REPRODUCTION AND SPEED OF POPULATION GROWTH IN PRESENCE OF MIGRATION: A DISTRICT LEVEL STUDY IN THREE BORDER STATES OF NORTH-EAST INDIA

Introduction:

The size of the population and its growth in India has been a major hurdle in achieving the goal of population stabilization. The National Population Policy launched in 2000 had the medium term objective to achieve the replacement level fertility by 2010. This also envisages states to bring their policies, giving priority to local issues in coherence with the goals and objectives prescribed in the national policy (IIPS, assessed on 2011). The need of the hour, then, is not only to look at the population problem in macro or all India level alone but also to pay special attention to the problem of the individual states and also to inter-state variations, and formulate a population policy that will take into account these variations and make the all India policy an integrated whole of appropriate policies for the constituent individual states (Rao 1981).

In addition to births and deaths, migration is the third factor which influences the growth of a population. The North-East region of India is bounded by five countries (Bangladesh, Bhutan, China, Myanmar and Nepal), and comprised of eight states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura). The region is connected with the rest of India by just a 22 km-long land corridor passing through Siliguri town in the eastern state of West Bengal. The region accounts for 8.06 per cent of the country's territory and 3.73 per cent of the total population (Census of India, 2001). Characterized by its extraordinary ethnic diversity, the region is inhabited by three distinct groups of people: the hill tribes, the plain tribes and the non-

tribal population of the plains. Further, most of these states are small in size and population, landlocked and hilly, and have poor communications and transportation infrastructure. The region also lacks in terms of key development indicators (Singh 2009).

The states of the region are influenced by migration, both internal and external. The continued influx of alleged illegal immigrants from Bangladesh has been of deep concern in the region, as some of these states have experienced a comparatively high growth rate of population in the post-Independence period, with illegal immigration widely perceived to be the key factor responsible (Singh 2009).

This paper concentrates on the three states out of the eight states of North-East India: Assam Tripura and Meghalaya. The British occupation of Assam and subsequent expansion of power to surrounding areas brought massive changes in the society, polity and economy of the North-East region. With the development of the tea, oil and coal industries, the demand for migrant labour expanded and this attracted large-scale immigration from other parts of the country. Further, the availability of surplus land attracted a large number of cultivators from nearby East Bengal/East Pakistan. Only after the partition of India immigration from what is Bangladesh today become 'illegal' (Singh 2009). In a recent study it was estimated that the volume of undocumented migration in Assam is over half a million during 1991-2001 and over 1.3 million during 1971-2001 (Nath et al. 2012). However, this issue of migration assumed political and communal overtones after independence, and continues to be an issue of concern. The continuance of illegal Bangladeshi migration allegedly threatens the demographic pattern of Assam,

so much so that the majority Assamese community stands threatened of being relegated to minority status (Goswami 1996, Governor of Assam 1998).

The growth of population in Assam during 1951-2001 was 136.38 per cent against the national growth rate of 116.30 per cent. In 1951-61, there was a 34.98 per cent increase in the population of Assam as against 21.64 per cent nationally. It was 34.95 per cent in 1961-71 and 47.60 per cent in 1971-1991 (As no census could be taken in Assam in 1981, the population growth rate for 1981-91 was projected at 24.24 per cent).

In Tripura, the influx from across the border has reduced the state's tribal population to a minority, making it the only state in the country that has been transformed from being a predominantly tribal to a non-tribal state. In the 2001 census, Scheduled Tribes (STs) constituted only 31.1 per cent of the state population of 3.2 million, while six decades earlier they comprised at least 50 per cent of the population. Anger over this demographic transformation led to tribal insurgency in the state (Singh 2009).

Meghalaya, which shares a 443-km-long border with Bangladesh, has also become another destination for the Bangladeshis as well as for people from the other states of India. This caused populations to increase rapidly, leading to land pressure on indigenous populations and their marginalization. Meghalaya has endured massive communal riots between migrants from Bangladesh and Bengal and there have been measured and measurable increases in the rate of in-migration and immigration due to economic pressures from Nepal, Bengal, Bihar and due to political pressures against the indigenous peoples of Bangladesh (Waats 1999).

The growth of a population being a function of both fertility and mortality (without migration), Net Reproduction Rate (NRR) is a more appropriate index of the

extent to which population stabilization is attained. The NRR is a synthetic demographic rate that measures the average number of daughters per woman who survive to the average reproductive age. Essentially, the Net Reproduction Rate measures, to what extent one generation is replaced by the next generation - taking into account both the level of (period) fertility and mortality. The NRR is probably the most accurate (period) measure of the actual demographic situation in a particular population. It eliminates age structure effects, which can seriously distort the rates of population increase or decline, as well as the birth and death rates. The NRR shows, how a population would change with the *current* vital rates (China-Profile, assessed on 2011).

In populations with low levels of mortality, as in most developed countries, the replacement level of Total Fertility Rate (TFR) is about 2.1 whereas in populations with higher mortality, in particular high childhood mortality, the replacement level of TFR can be as high as 3.5 or 4.0. Thus, fertility rates that correspond to an NRR of 1.00 are often referred to as replacement level fertility (Preston et al. 2003).

In India, due to insufficient vital registration, the Sample Registration System (SRS) has emerged as the main source of fertility and reproduction estimates [Crude Birth Rate (CBR), Total Fertility Rate (TFR) and Gross Reproduction Rate (GRR)][1] at the state level, but does not provide district level estimates. Even SRS does not provide

[1] CBR (period) is the number of births in a particular period divided by the number of person-years lived in the population during the same period.
TFR is the average number of children a woman would bear if she survived through the end of the reproductive life span and experienced at each age a particular set of age-specific fertility rates. (contd.)
GRR represents the number of female births an average woman would have if she lived through the end of her reproductive age.
NRR represents the average number of daughters that the female members of a birth cohort would bear during their reproductive life span if they were subject to the observed age-specific maternity rates and mortality rates throughout their lifetimes. If NRR >, =, < 1.00, then a cohort of girl babies will leave behind a larger, equal or smaller cohort of daughters respectively than they themselves represented.

state level estimates of NRR. Moreover, though the National Family Health Surveys (NFHS) provide comparable estimates of fertility for the states and the union territories, they do not give district level estimates. The District Health and Facility Surveys (DHLS) too do not provide these estimates.

Traditionally, computation of NRR requires the female age specific survival probabilities within the childbearing period (generally obtained from a female life table) and the female age specific fertility rates both of which are not available at the district level of India from the readily available sources like the SRS and NFHS's nor they can directly be computed due to poor registration of births and deaths.

Demographers have developed several mechanisms to estimate fertility by different direct and indirect methods (The Concept of Dual Record System by Chandra Sekar and Deming (1949); Birth Order Statistics in Stable Condition (Brass and Coale 1968); the Reverse Survival Technique (Shryock and Seigel 1976); Brass's P/F Ratio Method (Brass and Coale 1968); Rele's (1967, 1987) Method; Stable Population Method (United Nations 1983); Coale's (1981) Method; Generalized Population Method (Preston 1983); Palmore (1978) Method; Gunasekaran and Palmore (1984) Method; etc.).

In India, Bhat (1996) has used regression method to estimate TFR from CBR for state level data from SRS for the periods 1979-81 and 1989-91. However, low coverage of birth registration in the vital registration system possibly could not attract many demographers to utilize these data to estimate fertility. So far fertility estimates at regular intervals below the state level are not readily available from any other source. A few researchers (Parasuraman and Ram 1988; Das Gupta and Bhat 1995; Guilmoto and Rajan 2002) and the Registrar General of India 1989, 1997 have used different indirect

techniques to estimate fertility rates at the district level using census data (IIPS, assessed on 2011). However, possibly due to the absence of reliable mortality information (Life Tables) none attempted to estimate NRR at the district level of India.

The conventional NRR and the intrinsic rate of growth (derived from the NRR and the age specific fertility rates) are measures not well suited to a world in which migration plays a major role. These measures demonstrate the implications of keeping age specific rates of fertility and/or mortality fixed at some observed level and setting age specific migration rate at zero. However, compact formulas can be derived without the assumption of zero net migration (Preston and Wang 2007).

One of the indirect methods, called 'The variable-r method' (Preston et al. 2003) suggests that NRR can be recaptured without any reference to the underlying mortality and fertility schedule if good quality age data are available from two censuses taken 5 or 10 years apart along with the data of inter-censal age specific female births. The NRR computed from such inter-censal data (call it NRR*) and the intrinsic growth rate derived from the NRR* (call it r*) include provision for allowance of net migration. The NRR* indicates how many daughters would be born, on average, to a cohort of female babies who pass through life and are subject at each age to observed rates of fertility, mortality and migration. The intrinsic growth rate in the presence of migration (r*) is a precise measure of how fast a population would eventually grow if the current age specific rate of fertility, mortality and migration were maintained indefinitely. Of course r* will not be affected by migration that occurs beyond the age of childbearing (Preston and Wang 2007).

The North-East India has eight states with 76 districts as per 2001 census. Considering the enormity of giving a district level analysis for all these districts in a single paper we have chosen the districts of the three states (Assam, Tripura and Meghalaya) for estimating NRR, before and after allowance for migration and assess the speed of the population growth of these districts in presence of migration. We have taken the period 1991-2001 for this paper as the 2011 census data have not been published at the time of preparing this paper.

Data and Methodology:

(i) Estimation of conventional NRR (before allowance for migration):

Choudhury and Sarma (2011) have generated one parameter model life tables for India and its major states where life expectancy at birth (e_0^0) is the only input. The e_0^0 for the districts can be estimated by regression method using the estimated infant mortality rates of the districts and the proportion of persons aged 65 years and above (Sarma and Choudhury 2010). Thus, the life tables for the districts of the major states can be obtained from the estimated e_0^0.

Guilmoto and Rajan (2002) estimated the Total Fertility Rate (TFR) for the districts of India using 2001 census data. These are the recent estimates at district level and have been used in the present study for estimating the GRR and NRR for the districts of the selected states.[2]

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[2] $GRR = TFR * \frac{1}{1+SRB}$, (Preston et al. 2003)

where SRB is the sex ratio at birth computed as $SRB = \frac{BR(M)}{BR(F)} = \frac{BR(T) - BR(F)}{BR(F)}$

$BR(M), BR(F)$ and $BR(T)$ denotes the male, female and total Birth Rates respectively.

The Birth Rates for the selected states and their districts can be estimated by the reverse survival technique using the 0-4 population of 2001 census and the 0-4 survival probabilities from our generated life tables. These Birth Rates are centered on mid 1998 as the 0-4 population in the 2001 census refers to the births during 1996-2001.[3]

This estimation process is sensitive to the level of age misstatement of the 0-4 population. However, with rapid improvement in the literacy level the intensity of age misstatement is decreasing rapidly and the quality of age data in the 2001 census has most probably improved compared to the previous censuses (Guilmoto and Rajan 2002).

Using the estimated GRR, NRR can be estimated by multiplying the GRR with the probability of survival of a female baby to the mean age of childbearing. [4]

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[3] The population in the mid of 1998 is computed by

$P_{mid1998} = P_{2001}e^{-2.5r}$; where P_{2001} is the total population in 2001, r is the exponential growth rate of population during 1991 to 2001.

The BR for the mid of 1998 is computed by the Reverse Survival Method as

$$BR(1998) = \frac{1}{5}\frac{{}_5P_0 \big/ P_{2001}\, e^{-2.5r}}{{}_5L_0 \big/ 5l_0} = \frac{l_0\ {}_5P_0}{P_{2001}e^{-2.5r}\ {}_5L_0} = \frac{l_0\ {}_5P_0}{p_{2001}e^{-2.5r}({}_1L_0 + {}_4L_1)}$$

where l_0 = 100000, ${}_5L_0 \big/ 5l_0$ is probability of survival in the age group 0-4 and ${}_5P_0$ is the population aged 0-4 in 2001 census. ${}_1L_0$ and ${}_4L_1$ can be taken from the generated district life tables.

[4] $NRR = GRR * p(A_M)$ (Preston et al. 2003)

Where $p(A_M)$ is the probability of survival from birth to the mean age of childbearing, generally taken as 29 years (Namboodiri 1991).

It is to be noted that $A_M = \dfrac{\int_\alpha^\beta m(a)ada}{\int_\alpha^\beta m(a)da}$ (Preston et al. 2003) (*contd.*)

The probability of survival of a female baby to the mean age of childbearing [$p(A_M) = p(29)$] can be calculated from the generated female life tables by interpolating between age 25 and 30.

From SRS data A_M are computed for the states of India and found to vary from 25.9 to 29.6 years. However, the estimates of NRR computed by taking A_M =29 do not differ from the ones taking the corresponding estimated values of A_M for the states. So, the assumption of A_M =29 is justified.

It is to be noted that the SRB calculated from the estimated birth rates are centered on mid 1998 while the TFR estimated by Guilmoto and Rajan (2002) are centered on 1997.

(ii) Estimation of NRR* and r*:

Estimation of NRR* requires good quality data for female population at 5 years age interval up to age 45 from two censuses along with the inter-censal age specific female births. The female age data are available at the district level in 1991 and 2001 censuses, but the inter-censal births are not available at the district level. United Nations Manual X (1983) described a variant of Coale and Trussell's method of estimating age specific fertility rates and total fertility rates between two censuses. The data required for

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The analogous form for discrete data of 5 years age group being

$$A_M = \frac{\sum_{15}^{45} {}_5m_a\,(a+2.5)}{\sum_{15}^{45} {}_5m_a}$$

Where ${}_5m_a$ is the female age specific fertility rate in the age group a to a+5.

this are children ever born classified by 5 years age group of mothers and the number of women classified by 5 years age group, both from two censuses 5 or 10 years apart. These data are available at the district level of India from 1991 and 2001 censuses. There is a general tendency for older women to omit some of their children, perhaps those who have died or who have left home. Such omission error may result in under estimation of fertility of older women (United Nations 1983). In estimating the age specific fertility for selected states and their districts we have encountered, in some cases, such omission errors in the age group of 40-44 and 45-49. However, the magnitudes of the fertility rates in these age groups are so small that they may be ignored. A comparison of the age specific fertility rates estimated this way and that of SRS and NFHS-2 are presented in Table 1(i)-(iii). After estimating the age specific fertility rates, the inter-censal age specific births are obtained from the age specific fertility rates by multiplying them with the corresponding interpolated female population of 1996. Dividing the age specific inter-censal births by (1+ SRB), the age specific inter-censal female births are estimated. Using these estimated age specific inter-censal female births and the age distribution of the female population of 1991 and 2001 censuses, NRR* for the districts can be estimated.[5]

[5] Estimation of NRR* (Preston et al. 2003)

$$NRR^* = \sum {}_5 v_x . \exp(S_x); \qquad {}_5 v_x = \frac{{}_5 B_x}{B}$$

$$S_x = \sum_{x=0}^{a-5} 5.{}_5 r_x + 2.5.\ {}_5 r_a; \qquad {}_5 r_x = \frac{1}{10} \ln \left(\frac{{}_5 N_x{}^{2001}}{{}_5 N_x{}^{1991}} \right) \qquad (\textit{contd.})$$

Using the estimated NRR*, the age specific proportion of female births and age distribution of female population from the two censuses r* can be estimated by iteration method (Preston 2003).[6]

Results and Discussion:

Table 2 presents the estimates of NRR, NRR*, the difference between them, the r* in percentage and the observed growth rates of female population in percentage for the selected states and their constituent districts. In Assam, only one district, (viz., Jorhat, NRR=0.94) achieved below replacement level NRR while in Meghalaya and Tripura all districts have above replacement level NRR.

Allowing for migration, the districts of Assam present a mixed picture. The low fertility districts of upper Assam (eastern part) (viz., Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat) have been experiencing immigration. Immigration raises the NRR in these districts by 0.16-0.21 considering the immigration to Golaghat as negligible (see limitations). Immigration also raises the NRR of Jorhat from below replacement level to above replacement level. The districts of lower Assam (western part) have very high fertility and except Kamrup all (viz, Kokrajhar, Dhubri, Goalpara, Bongaigaon, Barpeta

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${}_5B_x = Number\ of\ female\ births\ in\ the\ age\ group\ x\ to\ x+5;\ \ B = Total\ Number\ of\ female\ births$

${}_5N_x^{2001} = Number\ of\ females\ in\ the\ age\ group\ x\ to\ x+5\ as\ per\ 2001\ census$

${}_5N_x^{1991} = Number\ of\ females\ in\ the\ age\ group\ x\ to\ x+5\ as\ per\ 1991\ census$

[6] Iteration method is used to find the value of r* that satisfies the equation

$$\int_0^{\infty} e^{-r^*a} v(a) e^{\int_0^a r(x)dx} da = 1$$

A starting value of r* is taken as [ln(NRR*)]/27 and a reasonable procedure for adjusting r* is to adjust the latest value r* by $\Delta r^* = [s-1]/27$, where s is the value of the left-hand side of the equation.

and Nalbari) have been experiencing net emigration. The emigration from Goalpara and Nalbari are considered negligible. Immigration raises the NRR of Kamrup by 0.37 while emigration reduces the NRR of the other districts of this part by 0.10-0.33. Some districts of middle Assam (viz, Darrang and Marigaon) have been experiencing net emigration and this reduces their NRR by 0.10-0.13 and of the other two districts (viz, Nagaon and Sonitpur) of this part, Sonitpur has been experiencing net immigration and this raises its NRR by 0.12 while Nagaon has been experiencing considerably negligible immigration. In the northern Assam, Dhemaji has been experiencing negligible emigration and Lakhimpur has been experiencing negligible immigration. In southern Assam, all the districts (viz., Karbi Anglong, North Cachar Hills, Cachar, Karimganj and Hailakandi) have been experiencing net immigration and this raises their NRR by 0.13-0.49 (Figure 1).

All the districts of Meghalaya are recipient of net immigration. Immigration raises the NRR of these districts by 0.38-0.66 (Figure 2) while in Tripura out of the three districts only one district (West Tripura) has experienced immigration and the other two districts (South Tripura and North Tripura) have experienced emigration (Figure 3).

The observed growth rates and the intrinsic growth rates in presence of migration (r*) both register the impact of migration, but in different ways. The observed growth rate gives equal weight to all migrants regardless of their age whereas migrants are weighted in r* by their expected future number of births at the age when they arrive or depart. Both the growth rates are based upon the same set of current age specific fertility, mortality and migration rates and the only difference between them is attributable to differences in the age distributions to which those rates are applied (Preston and Wang 2007). As the

current age distributions are younger than intrinsic age distributions, observed growth rates are higher than the intrinsic growth rates in all the districts of the two states.

If the present age specific rates of fertility, mortality and migration are maintained, the populations of all the districts of Assam would eventually be growing at annual rates of 0.12 percent to 2.05 percent, the populations of all the districts of Meghalaya would eventually be growing at annual rates of 2.59 percent to 3.25 percent. In Tripura, the population of the West Tripura district would eventually be growing at annual rate of 0.75 percent while the populations of South Tripura and North Tripura districts would eventually be declining at annual rates of 0.72 percent and 2.08 percent respectively.

Limitations of the Methodology and findings:

The methods used in the study are sensitive to data quality particularly of data at young ages. The variable-r method is mainly subject to two kinds of reporting errors: from changes in the patterns of age misreporting, and from differences in completeness of coverage. Application of the variable-r method for estimating the period net reproduction rate after allowing for migration (NRR*) uses age-specific growth rates and the proportionate age distribution of mothers at childbirth. The population age structure required by the variable-r method is the relative age distribution—that is, the age-specific growth rate. Even in the event of substantial underreporting, if two enumerations have similar characteristics of underreporting, the fertility estimate yielded by the variable-r method would closely resemble the results derived from a complete enumeration. Second, instead of focusing on one birth cohort, the variable-r method

makes use of the full age distribution from birth to the end of reproduction, thus providing a more stable measure of fertility (Cai 2008).

The NRR (without allowing for migration) estimates are based on (i) SRB, (ii) TFR and (iii) Probability of survival to the mean age of childbearing.

The SRB is based on BR(T) and BR(F) which are again based on 0-4 population of 2001 census. BR(T) and BR(F) are subject to the errors in 0-4 population. However, the SRB will not be affected if we assume that the levels of error are same in the 0-4 total population and 0-4 female population.

The TFR (estimated by Guilmoto and Rajan) are though obtained in a very indirect way the estimates seem to be reliable. In the process of estimating the NRR* from two census data we needed the inter-censal age specific births. These were estimated by the indirect method of increment of cohort parities from the data on Children Ever Born (CEB) reported by women of childbering period in the two censuses of 1991 and 2001. The process also gives estimates of CBR and TFR. These inter-censal estimates are satisfactorily closer to the estimates of Guilmoto and Rajan (both at state and district level) and also to the SRS estimates (at state level). However, we have not used these estimates in estimating NRR (without allowing for migration) as being based on two censuses they might be influenced by inter-censal migration.

The proposed estimates are subject to the limitations of the survival probabilities derived from life tables generated by Choudhury and Sarma. The generated life tables may not be as reliable at the district level as they are at the state level. However, the same life tables have also been used in estimating the district Birth Rates. In the absence of any direct check on the generated district life tables, their consistency has been established by

comparing the estimated BR(T) with the CBR as estimated by Guilmoto and Rajan based on survival rates obtained by using model life tables (South Model from the Coale and Demeny life tables). These two sets of Birth Rates are tolerably closer to each other.

Table 3 (i) presents the estimates of CBR and TFR based on the two censuses (1991, 2001) along with the corresponding estimates of SRS (1996) and NFHS-2 (1997-99) and Guilmoto and Rajan (centered on 1997) for the selected states. Table 3 (ii) presents the BR(T) based on 2001 census and the estimates of TFR based on two censuses (1991, 2001) along with the estimates of CBR and TFR by Guilmoto and Rajan for the districts of the selected states.

We would like to conclude that even though the sources of data used are known for quality problems, errors in the data do not affect our estimates significantly.

To be doubly ensured about the level of error that might creep in we have tested our results by computing NRR by the traditional method using SRS age specific fertility rates (1996) and life tables (1994-98) for the five states Assam, Kerala, Rajasthan, West Bengal and Uttar Pradesh and found differences of 0.00, 0.05, 0.00, 0.01 and 0.10 respectively. These five states are selected because we have generated female life tables only for these five states and can compare with the NRR estimated by our method. The maximum difference found in Uttar Pradesh may be due to the fact that some parts of it were cut off in the year 2000 to form a new state Uttaranchal and the generated life tables are based on SRS life tables covering a period from 1970-75 to 2001-05.

Finally, to be at safe side, we have decided to ignore a difference of less than 0.1 between NRR* and NRR as negligible that might be due to relative error in the values of

NRR. A difference of 0.1 and above (10% or more) is considered due to the influence of migration.

Table 1 (i). Age Specific Fertility Rates of Assam based on two censuses (1991, 2001), SRS (1996) and NFHS-2 (1998-99):

Age group	Census (1991, 2001)	SRS (1996)	NFHS-2 (1998-1999)
15-19	0.067	0.054	0.040
20-24	0.195	0.187	0.110
25-29	0.201	0.180	0.084
30-34	0.109	0.130	0.052
35-39	0.050	0.061	0.014
40-44	0.00	0.029	0.00
45-49	0.00	0.006	0.00

Table 1 (ii). Age Specific Fertility Rates of Meghalaya based on two censuses (1991, 2001), SRS (1996) and NFHS-2 (1997-99):

Age group	Census (1991, 2001)	SRS (1996)	NFHS-2 (1997-1999)
15-19	0.061	0.046	0.086
20-24	0.215	0.151	0.211
25-29	0.243	0.198	0.232
30-34	0.175	0.170	0.184
35-39	0.133	0.120	0.105
40-44	0.052	0.082	0.080
45-49	0.013	0.039	0.014

Table 1 (iii). Age Specific Fertility Rates of Tripura based on two censuses (1991, 2001), SRS (1996) and NFHS-2 (1998-2000):

Age group	Census (1991, 2001)	SRS (1996)	NFHS-2 (1998-2000)
15-19	0.074	0.038	0.075
20-24	0.186	0.130	0.126
25-29	0.161	0.126	0.102
30-34	0.077	0.073	0.049
35-39	0.032	0.030	0.019
40-44	0.002	0.012	0.003
45-49	0.00	0.003	0.00

Table 2. The NRR, NRR*, the difference between them, the r* (%) and the actual growth rates (%) for the states Kerala and Assam and their constituent districts (1991-2001).

District	NRR	NRR*	(NRR*-NRR)	r*(%)	Observed growth rate(%)
Assam	1.31	1.37	0.06*	1.19	1.80
Kokrajhar	1.33	1.18	-0.15	0.61	1.25
Dhubri	1.68	1.58	-0.10	1.72	2.04
Goalpara	1.59	1.58	0.01*	1.70	2.12
Bongaigaon	1.44	1.10	-0.33	0.38	1.16
Barpeta	1.60	1.34	-0.26	1.10	1.74
Kamrup	1.11	1.48	0.37	1.51	2.45
Nalbari	1.16	1.12	0.04*	0.44	1.24
Darrang	1.34	1.24	-0.10	0.12	1.50
Marigaon	1.62	1.49	-0.13	1.49	1.96
Nagaon	1.52	1.53	0.01*	1.60	2.09
Sonitpur	1.23	1.35	0.12	1.14	1.76
Lakhimpur	1.39	1.42	0.03*	1.27	1.79
Dhemaji	1.47	1.39	-0.08*	1.29	1.85
Tinsukia	1.22	1.38	0.16	1.25	1.91
Dibrugarh	1.02	1.18	0.16	0.64	1.43
Sibsagar	1.01	1.17	0.16	0.62	1.59
Jorhat	0.94	1.15	0.21	0.53	1.48
Golaghat	1.12	1.16	0.04*	0.57	1.39
Karbi Anglong	1.47	1.65	0.18	1.86	2.16
North Cachar Hills	1.25	1.74	0.49	2.05	2.37
Cachar	1.30	1.45	0.15	1.39	1.80
Karimganj	1.47	1.61	0.14	1.78	1.98
Hailakandi	1.49	1.62	0.13	1.78	1.93
Meghalaya	1.75	2.21	0.46	2.79	2.76
West Garo Hills [1]	1.54	2.01	0.47	2.59	2.57
East Garo Hills	1.66	2.32	0.66	3.00	2.87
West Khasi Hills	2.14	2.52	0.38	3.12	3.05
East Khasi Hills [2]	1.47	2.01	0.54	2.59	2.63
Jayantia Hills	2.10	2.57	0.47	3.25	3.17
Tripura	1.09	1.22	0.13	0.80	1.51
West Tripura	1.02	1.23	0.21	0.75	1.74
South Tripura	1.13	0.83	-0.30	-0.72	-0.01
North Tripura	1.18	0.59	-0.59	-2.08	-1.59

* indicates negligible

Note: Between 1991 and 2001 South Garo Hills has been created by cutting a portion from West Garo Hills and Ri Bhoi has been created by cutting a portion from East Khasi Hills

1. Includes South Garo Hills

2. Includes Ri Bhoi

Table 3 (i). Estimates of CBR and TFR based on two censuses (centered on 1996), SRS (1996-98), NFHS-2 (1997-99) and as estimated by Guilmoto and Rajan (centered on 1997) for Assam, Meghalaya and Tripura:

State	Census	SRS	G&R	NFHS-2	Census	SRS	G&R	NFHS-2
	CBR				TFR			
Assam	26.2	27.9	27.0	21.8	3.0	3.2	3.19	2.31
Meghalaya	33.8	29.9	33.6	35.7	4.5	4.0	4.5	4.57
Tripura	22.9	18.1	21.2	N.A.	2.6	2.1	2.5	N.A.

*G&R: Guilmoto and Rajan ; N.A.: Not Available

Table 3 (ii). Estimated Total Birth Rates (based on 2001 census) and TFR (based on 1991, 2001 censuses) along with the estimates of CBR and TFR by Guilmoto and Rajan:

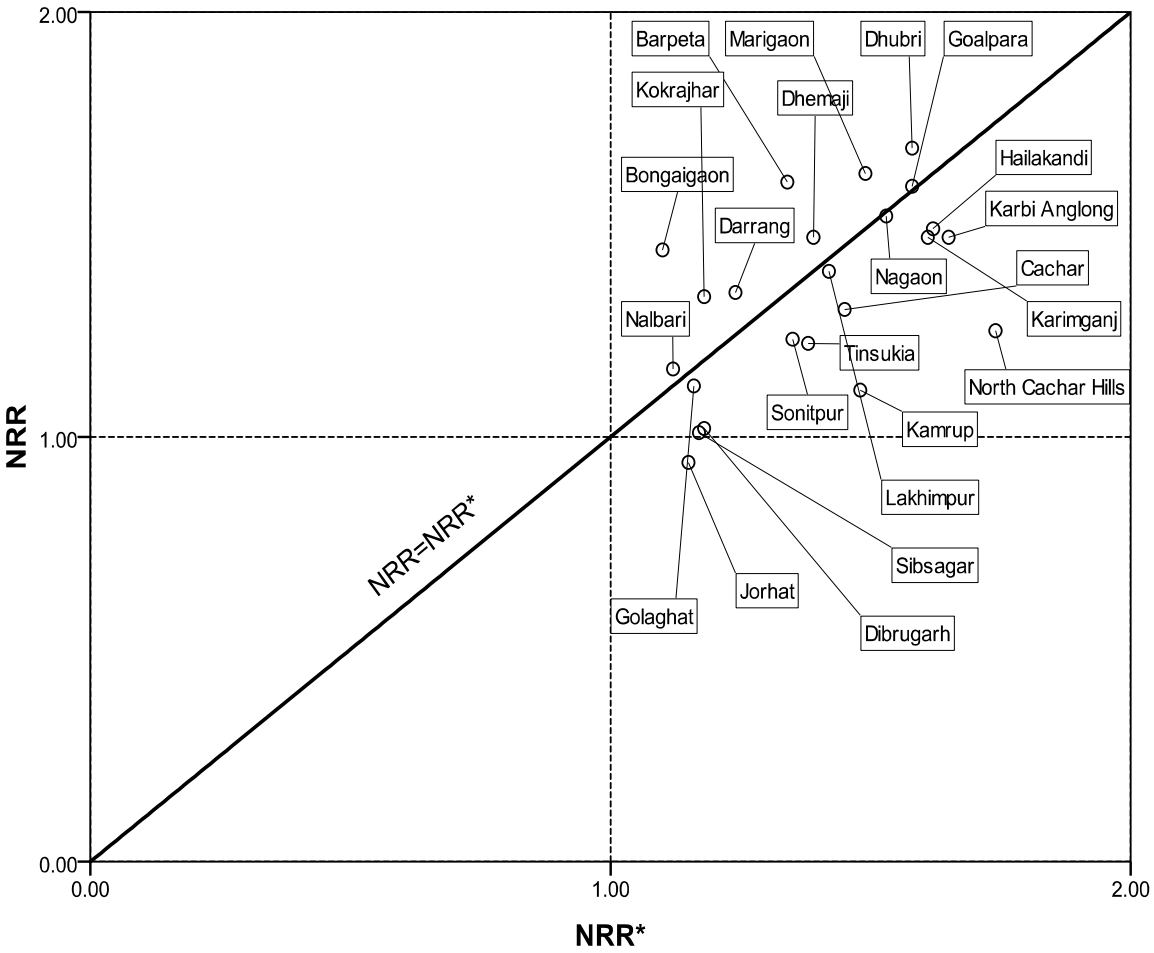
District	BR(T) (Based 2001 census)	CBR (G&R)	TFR (Based on 1991-2001 censuses)	TFR (G&R)
Assam	26.0	27.0	3.0	3.2
Kokrajhar	27.0	29.3	3.7	3.3
Dhubri	33.7	35.2	4.3	4.3
Goalpara	30.7	32.0	3.8	3.9
Bongaigaon	27.9	29.4	3.5	3.5
Barpeta	28.9	30.8	3.4	3.8
Kamrup	21.5	22.1	2.4	2.6
Nalbari	21.7	23.0	2.9	2.7
Darrang	28.2	29.1	3.2	3.4
Marigaon	29.7	31.8	3.5	3.9
Nagaon	28.7	29.9	3.4	3.6
Sonitpur	25.1	25.6	3.0	3.0
Lakhimpur	25.5	27.4	3.9	3.3
Dhemaji	25.8	27.7	3.1	3.5
Tinsukia	24.0	25.1	2.7	2.9
Dibrugarh	21.4	22.0	2.4	2.4
Sibsagar	21.5	21.6	2.5	2.4
Jorhat	20.0	19.4	2.4	2.2
Golaghat	22.5	23.3	2.7	2.7
Karbi Anglong	28.3	29.6	3.5	3.7
North Cachar Hills	25.6	26.4	3.1	3.1
Cachar	24.4	25.3	2.9	3.1
Karimganj	27.5	29.0	3.5	3.6
Hailakandi	29.3	30.2	3.7	3.8
Meghalaya	33.9	33.6	4.5	4.5
West Garo Hills [1]	39.8	32.1	3.5	4.1
East Garo Hills	30.5	34.2	4.3	4.4
West Khasi Hills	40.3	38.6	6.7	5.5
East Khasi Hills [2]	30.5	27.7	5.9	3.6
Jayantia Hills	39.9	38.0	5.9	5.4
Tripura	20.3	21.2	2.6	2.5
West Tripura	18.6	19.6	2.3	2.3
South Tripura	20.7	21.8	2.9	2.6
North Tripura	20.7	23.4	2.8	2.8

Note: Between 1991 and 2001 South Garo Hills has been created by cutting a portion from West Garo Hills and Ri Bhoi has been created by cutting a portion from East Khasi Hills

1. Includes South Garo Hills

2. Includes Ri Bhoi

Figure 1. NRR and NRR* of the districts of Assam (1991-2001)



Districts below the diagonal have been experiencing immigration and above the diagonal have been experiencing emigration.

Figure 2. NRR and NRR* of the districts of Meghalaya (1991-2001)

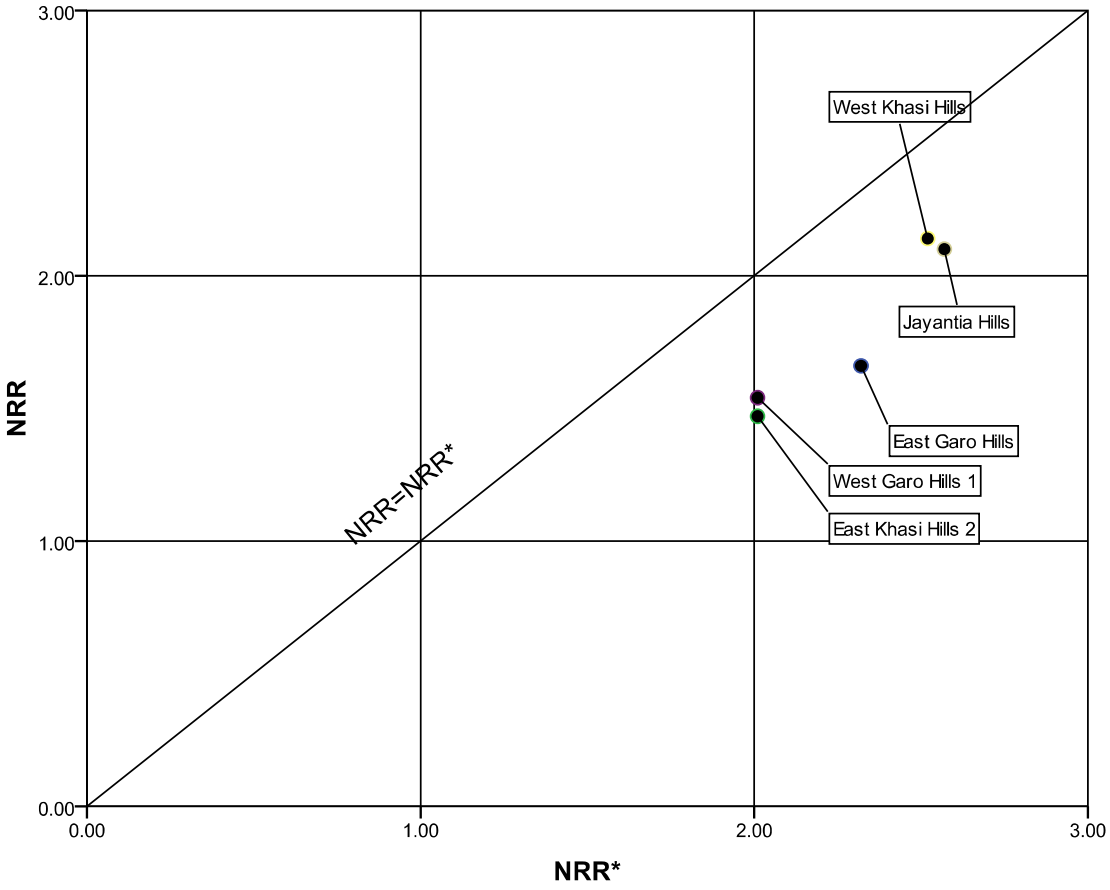
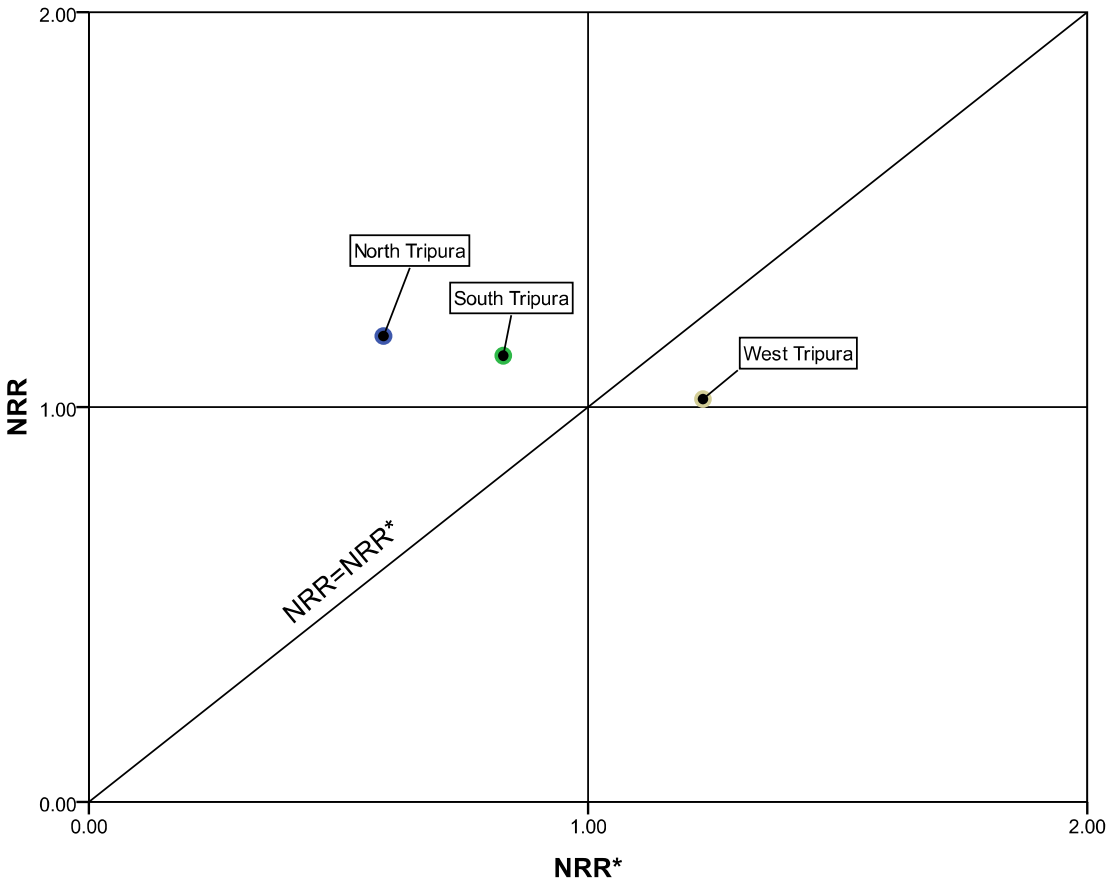


Figure 3. NRR and NRR* of the districts of Tripura (1991-2001)



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