii) agricultural production is low, and (iv) overall population density is low.

We have already seen how the size of settlements govern the spacing. In the following few paragraphs we will test King's finding keeping in mind that the economic poten-

tialities of the Ganga-Rind doab (G-R doab) is greater than that of the Yamuna-Rind doab (Y-R doab).

During the PGW period the average spacing of small villages in the G-R doab was 11 km. while in the Y-R doab it was 16 km. The average spacing of big village in the G-R doab was 25 km. and in the Y-R doab it was 45 km. The average spacing of regional centres was 36 km. in the G-R doab while in the Y-R doab there was only one regional centre. (Table 16, Fig. 9).

During the NBPW period the average spacing of small villages and big villages was 8 km. and 15 km. respectively in the G-R doab while it was 10 and 28 km. respectively in the Y-R doab. The spacing of the regional centres in the G-R doab was 31 km. while in the Y-R doab there was only one regional centre (Table 16, Fig. 9).

Table 15

Average Spacing of Settlements During the Protohistoric and Early Historic Periods in Ganga-Rind and Yamuna-Rind Doab

| Cultural Periods | Ganga-Rind doab | Yamuna-Rind doab | Kanpur general |
|---|---|---|---|
| BRW | — | — | 29 |
| PGW | 11 | 16 | 13 |
| NBPW | 8 | 10 | 9 |
| Early Historic | 6 | 8 | 7 |

Table 16

Average Spacing settlements in Various categories in the Ganga-Rind, and Yamuna-Rind doab

| Cultural Periods | Regional Centre | | Big Village | | Small Village | |
|---|---|---|---|---|---|---|
| | G–R doab | Y–R doab | G–R doab | Y–R doab | G–R doab | Y–R doab |
| PGW | 36 | — | 25 | 45 | 11 | 16 |
| NBPW | 31 | — | 15 | 28 | 8 | 10 |
| Early Historic | 16 | 28 | 11 | 14 | 7 | 8 |

During the Early Historic period the average spacing of small village, big village and regional centres was 7 km. 11 km. and 16 km. respectively in the G-R doab while it was 8 km. 14 km. and 29 km. respectively in the Y-R doab (Table 16, Fig. 9).

These differences in the spacing patterns in the two ecological zones of the district show that it is not only the size of the settlements that determines the spacing among them but also the economic potentialities of the area.

A comparative study of the spacing pattern of villages during the protohistoric and early historic period shows that the pattern of population distribution remains the same. The changes we see are more quantitative in nature than qualitative.

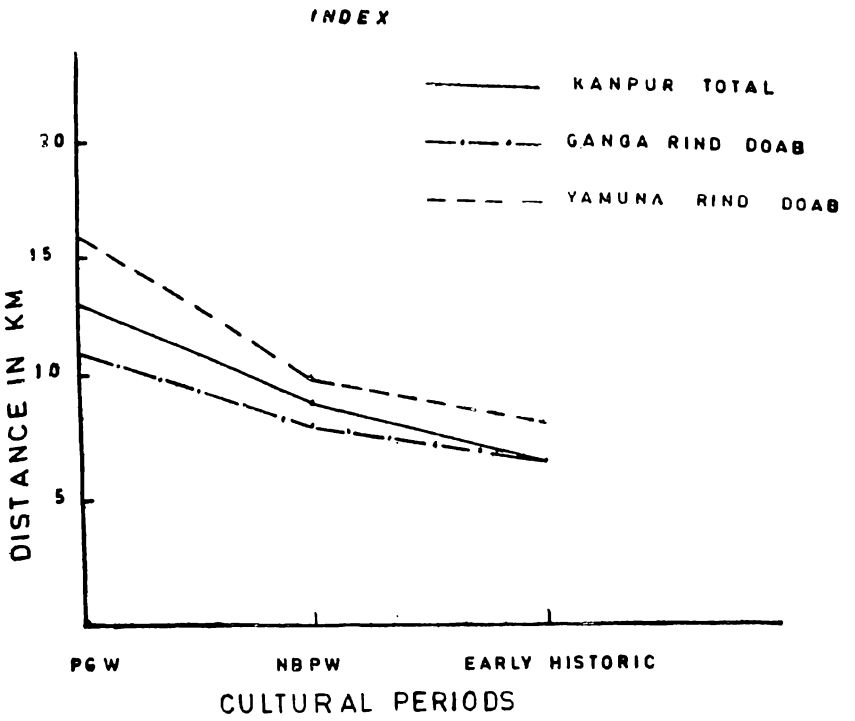



Fig. 9 Average spacing between two Settlemnts in Ganga-Rind, Yamuna-Rind doab and total Kanpur district

**Growth Rate of Population**

Population growth rate has recently become the central issue in archaeological models for culture change (Binford 1968; Boserup 1965; Flannery 1969; Smith 1972; Smith and Young 1972). Carneiro and Hilse (1966) provided an estimate of 0.1% for annual growth rate during neolithic period in the Near East on the basis of guess-estimate of 50,000 to 100,000 persons at the beginning ef neolithic period and about 1-12 million persons at about 4,000 B. C. The figures indicate a probable growth rate between 0.08 and 0.12% per year. Hassan (1973) used the data obtained by Hole *et al.* (1969) from Deh Luran and arrived at a estimate of the annual growth rate of 0.08% during dry farming and 0.12% during irrigated farming periods. A lower annual growth rate of 0.03% was estimated for the period preceding the neolithic and 0.23% for the period immediately after the neolithic (Hassan 1973 : 539). Cowgill (1975) using population data from many parts of the world came to conclusion that annual growth rates between 0.01 and 0.02% are common for over all regional trends for B. C. and early A. D. periods. For intensive agricultural societies there have been several estimates. The annual growth rate from late Uruk period to Dynastic period in southern Mesopotamia has been estimated to be slightly less than 0.5% (Hassan n. d.). At Ixtapalapa, Mexico two periods of rapid population growth between 1200 B. C. and 1520 A.D· are characterised by annual growth rate of 0.59 percent and 0.39% (Hassan 1973). At Kaminaguyu, Guatemala the annual growth rate from about 800 B. C. to 700 A. D. is thought to have been 0.1% on the average (Hassan 1973).

On the basis of total population estimated for Kanpur district for different cultural periods the average annual growth rate from 1350 B. C. to 250 B. C. comes to 0.21% and from 250 B. C. to 150 A. D. it comes to 0.17% (Fig. 10).

It is interesting to note that statistically estimated population from 1350 to 250 B. C. from a base population of 4646

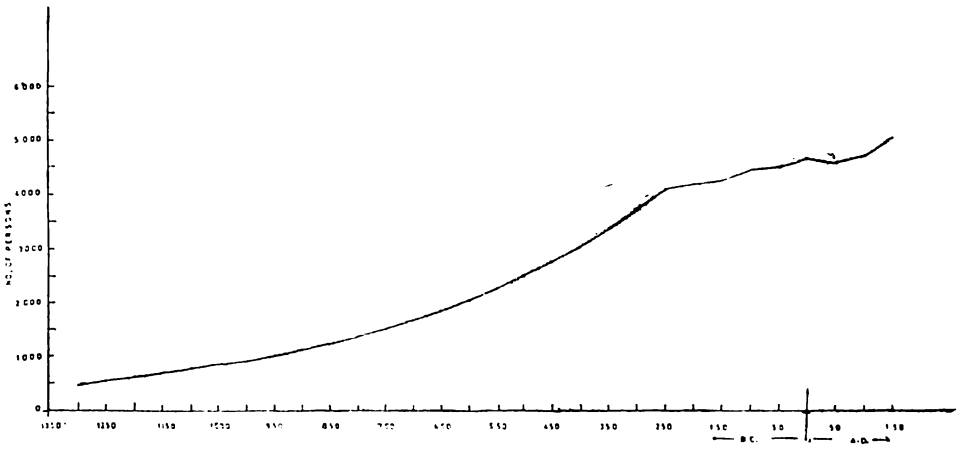


Fig. 10 Probable population growth per 50 years in District Kanpur.

multiplied by an annual growth rate of 0.21%, the floor area population in 750 B. C. and 250 B. C. are in close aggrement. The floor area population in 750 B. C. was 14,509 while statistical population comes to 15,559, a difference of only 1050. In 250 B. C. the floor area population was 37,909 while statistically estimated population comes to 38,500, a difference of only 615. But from 250 B. C. to 150 A. D. the growth rate came down. If we apply the annual growth rate of 0.21% we get the total population to be 95,390. This is 16,693 more than the floor area population. The floor area population can be reconciled only if we assume an annual growth rate of 0.17% which will give a population of 79,005, just 72 less than the floor area population.

To this exponential growth several valid objections can be raised. Bronson (1978 : 38) has pointed out that if we consider the probable history of population within a restricted area, as is the case here, the exponential growth model becomes unsatisfactory as a predictor of demographic change and density. According to him in a restricted area the growth curve is always logistic, instead of exponential.

The net increase in the population of Uttar Pradesh in 50 years (1881-1931) was 10.6% (Table 17). From Turner's (1933 : 24-28) account of the general conditions that prevailed in the state during those 50 years we find that most of the natural factors affecting population growth were operating without much human interference. The decade from 1881-1891 has been described as prosperous, immune from serious calamities and fairly good in general conditions. Between 1891 and 1901 there was a series of famine which affected the growth rate considerably. Between 1901 and 1911 there was a decrease in population due mainly to famines of 1907 and 1908 and exceptionally bad maleria and plague epidemics in 1908. In the decade 1911-21 the state was badly hit by epidemics like maleria, plague, cholera and influenza in 1911-12, 1917-18, 1918-19 and 1919-20. The failure of rains in 1913-14, 1918-19 and 1920-21 also caused considerable decrease in population growth. The decade 1921-31 was free from serious epidemics. The rainfall was timely, crops were good and the general health condition of the people was also good.

From the above brief description we can see that several factors like failure of rains, desease and famine affect population growth considerably. Similar or even worst conditions can be imagined to have prevailed during the protohistoric and early historic periods.

Table 17

Population Growth in Uttar Pradesh Between 1881 and 1931

| Year | Total Population | Variation in Percentage |
|---|---|---|
| 1881 | 43,776,180 | |
| 1891 | 46,501,345 | +6.3 |
| 1901 | 47,312,312 | +1.7 |
| 1911 | 46,806,484 | -1.0 |
| 1921 | 45,374,939 | -3.1 |
| 1931 | 48,408,763 | +6.7 |
| | Net increase | +10.6 |

Now, if we draw a population growth curve for Uttar Pradesh between 1881 and 1931 we see that the curve is not exponential but logistic in nature (Fig. 11A). This logistic growth curve was possible to obtain because we have the actual population figures for each decade from 1881 to 1931. If in the place of these decennial figures we had only total population figures for years 1881 and 1931 the growth curve would have been exponential in nature (Fig. 11B). Our data for protohistoric and early historic periods fall in the latter category. Since we do not have total population estimates at various points we cannot draw a logistic growth curve even if the actual population growth has been in that manner.

**Retarded Population Growth**

From the preceding analysis of population growth we see that there was a steady population growth from 1350 B. C. to 250 B. C. but it declined after 250 B. C. The reasons for this decline in the growth rate may not be possible to explain fully but some speculations can be made. The explanation may lie partly in the break-up of the Mauryan empire after the death of Ashoka the Great. The smaller states that came into existence were continuously warring with each other. At the same time northern India witnessed several invasions by external tribes like Sakas, Indo-Bactrians, Parthians and Kushanas. Stability and peace in the Ganga-Yamuna doab was restored only with the establishment of Kushan empire in the second half of the first century B. C. The frequent wars must have taken heavy toll not only of the healthy men in the society but also seriously impared the administrative system and reduced its effectiveness in rendering relief during famines, epidemics, floods etc. Singh (1975 : 357) considers wars, famines and floods as the major reasons for the decline in the population during 5th-6th century B. C. when the political and the social condition of India was almost same as that of a couple of centuries before and after Christ. Renfrew (1972 : 230) considered warfare as the major reason for the decline in the population growth in Coconia, Eubia and Cyclades during the Neolithic and Bronze Age periods.

A

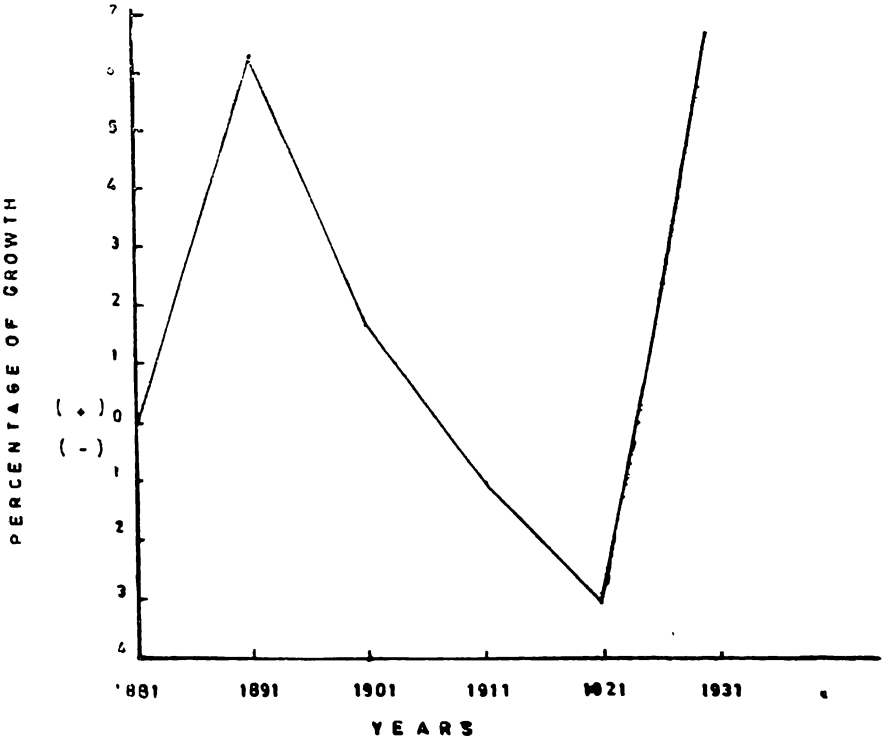



Fig. 11 A

B

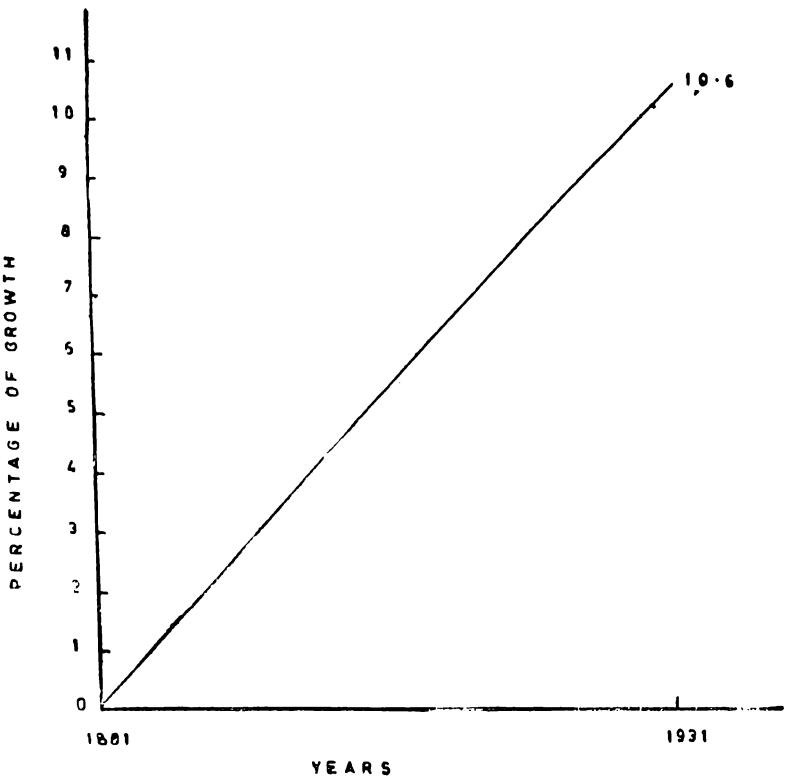



Fig. 11 B
Population Growth in Uttar Pradesh

Other factors which affect population growth are technology for exploiting the natural resources and the carrying capacity of the area. It has been argued (Maynard-Smith 1974 : 16) that when a population enters a hitherto uninhabited area or when new modes of production make the growth possible, a very rapid rate of growth in population is experienced and the curve is first exponential. But when population approaches the level of exhaustion of the available resources the rate of growth diminishes, and may reach zero percent. The logistic equation $dt = dx\text{-}bx^2$ describes such pattern of growth. This, of course, is a kind of simplification that is commonly made when speaking of demographic process and it naturally masks the complexity of any real cause. In fact, it is in the upper part of the logistic curve that the population stress arises. In the exponential curve both population and the rate of growth continue to increase. In the logistic growth although the population continues to grow for a considerable period, it grows slowly. Renfrew (1976 : 215) points out that the rate of increase will diminish only if either death rate is increased or birth rate is decreased and it is here the notion of population stress is relevant.

However, the subject of demographic studies for early societies is a difficult and uncertain one. The factors affecting the population growth are so numerous (Fig. 12) that it is difficult to pin-point any single one. While the logistic growth pattern has been demonstrated in several cases (Schacht 1930; Renfrew 1972; Ammarman *et al.* 1976), the precise mechanism of its operation is not well understood. What is fairly well established is that the population level—the saturation point at which the growth estabilizes—is generally well below the theoretical carrying capacity of the area (Birdsell 1957; Binford 1968). The amount of food procured by a specific ecological/technologic adaptation sets a limit on the population size. An increase in this amount, as a result of an innovation or the occupation of prestine environment will allow the population to grow to a new limit. If the population exceeds this limit the

reduction of resources will lead to lowering of the maximum potential population size and a reduction in the population. The mechanism may be repeated generating oscillation around the average population size. The surplus population may on the other hand immigrate, if adjascent territories are open and ecologically favourable.

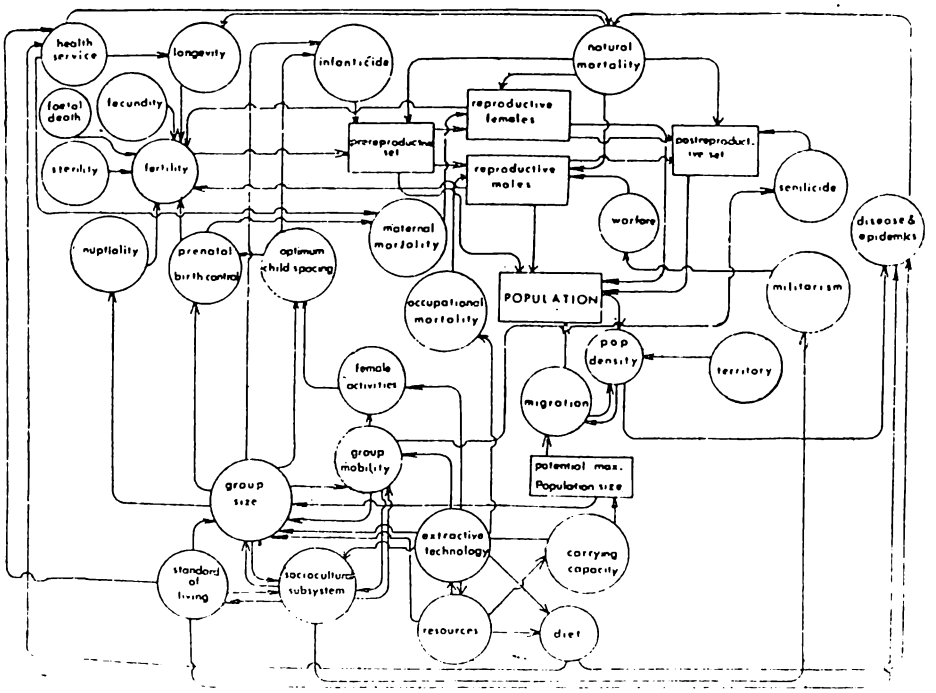



Fig. 12 A schematic model showing interrelationship between demographic factors directly related to population growth (e. g. nuptiality, birth control, fecundity, sterility, foetal death, age/sex structure, fertility, and mortality) and factors related, to the pattern of ecological/cultural adaptation (e. g., extractive technology, group mobility, local group size, carrying capacity, standard of living, and diet).

## Population of the Ganga-Yamuna Doab

On the basis of the data obtained from Kanpur we can have some idea of the population during different cultural periods for the entire Ganga-Yamuna doab. The total area of the Ganga-Yamuna doab measures 69,000 sq. km. By extrapolating the Kanpur data we get following population figures for the different cultural periods : BRW 52,000; PGW 163,300; NBPW 426,000 and Early Historic 900,000. These estimates

are only for the rural population because in the absence of the city in the past in the present area of Kanpur district no estimate for the urban population has been made. It may be reasonable to suggest that during NBPW and Early Historic periods 10% of the total population lived in the four cities—Hastinapura, Mathura, Kampilya, and Kausambi—of the doab. By adding this 10% we get the total population of 468,000 for NBPW and 990,000 for Early Historic period.

Table 18

Settlement-wise population estimate (@ 270 persons pea hect.) during different cultural periods in Kanpur District

| S. No. | Name of site | Pd. A | Pd. B | Pd. C | Pd. D |
|---|---|---|---|---|---|
| 1. | Ainti | — | 189 | 284 | 406 |
| 2. | Akbarpur | — | — | — | 406 |
| 3. | Amauli | 6 | — | 216 | 216 |
| 4. | Ankin | — | 406 | 113 | 1626 |
| 5. | Antapur | — | 216 | 325 | 325 |
| 6. | Atwa | — | 298 | 298 | 569 |
| 7. | Attwa | — | — | 195 | — |
| 8. | Aujhan | — | 406 | 762 | 762 |
| 9. | Auron Tahirpur | — | 174 | — | — |
| 10. | Bachna | — | 216 | 406 | 406 |
| 11. | Badan Newada | — | — | 121 | 219 |
| 12. | Badshahpur | — | — | 293 | 455 |
| 13. | Bahbalpur | — | — | — | 813 |
| 14. | Bairi | — | — | 474 | 949 |
| 15. | Blai Khurd | — | 195 | 338 | 338 |
| 16. | Banipara Mahraj | — | — | — | 1626 |
| 17. | Bara | — | — | 180 | 180 |
| 18. | Barauli | — | — | — | 271 |
| 19. | Behta | — | — | — | 427 |
| 20. | Berhat | — | — | 174 | 422 |
| 21. | Bewaine | — | 162 | 341 | 593 |
| 22. | Bhadras | — | 271 | 434 | 813 |
| 23. | Bhaseni | — | — | 569 | 1184 |
| 24. | Bhiwan | — | — | — | 271 |
| 25. | Bhisar | — | — | — | 130 |
| 26. | Bhitargaon | — | — | — | 813 |
| 27. | Bihupur | — | — | 153 | 325 |

| S. No. | Name of site | Pd. A | Pd. B | Pd. C | Pd.D |
|---|---|---|---|---|---|
| 28. | Bijaipur | 406 | 406 | 609 | 609 |
| 29. | Binaur | — | — | — | 813 |
| 30. | Birhar | — | — | 358 | 566 |
| 31. | Biria Derapur–A | — | — | 216 | 216 |
| 32. | Biria Derapur–B | — | — | 162 | 162 |
| 33. | Buhnar | — | 189 | 338 | 678 |
| 34. | Chandanpur | — | 174 | 174 | 174 |
| 35. | Chandanpur | — | — | 273 | 273 |
| 36. | Chaparghata | — | — | — | 216 |
| 37. | Chaurah | — | — | — | 528 |
| 38. | Chilauli | — | — | — | 325 |
| 39. | Debipur | — | 216 | 216 | 338 |
| 40. | Deoha | — | 216 | 338 | 1084 |
| 41. | Durgapur | — | — | 162 | 244 |
| 42. | Gaganpura Charsa | — | — | — | 216 |
| 43. | Gahlon–A | — | — | — | 94 |
| 44. | Gahlon–B | — | — | 152 | 356 |
| 45. | Galatha | 406 | 711 | 813 | 1518 |
| 46. | Garhia Sikandra | — | — | — | 373 |
| 47. | Gaupur | — | — | — | 130 |
| 48. | Ghatwa | — | — | 216 | 216 |
| 49. | Gilwat | — | — | 609 | 813 |
| 50. | Gobrauri | — | — | 271 | 271 |
| 51. | Gopalpur | — | — | — | 271 |
| 52. | Goraiya–A | — | — | — | 151 |
| 53. | Goraiya–B | — | — | 298 | 298 |
| 54. | Gurdahi Khurd | — | — | — | 474 |
| 55. | Gurgawan | — | — | 195 | 195 |
| 56. | Hathei | — | — | 183 | 183 |
| 57. | Hathigawan | — | — | 216 | 1084 |
| 58. | Hulasipur | — | — | — | 216 |
| 59. | Indayan | 203 | 203 | 477 | 813 |
| 60. | Indrukh | — | — | 440 | 921 |
| 61. | Jahangirabad | — | 609 | 609 | 1356 |
| 62. | Jajmau | 813 | 813 | 1336 | 1898 |
| 63. | Kakwan–A | — | — | — | 501 |
| 64. | Kakwan–B | — | — | — | 61 |
| 65. | Kamalpur | — | — | — | 389 |
| 66. | Kamsan | — | — | 130 | 130 |
| 67. | Kamasia | — | 509 | 813 | 1220 |

| | | | | | |
|---|---|---|---|---|---|
| 68. | Karankhara | — | 67 | 67 | — |
| 69. | Karchalipur | — | 216 | 645 | 645 |
| 70. | Karchalipur | — | — | 434 | 694 |
| 71. | Kashipur-A | — | 102 | 102 | — |
| 72. | Kashipur-B | — | — | 162 | 162 |
| 73. | Kashipur-C | — | — | — | 271 |
| 74. | Katka | — | 406 | 406 | 406 |
| 75. | Keilai | — | — | 813 | 1310 |
| 76. | Khajuri | — | — | 203 | 203 |
| 77. | Khalla | — | — | — | 271 |
| 78. | Kheora | 244 | 244 | 509 | 868 |
| 79. | Kherakursi | — | 813 | 1356 | 1898 |
| 80. | Khirsa | — | — | — | 273 |
| 81. | Kisankhera-A | — | — | — | 281 |
| 82. | Kisankhera-B | — | — | 158 | 158 |
| 83. | Kishora | — | — | — | 271 |
| 84. | Kismara | — | — | — | 481 |
| 85. | Kurain | — | — | 298 | 813 |
| 86. | Kurtha | — | — | — | 338 |
| 87. | Lalabhagat | — | — | — | 949 |
| 88. | Lamahra | — | 142 | 142 | 254 |
| 89. | Mahrajnagar | — | — | — | 338 |
| 90. | Mahraipur | — | — | 153 | 528 |
| 91. | Mahulia | — | — | 135 | 135 |
| 92. | Mandauli | — | — | 65 | 325 |
| 93. | Mathurapur | — | — | — | 954 |
| 94. | Mati Kisanpur | — | — | 130 | — |
| 95. | Mawar | — | 271 | 406 | 684 |
| 96. | Milanpur | — | 130 | 423 | 560 |
| 97. | Musanagar | 813 | 813 | 1356 | 1627 |
| 98. | Narainpur | — | — | — | 146 |
| 99. | Narkhurd | — | — | — | 684 |
| 100. | Nawabganj | 406 | 406 | 1084 | 2033 |
| 101. | Nibiakhera | — | — | 219 | 219 |
| 102. | Nonha Narsingh | 271 | 271 | 347 | 1423 |
| 103. | Padrilalpur | — | — | 136 | 325 |
| 104. | Pahewa | — | — | — | 271 |
| 105. | Palahpur | — | 271 | 542 | 1186 |
| 106. | Panchgawan | — | 195 | 271 | 271 |
| 107. | Panka | — | — | — | 101 |
| 108. | Panki | — | — | — | 509 |
| 109. | Parsaurah | — | — | — | 101 |

| S. No. | Name of site | Pd. A | Pd. B | Pd. C | Pd.D |
|---|---|---|---|---|---|
| 110. | Pasikhera | — | — | 170 | 170 |
| 111. | Pichora | — | — | — | 352 |
| 112. | Pipergaon | — | — | — | 130 |
| 113. | Pooran Purwa | — | — | 338 | 949 |
| 114. | Pura Sukul | — | — | 121 | 121 |
| 115. | Radhan–A | 1084 | 1084 | 2373 | 3049 |
| 116. | Radhan–B | — | — | — | 338 |
| 117. | Rahmpur Bisdhan | — | 121 | 271 | 1356 |
| 118. | Raipur | — | — | 338 | 338 |
| 119. | Ranipur | — | — | 174 | 325 |
| 120. | Rasdhan | — | — | 357 | 711 |
| 121. | Rasulpur Bhuranda | — | 162 | 338 | 509 |
| 122. | Rataipur | — | — | 305 | 305 |
| 123. | Rataipur | — | — | 121 | 271 |
| 124. | Ratanpur–A | — | 158 | 158 | — |
| 125. | Ratanpur–B | — | — | — | 174 |
| 126. | Reona | — | — | 203 | 338 |
| 127. | Rohini | — | — | 174 | 174 |
| 128. | Sanjeti Badshahpur | — | 509 | 678 | 678 |
| 129. | Sambhalgarh | — | 173 | 173 | — |
| 130. | Salempur Mahera | — | — | — | 174 |
| 131. | Sambhua | — | — | — | 305 |
| 132. | Sandila | — | — | 271 | 271 |
| 133. | Sanihapur | — | 387 | 678 | 678 |
| 134. | Sankim Buzurg | — | — | — | 509 |
| 135. | Sanon | — | — | 352 | 352 |
| 136. | Sapai | — | 216 | 216 | 949 |
| 137. | Sarigang | — | 162 | 427 | 427 |
| 138. | Seng–A | — | — | 213 | 213 |
| 139. | Seng–B | — | 130 | 130 | — |
| 140. | Siddhapur Sheoli | — | 423 | 423 | 949 |
| 141. | Terhwa | — | — | — | 273 |
| 142. | Tegaine | — | — | 509 | 509 |
| 143. | Tora–A | — | 102 | 102 | — |
| 144. | Tora–B | — | — | 418 | 418 |
| 145. | Turraya | — | — | 162 | 162 |
| 146. | Udaipur | — | — | — | 1084 |
| 147. | Udaipur | — | — | 406 | 1626 |
| 148. | Umaran | — | — | 509 | 711 |
| 149. | Uttha | — | 130 | — | 563 |
| 150. | Valmiki Ashram | — | — | 325 | 325 |

**Notes :**

1. It is important here to state briefly some of the problems connected with explored data and the population estimates.

First of all, the total number of sites. It is rather difficult to say with any degree of certainity that the total number of sites discovered is exactly the same that were occupied during different cultural periods. Some sites on the river banks might have got totally eroded due to changing river course. Sites with thin habitation deposit often get leveled which being converted into agricultural field and after the lapse of some time all the surface indications are lost. Some sites may have got buried under the sprawling city of Kanpur. Further, the possibility of a few sites remaining unexplored cannot be ruled out.

The size of sites during different cultural periods has been decided only on the basis of distribution areas of distinctive pottery types. With this criterion we can be sure only of the terminal period of habitation. Surface exploration allows no firm check on the area of occupation at a site prior to the terminal stage. Thus it remains an assumption that the area represented by a particular type of ceramic represents the actual area occupied during that period. Adams (1965 : 121-24) in his classic study of Diyala plains assumed the area of occupation during the terminal period as the representative area for all the periods represented on the site. Adams feels that the assumption that early areas of habitation equalled maximal (or even aggregate) areas of the latter settlements must tend systematically to increase an estimate the former and this compensates for the percentage of loss the site may have suffered through erosion, alluviation as also for undiscovered sites.

The data from surface collection allow us to presume that all the settlements in the area were occupied contemporaneously and not subsequently within a broad period of several centuries. This fails to take into account the possibility that at least a few sites may have been occupied subsequently or abandoned earlier than others. Thus an insufficient grip on the chronological control on the sites makes it impossible to distinguish the periods ,beyond different cultural levels.

It is also difficult to determine whether the site was temporarily or permanently occupied. The thickness of deposit is not a very reliable indicator of the duration of the site. As Chang says "a pile of industrial waste accumulated by ten flint knappers in one day or

a pile accumulated by one flint knapper in ten days would be difficult, if not impossible to determine" (Chang 1972 : 10) Fig. 13 shaws the variable that might influence the reconstruction of demographic parameters from settlement data.

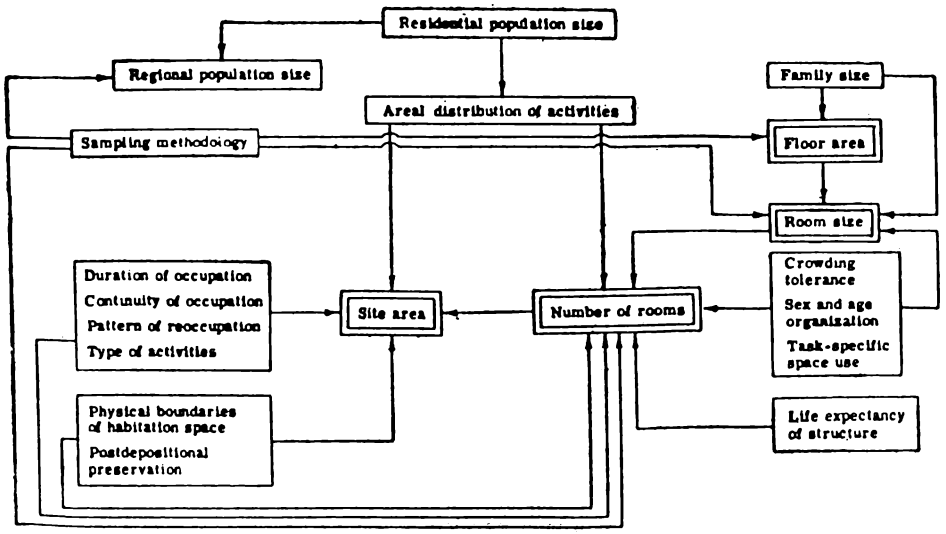



Fig. 13. Variables that might influence reconstruction of demographic parameters from settlement data.

These limitations are indeed very common and most of the time beyond the control of archaeologists. This may sometimes disappoint archaeologists because due to these limitations it is difficult to adequately deal not only with accurate estimates of populations but also several other aspects of cultural and social behaviour of the past people. But we have to put up with these limitations. "Archaeologists must learn to live with the realization that their desire to study the whole cultural systems cannot be realized. Much of the weakness of modern archaeology results from a tendency among archaeologists to treat their discipline as being merely the 'past tense of ethnology' or a kind of 'palaeoanthropology', rather than defining its goals in terms of the potentialities of its data" (Trigger 1978 : 151).

However, it may be pointed out that importance of such work is not in their absolute value of the figures presented for different cultural periods but their relative value. The forces which lead to burial or destruction of sites are sufficiently unbiased for all the sites of different cultural periods. One can always proceed towards a more realistic interpretation within acceptable limits of errors.

2. To estimate the population of the Indus sites Fairservis (1967) compared the excavated house plans with those of modern villages in the same region and thereby established the mean area of ancient houses. Assuming six persons per house and knowing the total floor area he estimated the population at a site.

Frankfort (1950) in his excavation in Mesopotamia found nearly 20 houses in one acre area. With an assumption of 6-10 persons per house he estimated 297 to 494 persons per hectare i. e. 34 to 20 sq. m. per person. He also compared his data with contemporary population of Alleppo and Damascus and found that contemporary living population and past population estimates were in good aggrement. Frankfort's estimate was derived from large densely settled sites and was intended only to apply to individual example of such kind, Its inherent deficiencies are multiplied several times if it is applied to an entire region containing types of settlements whose size and architectural details are not so well known and where the sites have not been completely surveyed.

Adams (1965) estimated Diyala plain's population by taking 3.5 persons per family and 200 persons per hectare. This figure takes into account also the non-residential areas like lanes, gardens, and wells, beside public buildings.

Braidwood and Reed (1957) took the size of population that lives now on the mound of Ebril and arrived at an estimate of 526 persons per hectare (19.5 sq. m. per person) in the towns. Hole and Flannery (1967) while working in Iran assumed, without adducing any numerical data in support of their thesis, that all the sites between 1 and 2 hect. size had on average 100 persons and those of 3-4 hect. size had 200 persons.

3. The estimates obtained from this analysis are not the final words on this problem. The correlation between site area and population is always tentative. Variation in estimate and other inherent source of errors always remain there. Cook and Heizer (1965, 1968) have shown that in the state of California habitation site ranging in size from 370 to 9, 200 sq. m. may have the same number of 30 persons and at the site of 40,000 sq. m 15 to 300 persons. The reasons for such variations are not very clear but it seems that precise relationship between the surface area of a site and population is related to ecological factors of the area in which the site is found. Some what different relationship was obtained for the sites in hilly areas, deserts, and coastal environment and for the sites in which

houses were for single family and those in which multi-family dwellings were common. To sum up, if archaeologists can correlate the population and floor area they can use the formula for other similar sites in the same homogenous area and environment.

4. Even in case of an excavated site the problem of precise estimate of population remains unsolved. It is almost impossible to determine whether all the houses in the settlements were occupied at the same time or at different times, and in the same way it is difficult to say whether all the sites plotted on the distribution map were occupied simultaneously or at different times.

5. In deciding the family size beside considering the Census data one should keep in mind the biological and demographic factors also. Cook (1972 : 13-14) says "If a population is to maintain itself, each reproductive pair must produce two offsprings who survive to maturity. Hence the absolute minimum family size if the group is not to head for extinction, is four. Under usual circumstances, in order to allow for death in early years each pair must produce at least 3 children. Hence the family size will approach five. If additional numbers are to be allowed, and these average one per family the household reaches close to six. Thus it would be expected that if conditions are normal or nearly so, the number of persons in a nuclear family would range from 4.5 to 6.0 If the admission of a supernumerary number is literal, the value may reach 6.5. Indeed, a household number of 7.0 or above may be *prima facie* evidence for domestic extension".

6. This is of course, a wide generalization with numerous exceptions. In a hilly tract or a forested area, for instance Himalayan and Satpura tracts the rainfall is high but density is low. The soil of the area plays quite an important role.

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