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Spatio-temporal Variations in fertility Pattern of Punjab-Pakistan

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ABSTRACT

Containing over 90 million inhabitants, population wise Punjab Province of Pakistan is a big region, even bigger than many of the world's countries and most of the countries of Muslim World. It contributes about 56% to the country's total population which is the worlds sixth biggest with regard to population size. The rate at which population of Punjab has grown as a result of natural increase is a matter of national consequence and, therefore, needs an appropriate look. In this regard, study of fertility levels attains the status of basic ingredient. This study is aimed at to present a clearer picture of fertility levels and pattern in Punjab. The analysis of fertility levels in spatial perspective is based on the census data measured at district level. A satisfactory picture of the spatial pattern of fertility can't be presented by using any single measure of fertility. Therefore, seven different sets of basic summery measures have been used to compute fertility, which provide a reliable picture of fertility levels. These measures include crude birth rate (CBR), general fertility rate (GFR), child woman ratio (CWR), marital fertility rate (MFR), gross reproduction rate (GRR), age specific fertility rate (ASFR) and total fertility rate (TFR). CWR has been computed for 1981 and 1998 census data whereas all other measures are based on 1998 census data which is the latest available. The spatial pattern of fertility computed from these measures has been presented statistically and cartographically. The results indicate that fertility levels of the districts of same province as well as rural-urban areas of the same districts vary markedly. Some of the districts show considerably high rate of fertility than others. This may reasonably be attributed to the differences in their level of socio-economic development. The study thus suggests that by increasing the pace of socio-economic development at district level, fertility rates can be reduced and process of rapid population growth can be slowed down.

KEY WORDS: Punjab, Fertility pattern, Fertility measures.

Introduction

Population size of any region at any given period of time is essentially the outcome of interaction between fertility, mortality and migration. These dynamic

processes shape population growth and control its size and, therefore, are the issues of not only national but international concern. In this conjunction, fertility is the most fundamental facet of human life and its role in most cases appears to be governing one, especially in the population growth process of less developed regions of the world. In Pakistan and many other countries, high rate of fertility has resulted explosive growth of population giving birth to numerous environmental and socio-economic problems. It is now universally realized that high rate of fertility and resulting rapid growth of population hinders the progress and dilutes the gains of socio-economic development. In view of its enormous impact on population augmentation and socio-economic attributes of the society, need for the study of fertility can't be ignored particularly for a heavily populated and rapidly growing region like Punjab. On account of population size, Pakistan with a population of 184.8 million (World Population Data Sheet, 2010) is a big country and its province Punjab, bearing over 90 million inhabitants, alone is bigger than many countries of the world. Such a massive size of population is certainly the out come of high fertility and resulting high growth rate which, in Punjab, is even higher than many less developed countries of the world. Therefore, in the context of socio-economic development the foremost need of this region is to take on the issue of fertility effectively.

Fertility is measured as the frequency of births in a population. Normally, a birth rate refers to the births over a specific period of time. There are thus two alternative approaches. One is to consider a short period of time usually one year and the other is to measure fertility over the complete period of reproductive life. Different measures of fertility are thus in use. Among these TFR and GRR are the cohort measures whereas the remaining measures (mentioned above) deal with period fertility (Weeks, 1986: 105). The cohort analysis considers the experience of one group of people over time usually all those born or marrying during a particular time interval. Whelpton (1954) introduced this method of fertility analysis in American fertility surveys. Period fertility in contrast, considers the events occurring during a specific period of time. The choice of a measurement tool depends upon the nature of problem and the type of available data. Such as by using 1981 census data of Pakistan, only CWR can be calculated directly, but from 1998 census data, other fertility rates can also be computed.

Furthermore, a birth involves two parents so it might be desirable to measure fertility by mother's, by father's or by the couple's characteristics. However, the common practice is to measure fertility with reference to females because it eliminates many problems, such as the shorter and more clearly defined reproductive span of females has arithmetical advantage[1]. Many other difficulties may also appear while measuring fertility, therefore, no single measure gives absolutely accurate results. For example, in our Islamic society child bearing is permitted only within the social institution of marriage and only legitimate births are counted. We have thus the problem of proper accounting of the numerator for

the fertility rates which essentially have to relate the number of births to the exposed group of females. For such reasons, it becomes difficult to identify the group of women exposed to child bearing and to find exact rate of fertility. In addition, a conception may end up in abortion, still birth, single birth or multiple births[2]. These different types of outcomes prevent the establishment of a one-to-one correspondence between females and the births. Variable views thus exist about the different measures of fertility. For example, Cox opines that although various measures of fertility are in practice but for statistical analysis it is more meaningful to measure the number of births against the number of persons over the age of puberty than it is to express births as a proportion of population as a whole (Cox, 1993: 83). In this regard only a section of population, the females in reproductive age group biologically identified as between menarche and menopause and for statistical purposes from age 15 to 49 years[3] are capable of child bearing (Ramakumar, 1986: 86). Nevertheless, every woman in the reproductive age group is not necessarily capable of producing a live birth. Fecundity is also a varying factor among them and a fecund woman may experience some temporary infecundity. Apart from these biological aspects, fertility has an additional behavioral component. It can be controlled by conscious adoption of contraception or other means of birth control. Thus, we have 'controlled fertility' that is distinct from 'natural fertility'[4]. Any how, both the approaches have been used in this study to assess the fertility of Punjab at district level. On the one hand, based on births and population data of one year, fertility has been measured by vital rate, and on the other hand it has been measured as the number of births per person during the child bearing period.

Material and Method

At the first step required data was computed from the district and provincial census reports of Punjab and then fertility levels by districts as well as by rural-urban areas were computed. Though, fertility can be ascertained from the statistics of births, its direct measurement, however, is a troublesome subject. Modern fertility studies still place heavy stress on developing adequate tools of measurement. In search of adequate method to measure fertility, different yardsticks have been developed. But none of them alone is suitable for all purposes. Therefore, it becomes necessary to appreciate the merits and demerits of each method so that a realistic appraisal can be made of any figure quoted (Pollard et al, 1987: 80). Following yardsticks were used to compute fertility levels:

1. Crude Birth Rate (CBR) = Total number of live births in a year × 1000 / Mid year total population.
2. General Fertility Rate (GFR) = Total number of live births in a year × 1000 / Total number of females aged 15-49 years.

3. Child Woman Ratio (CWR) = Total number of children of age 0-4 years × 1000 / Total female population of age15-49 years.
4. Marital Fertility Rate (MFR) = Live births in a year × 1000 / Total married females of age 15-49 Years.
5. Age Specific Fertility Rate (ASFR) = Total live births in a year to women in specified age group × 1000 / Total number of women in that specified age group.
6. Total Fertility Rate (TFR) = Σ ASFRs × 5 / 1000.
7. Gross Reproduction Rate (GRR) = TFR × female live births in a year / All live births in a year; or GRR = ASFRs for female births × 5 / 1000; or GRR= TFR × 0.49 (this factor is arrived at by assuming that the sex ratio at birth is 105 males to 100 females. Thus the proportion of females in total number of births is 100 ÷ 205 = about 0.49.

Table 4 of the 1998 census reports provides the data for total population, total female population and female population of age 15-49 years, number of females in specific age group and total number of children age 0-4 years. Table 29 supplies data for the total number of children born alive and ever married women of age 15-49 years. Table 33 contains data for total number of live births in a year, total female live births in a year, total ever married females of age 15-49 years, total number of live births during last 12 months to women in specified age group. By using census data fertility of the region has been measured with the application of above mentioned methods which will be discussed henceforth.

Fertility levels in Punjab

Using census data fertility levels of the Punjab and its districts have been computed by the application of seven different conventional methods. Tables 1, 2 and 3 display the results for all areas, rural areas and urban areas respectively. It is obvious that fertility levels markedly differ by districts. The districts which are socio-economically less development show higher fertility rates compared to the districts which are socio-economically in better position. Similarly, rural areas show higher fertility than that of their urban counterparts.

Table 1: District wise fertility pattern of the Punjab (all areas)

Districts	CBR	GFR	CWR	CWR*	MFR	ASFRs							TFR	TFR**	GRR
	1998	1998	1981	1998	1998	15-19	20-24	25-29	30-34	35-39	40-44	45-49	1998	2001	1998
Hafizabad	22.22	101.31	724.92	643.77	151.49	23.64	124.89	191.66	155.79	114.21	59.35	25.21	3.47	4.9	1.67
Khushab	31.18	130.46	622.36	571.05	198.00	42.62	137.72	217.98	200.72	132.98	102.62	92.92	4.63	4.3	2.32
Jhelum	21.75	90.87	605.17	535.40	136.87	15.96	120.03	176.17	152.01	105.30	44.66	19.67	3.17	3.8	1.60
Bhakkar	21.43	98.28	732.73	677.08	144.23	21.46	118.91	162.64	161.99	118.29	65.21	32.85	3.4	4.7	1.69
Mianwali	34.66	151.06	703.88	638.34	223.17	67.07	149.58	195.03	223.46	184.69	118.29	173.97	5.56	4.7	2.79
Chakwal	40.4	161.41	571.78	506.15	238.00	44.55	167.84	230.02	256.87	197.01	138.75	160.55	5.97	3.9	2.92
Rajanpur	21.55	107.74	863.21	892.60	132.01	43.26	136.50	143.43	147.28	112.71	98.76	45.84	3.63	5.7	1.74
Layyah	19.39	91.20	791.15	736.54	130.59	28.44	97.07	143.48	136.82	127.44	77.29	36.59	3.23	5.8	1.56
M. Bahauddin	22.45	99.49	624.74	594.06	146.48	20.00	110.68	172.81	88.32	61.04	13.28	16.06	2.41	4.2	1.23
Lodhran	23.75	112.45	818.70	744.83	148.00	38.72	158.92	169.96	163.00	119.84	53.39	35.34	3.60	5.1	1.79
Narowal	25.35	115.63	758.53	684.51	175.79	16.40	124.94	217.02	203.53	176.25	75.25	38.62	4.26	4.7	2.12
Attock	24.63	102.04	637.61	530.41	149.13	30.26	150.50	196.11	161.64	93.47	38.35	10.30	3.40	4.1	1.74
Pakpattan	26.52	121.25	719.75	657.50	176.22	22.09	129.43	204.50	94.77	76.28	43.54	22.88	3.0	4.7	1.48
T. T. Singh	33.86	150.15	664.11	596.27	233.62	24.94	147.79	242.76	254.93	191.81	148.40	104.05	5.57	4.6	2.72
D. G. Khan	27.31	136.36	874.47	874.20	168.31	58.77	161.29	195.38	176.82	157.80	119.72	75.08	4.72	5.5	2.39
Sahiwal	19.05	84.38	701.39	602.17	130.92	15.98	96.14	159.58	73.27	43.98	175.12	10.51	2.87	4.6	2.24
Gujrat	24.85	106.07	627.56	562.62	159.61	22.72	117.66	198.57	198.71	121.25	55.11	36.13	3.75	4.0	1.90
Bahawalnagar	31.63	143.08	712.25	657.08	209.36	21.37	170.60	233.08	246.24	149.11	90.04	84.28	4.97	4.8	2.63
Khenewal	25.63	116.29	711.41	649.69	169.27	30.01	136.11	192.61	180.02	135.58	77.71	67.93	4.09	5.0	2.01
Vehari	36.73	168.01	728.25	657.5	242.84	46.81	179.96	272.86	230.25	110.85	125.14	139.87	5.52	4.8	2.62
Okara	27.35	125.70	710.14	663.91	181.70	25.84	149.41	211.57	204.90	141.57	90.65	43.84	4.33	4.6	2.12
Kasur	33.91	163.21	784.78	734.52	237.37	31.64	182.38	276.07	280.61	190.72	134.86	71.44	5.83	5.0	2.92
Bahawalpur	23.23	108.37	774.57	693.52	147.06	31.98	140.41	185.68	153.73	118.97	68.72	35.37	3.67	5.0	1.89
Muzaffargarh	26.35	129.75	852.93	839.04	163.11	53.57	171.18	201.87	174.20	143.37	81.88	41.96	4.34	5.5	2.12
Sargodha	24.56	108.25	671.93	597.94	158.25	27.54	135.80	190.78	171.60	125.56	60.84	39.29	3.75	4.3	1.86
Sialkot	24.75	109.16	715.46	618.77	168.53	16.47	123.17	201.50	187.75	118.35	51.51	21.58	3.60	4.7	1.76
Jhang	30.53	138.16	652.72	628.99	196.81	36.72	165.13	230.94	210.19	158.41	101.08	61.36	4.8	4.4	2.37
Multan	25.33	115.67	718.42	655.19	162.76	29.69	155.20	199.76	172.72	121.68	60.46	47.62	3.93	5.0	1.95
R. Y. Khan	35.14	166.06	784.72	770.01	222.03	51.49	206.33	238.31	228.47	233.88	120.24	89.46	5.8	5.0	2.95
Sheikhupura	36.35	169.02	762.83	685.96	252.57	52.20	178.69	269.00	264.80	198.28	158.07	99.16	6.10	5.0	3.11
Rawalpindi	21.02	86.17	637.21	501.04	134.17	20.51	109.35	172.99	138.89	87.02	39.78	21.25	2.94	4.0	1.39
Gujranwala	25.45	115.23	757.15	638.70	177.34	17.28	131.37	217.50	87.86	63.04	35.25	24.92	2.9	4.9	1.4
Faisalabad	28.92	128.27	673.44	597.36	198.17	22.86	130.02	208.05	199.47	171.44	111.77	106.54	4.8	4.4	2.28
Lahore	18.95	80.72	695.77	535.25	125.55	14.32	102.59	163.02	130.65	74.01	41.77	23.40	2.74	4.4	1.37
Punjab	27.17	122.07	715.01	639.44	178.48	29.9	142.6	205.6	191.9	141.7	85.5	62.4	4.3	4.7	2.13

Source: PCRs and DCRs of the Punjab 1981& 1998, and Pakistan Population Data Sheet, 2001.
*NIPS also calculated the same CWR. **TFR calculated by NIPS, 2001.

Table 2: District wise fertility pattern of the Punjab (rural areas)

Districts	CBR	GFR	CWR	CWR	MFR	ASFRs							TFR	GRR
	1998	1998	1981	1998	1998	15-19	20-24	25-29	30-34	35-39	40-44	45-49	1998	1998
Hafizabad	22.61	104.23	703.67	658.95	153.31	27.00	134.13	190.65	158.57	113.26	59.93	23.93	3.53	1.66
Khushab	29.36	123.07	616.23	575.68	186.15	31.49	132.68	211.52	187.34	131.36	97.90	81.48	4.36	2.18
Jhelum	23.25	95.90	596.50	552.57	141.87	17.43	127.79	187.83	159.35	110.69	47.99	20.39	3.35	1.66
Bhakkar	22.48	103.51	739.09	687.07	150.14	22.65	124.70	168.45	164.35	126.75	71.82	35.43	3.57	1.77
Mianwali	36.49	159.87	709.29	662.40	232.08	72.27	157.41	194.98	234.97	197.46	134.37	187.89	5.89	2.91
Chakwal	39.8	159.15	567.34	509.27	233.10	42.76	168.73	227.77	249.29	191.69	139.10	156.62	5.88	2.87
Rajanpur	22.76	115.23	869.13	920.31	137.64	48.87	144.81	148.33	157.75	120.57	107.33	10.18	3.67	1.76
Layyah	19.24	91.70	838.20	762.65	129.19	30.35	98.75	142.35	136.78	129.13	75.49	35.05	3.23	1.56
M. Bahauddin	22.59	101.12	616.68	607.65	146.54	22.06	109.85	171.16	180.17	126.85	23.12	34.97	3.34	1.73
Lodhran	23.42	111.30	819.78	752.05	144.76	38.90	159.37	166.80	160.60	116.28	51.01	34.68	3.63	1.81
Narowal	26.70	122.64	761.71	698.60	184.96	17.41	133.08	227.59	215.74	190.29	82.34	41.48	4.54	2.27
Attock	26.87	110.69	597.14	540.87	160.17	33.77	165.84	210.43	175.94	103.57	38.94	10.32	3.69	1.90
Pakpattan	26.49	122.20	719.11	673.16	175.85	22.68	129.97	204.01	195.58	168.28	92.98	48.02	4.30	2.12
T. T. Singh	35.16	157.28	655.68	609.67	241.78	25.19	156.42	250.85	267.01	203.50	160.32	99.89	5.81	2.81
D. G. Khan	27.83	142.00	885.49	922.56	169.40	65.58	168.17	200.72	176.11	166.64	123.20	77.58	4.89	2.47
Sahiwal	19.93	89.13	696.46	615.72	136.49	16.32	100.05	167.99	161.83	100.41	38.31	23.35	3.04	1.46
Gujrat	23.02	97.88	615.60	581.38	144.45	15.14	118.39	194.41	171.66	110.48	49.27	23.99	3.41	1.73
Bahawalnagar	33.26	151.30	706.41	666.978	218.89	19.66	179.05	244.00	265.09	73.55	94.98	90.61	4.83	2.60
Khenewal	27.34	124.96	714.06	663.57	179.28	32.90	146.40	204.02	193.73	146.90	81.57	73.51	4.39	2.17
Vehari	37.50	172.70	724.92	669.25	246.76	51.31	182.94	282.12	225.65	225.02	124.68	148.92	6.20	3.12
Okara	29.41	135.44	698.13	683.85	193.12	28.50	159.07	218.94	223.10	155.37	105.26	49.93	4.70	2.29
Kasur	35.10	171.89	782.18	769.36	245.40	35.74	191.73	281.02	296.23	20.32	144.18	80.69	5.24	2.61
Bahawalpur	23.10	108.76	785.91	724.04	143.25	32.45	139.27	180.33	152.33	124.50	72.98	37.13	3.69	1.89
Muzaffargarh	26.77	133.00	863.20	864.48	163.72	57.72	173.99	202.61	177.93	145.20	86.47	45.34	4.44	2.18
Sargodha	25.95	115.73	660.01	622.72	164.69	34.68	143.67	197.72	180.33	132.57	64.87	47.52	4.00	1.98
Sialkot	25.62	114.87	723.90	660.49	173.98	20.23	136.92	215.33	206.18	133.63	58.74	23.94	3.97	1.94
Jhang	32.76	149.66	644.04	646.53	208.65	42.13	174.93	243.49	226.51	173.69	112.46	69.54	5.21	2.57
Multan	27.26	128.64	717.76	734.05	168.62	38.03	176.57	201.52	190.68	144.34	62.54	54.55	4.34	2.17
R. Y. Khan	35.75	171.27	789.94	797.39	223.64	56.07	211.94	230.11	238.13	256.06	221.97	94.33	6.04	3.06
Sheikhupura	37.32	176.02	760.44	707.97	260.21	60.23	187.41	272.27	262.69	205.58	181.48	103.60	6.36	3.26
Rawalpindi	22.12	90.28	631.53	523.77	138.52	15.06	118.27	183.56	153.39	100.83	44.12	14.14	3.14	1.51
Gujranwala	26.64	124.58	748.46	700.38	186.06	22.07	144.69	122.85	192.72	149.85	94.09	62.82	4.44	2.19
Faisalabad	30.07	136.80	649.33	633.47	205.70	31.17	139.91	209.53	209.77	179.60	116.19	118.06	5.02	2.42
Lahore	23.88	114.22	817.08	731.29	163.76	25.65	155.08	213.78	176.74	104.52	60.60	32.39	3.84	1.84
Punjab	29.03	133.08	718.28	683.02	188.63	35.2	155.8	214.7	205.9	158.7	96.5	70.3	4.7	2.34

Source: PCRs and DCRs of the Punjab 1981& 1998.

Table 3: District wise fertility pattern of the Punjab (urban areas)

Districts	CBR	GFR	CWR	CWR	MFR	ASFRs							TFR	GRR
	1998	1998	1981	1998	1998	15-19	20-24	25-29	30-34	35-39	40-44	45-49	1998	1998
Hafizabad	21.19	93.83	794.74	604.87	146.54	15.58	100.90	194.29	148.64	116.49	57.79	29.01	3.31	1.68
Khushab	36.55	152.14	643.21	557.44	233.22	73.43	152.82	238.03	240.58	137.84	115.44	127.93	5.43	2.75
Jhelum	17.85	77.12	646.92	488.44	122.25	11.93	99.91	145.99	131.65	90.12	35.25	17.43	2.66	1.41
Bhakkar	15.93	71.57	697.21	626.01	111.77	15.91	87.90	130.47	131.87	78.41	33.03	18.21	2.47	1.22
Mianwali	27.70	118.39	678.59	549.10	187.18	48.70	119.90	195.26	179.06	140.11	62.23	122.68	4.33	2.26
Chakwal	44.7	177.59	605.01	483.81	276.76	56.59	161.6	246.41	314.45	235.46	136.18	191.08	6.7	3.27
Rajanpur	14.38	67.08	812.24	742.21	95.54	18.63	88.94	114.65	99.19	68.24	49.75	16.81	2.28	1.56
Layyah	20.37	88.13	678.31	575.99	140.31	16.87	86.47	150.65	137.07	118.04	88.12	46.29	3.21	1.55
M. Bahauddin	21.63	90.95	700.31	522.88	146.14	10.00	114.93	181.90	154.75	101.86	49.16	18.22	3.15	1.51
Lodhran	25.69	119.06	809.18	703.36	168.23	37.78	156.34	190.49	176.78	140.17	67.09	39.40	4.04	1.99
Narowal	15.66	67.98	740.90	588.72	109.33	9.18	68.25	146.16	124.66	85.76	29.57	18.28	2.40	1.20
Attock	16.32	69.11	625.04	490.61	104.99	16.89	90.32	141.39	109.81	58.89	36.11	10.25	2.32	1.14
Pakpattan	26.71	115.89	723.78	568.77	178.44	19.08	126.27	207.40	230.98	128.84	66.80	29.01	4.04	2.02
T. T. Singh	28.23	120.74	706.41	541.04	197.80	23.98	113.12	207.80	204.61	144.77	97.53	123.39	4.57	2.37
D. G. Khan	24.06	106.18	796.47	615.71	160.93	27.70	123.30	163.41	180.80	112.23	100.54	60.82	3.84	1.99
Sahiwal	14.59	61.53	726.29	507.29	101.92	14.49	77.38	117.43	110.91	57.51	29.14	12.59	2.09	1.10
Gujrat	29.63	127.68	679.37	513.09	202.66	42.42	115.82	194.23	269.78	150.25	71.06	73.19	4.58	2.30
Bahawalnagar	24.75	109.21	739.08	616.32	167.66	23.29	134.48	186.86	166.02	116.23	70.14	55.62	3.76	1.80
Khenewal	17.63	77.35	700.64	587.37	120.48	18.01	89.21	139.82	118.02	85.38	60.01	40.16	2.75	1.31
Vehari	32.73	144.49	749.04	598.67	221.74	26.02	164.39	223.82	253.31	164.01	127.43	91.59	5.27	2.41
Okara	20.48	93.45	754.97	597.89	141.54	17.60	116.16	186.83	145.50	98.03	40.97	21.34	3.13	1.56
Kasur	29.89	135.96	793.87	625.11	210.08	19.08	152.31	260.36	232.10	152.57	105.69	40.50	4.81	2.43
Bahawalpur	23.58	107.36	737.50	516.12	157.98	30.88	143.44	200.42	157.25	105.77	57.79	28.46	3.62	1.90
Muzaffargarh	23.50	109.27	845.70	678.96	158.53	29.37	152.36	196.86	151.40	132.55	53.36	19.02	3.67	1.71
Sargodha	21.02	89.92	712.97	537.21	140.87	11.06	116.41	173.37	149.73	109.23	50.73	16.76	3.13	1.58
Sialkot	18.09	76.30	684.71	508.20	124.16	6.20	86.19	165.74	138.90	77.27	32.91	15.21	2.61	1.27
Jhang	23.22	101.98	678.04	573.78	155.92	21.75	133.14	189.46	158.19	111.59	64.53	31.38	3.55	1.75
Multan	22.69	99.20	722.87	555.07	153.95	20.18	128.17	197.35	139.29	93.61	57.76	37.55	3.42	1.66
R. Y. Khan	32.65	146.15	758.51	665.27	215.09	35.80	183.91	271.93	191.87	153.72	113.53	68.52	5.09	2.64
Sheikhupura	33.61	150.35	773.5	627.25	231.36	31.04	154.46	260.23	270.29	179.98	96.35	86.32	5.39	2.72
Rawalpindi	20.05	82.51	643.61	480.83	130.19	25.44	101.67	164.03	126.22	75.24	35.81	28.64	2.78	1.30
Gujranwala	24.29	106.63	770.04	582.04	168.85	12.84	119.00	212.48	181.64	119.94	58.53	39.88	3.72	1.79
Faisalabad	27.39	117.47	728.66	551.69	188.03	13.08	118.07	206.13	186.07	161.11	105.83	89.39	4.39	2.09
Lahore	17.90	74.51	675.76	498.91	117.74	12.16	92.83	153.48	121.85	68.66	38.43	21.83	2.54	1.21
Punjab	23.09	99.35	706.66	549.54	155.41	19.5	115.2	186.1	162.6	108.3	62.3	44.4	3.50	1.73

Source: PCRs and DCRs of the Punjab 1981& 1998.

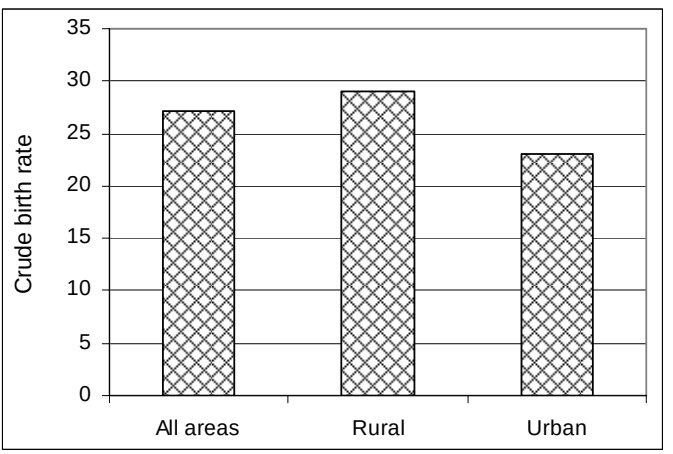
Crude birth rate (CBR)

Birth rate expresses the number of live births per thousand population in a given year and directly points to the contribution of fertility to the growth rate of population. It tells how much births are contributing to population growth and thus could serve as a good measure of overall changes caused by the addition of newborns. Because of indicating exact rate of addition to the population through births, simplicity in concept and measurement, it is frequently used measure of fertility (Preston et al, 2001; Shrivastava, 1994; Jones, 1990; Pollard, 1987; Ramakumar, 1986; Raj, 1986; Haupt and Kane, 1980; and Barclay, 1958). But it is a least sophisticated measure and presents only the most general judgment of fertility as the calculation is based on total births and total population. These figures make no allowance for variations in the ratio of sexes, postponements or accelerations of marriages, differences in the age distribution etc. The inclusion in denominator of a large mass of males and of young girls and old women not exposed to any possibility of childbearing is thus its disadvantage. It is not safe to find out fertility on the basis of whole population because in no region whole population can always be fertile. Moreover, birth rates are different in different years and between populations of different areas. Temporal and spatial variations in the number of births cause differences in CBR. For instance, if in any district a large number of births occur in a year then many females will not be able to give birth to a child in the succeeding year due to biological causes like post-partum amenorrhea, secondary sterility, gestation period etc. This necessarily means that exposed population will get reduced and the number of births of the succeeding year will also be reduced there and the change in population size will be little[5]. Therefore, if CBR is calculated for the year when large number of births occurs it will be elevated telling that the population belongs to a high fertility group. Similarly, if it is calculated for the year when small number of births occurs will remain low telling that the population belongs to a low fertility group. Because of this limitation, CBR may not be able to present the real picture of fertility of a population and may lead towards erratic conclusions. This weakness, however, can be managed, if data allows, by taking average for three years. The impact of this weakness may also be diluted with an increase in population size. Any how, despite all such shortcomings CBR is a useful measure of fertility for comparison purposes (Shrivastava, 1994) because proportion of the population at risk to child bearing (15-49 years) in the total population doesn't vary so much (Jones, 1990).

The CBR computed for Punjab on the basis of one year census data of the births is 27.17[6]. It varies from 23.09 for urban areas to 29.03 for rural areas of the region (fig 1). A difference of 5.94 births per thousand population between rural and urban areas is an evident indication that natural growth rate of rural population is noticeably faster than the growth rate of urban population. It thus answers the question that certainly higher fertility rates prevail in the rural and comparatively lower in the urban areas of the Punjab. This finding is also in congruence with the previously conducted studies by Hakim et al (1998) and NIPS (1992) that also

pointed out lower fertility rate among urban population than that of their rural counterparts. More or less similar pattern has been found in the districts of Punjab. The difference in fertility between rural and urban sections of population may also be reflective of the difference in their level of socio-economic development and difference in mind sets of the people concerning socio-economic progress and family size.

Fig 1: CBR in the Punjab computed from 1998 Punjab provincial census report

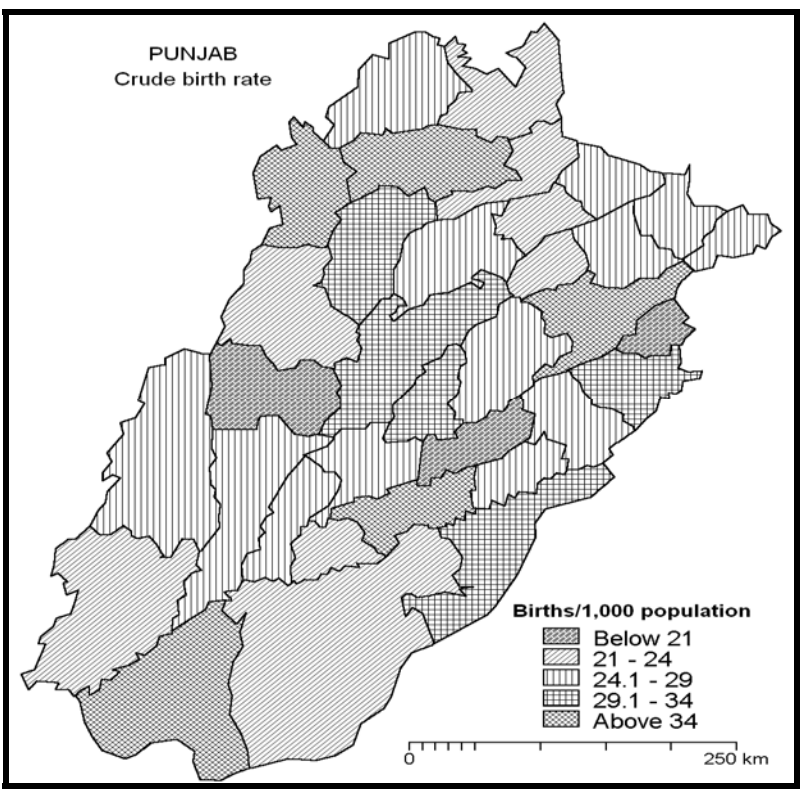


Among the districts, CBR is lowest in Lahore (18.95) and highest in Chakwal (40.4). Exactly in half of the districts of Punjab CBR is above and in the other half it is below 25.4 (table 1). Table 4 shows that it is below 21 in just three districts Lahore, Sahiwal and Layyah. Eight districts namely Hafizabad, Jhelum, Bhakkar, Rajanpur, Mandi Bahauddin, Lodhran, Bahawalpur and Rawalpindi, qualify for second category of 21-24. Thirteen districts namely Narowal, Attock, Pakpattan, D. G. Khan, Gujrat, Khenewal, Okara, Muzaffargarh, Sargodha, Sialkot, Multan, Gujranwala and Faisalabad qualify for third category of 24.1-29. Five districts Khushab, T. T. Singh, Bahawalnagar, Kasur and Jhang lie in fourth category of 29.1-34 and remaining five districts Mianwali, Chakwal, Vehari, R.Y. Khan and Sheikhupura belong to fifth category having CBR above 34. Map 1 displays the pattern of CBR in the region. Besides others, the main reason for the marked variations among districts can be the use of only one year data (the drawback of which has been mentioned in the foregoing discussion) for estimation of CBR. Wide disparities are found within the rural as well as urban areas at district level also. As regards rural areas of the districts, Layyah shows the lowest (19.24) and Chakwal shows the highest (39.8) crude birth rate (table 2). Table 3 shows the range of differences among the urban populations of the districts. Rajanpur shows the lowest (14.38) and Chakwal again shows the highest (44.7) crude birth rate.

Table 4: Grouping of the districts by crude birthrate

Category	CBR	No. of districts	Names of districts
1	Below 21	03	Lahore, Sahiwal and Layyah
2	21-24	08	Hafizabad, Jhelum, Bhakkar, Rajanpur, Mandi Bahauddin, Lodhran, Bahawalpur and Rawalpindi
3	24.1-29.0	13	Narowal, Attock, Pakpattan, D. G. Khan, Gujrat, Khenewal, Okara, Muzaffargarh, Sargodha, Sialkot, Multan, Gujranwala and Faisalabad
4	29.1-34	05	Khushab, T. T. Singh, Bahawalnagar, Kasur and Jhang
5	Above 34	05	Mianwali, Chakwal, Vehari, R.Y. Khan and Sheikhupura

Map 1: Crude birth rate in the Punjab (data from table 1)



General fertility rate (GFR)

This measure, also known as fertility rate, denotes the number of live births per thousand women of ages 15-49 in a given year (Preston et al, 2001; Shrivastava,

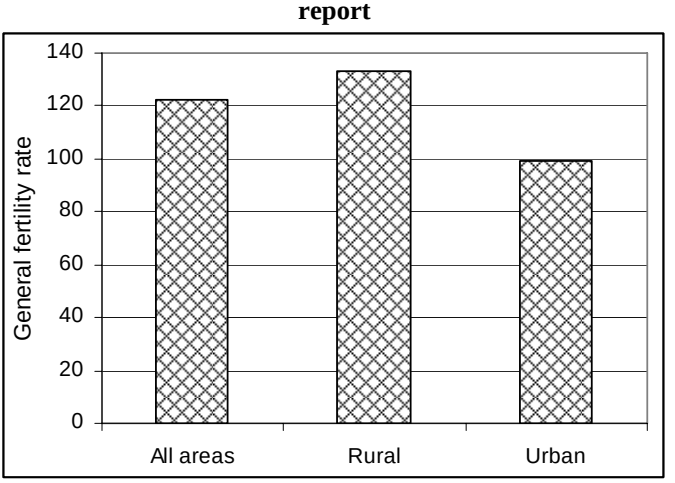
1994; Jones, 1990; Pollard, 1987). The calculation of GFR is based on the data obtained from table 4 and table 33 of the district census reports of 1998 for reproductive age females and for live births in a year respectively. In order to restrict the denominator of the rate to potential mothers, all males and those females who are not in the childbearing age are excluded. This is why the GFR of the population of Punjab and districts is about 4 to 5 times higher than CBR. As far as fecundity status and exposure to the conception is concerned, women of all age groups from 15-49 years are not homogeneous and births are not spread evenly over this reproductive age range. GFR, therefore, is a crude fertility rate. The main advantage of this measure is its substantial control for age and sex structure. It relates births more nearly to the age-sex specific group at risk of giving births. This eliminates distortions that might arise because of different age and sex distributions among populations (Haupt and Kane, 1980). Therefore, GFR is much more indicative of changes in fertility behavior than is the CBR. For the population where enumeration is satisfactory this rate gives good results and provides better basis to compare fertility levels.

CBR and GFR calculated for Punjab are related by;

CBR= GFR × Proportion of females in total population/100.

GFR for the Punjab is 122.07 whereas for urban areas it is lower (99.35) and for rural areas higher (133.08) than that of provincial level again indicating the higher fertility rate in rural areas (fig 2).

Fig 2: GFR in the Punjab computed from 1998 Punjab provincial census report

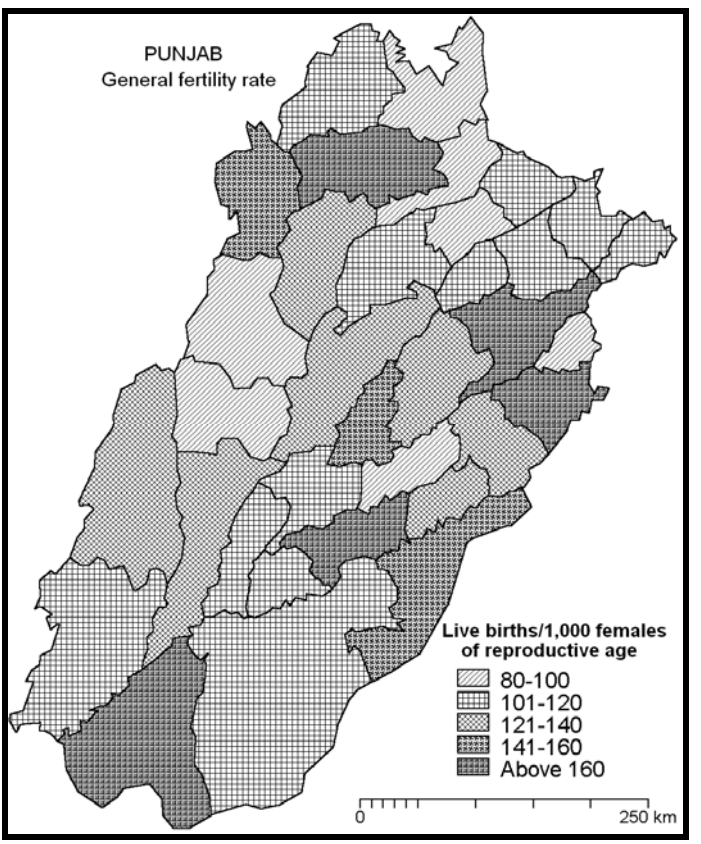


Among the districts lowest GFR (80.72) has been observed for Lahore and highest (169.02) for Sheikhupura. On the basis of GFR, the districts of Punjab have been placed into five categories (table 5) which have been mapped to show up spatial view of fertility pattern in terms of general fertility rate (map 2).

Table 5: Grouping of the districts by general fertility rate

Category	GFR	No. of districts	Names of districts
1	80-100	07	Jhelum, Bhakkar, Layyah, Mandi Bahauddin, Sahiwal, Rawalpindi, Lahore
2	101-120	12	Hafizabad, Rajanpur, Lodhran, Narowal, Attock, Gujrat, Khanewal, Bahawalpur, Sargodha, Sialkot, Multan, Gujranwala
3	121-140	07	Khushab, Pakpattan, D.G. Khan, Okara, Muzaffargarh, Jhang, Faisalabad
4	141-160	03	Mianwali, T. T. Singh, Bahawalnagar
5	Above 160	05	Chakwal, Vehari, Kasur, R. Y. Khan, Sheikhupura

Map 2: General fertility rate in the Punjab (data from table 1)



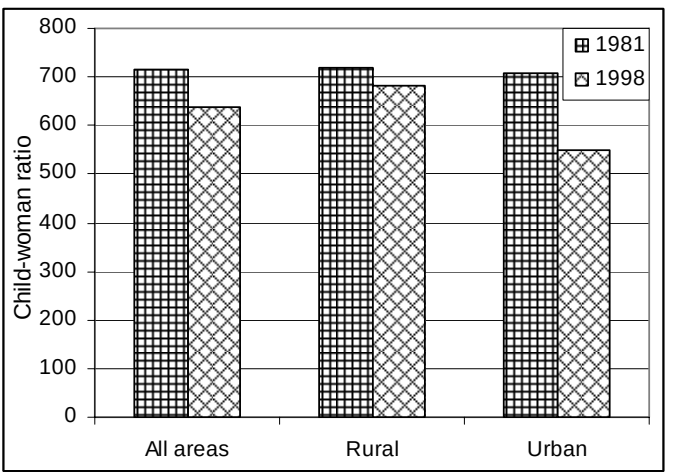
It is evident that in most of the districts GFR is above 100, which is an indication of high fertility in the region. Among the rural populations of the districts, Vehari ranks highest and Rawalpindi ranks lowest having a GFR of 171.89 and 90.28 respectively (table 2). In case of urban areas, highest GFR (177.59) has been found in Chakwal and lowest (67.98) in Narowal district (table 3).

Child woman ratio (CWR)

It is a simpler summary measure of fertility useful for sub-national projections (Shrivastava, 1994). It provides an index of fertility conceptually similar to GFR and is commonly calculated from census data for comparison purposes. The index is calculated as the number of children aged 0-4 years per 1000 women of child bearing age in a given year (Weeks, 2005; and Barclay, 1958). This tool has been specifically designed to furnish a useful measure of fertility when detailed data on births are lacking. It serves well as a relative measure to compare the fertility performance of the population of different sections and areas, such as the districts of Punjab. It is also widely used in population geography for micro-level spatial studies (Jones, 1990). Its great operational advantage is that the basic data are available from census age tables. It is also considered good to compare the fertility performance of the different sections of same population. The higher index value indicates the higher level of fertility and vice versa. Nevertheless, it can be affected by the under enumeration of infants, by infant and childhood mortality rates, and by age distribution of women within the childbearing span. As instead of actual births, the results are derived from the group of survivors of the preceding 5 years so unavoidably include the effects of infant and childhood mortality that occurs during this period. In less developed areas where infant and child mortality component is significant, CWR may under estimate the fertility levels. Thus, differences between populations of the districts in child mortality may cause complications for fertility comparisons.

Tables 1, 2 and 3 present a temporal and spatial comparison of the CWRs. It is evident from table 1 that CWR in Punjab has declined from 715.01 in 1981 to 639.44 in 1998 showing a marked change of 75.57 children of ages 0-4 years per 1,000 women of reproductive ages (fig 3). In rural areas, it declined from 718.28 in 1981 to 683.02 in 1998 indicating a difference of just 35.26 children that is more than 2-times lower than that of provincial level (table 2). In case of urban areas, it declined substantially from 706.66 in 1981 to 549.54 in 1998 pointing to a difference of 157.12 children that is more than two times higher than that of provincial level (table 3). The fall in CWR can be attributed to several factors like the promotion of the ideology of quality child, increasing financial costs of childbearing, difficulties of urban environments, and rising individualism.

Fig 3: CWR in Punjab computed from 1981 and 1998 Punjab provincial census reports



Amongst the districts, CWR highly varies i.e. between a minimum of 501.04 children in Rawalpindi to a maximum of 892.60 children per 1,000 women in Rajanpur showing a difference of 391.56 children. It is evident from comparison of 1981 and 1998 fertility ratios (table 1) that except Rajanpur all other districts have shown more or less a declining trend. On the basis of change in CWRs, the districts of the Punjab can conveniently be put into four broader groups. The first group includes four districts where the decline in CWRs is above 100 children per 1,000 women of reproductive age. These districts are Lahore (160.52), Rawalpindi (136.17), Gujranwala (118.45) and Attock (107.20) which observed comparatively faster socio-economic change and rapid urbanization. Comparatively higher male and female singulate mean age at marriage (SMAM) have been noted in all these districts. Except Attock other three districts are also characterized with higher proportion of urban as well as literate population (table 1). Second group includes twenty three districts where the decline in CWRs is above 50 but below 100 children. In these districts socio-economic development has started to constraint the fertility and the process of fertility transition can be further geared up by accelerating the process of socio-economic development. Third group includes six districts namely D. G. Khan (0.27), Muzaffargarh (13.89), R. Y. Khan (14.71), Jhang (23.73), Mandi Bahauddin (30.68) and Okara (46.23) where decline is below 50. Among these districts, negligible decline has been noted in D. G. Khan which is just 0.27. The high proportion of rural population, low female literacy level and low female SMAM are the main causes of slow change. The process of socio-economic change in these districts looks to be considerably slow and the lowest proportion of urban population, lowest female literacy ratio and lowest female SMAM are specifically notable in Muzaffargarh and D. G. Khan districts

(table 1). Fourth group includes another socio-economically less developed district Rajanpur that has shown an increase of 29.39 children rather than decrease in CWR. The proportion of urban population, literacy ratio and SMAM are notably low in this district.

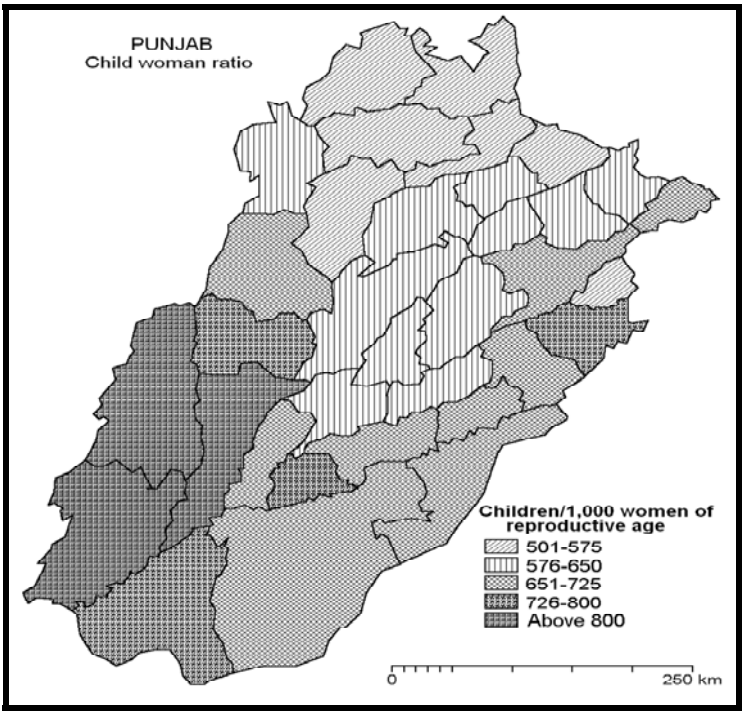
Almost similar trends are found in rural as well as in urban areas of the districts. Amongst the rural areas, the ratios vary from a minimum of 523.77 again in Rawalpindi to a maximum of 922.56 in D. G. Khan indicating a variation of 398.79 children (table 2). Comparison of 1981 and 1998 ratios for rural areas reveals that except six districts namely Rajanpur, D. G. Khan, Muzaffargarh, Jhang, Multan and R. Y. Khan, all other districts show a declining trend of fertility and the decline is highest (107.76) in Rawalpindi. In urban areas, fertility ratios vary from a minimum of 480.83 in Rawalpindi to a maximum of 742.21 in Rajanpur pointing to a difference of 261.38 children. Comparison of 1981 and 1998 ratios for the urban areas of the districts indicates a significant declining trend in all the districts of Punjab with highest (221.38) in Bahawalpur and lowest (71.20) in Bhakkar (table 3).

The above analysis suggests that significant changes have occurred in the CWRs of most of the districts. These changes are attributed to the overall improvements in the economic conditions, standard of living, literacy and education, increasing age at marriage and awareness among the people. On the basis of this declining trend it can be argued that the province is experiencing slow paced fertility transition. However, the changes occurring in urban areas are faster and more significant than the rural areas of the region. This is due to the fact that the impact of overall socio-economic development on fertility reduction is more pronounced in urban areas compared to their rural counterparts. Furthermore, the analysis of CWR's for Punjab and districts supports the hypothesis that fertility tends to be lower in urban populations and higher in rural populations as the districts with higher proportion of urban populations have shown significant change in their CWRs and they are subjected to faster transition than rural areas. On the basis of CWR derived from 1998 census, districts of the Punjab have been placed into five groups (table 6).

Table 6: Grouping of the districts by child woman ratio

Category	CWR	No. of districts	Names of districts
1	501-575	07	Khushab, Jhelum, Chakwal, Attock, Gujrat, Rawalpindi, Lahore
2	576-650	11	Hafizabad, Mianwali, Mandi Bahauddin, T. T. Singh, Sahiwal, Khenewal, Sargodha, Sialkot, Jhang, Gujranwala, Faisalabad
3	651-725	09	Bhakkar, Narowal, Pakpattan, Bahawalnagar, Vehari, Okara, Bahawalpur, Multan, Sheikhupura
4	726-800	04	Layyah, Lodhran, Kasur, R. Y. Khan
5	Above 800	03	Rajanpur, D. G. Khan, Muzaffargarh

Map 3: Child woman ratio in the Punjab (data from table 1)



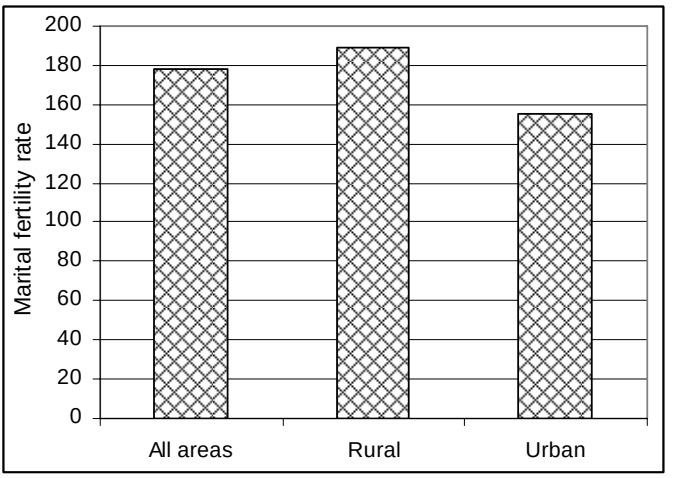
Map 3 portrays the spatial pattern of CWR by using these groups. It depicts clearly the prevalence of higher fertility norms in the south-western districts of D. G. Khan, Rajanpur and Muzaffargarh and relatively lower fertility in the northern districts concentrated mostly in the Potwar plateau. The indicators of socio-economic development like employment ratio literacy ratio, age at marriage etc. indicate that socio-economic conditions of the people are poor in the districts showing high fertility compared to the northern districts of the region.

Marital fertility rate (MFR)

This measure expresses the number of live births in a year per 1,000 ever married women of reproductive age (Weeks, 2008). It relates the births that occur during a year to married women of childbearing age and thus helps in estimating the performance of only exposed group of women at risk. However, its use is not very common. Table 1 reveals that MFR for the Punjab in 1998 was 178.48, for rural areas 188.63 and for urban areas 155 (fig 4). It varies markedly among the districts ranging from as low as 125.55 in Lahore to as high as 252.57 in Sheikhupura. Among rural areas, it is highest (260.21) again in Sheikhupura and lowest (129.19)

in Layyah (table 2). In case of urban areas lowest MFR (95.54) has been found in Rajanpure and highest (233.22) in Khushab (table 3).

Fig 4: MFR in Punjab computed from 1998 Punjab provincial census report



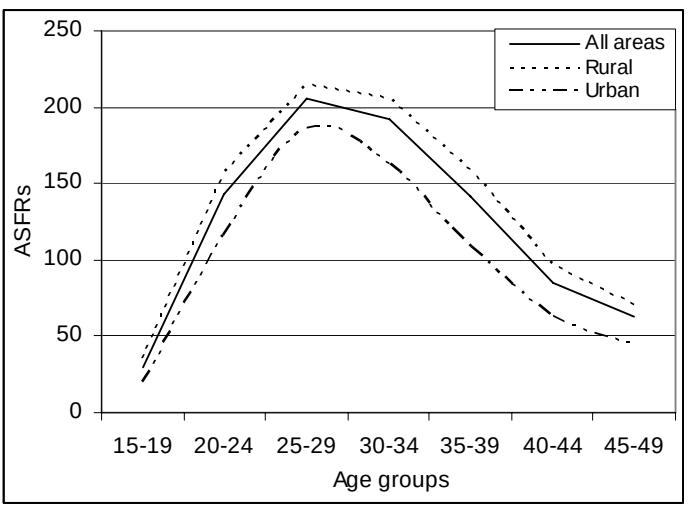
Age specific fertility Rates (ASFRs)

These rates are usually expressed as the number of births occurring annually per 1,000 women of specific age (Weeks, 2008; Jones, 1990; and Pollard et al, 1987). To find out differences in fertility behavior at different ages, fertility rates for Punjab and districts have been calculated for specific age groups in 5-years age interval[7]. These rates are based on the number of women in each age group of reproductive span irrespective of their marital status. This measure comprises a set of seven rates instead of just one average figure and allows the detailed comparison between populations. The set of rates reveals the distribution of frequencies of births among women according to age. Obviously, the likelihood of women giving birth varies with age, therefore, ASFRs have been found to be a very useful measurement. These rates are not significantly distorted by any variations in age composition, either in the total population or among the females of childbearing ages. This method is thus the most useful single step measure in analyzing the fertility performance of a calendar year and provides considerable improvement in precision. These rates give us an indication to direct the family planning measures towards a particular age group of women i. e. group with high fertility. However, misleading indications of fertility can still result if ASFRs are used at times when marriages are accelerated or postponed. Finally, the ASFRs can be utilized in computing other important fertility measurements, to be discussed below.

In Punjab, the women start childbearing at an early age and continues to do so up to the age of 49. Tables 1, 2 and 3 present the pattern of ASFRs for Punjab and

districts and also for rural and urban areas[8]. The tables underline the fact that rates are low in the 15-19 years age group, rise to peak in most of the districts in the 20-29 years age groups and then decline to moderate levels in the 30-39 years age groups, and to low levels in the 40-49 years age groups. The pattern of ASFRs in the province (fig 5) and in different districts is reasonably similar, but the rates for comparatively developed districts and for urban areas are generally lower for all age groups.

Fig 5: ASFRs in the Punjab computed from1998 Punjab provincial census report



According to the age at which fertility reaches its peak, the fertility patterns of the different areas can be classified into three main types; an early-peak pattern in which the maximum fertility occurs in the age group 20-24, a late-peak pattern in which the highest fertility is in the age group 25-29 or higher, and a broad-peak pattern in which fertility differ slightly in the age groups 20-24 and 25-29 but at the same time greatly exceeding than the rates for younger and older groups (United Nations, 1965:106). ASFRs for Punjab indicate late-peak pattern (fig 5). As regards all areas, in Mianwali, Chakwal, Rajanpur, T. T. Singh, Gujrat, Bahawalnagar and Kasur fertility is at its maximum in age group 30-34 whereas in all other districts maximum fertility is observed in age group 25-29. As regards rural areas of the region, in Mianwali, Chakwal, Rajanpur, T. T. Singh, Bahawalnagar, Okara, Kasur, R. Y. Khan, Gujranwala and Faisalabad fertility is at its maximum in age group 30-34 while in all other districts, maximum fertility has been noted for 25-29 years age group. In case of urban areas, Khushab, Bhakkar, Chakwal, Pakpattan, D. G. Khan, Gujrat, Vehari and Sheikhupura have maximum fertility in age group 30-34 and all other districts have maximum fertility in age

group 25-29. Although, in all the districts as well as in rural and urban areas of the districts late-peak of fertility has been observed but in most of the areas the difference in fertility in the age groups 20-24, 25-29 and 30-34 is little which points towards the broad-peak pattern also.

Fig 5 shows that the widening of gap in fertility rate between rural and urban populations of Punjab tends to proceeds as age progresses. This pattern generally indicates that during the early years of married life most of the couples may have same intentions of childbearing no matter they are living in rural areas or urban areas. However, at the later stages after having desired number of children, couples living in urban areas may become more mindful about limiting their family size compared to the couples living in rural areas who may continue childbearing till late to the reproductive span. Besides, the narrowness of fertility gap between the rural and urban sections of population at lower ages may also be reflective of the impact of socio-economic improvement that can bring the change in fertility behaviour of young population living even in rural areas.

Furthermore, the age pattern of fertility depicts some interesting inter-district differences which are not reflected by any other method of fertility measurement. For instance, females aged 15-19 years have highest fertility rate (67.07) in Mianwali district and lowest (14.32) in Lahore district showing a marked difference of 52.75 between maximum and minimum figures. Both the districts also show considerable deviation from provincial level of 29.9. Some other notable districts where fertility rate in this age group is high are D. G. Khan (58.77), Muzaffargarh (53.57), Sheikhupura (52.20) and R. Y. Khan (51.20), and the notable districts with low rate are Jhelum (15.96), Sahiwal (15.98), Narowal (16.40) and Sialkot (16.47). The females aged 30-34 years have been found with highest fertility rate than all other age groups only in seven districts, namely, Kasur, Chakwal, T. T. Singh, Bahawalnagar, Mianwali, Gujrat and Rajanpur, whereas in the remaining districts, the females aged 25-29 have shown highest fertility rates. As regards the fertility rate of females of aged 45-49 years, Attock, Sahiwal, Mandi Bahauddin and Jhelum are notable for the lowest, and Mianwali, Chakwal, Vehari, Faisalabad and T. T. Singh are notable for the highest rates (table 1).

Almost similar pattern has been found in rural as well as in urban areas of the province and districts (tables 2 & 3). The rate of childbearing is appreciably higher in the 20-34 year age groups than in the 15-19 and 35-49 year age groups. Fertility is inhabited in the 15-19 years age group by cultural factor of delayed marriage and in the post 30 years age groups by the biological factor of reduced fecundity.

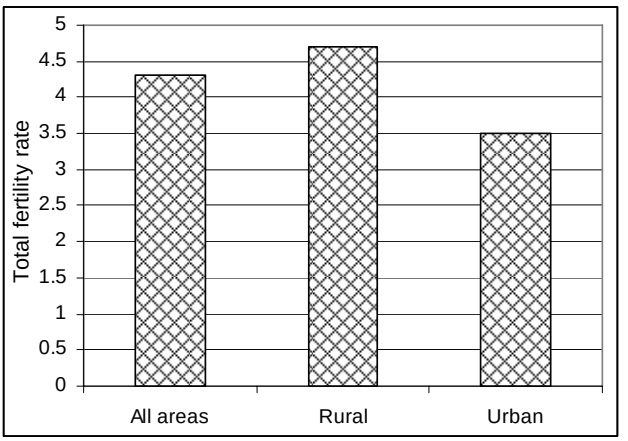
Total fertility rate (TFR)

This most widely used summery measure of fertility is computed as the sum total of ASFRs. It is the average number of children that are expected to be born to a

woman during her reproductive age span if she were to pass through all her reproductive years confirming to the age-specific fertility rates of a given year (Preston et al, 2001; Haupt and Kane, 1980; and Shryock et al, 1976). It tells the estimated average number of children that would be born to each woman if the current rates remained constant. TFR is considered to be the most important indicator of fertility because it answers as nearly as possible the question; how many children women are having nowadays? The figure it gives is hypothetical as it is based on age specific birth rates in one year only (Jones, 1990). Though, it is calculated from period data (ASFRs) but technically is a cohort measure because it sums up, in a single figure, the fertility of all women at a given point in time, and tells that this is the total number of children a woman would have if the fertility rate for a given year applied to her throughout her childbearing span. It may also be termed as a synthetic cohort measure because in reality, no individual woman is very likely to pass through her reproductive age corroborating to the age-specific fertility rates of any single year (Weeks, 2005). These rates change and fluctuate from year to year, even if gradually. For instance, women who were aged 15-19 in 2005 may delay childbearing than women aged 15-19 in, say, 1992. They would lower the TFR a bit in 2005 and then raise it several years later when they start their childbearing. However, year to year fluctuations in the TFR may reflect changes in the timing of births rather than changes in the average number of births of women. Although, TFR requires a lot of data but it is advantageous over other measures because it is a single figure cohort measure and independent of age structure (Newell, 1988). TFR and GFR are closely related. In fact TFR= GFR × 35 / 1000. This gives almost the same results of TFR calculated for the Punjab on the basis of ASFR's[9].

Tables 1, 2 and 3 present the TFR for Punjab and districts and also for rural and urban areas. It is evident from the tables that TFR for the province computed from census data is 4.3. It is slightly lower than the national TFR (4.5) calculated from 1998 census data (Feeney and Alam, 2003: 89). It varies from 4.7 in rural areas to 3.5 in urban areas showing a difference of 1.2 births per woman (fig 6). Thus it clearly supports the proposition that fertility tends to be lower in urban and higher in rural populations and there is an inverse relationship between the degree of urbanization and fertility. Among the districts, highest TFR (6.1) is found in Sheikhupura and lowest (2.41) in Mandi Bahauddin.

Fig 6: TFR in the Punjab computed from1998 Punjab provincial census report



The difference between replacement level fertility (2.1) which is needed to stabilize the population and TFR for Punjab is 2.2. This difference is known as excess fertility[10]. For rural areas, excess fertility is 2.6 and for urban area 1.4. This means that fertility in Punjab had to decrease by 2.2 births per woman in order to move the province towards population stabilization. Though, it is not an easy task but achievable through well-organized policies focusing on to bring changes in economic conditions, social norms and attitude of the people towards family size. Furthermore, depending upon actual fertility, excess fertility differs significantly from district to district ranging from as low as 1.7 in Jhelum to as high as 3.6 in Rajanpur. In most of the districts of Punjab excess fertility is higher than the actual fertility of many countries like Sri Lanka (2.0), Turkey (2.2), Indonesia (2.4), India (2.9) and so on (World Population Data Sheet, 2007).

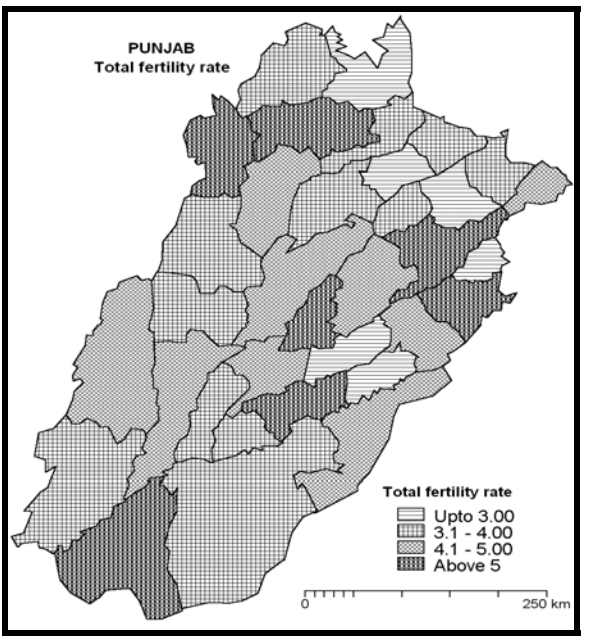
Among the rural areas of the districts highest TFR (6.36) has been found again in Sheikhupura and lowest (3.04) in Sahiwal (table 2). As regards urban areas of the districts, highest TFR (6.7) is found in Chakwal and lowest (2.09) in Sahiwal (table 3). On the basis of TFR districts of the Punjab have been grouped into four categories (table 7) and results have been displayed on the map 4. Most of the districts are attributed with high TFR even higher than the TFR of many less developed countries of the world mentioned elsewhere.

Table 7: Grouping of the districts by total fertility rate

Category	TFR	No. of districts	Names of districts
1	Up to 3.00	06	Mandi Bahauddin, Pakpattan, Sahiwal, Rawalpindi, Gujranwala, Lahore
2	3.1-4.00	12	Hafizabad, Jhelum, Bhakkar, Rajanpur, Layyah, Lodhran, Attock, Gujrat, Bahawalpur, Sargodha, Sialkot, Multan
3	4.1-5.00	09	Khushab, Narowal, D.G. Khan, Bahawalnagar,

4	Above 5.00	07	Khanewal, Okara, Muzaffargarh, Jhang, Faisalabad Mianwali, Chakwal, T. T. Singh, Vehari, Kasur, R. Y. Khan, Sheikhupura

Map 4: Total fertility rate in the Punjab as computed from 1998 district census reports



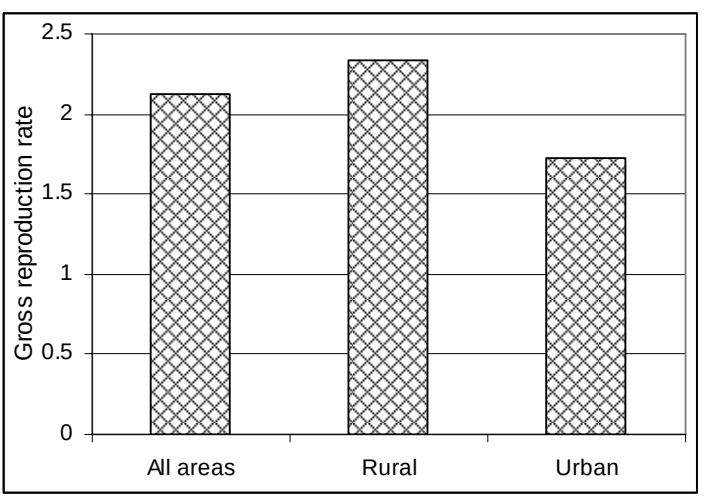
The TFR is relatively higher in socio-economically less developed districts. NIPS has recorded the lowest TFR for Rawalpindi, Jhelum and Chakwal (table 1)where most of the people are engaged in government jobs; specifically their large proportion is employed in Pakistan armed forces. Literacy rate in these districts is also relatively higher. Conversely, the highest TFR has been recorded for Rajanpur, Layyah, Lodhran, D. G. Khan and Muzaffargarh districts which are (comparatively) socio-economically less developed. In these districts literacy rate is relatively low and most of the people are engaged in agricultural activities. This may be an indication of the trueness that socio-economic conditions play significant part in determining the fertility behaviour of the people.

Gross reproduction rate (GRR)

This rate is another summary measure which has been used to calculate the current fertility of Punjab. It represents the number of female births (potential future mothers) per woman or per 1,000 women passing through their childbearing age if the age specific birth rates of a given year remained constant and if no woman entering the reproductive period died before reaching menopause. (Preston et al,

2001). It is similar to TFR except that it counts only maternity rates instead of total births and literally measures reproduction, a woman reproducing herself by having a daughter (Haupt and Kane, 1980). More to the point, the sum of age-specific birth rates of women of ages 15-49 years restricted to female births only is called as GRR[11]. It measures the number of daughters a cohort of women will have and yields values that are about one half of the TFR (Shryock et al, 1976; and Barclay, 1958). It indicates the extent to which women reproduce themselves during a generation assuming no mortality. It is a gross measure of fertility because it does not account for mortality and assumes that a female will survive through all her childbearing years[12]. It also overlooks changing fertility. However, it has achieved a wider currency in the study of replacement rate and speed of reproduction (Ramakumar, 1986). It can also be used to compare the current fertility of various groups and areas such as the districts of Punjab. According to 1998 census data, GRR for Punjab is 2.13 for all areas, 2.34 for rural areas and 1.73 for urban areas (fig 7). It means that at the aggregate level a woman is replaced by 2.13 daughters, in rural areas by 2.34 daughters and in urban areas by 1.73 daughters. At district level, GRR varies from a minimum of 1.23 in Mandi Bahauddin to a maximum of 3.11 in Sheikhupura (table 1). For rural areas, it varies from a minimum of 1.46 in Sahiwal to a maximum of 3.26 in Sheikhupura (table 2). For urban areas, it varies from a minimum of 1.10 in Sahiwal to a maximum of 3.27 in Chakwal (table 3).

Fig 7: GRR in Punjab computed from1998 Punjab provincial census report



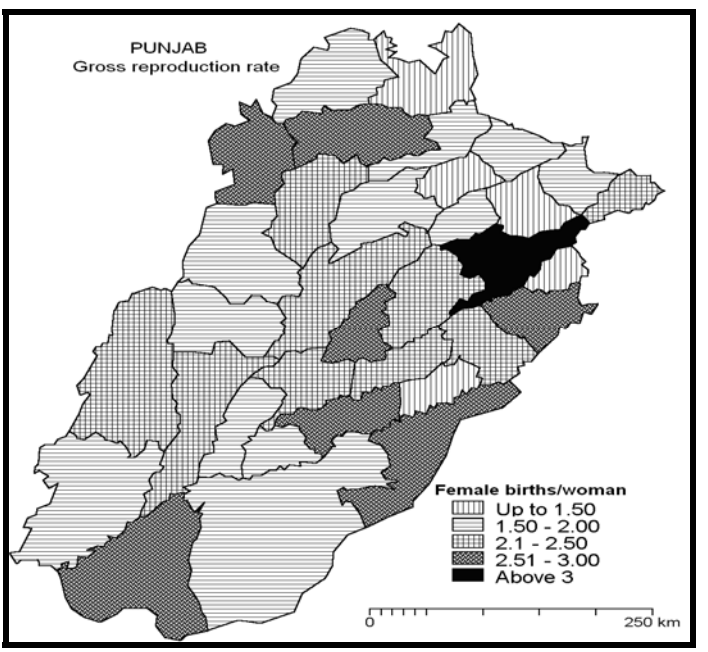
On the basis of GRR the districts of the Punjab have been placed into five categories in ascending order (table 8). Most of the districts fall into the second and third categories while minimum number of districts is found in fifth and first categories. Map 5 portrays the spatial pattern of GRR. Following the pattern of

TFR, the highest GRR have been found in Sheikhupura followed by R. Y. Khan, Kasur, Vehari, Bahawalnagar, T.T. Singh, Chakwal and Mianwali.

Table 8: Grouping of the districts by gross reproduction rate

Category	GRR	No. of districts	Names of districts
1	up to 1.50	05	Mandi Bahauddin, Pakpattan, Rawalpindi, Gujranwala, Lahore
2	1.50-2.00	12	Hafizabad, Jhelum, Bhakkar, Rajanpur, Layyah, Lodhran, Attock, Gujrat, Bahawalpur, Sargodha, Sialkot, Multan
3	2.1-2.50	09	Khshab, Narowal, D. G. Khan, Sahiwal, Khanewal, Okara, Muzaffargarh, Jhang, Faisalabad
4	2.51-3.00	07	Mianwali, Chakwal, T. T. Singh, Bahawalnagar, Vehari, Kasur, R. Y. Khan
5	Above 3.00	01	Sheikhupura

Map 5: Gross reproduction rate in the Punjab (data from table 1)



More to the point, all the sets of measures used to assess fertility pattern for the province suggest wide variations at the district level. The fertility pattern reflected by CWR computed from census data and TFR estimated by NIPS (table 1) is almost identical. These fertility rates are, therefore, assumed to be reflective of true picture of fertility pattern in the region and more reliable for current purpose than that of other fertility rates examined in this chapter. Therefore, both these rates will be used for further analysis in the next chapter. Both the rates (TFR and CWR) indicate that fertility in the province and in the districts is

considerably high. Although, TFR of the Punjab is little bit lower than that of the national level (4.8), NWFP (5.1) and Baluchistan (5.4) but it is equivalent to that of Sindh and higher than Islamabad (4.0). It is markedly higher than the TFR of Bangladesh (3.0), India (2.9), Iran, Indonesia and Algeria (2.7 each), Turkey (2.2), Sri Lanka (2.0), China (1.7), and many other areas of the world (World Population Data Sheet, 2007). Similarly CBR of the Punjab (27.17) is higher than China (15.2), India (24.0), Iran (22.2) and many other areas of the world (ESCAP, 2002). CWR of the Punjab (639.44) is also lower than the national level (667), Sindh (667), NWFP (754) and Baluchistan (782) but higher than Islamabad (510).

To sum up, we saw that although fertility rates in Punjab and in Pakistan as well, are high enough, but there is an evidence of a sustained fertility decline as well (also see Rukanuddin and Farooqi, 1988; Shah and Cleland, 1988; and Shah et al, 1986). The onset of fertility transition is evident from the comparison of CWR for the province as well as for the districts for two different census years[13]. Various surveys also suggested that during the last three decades, Pakistan as well as Punjab has experienced fertility transition. From PGE (1962-65) data total fertility rate (TFR) over 7 children was estimated. Afterwards, PFS (1976) has estimated TFR over 6.3 indicating a clear decline. Whilst, Retherford et al (1987) and Shah et al (1986) regarded the fertility rate yielded from PFS data as spurious. They alleged that the decline shown in fertility rate was an artifact of the data. However, their claim can be rejected on the basis that most of the studies (including current one) have confirmed the declining trend of fertility. PCPS (1986) estimated TFR 6 children and NIPS (1992) 5.4 children again indicating a declining trend related mainly to increasing age at marriage and contraceptive use. From PCPS (1998) data TFR 5.6 was estimated whereas PFFPS (1998) yielded TFR 5.36 for Pakistan and 5.28 for Punjab indicating a declining trend. PRHFPS (2000- 01) estimated TFR 4.8 for the period of 1997-2001. NIPS (2001) estimated TFR 4.8 for Pakistan, and 4.7 for Punjab indicating further decline[14]. Although questioning, but Economic Survey of Pakistan (2007), Pakistan Demographic Survey (2005), and some other sources[15] mentioned that TFR for Pakistan has now reached down to 3.8 and in this decline Punjab played the major role. Furthermore, it is believed that in recent decades, fertility rate has started to decline in response to modernization policy of the government, increasing awareness specifically through electronic media, rising levels of literacy and age at marriage, and increase in contraceptive prevalence rate (PDS, 2005; and NIPS, 1992). The onset of change in fertility pattern is more significant in the districts that are relatively more developed economically and socially. Therefore, variations in fertility rates can be explained by the variations in prevailing socio-economic and demographic conditions in the region to be discussed in the next chapter.

Conclusion

Due to their merits and demerits various fertility measures employed give variable results but all of them suggest that overall fertility rate in Punjab and in all of its districts is high enough which may impede socio-economic development. In urban areas fertility is evidently lower than rural areas. Comparison of CWR data for two censuses clearly indicates the onset of fertility transition in the region.

Notes

1. Though length of reproductive life span may differ from one woman to another but for statistical purposes it has been fixed from 15-49 years.
2. Roughly one confinement in 80 results is a multiple birth. This raises the question that whether the unit of measurement should be the number of live births or the number of confinements. In some cases data of confinements are collected and mostly the emphasis is on the data of live births. However, little difference results from using either approach because the difference between confinements and births is very small (A. H. Pollard, Farhat Yousif and G. N. Pollard, 1987, Demographic Techniques, Second Edition Reprint, Pergamon Press, New York, p. 82).
3. Some times other age ranges such as 15-44 and 18-49 etc. are also used to avoid the dilution of birth data by low birth rate ages.
4. Natural fertility refers to the fertility of populations in the absence of any form of contraception. Henry (1961) introduced this concept (L. Henry, 1961, Some Data on Natural Fertility, Eugenics Quarterly, Vol. 8, pp. 81-91).
5. Besides CBR, these variations may influence the other measures of fertility also such as ASFRs, TFR etc. and can be avoided by taking the average of three years births. Hence, CBR can be calculated as; CBR= 1/3 (B1/P1 + B2/P2 + B3/P3) K. Where, B and P stand for births and populations of three consecutive years respectively and K for constant (R. Ramakumar, 1986, Technical Demography, Wiley Eastern Ltd. New Delhi. p. 87).
6. Pakistan Fertility and Family Planning Survey 1996-97, (published in 1998) indicated that CBR for Punjab is 31.4 and for Pakistan is 31.8 births per thousand population.
7. Single-year rates can also be used, and as a further refinement, ASFRs can be computed separately for married women (age specific marital fertility) when the effect of variations in marriage patterns is excluded. When these rates are calculated according to characteristics other than age and sex, such as ethnicity, employment status, occupation, socio-economic status etc. are usually referred to as differential rates.
8. These rates have been calculated on the basis of one year age specific birth data. A further improvement in this method can be made by taking average of the three years age specific births.
9. TFR can also be computed by (i) Rele's method that is GRR (1 + Sex Ratio of 1.05 at birth). This method also gives almost the same figures of TFR as calculated from ASFRs. For example, it gives TFR of 4.36 for Punjab, 3.42 for Hafizabad and 3.87 for Bahawalpur (Population Census Organization of Pakistan, 1986, A Population profile of Pakistan, Islamabad, p. 66). (ii) The results obtained by dividing total births to total ever married females of age 15-49 years are almost similar to the TFR computed by NIPS (table 5.1). (iii) TFR=Live births in a year/Total women aged

15-49 (Peter R. Cox, 1993, Demography, Reprint of Fourth Edition, Universal Book Stall, New Delhi, p. 91).

10. Excess fertility = Total fertility rate – Replacement level fertility (2.1).
11. GRR is also called as one sex model of fertility measurement which is in fact a refinement of TFR. It is called gross because it assumes that a female will survive through all her reproductive span.
12. To take account of mortality risks net reproduction rate can be calculated which represents the number of female children that a female child just born can expect to bear, taking into account her risk of dying before the end of her reproductive years. This rate is always less than the GRR and represents the future potential for growth inherent in a population's fertility and mortality regimes (John R. Weeks, 1986, Population: An Introduction to Concepts and Issues, Third Edition, Wadsworth Publishing Company, California, pp. 102-106).
13. The comparison of CWR for 1981 and 1998 made in the section 5.1.3 of this chapter suggests a decline in fertility.
14. NIPS (National Institute of Population Studies), 2001, Pakistan Population Data Sheet.

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