

Applied Study of Malthusian law of Population Growth; Statistical Comparison in Indian Experience

Dr.Nathier Abas Ibrahim
Business Economic Collage
AL-Nahrain University

المستخلص

تعد الهند من الدول ذات الحضارة العريقة وتحتل مساحة أكثر من 3 مليون كم² تمتد من جبال الهمالايا في الشمال الى المحيط الهندي في الجنوب وتسمى بشبه القارة الهندية وتشكل مساحتها ما يقارب 2.5% من مساحة العالم وهي دار لما يقارب سدس سكان العالم. وخلال النصف الثاني من القرن الماضي ازداد سكان الهند بما يقارب 650 مليون نسمة وهذا العدد شكل نسبة نمو وكثافة سكانية عاليتين، ولذلك فالبلد بحاجة الى تخفيض معدلات الخصوبة والوفيات، علما بان زعيمها الراحل غاندي كان اول من اوجد نظام تحديد النسل في قارة آسيا وهذا النظام لم يمكن الدولة من تطبيقه على جميع افراد المجتمع بسبب اختلاف الطبقات والاديان ووجود طبقات فقيرة ومهاجرة من منطقة لاخرى داخل البلد لا يمكن السيطرة على تحديد نسلها. تحتل الهند الان المركز الثاني في العالم بعد الصين من حيث عدد السكان إذ تجاوز 1.03 بليون نسمة، ولمرو اكثر من ستين عاما على الاستقلال وتطبيق برنامج تحديد النسل فقد انخفض معدل الولادات من 42 الى 28 لكل 1000 طفل ورافق ذلك انخفاض في معدلات الوفيات وانخفضت نسبة الذكور الى الاناث بمقدار 4% من عام 1901 الى عام 2001.

يعد المجتمع الهندي من المجتمعات شبه المستقرة وقام الباحثان Ebraheem & Biswas في عام 1986 باختبار الفرضيات لهذا المجتمع تحت فرضية انخفاض معدلات الخصوبة ضمن برنامج مخطط مع انخفاض بسيط في معدلات الوفيات بالاعتماد على احصاءات الهند لعامي 1971 و1981 وتأسيسا على فرضيات 1972 Coale للمجتمعات شبه المستقرة. هذا البحث هو محاولة لاختبار الفرضيات ذاتها بالاعتماد على احصاء 2001 وعمل مقارنة بين الاستنتاجين مع تقدير الاحصاءات لبعض السنوات القادمة.

Introduction :

India is one of the earliest known civilization, covering an area of (3287263) sq km, extending from the snow-covered Himalayan heights to the tropical rainforests of the south. India has only (2.5) percent of global land whereas it has to provide home for one-sixth of world's population. on examining the past trends of India's population, it may be observed that during the latter half of the twentieth century, about (650) million populations were added to the country, thus living in a country with a high population density and high growth rate. India in need a transition from high fertility high mortality to a low fertility low mortality and towards stable population situation. India was the first country in Asia which introduced family planning program in the national level in the year (1952) so if we look at fertility transition in comparison to infant mortality rate we get an idea of how India has experienced these transitions will make us understand the overall demographic changes in India. United Nations has projected the total fertility rates below replacement level as (2.1) children per women, so it will be very important to look into details about the mortality – fertility transition and trends of life expectancy at birth of males & females. The declining fertility & mortality & high chance of survival contributions to change in age – composition of population, India being the second most populous country in the world and having around (1.03) billion of population. The sex ratio in India is more skewed towards in recent decades, in the decennial census the number of girls per 1000 boys aged (0 – 6) years was (962) in (1981), (945) in (1991) and (927) in (2001) and the discrepancy was more acute in urban area

from (959 to 906) between (1981-2001) than the rural area (963-934), and that because of the higher mortality rates in female than in male children. Low sex ratios have also been recorded in other Asian countries, most notably China, where (847-877) girls were born for every (1000) boys in (2002), India has a higher fertility rates than China.

At more than (60) years of independence with the programs based on the vision of the first prime Minister to turn India into a technologically & industrially developed country. Indians birth rate dropped from (42-28) live per thousand, this decline in fertility is normally associated with a preceding decrease in the mortality rate. However, sex-ratio for the Indian population suggests that this mortality decline has not occurred equally for both sexes. The female-male ratio declined (0.04) from census 1901-2001.

The population of India has quasi-stable population with high growth rates over decades. Biswas & Ibrahim (1986) examined the hypothesis of this population under the assumptions of consistency decreasing of fertility rates under planned program, with negligible change in the mortality pattern, the researchers used the data of census of India (1971 & 1981), based on generalizing Coale (1972) assumptions for the quasi-stable population with decreasing fertility & constant mortality. This paper is an attempt to test the same assumptions by using census of India (2001) and make comparison for the two results, and predict some of the forthcoming census.

The Model:

Let

the probability of giving birth between the age

the survival probability between the age

At time (t).

Coale (1972) assumptions for the quasi-stable population with decreasing fertility & constant mortality are given by :

Biswas & Ibrahim (1986) generalized this model for Indian population characterized by decreasing fertility & increasing survival probability subject to the condition that decreasing in fertility is more than that of increasing in survival probability, we have the following:

=

2-

3- $R(t) = \text{Net Reproductive Rate (NRR) per woman per year.}$
 $-4B(t) = (\text{birth at time } (t))$

5- (α, β) being the upper & lower age limits of child bearing interval.
 Then

Where $R(0)$ is the net reproductive rate (NRR) at $t=0$.

Also:

Using (2) ,by the mean value theorem of integral calculus ,where α
: The difference equation in $B (t)$ given by

Generalizing Coale's method for (1 & 2) we get;

Where (T_0) is the mean age of child bearing (approximately taken to be equal to T_0). And the solution of equation (3)by using Coales(1972) approach satisfying;

Where (is the variance bof the corresponding stable age distribution denoting by.

Putting $R (0) =1$, we get:

Therefore, equation (3)

We have;

$=P(t)$
Where is the highest possible age for survival

Putting the parabolic solution (4) for $B(t-x)$ we have;

$\Rightarrow$
 $=$

Census of India period is " 10 " years & it has been taken as unit time.
By the mean value theorem of integral calculus we have;

(9)

We have

$\Rightarrow$

In general;

Which shows that the population size will be continuously increasing provided each of (k') 's are non negative & $c(t)$'s are greater than unities, this necessitates;

Also
 $=t, t+1, t+2$

.....

Holding for two consecutive decennium, may be applied over individual years in the following pattern:

1/10

Similarly
10/2

And

$x/10$

The growth rate between is a geometric rate with common ratio;
for $t = t, t+1, t+2, \dots$

$C(x, t)$ & k' but decreasing over time & the growth rate will be decreasing over decades as a quasi-stable population pattern & as long as ;

In the application part we will see the growth rate of India over decades since census 1901 .

Application:

Let;

P (female population corresponding the year (

B (female birth during

$C(x, t)$ The proportion of female population between age $(x, x + 1)$

$C_s(x, t)$ The corresponding stable population .

We have:

For

We use "Simultaneous Equation" method for equation (10) to estimate $(k_1+k_2), T_0, \& \}$. The data collected from census of India 2001 /life tables for the ages (15 – 45) to get $c(x, \& \}$, U.N life tables level 13 to get $c_s(x, \& \}$. Table (1) shows the data collected from census of India 2001 (where total female population is 496454000)

Table (1):Number of female by age group with its proportion;

$C_s(x, t)$	$C(x, t)$	No. Female	Age group
0.1025	0.0932	46275899	15 -
0.0881	0.0875	43442982	20 -
0.0754	0.0843	41864847	25 -
0.0642	0.0744	36912128	30 -
0.0544	0.0696	34535358	35 -
0.0459	0.0521	25859582	40 - 45

The estimated values were:

$= 0.14$

$T_0 = 17.5$

2 - After estimating $(k_1 + k_2), T_0$ we substitute the estimated values in:

(Which is obtainable by taking logarithms on both sides of equation (8')

From census of India 1991 & 2001 we get;

$P(t + 1) = 496454000$; female population of India 2001.

$P(t) = 403360000$; female population of India 1991 .

$B(t+1) = 6566589$; female birth in 2001 .
 $B(t) = 5913793$; female birth in 1991 .

3 - The ratios of the survival probability are in increasing pattern as shown in the basic assumption (2) at the age there for ;

Also as per our assumption in (1) ;

Then for

Then we can estimate the female population of India for 2011 & 2021 :

$P(t+2) = 587305082$

$P(t+3) = 690670776$

4 - The ratios of females birth at time t are which shows decreasing pattern;

5-Growth of Indian population since 1901 shows in table (2):

Table (2):population growth 1901-2001;

Decennial growth (%)	Population(in crore)	Census year	Sl.No.
-	23.84	1901	1
5.75	25.21	1911	2
(-1)0.31	25.13	1921	3
11	27.9	1931	4
14.22	31.87	1941	5
13.31	36.11	1951	6
21.51	43.92	1961	7
24.8	54.82	1971	8
24.64	68.33	1981	9
23.86	84.63	1991	10
21.54	102.86	2001	11

Source: census of India 2001 ,Registrar general of India.

6- Census of India 2001 main results :

Table (3):Main result of Indian population;

3.32 births per woman	Total fertility rate
10.7%	Under 5 population
22.2%	Female (15 – 45) year age group
54.3%	Female literacy rate
16.8 years	Average age at first marriage
19.6 years	Average age at first birth
23.8	Crude birth rate
7.6	Crude death rate
57	Infant mortality rate
63	Life expectancy for male
65	Life expectancy for female

Source: census of India 2001 ,Registrar general of India.

Table (4): Main proportions;

Female	male	person	item
496514346	532223090	1028737436	population
21.97	21.14	21.54	Growth rate 1991-2001
Proportion of population by religious communities			
80.3	80.6	80.5	Hindus
13.5	13.4	13.4	Muslims
2.4	2.3	2.3	Christians
1.8	1.9	1.9	Sikhs
0.8	0.8	0.8	Buddhists
1.2	1.1	1.1	others
Proportion of :			
16.2	16.2	16.2	Scheduled cast population
8.4	8	8.2	Scheduled tribes population
Proportion of population by broad age-group			
35.1	35.6	35.3	0 - 14
33.9	33.7	33.8	15 - 34
22.9	23.3	23.1	35 - 59
8.0	7.4	7.7	60 ⁺
933			Sex ratio of total population
927			Child sex ratio (0 - 6 years)
53.7	75.2	64.8	Literacy rate
25.6	51.7	39.1	Work participation rate

Source: census of India 2001, Registrar general of India.

Table (4) shows that the first religion in India is Hindus(80.5) ,the second is Muslims (13.4),& other religion (6.1),the youth age was the highest by (35.1),the lowest is the aging age (8%). The sex ratio shows decreasing pattern overall decades table (5).

Table (5):Trends in census population in India (1901 – 2001)

Sex ratio(Females per 1000 Males)	Total population (in thousands)			Year
	Females	Males	Persons	
972	117360	120790	238400	1901
964	123710	128390	252090	1911
955	122770	128550	251320	1921
950	135790	142930	278980	1931
945	154690	163690	318660	1941
946	175560	185530	361090	1951
941	212940	226290	439230	1961
930	264110	284050	548160	1971
934	329950	353370	683330	1981
926	407060	439360	846420	1991
933	496450	532160	1028610	2001

Source: census of India 2001 ,Registrar general of India.

Conclusion:

Population growth rate in India has been very high and its demographic features are showing signs of demographic transition .However it is also becoming clear that the pattern of growth and demographic structure varies widely

geographically as well as among communities and different religious and social groups. Keeping such diversity in mind and considering the importance of small communication multi-cultural society as sources of potential socio-economic development in India, a key and unusual demographic feature of India is an imbalance in the sex ratio. The juvenile sex ratio, the ratio of females to males aged (0 – 6) years has been declining even more sharply, while most countries around the world have a small imbalance in their juvenile sex ratios for biological reasons (i.e. there is a biological tendency for more male than female babies to be born to compensate for the slightly higher risk of mortality among new born boys), the imbalance in India is acute and is indicative of prenatal selection and excess female infant and child mortality. Table (3, 4 & 5) gives more pictures for the same. As a comparison with the study Biswas & Ebraheem 1986, in the first study (while in the present study is also the estimated female population for 1991 & 2001 was (403360000, 496454000 respectively) while in the present study is (38746400 & 462963000 respectively), the all figures for the present study seems to be better than the first.

References:

- 1- Biswas S & Ebraheem N.A. 1986 "A modified Quasi-Stable population Technique for a non-stable population". Journal of Management Science & Applied Cybernetics, Vol.3 No.1, 1986. India.
- 2- Biswas S. & Ebraheem N. A. 1987 "Applicability of Malthusian Law of Population Growth, A note on Indians Experience" Demography India Vol.16 No.1 INDIA
- 3- Biswas S. & Ebraheem N. A. 1987 "On a method of prediction of population estimates based on Kendall's birth & death process" International journal for system science (U.K)
- 4- Biswas S. & Ebraheem N.A. 1988 "On an application of the diffusion approximation of the generalized birth & death process for stochastic population projection" "Communication in statistics" Vol. 17 No.3 USA
- 5- Coale A.J. 1972 "Growth & structure of human population" a mathematical investigation" Princeton, New Jersey, Princeton University Press.
- 6- Ibrahim N. A. 2010, "Applied study to estimate the mean age of child bearing in the net fertility schedule for quasi stable population" Accepted for publication in "Journal of Baghdad College of Economic Sciences University" Baghdad, Iraq.
- 7- Ibrahim, Nathier Abas, 2010. "Statistical Study for Indian Quasi-Stable population". Accepted for publication in, "Accounting & Financial Studies Journal". Post graduate institute for accounting & financial studies. Baghdad, Iraq.
- 8- Registrar General of India 2005, SRS based a bridge life tables, office of the registrar general and census commission.
- 9- <http://projected total population by sex on 1st March, 2001-2006, India>.
- 10- [http://census of India \(2001\), life tables](http://census of India (2001), life tables).