Rama Bhargava

India's Population Projections According to Family Size, 1971-2001

THE increasing concern about the rapid population growth of India has stimulated great interest in estimating the population in future dates assuming that the couples limit the size of their families at a fixed number of children. Various attempts have been made to study the impact of the increase in population in future, under different fertility and mortality assumptions including projection by Kingsley Davis[1], Ajit Das Gupta and Murari Majum-dar[2], Coale and Hoover[3] and the Expert Committee set up by the Planning Commission under the chairmanship of the Registrar General India[4]. Following these, an attempt here is made to project the population taking the average number of children per family as a measure of fertility. These projections take into account the [average number of children per family, or completed family size, assuming it to be equal to the total fertility rate (TFR).

1. Davis, Kingsley, *The Population of India and Pakistan,* Princeton, Princeton University Press, 1951, pp. 88-90.

2. Das Gupta, Ajit and Majumdar, Murari : *India 1956-2001, Population Projections,* Calcutta. Indian Statistical Institute, 1954 (Working Paper for the UN Seminar on Population in Asia and the Far East held at Bombay).

3. Coale, A. J. and Hoover, Edgar M., *Population Growth and Economic Development in Low Income Country,* Princeton, Office of the Population Research, 1958, pp. 359-367.

4. *Report on the Population Projections worked out under the guidance of the Expert Committee set up by the Planning Commission under the Chairmanship of the Registrar General,* India, Office of the Registrar General, Ministry of Home Affairs, Govt. of India, New Delhi.

Methodology and Assumptions

The age specific fertility rates for different sizes could be based on the pattern of some country having the requisite total fertility. However, age specific fertility rates of Asian countries for which data are complete and reliable do not agree with the Indian pattern even though the total fertility rate is the same. The age specific fertility rates (ASFR) in the age group (15-19) on account of low age at marriage are very high compared to countries like Taiwan, Japan, Korea, Israel, etc., which have considerably lower rates for this age group. Hence the pattern of ASFR could not be borrowed from other countries. Alternatively, the 1961 ASFR adjusted by Rao[8] have been taken and allowed a gradual reduction over time to correspond to TFR of 5, in 1971 and then declining to 4, 3 and 2 as given in Table 1. The age specific fertility rates per person are given in Table 2.

TABLE 1—PERCENT DECLINE *(A)* AND PERCENTAGE DISTRIBUTION OF AGE SPECIFIC RATES *(B)* BY FAMILY SIZE

Age	*Family size*								
	6 *B*	*A*	*5* *B*	*A*	*4* *B*	*A*	*3* *B*	*A*	*2* *B*
15-19	13.90	20	12.12	45	10.37	60	9.96	80	6.89
20-24	25.46	10	24.99	25	25.91	40	2738	55	29.36
25-29	23.60	—	25.74	10	20.82	25	31.74	40	36.30
30-34	18.20	5	18.85	25	18.52	50	16.31	70	14.00
35-39	12.35	10	12.12	35	10.89	55	9.96	70	9.51
40-44	4.79	10	4.70	35	4.22	60	3.43	75	3.07
45-49	1.70	20	1.48	45	1.27	60	1.22	80	0.87
Total	100.00		100.00		lOj.OO		100.00		100.00

5. Rao, S. L. N. *Differential Fertility in India by State,* Demographic Training and Research Centre, Bombay, 1961 (Mimeographed).

TABLE 2—AGE SPECIFIC FERTILITY RATES PER PERSON

Age	Family Size				
	6	5	4	3	2
15-19	.16677	.12124	.08294	.05979	.02758
20-24	.30555	.24988	.20730	.16427	.11745
25-29	.28324	.25738	.23058	.19042	.14521
30-34	.21836	.18848	.14813	.09785	.05598
35-39	.14822	.12124	.0871 1	.06979	.03802
40-44	.05749	.04697	.03376	.02057	.01228
45-49	.02037	.01481	.01018	.00731	.00348

In reducing the age specific fertility rates to give the required level of TFR, it is observed from experience that the decline is least at ages 15-19 and 40^{+}, It is extremely unrealistic, in fact impossible, to have very reduced rates in 1971. Thus a gradual decline in the fertility rates is made so that they reach the desired level by 1981-86, and then a constant level is maintained. The expectations of life at birth upto 1981 have been taken from Life Tables prepared by Immerwahr and Sinha[6] and for the remaining period the same rate of change has been considered. The eg are given in Table 3.

TABLE 3-EXPECTATION OF LIFE AT BIRTH

Year	*Males*	*Females*
1971	50.58	51.24
1981	56.81	58.31
1991	61.85	64.25
2001	65.68	69.05

The population is then projected for 1971-2001 by component method under the following assumptions :

(i) Total fertility rates are equal the completed family sizes whereas the family sizes are taken as 5, 4, 3 and 2.

6. Immerwahr, G. E. and Sinha, U. P. *Mortality Rates for India 1951-81 for the use of Computer Simulation Model* No. UPS Sim-37/1970, India, International Institute for Popula tion Studies, Bombay, p. 20.

(ii) Zero net migration for the country.

(iii) Sex ratio at birth for India is 106 throughout.

(iv) Survival ratios for corresponding e" are taken from Coale and Demeny[7] Model West Life Tables.

The first four sets of projections are made by declining the fertility to the desired level and then projecting at that constant level upto 2001. The last two sets are for a gradual decline in the number of children per family over the period as given in Table 4, the last being more rapid than the previous.

TABLE 4—AVERAGE NUMBER OF CHILDREN PER FAMILY FOR VARIOUS SETS OF PROJECTIONS

Family size					*Declining Fertility*	
Year	*5*	*4*	*3*	*2*	*I*	*11*
1971-76	5	*5*	*5*	*5*	5	4.5
1976-81	5	4	4	4	4	3.5
1981-86	5	4	3	3	4	2.5
1986-91	5	4	3	2	3	2
1991-96	5	4	3	2	3	2
1996-2001	5	4	3	2	2	2

Projections under alternative fertility assumptions are given in Table 1 of the Appendix. These are then compared in Fig. 1 with projections made (i) under the guidance of Expert Committee[8] set up by the Planning Commission and (ii) the two projections of Vig[9] each made under the following two different assumptions:

7. Coale, J. and Demeny, P., *Regional Model Life Tables and Stable Population,* Prince-ton University Press, New Jersey, 1966.

8. *Report on the Population Projections worked out under the guidance of the Expert Committee.*

9. Vig, O. P., *Economic Impact of India's Family Planning Programme on School Age Population during 1971-91* (mimeographed).

Assumption I. The annual target recommended for the period 1971-79 by the Target Setting Committee have been assumed to be achieved during each year. For the period beyond 1978-79, for which no targets had been recommended, it is assumed that the tempo of achievement of the programme will be maintained and the targets for 1978-79 will continue to be achieved each year thereafter upto 1991.

Assumption II. The annual targets recommended for the period 1971-79 by the working group of the Planning " Commission, had been assumed to be achieved during each year. For the period beyond 1978-79 as in assumption I, it was envisaged that the same tempo would be maintained.

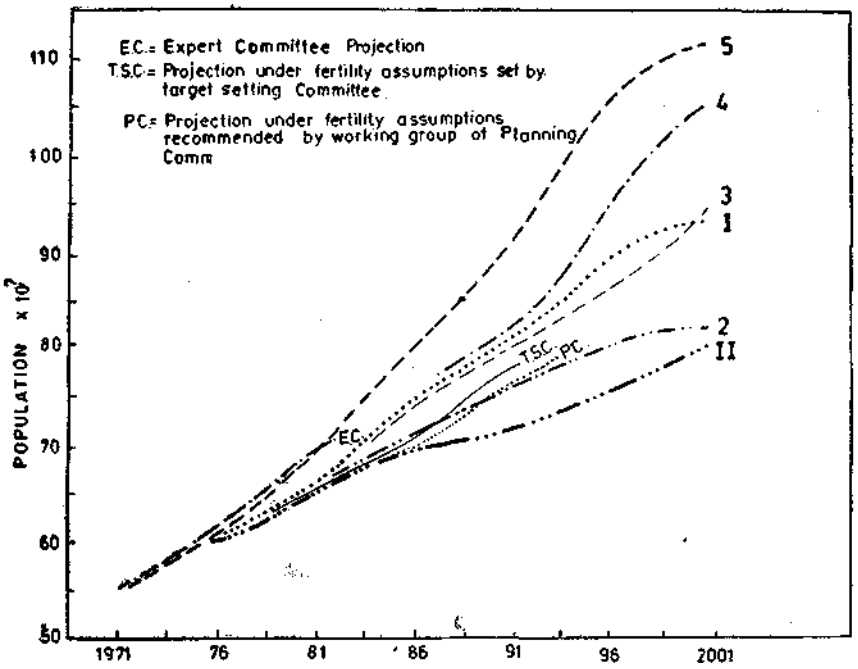

Fig. 1. Projected Population Growth Patterns under Alternative Fertility Assumptions.

It has been observed that the projections made by the Expert Committee are somewhat on the higher side. Our projections for family size 5 tally quite well with the results of the Expert Committee projections which, however, are available only upto 1981. Average number of children per family would be

less than five by 1981. The two projections of Vig[10] tally quite well for family sizes 2 and 3 projections. Projections have been worked out by Raghvachari[11] and Ambannavar[12] under six sets of fertility assumptions each assuming various rates of decline in GFR. The medium sets which are the most probable ones also tally well with the projections based upon the family sizes two and three. Thus we may say that if the targets set by the Target Setting Committee, are achieved, the average size of the family by 1991 would be between two and three.

The number of births during the period 1981-86 when the family size becomes constant, increases for each *quinquennial,* increasing the younger population each time. A large proportion of children who died from all kinds of diseases now live, grow up and have families. The number of youngsters who mature and become parents increases and a second boom effect is created. India's age pyramid is such that, unless a drastic reduction in fertility occurs the population will keep on increasing. Changes in the age composition under different hypotheses are given in Fig. 2. As the proportion of population in the child bearing ages decreases, the number of births will also decrease.

Birth rates (Appendix Table 3) fall considerably with the decline in family size. Beyond 1981-86, birth rates for 2, 3 and 4 child families show a downward trend, coming down to 18.5 per 1000 for a 2 child family while the rate of decline is much slower for 4 child family, coming down to about 30 by 2001. But the Government has a more ambitious programme — to bring the birth rate to 25 per thousand by 1981. This could be so only if the average family size comes down to 2 or at least 3 by then. The rate of growth, obtained from the projections based upon the assumption of family size 4 stabilizes after 1986. Even though the birth rate for 5 child family, more or less, stabilises after 1981-86, on account of improved conditions, the death rate declines and the gap between birth and death rate (Fig. 3) widens. The population would nevertheless continue to grow for another six decades reaching almost 1½ times its present size, even when parents had no more than enough

10. Vig O. P., *op. dt.*

11. Raghavachari, S., Population Projections, 1976-2001 in: *Base Ashish et al. (eds.}, Population in India's Development 1947-2000,* Vikas Publishing House, Delhi 1974.

12. Ambannavar, Jaipal, P., *Long Term Prospects of Population Growth and Labour Force in India,* Department of Economics, University of Bombay, Bombay 1975.

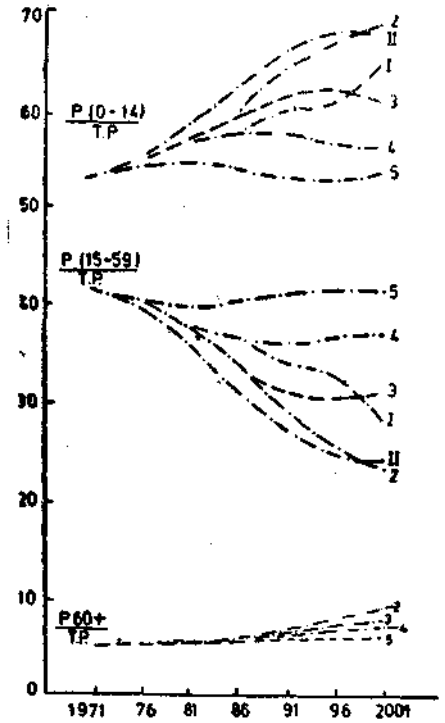

Fig. 2. Changes in age Composition under different Hypotheses.

children to replace themselves[13], because of the great bulk of persons entering the reproductive age group.

Dependency

Population change affects and is affected by several key aspects of society. With the decline in number of births, a relative abundance of older people occurs. The proportion of old would increase from about 5 % in 1971 to

13. Immerwahr, G. E., *Demographic Effects of Family Planning Indicated by Alternative Projections. Paper submitted for the All India Conference on after effects of family planning held in Patna* Feb. 4 and 5,1972, p. 1.

about 9% in 2001 for a 2 child family. The increase for five child family would be much less. The proportion in the younger age would also **decline**

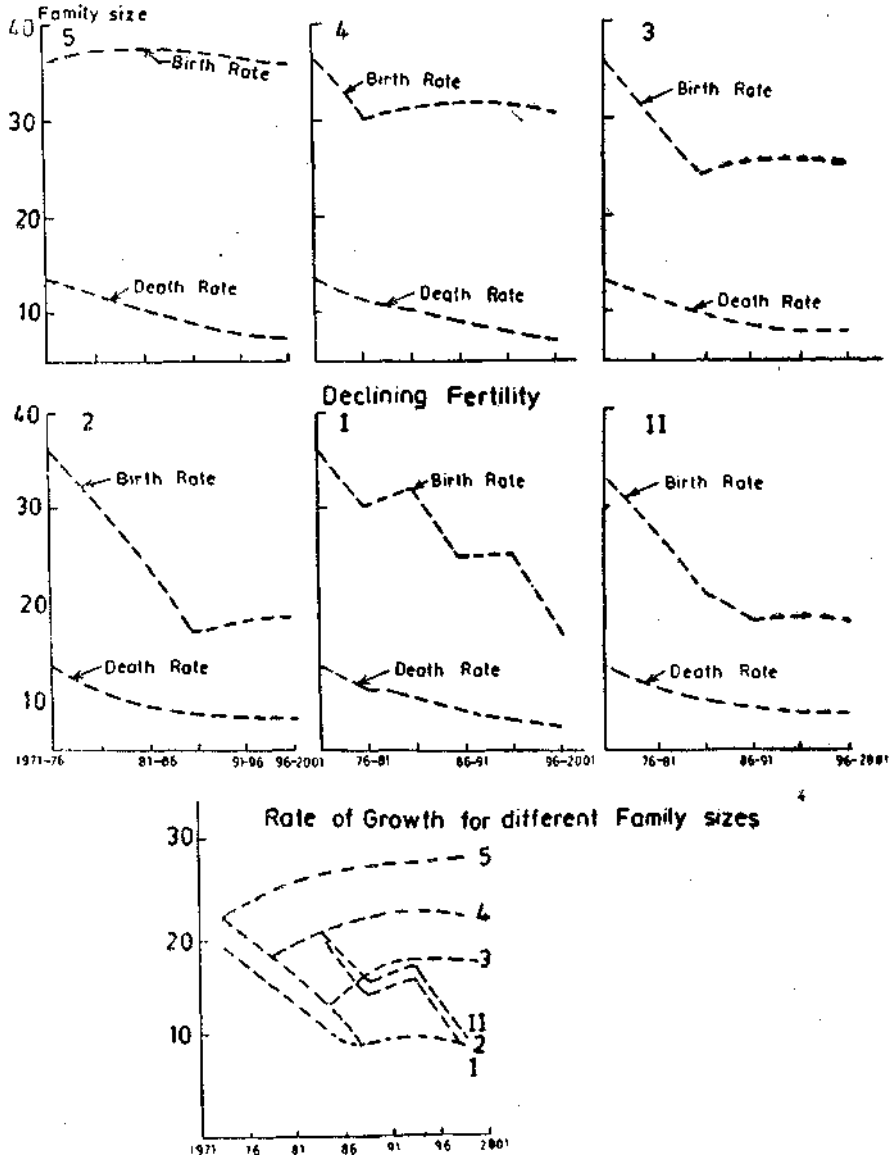

Fig. 3. Birth Rates, Death Rates under different Fertility Assumptions.

from 42% to 24% for a 2 child family, while for a 5 child family it would re-

main almost constant throughout from 1971 to 2001. Thus the dependency ratio, would also decline from 1.69 in 1971 to 0.92 in 2001 for a 2-child family while for a 5-child family it would remain almost the same as in 1971. Only with a rapid decline in fertility the total dependence will decrease (Fig, 4).

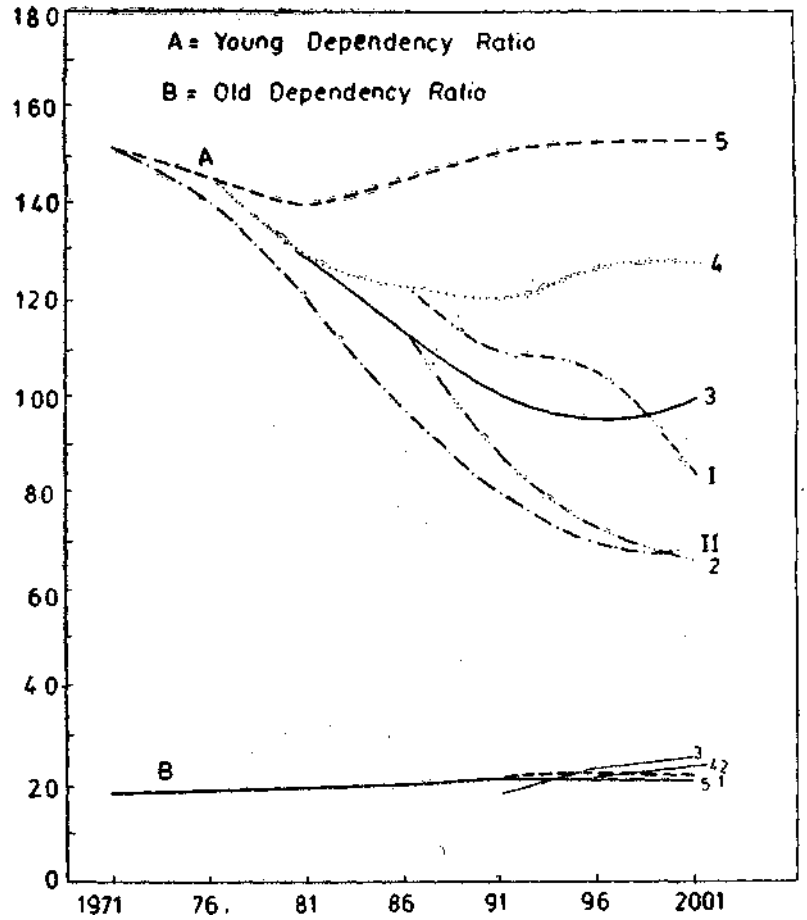

Fig. 4. Chart Showing Young and Old Dependency Rates, Per cent Population According to Family Size.

This is a crude measure of the average number of persons which each adult male would be required to support and care for, if the dependency load is equally divided amongst the adult male population.

Labour Force

Available labour force per thousand population [P(15-59)/T.Population] (Appendix Table 5) have been computed for different family sizes. Changes in (15-59) population occur only after 1991, though the proportion of labour force will change due to the change in total population. As the size of the family decreases, the proportion of economically active persons increases. Population entering the working age group would more than double itself by 2001 if the family size continues to be 5. Persons in 15-59 age group for family size 2 is about 86% of those for family size 5 in 2001. Provision of jobs for such large number of persons would be difficult and might strain the economy. Moreover, improved health and mortality conditions may induce a tendency to work even, after attaining the age 60, thereby making the employment problem even more difficult. No decrease in family size would affect the population entering the labour market at least for the coming two decades. In the *quinquennial* 1996-2001, for 5 child family the increase in (15-59) population would be roughly 9 million and even for a 2-child family by about 4 million.

School Age **Population**

With the increase in population the school age population (6-17 years) upto higher secondary would also increase. The pattern of primary and secondary education in India as given by the Education Commission is as follows :

TABLE 5

Level of education	*Class*	*Corresponding age group*
Lower Primary	I-IV	6-9
Upper Primary	V-VII	10-12
Lower Secondary	VIII-X	13-15
Upper Secondary	XI-XII	16-17

School age population according to education levels has been computed using Newton's interpolation formulae[14] as given below :

$$P_{6-9} = 0.672\,P_{5-9} + 0.176\,P_{10-14} - 0.048\,P_{15-19}$$
$$P_{10-12} = 0.056\,P_{5-9} + 0.608\,P_{10-14} - 0.064\,P_{15-19}$$
$$P_{13-15} = -0.088\,P_{5-9} + 0.536\,P_{10-14} + 0.152\,P_{15-19}$$
$$P_{16-17} = 0.032\,P_{5-9} + 0.104\,P_{10-14} + 0.328\,P_{15-19}.$$

There is no change in school age population (Appendix Table 6) till 1976 for all sets of projections ; changes occur beyond 1976. For a 2-child family the rate of increase is negative from 1986 onwards while for a 3-child family it is almost constant. For other family sizes it increases. For a rapidly declining fertility rates the rate of increase is again negative throughout. A more or less similar trend is seen throughout for primary education which is now compulsory in the country.

Conclusion

A continuous and rapid population growth would obviously have serinm and perhaps critical effects on the resources, environment and economy. This emphasises that people must limit their family size. For this proper education seems necessary.

Even for the birth rate to come down to 18 by 2001 the average number of children per family has to be restricted to two which appears to be a difficult task. Growth will also depend on the rapidity of decline in mortality. Regardless of what happens to the birth rate, the population will continue to grow. Only way to keep the growth checked is to change reproductive habits as early as possible. Then and only then will the economically active population dominate having a favourable impact on the economy. For a 2

14. Yeole, B. B. and P. R. Saraswathy, "On estimating the school age Population for compulsory education in some ECAFE countries", *Indian Education Review,* Vol. 7, January 1972, pp. 116-122.

or 3 child family, persons entering the labour market or the schools will be considerably less.

Acknowledgement

I am grateful to Dr. J. R. Rele, for his valuable suggestions and comments and to Dr. P. C. Saxena for his critical review of this paper.

APPENDIX

TABLE 1—POPULATION PROJECTIONS (IN '000) ACCORDING TO FAMILY SIZES

		1971	1976	1981	1986	1991	1996	2001
F.S. 5	M	283937	317389	359104	410160	470544	540772	622983
	F	264013	296315	336681	386327	445308	513244	593332
	T	547950	613704	695785	796487	915852	1054016	1216315
F.S. 4	M		317389	347999	386407	432355	484898	542920
	F		296315	326166	363827	408788	460241	517271
	T		613704	674165	750234	841143	945139	1060191
F.S. 3	M		317389	347999	373729	405280	441575	480844
	F		296315	326166	351800	383107	419122	458285
	T		613704	674165	725529	788387	860697	939129
F.S. 2	M		317389	347999	373729	390087	409605	430962
	F		296315	326166	351800	368693	388769	410876
	T		613704	674165	725529	758780	798374	841838
Declining fertility								
T	M		317389	347999	386407	417719	453938	475357
	F		296315	326166	363827	394901	430847	453055
	T		613704	674165	750234	812620	884785	928412
II	M		312676	338036	357325	373747	392495	411591
	F		291854	316747	336279	353237	372568	392499
	T		604530	654783	693604	726984	765063	804090

TABLE 2—PROJECTED BIRTHS (IN '000) ACCORDING TO FAMILY SIZES

	1971-76	*1976-81*	*1981-86*	*1986-91*	*1991-96*	*1996-2001*
F.S. 5	104914	120937	139595	158265	177990	202639
F.S. 4	104914	96812	112056	127294	140619	152218
F.S. 3	104914	96812	85032	96588	106392	113166
F.S. 2	104914	96812	85032	64714	71209	75970
Declining	fertility					
I	104914	96812	112056	96588	106392	76774
II	94435	85082	70933	64422	69349	71042

TABLE 3—PROJECTED VITAL RATES ACCORDING TO FAMILY SIZE

		Family Size				*Declining fertility*	
		5	*4*	*3*	*2*	*1*	*II*
1971	Dep. ratio	1.69					
	C. W. R.	624					
1971-76	B. R.	36.12	36.12	36.12	36.12	36.12	3278
	D. R.	13.48	13.48	13.48	13.48	13.48	13.14
	G. R.	22.64	22.64	22.64	22.64	22.64	19.64
	Dep. ratio	1.65	1.65	1.65	1.65	1.65	1.59
	C. W. R.	649	649	649	649	649	584
1976-81	B. R.	36.94	30.07	30.07	30.07	30.07	2703
	D. R.	11.87	11.29	11.29	11.29	11.29	11.06
	G. R.	25.07	18.78	18.78	18.78	18.78	15.97
	Dep. ratio	1.59	1.48	1.48	1.48	1.48	1.39
	C.W.R.	665	532	532	532	532	468
1981-86	B. R.	37.42	31.48	24.31	24.31	31.47	21.05
	D. R.	10.42	10.11	9.62	9.62	10.11	9.53
	G. R.	27.00	21.37	14.69	14.69	21.36	11.52
	Dep. ratio	1.65	1.45	1.31	1.31	1.45	1.19
	C. W. R.	697	559	424	424	559	354
1986-91	B. R.	36.99	32.00	25.53	17.44	24.72	18.14
	D. R.	9.09	9.15	8.91	8.48	8.76	8.74
	G. R.	27.90	22.85	16.62	8.96	15.96	9.40
	Dep. ratio	1.73	1.43	1.22	1.10	1.31	1.02
	C. W. R.	709	570	433	290	433	295
1991-96	B.R.	36.15	31.49	25.81	18.26	25.00	18.60
	D. R.	8.05	8.20	8.27	8.11	8.07	8.36
	G. R.	28.10	23.29	17.54	10.15	16.93	10.24
	Dep. ratio	1.75	1.50	1.19	0.98	1.28	0.95
	C. W. R.	704	581	440	307	440	298
1996-2001	B. R.	35.71	30.37	25.15	18.49	16.94	18.07
	D. R.	7.11	7.41	7.72	7.92	7.31	8.16
	G. R.	28.60	22.96	17.43	10.57	9.63	9.91
	Dep. ratio	1.75	1.52	1.25	0.92	1.09	0.95
	C. W. R.	700	571	445	299	282	298

NOTE:

$$\text{C. W. R.} = \frac{C\,(0-4)}{f\,(15\text{-}49)}$$

$$\text{Dependency ratio} = \frac{P\,(0-14) + P\,(60+)}{M\,(15\text{-}59)} \cdot$$

TABLE 4-PERCENT OF TOTAL POPULATION ACCORDING TO FAMILY SIZE 1971-2001

Family Size						*Declining Fertility*	
		5	*4*	3	*2*	*1*	*II*
1971	0-14/T.P.	41.67	41.67	41.67	41.67	41.67	41.67
	15-59/T.P.	53.22	53.22	53.22	53.22	53.22	53.22
	60+/T.P.	5.11	5.11	5.11	5.11	5.11	5.11
1976	0-14/T.P.	40.68	40.68	40.68	40.68	40.68	39.78
	15-59/T.P.	53.96	53.96	53.96	53.96	53.96	54.77
	60+/T.P.	5.36	5.36	5.36	5.36	5.36	5.45
1981	0-14/T.P.	39.63	37.69	37.69	37.69	37.69	35.85
	15-59/T.P.	54.80	56.56	56.56	56.56	56.56	58.23
	60+/T.P.	5.57	5.75	5.75	5.75	5.75.	5.92
1986	0-14/T.P.	40.33	36.66	34.50	34.50	36.66	31.48
	15-59/T.P.	53.92	57.24	59.19	57.19	57.24	61.92
	60+/T.P.	5.75	6.10	6.31	6.31	6.10	6.60
1991	0-14/T.P.	41.20	35.98	31.70	29.03	33.73	27.13
	15-59/T.P.	52.88	57.58	61.43	63.83	59.60	65.42
	60+/T.P.	5.92	6.44	6.87	7.14	6.67	7.45
1996	0-14/T.P.	41.46	36.91	30.72	25.60	32.61	24.51
	15-59/T.P.	52.53	56.38	61.91	66.49	60.23	67.20
	60+/T.P.	6.01	6.71	7.37	7.91	7.16	8.29
2001	0-14/T.P.	41.38	36.99	31.42	23.49	28.04	23.76
	15-59/T.P.	52.61	56.11	60.80	67.82	64.08	67.15
	60+/T.P.	6.01	6.90	7.78	8.69	7.88	9.09

TABLE 5—LABOUR FORCE RATES ACCORDING TO FAMILY SIZE 1971-2001

	Family Size				Declining Fertility	
	5	*4*	*3*	*2*	I	II
1971	532	532	532	532	532	532
1976	540	540	540	540	540	548
1981	548	566	566	566	565	582
1986	539	572	592	592	572	619
1991	529	576	614	638	596	654
1996	525	564	619	665	602	672
2001	526	561	608	678	641	672

TABLE 6-SCHOOL AGE POPULATION BY FAMILY SIZE 1971-2001 (IN '000)

	1971	*1976*	*1981*	*1986*	*1991*	*1996*	*2001*
5							
P(6-9)	62390	64082	69792	82758	98386	114295	129965
P(10-12)	40963	47948	47764	54432	65180	77102	89083
P(13-15)	36671	44865	46032	49668	58447	69768	81533
P(16-17)	22375	26870	30700	31256	35511	42461	50283
Total	162399	183765	194288	218114	257524	303626	350864
4							
P(6-9)	62390	64082	69792	68593	78110	91913	103742
P(10-12)	40963	47948	47764	53252	51080	61920	71530
P(13-15)	36671	44865	46032	51523	49408	55949	65756
P(16-17)	22375	26870	30700	31931	34125	34001	40454
Total	162399	183765	194288	205299	212723	243783	281482
3							
P(6-9)	62390	64082	69792	82758	61825	68777	78525
P(10-12)	40963	47948	47764	54432	49723	45699	54258
P(13-15)	36671	44865	46032	49668	51541	45513	49919
P(16-17)	22375	26870	30700	31256	34901	32396	30707
Total	162399	183765	194288	218114	197990	192385	213409
2							
P(6-9)	62390	64082	69792	82758	61825	49162	51372
P(10-12)	40963	47948	47764	54432	49723	44065	34758
P(13-15)	36671	44865	46032	49668	51541	48081	37234
P(16-17)	22375	26870	30700	31256	34901	33330	28735
Total	162399	183765	194288	228114	197990	194638	152099
I							
P(6-9)	62390	64082	69792	82758	78110	73016	77375
P(10-12)	40963	47948	47764	54432	51080	60345	52725
P(13-15)	36671	44865	46032	49668	49408	58424	53561
P(16-17)	22375	26870	30700	31256	34125	34901	38564
Total	162399	183765	194288	218114	212723	326686	222225
II							
P(6-9)	62390	64082	63830	60121	51958	47256	50760
P(10-12)	40963	47948	47267	47284	43388	37056	35299
P(13-15)	36671	44865	46812	47839	45878	39833	35344
P(16-17)	22375	26870	30984	31612	31390	28719	24663
Total	162399	183765	188893	-186856	172614	152864	146066