(EPC 2016 Submission – Extended Abstract)

"Projecting the regional explicit socioeconomic heterogeneity in India by residence"

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1 Background

The paper is embedded in an interdisciplinary case-study at the International Institute for Applied Systems Analysis (IIASA) that investigates the impact of Socioeconomic Heterogeneity in Model Applications (SCHEMA) and on the environment and well-being in India. This study is motivated by two research questions:

(1) How does the accounting of socioeconomic heterogeneity, measured by educational attainment, improve population projections for India?, and **(2)** How will changing patterns in urbanization affect the population projection, depending on the spatial scale (national vs. subnational) considered in the projections?

2 Introduction

Both of these research questions represent fundamental questions in the field of spatial demography and population research as social heterogeneity is strongly discussed. Lewin (2014)[1] postulated a correlation between socio-economic, demographic and other characteristics that produce social heterogeneity and can vary across space. Therefore social and spatial heterogeneity has to be considered.

Fig.1) Differentials in Total Fertility Rate in India by education, state, residence and region, 2013
(Source: Sample Registration System 2013, India)

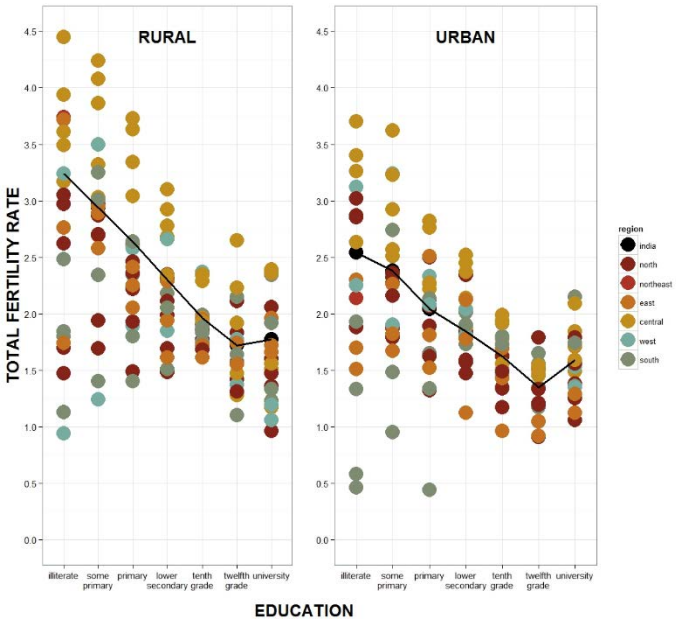


Figure 1 illustrates the variation in the level of Total Fertility Rate (y-axis) in India by level of education (x-axis) and by States/UTs in India, with rural and urban place of residence in two panels, the average TFR of India as black lines and the 6 regions. Here a negative association between education and fertility is visible in a downward gradient with a slight positive slope for university degree. This gradient is visible for both, urban and rural areas, but on different levels. There is also a large deviation within and between regions and states, like in Central India with higher fertility levels.

In total, three observations can be made, first, a steep negative gradient by education is visible reflecting the negative association between education and actual fertility. A slight positive slope for women with university education shows that those women possibly desire more children and are in a better economic

[1] Lewin (2014) The Meaning and the Implications of Heterogeneity for Social Science Research.

position to afford them. This U-shape can be observed in some European countries. Secondly, the same gradient is visible for urban and rural areas in India, but on a different level. This implicates a spatial dimension of fertility related to place of residence. Thirdly, we can see a large deviation within and between regions and states, as for instance states in Central India shows significant higher fertility levels among all educational groups, compared to the Indian average. The spatial dimension is not only visible in the case of fertility, but also of mortality and migration, so that an inclusion of spatial and social heterogeneity in the projections would better inform the prospective population development of India.

3 Methods

In this study we developed a multi-dimensional population **PROJECTION MODEL** that projects the population of India by five dimensions: three personal characteristics (age, sex, and educational attainment) and two spatial characteristics (35 States/Union Territories (UT), and with rural and urban, 2 residences). In total 70 sets of subnational populations are projected in 5 yearly steps from 2010 up to 2100.

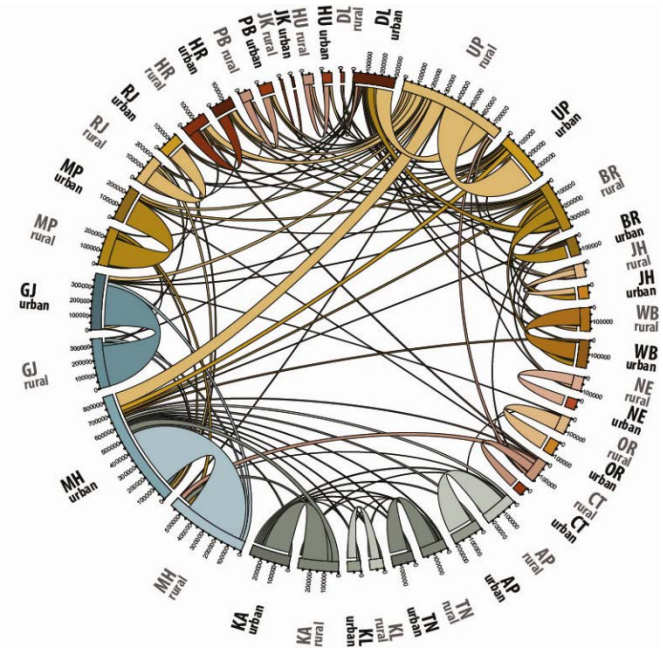
We defined a **BASE-LINE SCENARIO** to study the impact of spatial and socioeconomic differentials in demographic rates and education transitions on the population projection outcome. That will be the basis for the development of further plausible scenario narratives to project (including the Shared Socioeconomic Pathways (SSP) scenarios provided by IIASA). (KC & Lutz 2014)

FERTILITY (data available for all dimensions, SRS)
- Fertility rate among women with higher education levelled below replacement fertility

- While among women with lower levels of education the fertility rate has been declining and we assumed a continuation of this trend

MORTALITY (data by education **not** available, SRS)
- The trend in sex-specific life expectancy was extrapolated following the UN assumptions for India

Fig.2) Internal Migration in India by States & Residence, 2001



(INTERNAL) MIGRATION (data by education **not** available, Census 2001)

- Rates between and within State/UT by residence was estimated (see Fig. 2)

- Age and sex specific internal migration rates assumed to remain constant

- Due to very low rates, international migration was not considered

EDUCATION PROGRESSION (Census 2011)
- Transitions between 6 educational groups were estimated and extrapolated

- In case a region has lower level of educational attainment, a convergence to the sex and residence specific average Indian pattern by 2050 was assumed

URBANISATION (Census 2011)

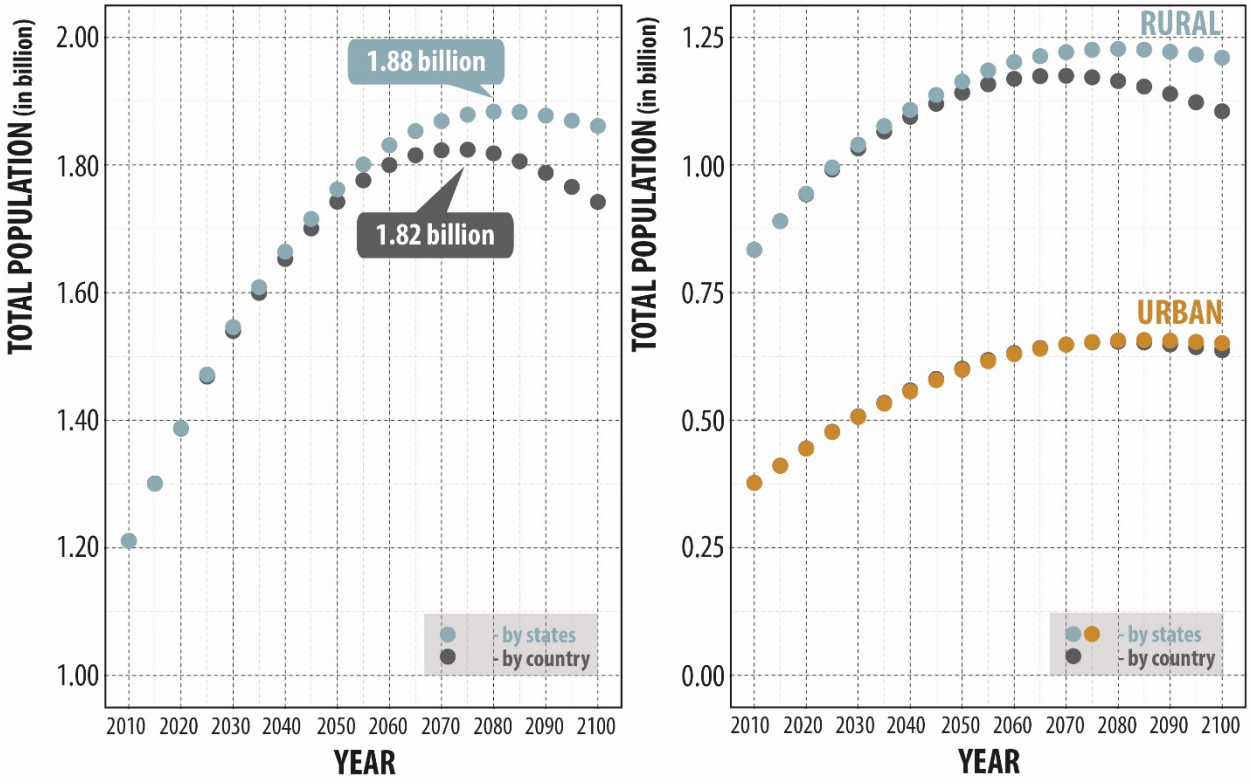
Referring to the 2011 Census, about 31 percent of the Indian Population are living in urban areas (statutory and census towns). While Statutory Towns are including all places with a municipality, corporation, cantonment board or notified town area committee etc., Census Towns are places that fulfill certain demographic and economic criteria[2]. Especially the Census Towns show quite some dynamics as for instance between 2001 and 2011 their number increased by 2532 from 1362 to 3984. Of these 2532 new Census towns about 71 percent fit all three criteria. Lowering the criteria of population size from 5000 to 4000 it would be 98 percent. In the further process we want to introduce an ***"urban reclassification scheme"*** that gives us an urban transition rate when inhabitants change their status from rural to urban settlements.

4 Results

In our baseline scenario, (aggregated) population of India is expected to increase to 1.88 billion by 2080, thereafter declining slowly to 1.86 billion by 2100. Newborns are being **"blamed"** for the increase of the population size, but in fact, the better mortality situation, which is expected in the future, is also a major component of the population growth.

When States/UT were **NOT** considered in the projection, we found the population peaking at lower level (1.82 billion) earlier by 2075 (see Fig. 3 & 4) before declining to 1.74 billion by 2100 (similar to UN and IIASA/WIC projection).

Fig.3) Population of India, 2010-2100 & Fig.4) Population of India by Residence, 2010-2100



[2] (A) A minimum population of 5000 inhabitants; (B) At least 75 percent of the male main working population is engaged in non-agricultural pursuits; and (C) A density of population of at least 400 per sq.km;

When not considering the State-level in the projection, we are implicitly assuming that each State has the same **"population weight"** throughout the projection and ignore domestic migration flows. However, due to differences in the demographic and socioeconomic structure among the rural and urban populations between states, their overall composition will change in the future.

For instance, the States of Uttar Pradesh (UP) and Bihar (BR) are inhabiting 29.7 percent of India's rural population in 2010. Due to the high fertility levels in the rural areas of UP and BR, this share would increase to 34.4 percent by 2050 and 42.0 percent by 2100. Their simple population weight would lower the pace of the fertility decline in rural India. Additionally, national projections ignore domestic migration flows that in general happen from higher fertility rural regions to lower fertility urban regions, states and districts.

Maintaining the 2001 rate of internal migration leads to slow rate of urbanization

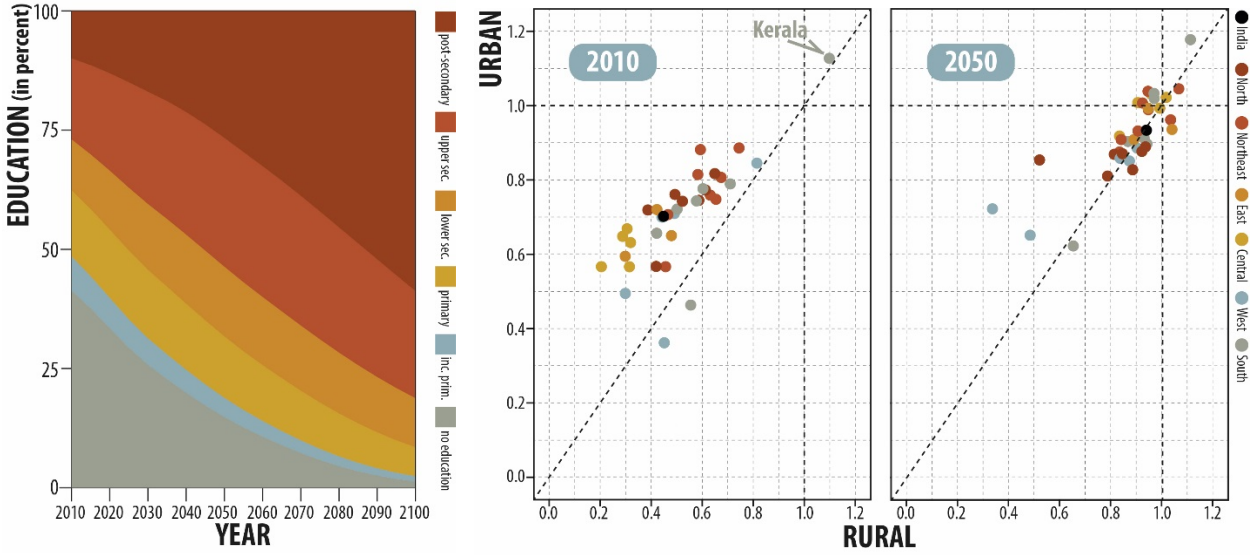
The proportion of urban population increased from 31 percent in 2010 to 34 percent in 2050 and 35 percent in 2100. This is much lower than UN's expectation. The source of urbanization due to reclassification of rural to urban region is not yet considered in this exercise and could result in modest increase in proportion urban.

It is interesting to see (see Fig. 4) that the total population in urban regions are almost same (slight lower in States/UT) in both projections. But all the increase (and more) is expected to occur in rural areas, 22 million by 2050 and 105 million by 2100.

Significant increase in the population's human capital

For e.g., the proportion among 25+ years old with upper secondary and post-secondary education would increase from 28.4 percent in 2010 to 53.6 percent by 2050 and 81.1 percent in 2100. (see Fig. 5)

Fig.5) Education in India, 2010-50 & Fig.6) Female to Male Ratio of population aged 25y plus with Upper Secondary and higher by region, 2010 & 2050



Towards Gender Balance in higher education

Figure 6 shows the gender ratio (female to male) among 25+ years old with upper secondary and post-secondary education by States/UT (points), regions (point color), with the ratio for the urban population on the y-axis and for the rural population on the x-axis, between 2010 and 2050.

In 2010, women in urban areas were more educated than those living in rural areas. But women in both areas were lagging behind men, except in Kerala (KL). In 2050, the other States/UTs will catch up fast converging to gender balance. Also the urban and rural differences get narrower in almost all States, except some low populated UTs in the Southern and Western Regions. This convergence is an implicit part of the projection that leads in the long run to a higher societal equality within India.

4.1 Conclusion

Referring back to our two research questions, whether the accounting for socioeconomic (educational attainment) and spatial (place of residence and subnational) heterogeneity affect our projections for India, the answer is YES. Preliminary results shows that overall population size will be higher when spatial heterogeneity is considered.

For India, with a population more than 1.2 billion and very high level of demographic and socioeconomic heterogeneity, the quality of population projections (for the country as well as for States/UTs) is enhanced when done by taking into account both spatial and socioeconomic (represented by educational attainment) heterogeneity.

Currently, work is underway to better represent the urbanization process happening in India in the projection model, and to include more recent migration data and define plausible narratives for the future.

5 References

5.1 Data:

India 2011 Population and Household Census. (http://www.censusindia.gov.in/2011-common/census_2011.html)

India 2001 Population and Household Census. (http://www.censusindia.gov.in/2011-common/census_data_2001.html)

India Sample Registration System (SRS). (http://www.censusindia.gov.in/2011-common/Sample_Registration_System.html)

India Demographic and Health Survey 2014-15 (DHS). (http://www.dhsprogram.com)

India Demographic and Health Survey 2005-06 (DHS). (http://www.dhsprogram.com)

5.2 Literature:

KC & Lutz (2014). The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100. Global Environmental Change.

Lewin (2014). The Meaning and the Implications of Heterogeneity for Social Science Research.

5.3 Model, Data, Charts & Illustrations:

The projections and the here shown charts were prepared by the authors in R. For the final printing the charts got edited in Adobe Illustrator CS5

The Circos plot with domestic net migration flows in India 2001 was conducted via a webinterface (http://mkweb.bcgsc.ca/tableviewer/visualize)

Illustrations of urban structures, villages and industry (http://www.freepik.com/free-vector)

Poster designed by Markus Speringer