PROJECTION OF SUBNATIONAL SOCIAL HETEROGENEITY IN INDIA

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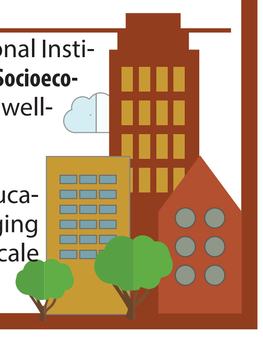
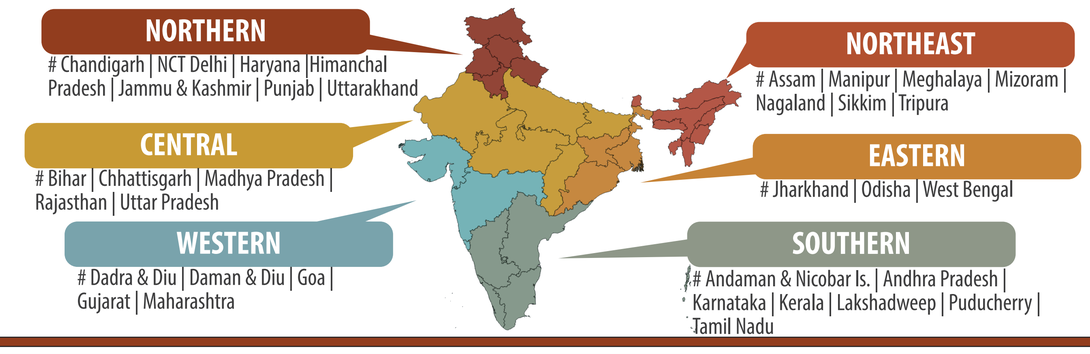
#1 BACKGROUND

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?



REGIONAL & STATE DIVISION OF INDIA (States and Union Territories):

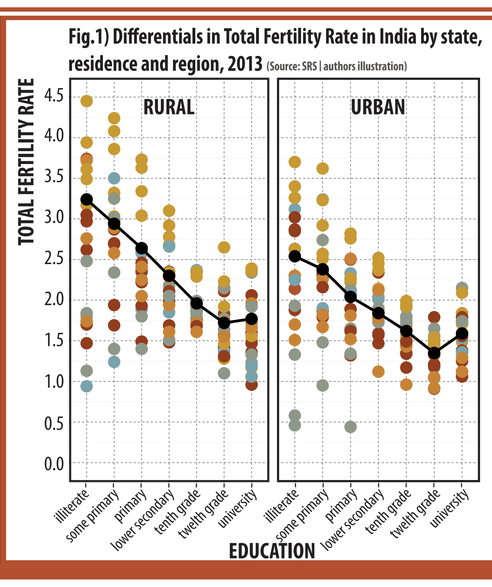


#2 INTRODUCTION

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) postulated a correlation between socioeconomic, demographic and other characteristics that produce social heterogeneity and can vary across space. Therefore social and spatial heterogeneity has to be considered

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.

Fig.1) Differentials in Total Fertility Rate in India by state, residence and region, 2013 (Source: SRS | authors illustration)



#3 METHODOLOGY

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.

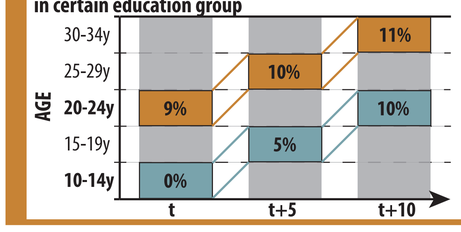
FERTILITY (data available for all dimensions, SRS)
- Fertility rate among women with higher education levelled below replacement fertility
- While among women with lower levels of education the fertility rate has been declining and we assumed a continuation of this trend

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

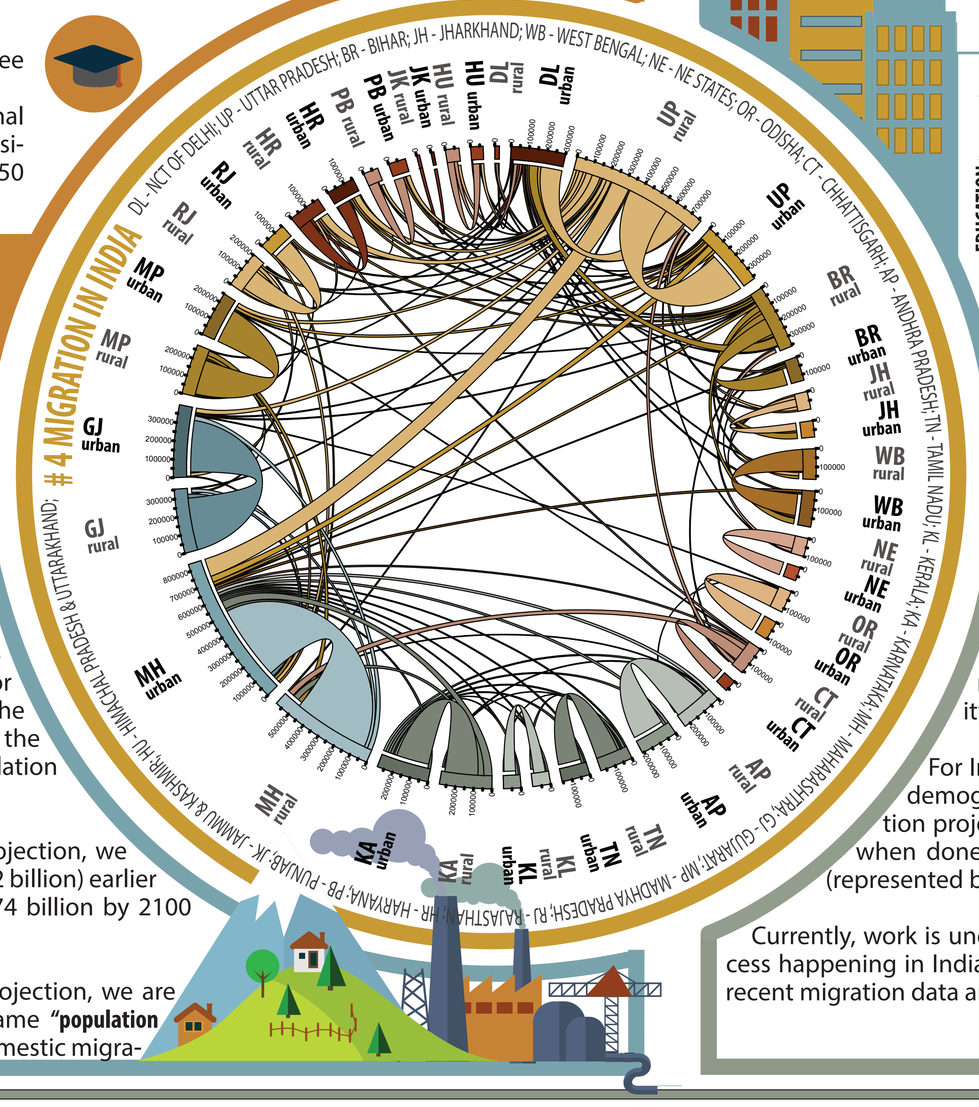
(INTERNAL) MIGRATION (data by education **not** available, Census 2001)
- Rates between and within State/UT by residence was estimated (see Fig. 4)
- Age and sex specific internal migration rates assumed to remain constant
- Due to very low rates, international migration was not considered

EDUCATION PROGRESSION (Census 2011)
- Transitions between 6 educational groups (see Fig. 2) 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

Fig.2) Scheme of Cohort Component Method with proportion in certain education group



#4 MIGRATION IN INDIA



#5 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.

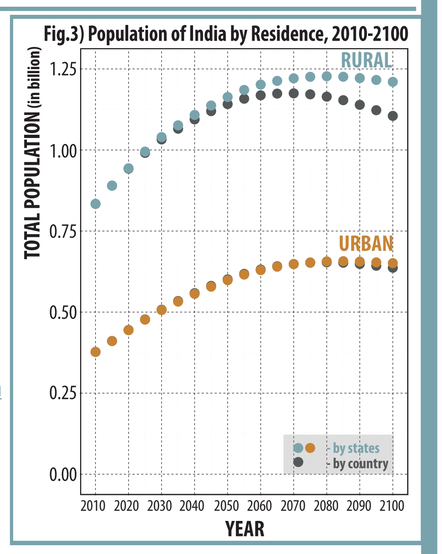
When States/UT were **NOT** considered in the projection, we found the population peaking at lower level (1.82 billion) earlier by 2075 (see Fig. 3 & 4) before declining to 1.74 billion by 2100 (similar to UN and IIASA/WIC projection).

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.

#5 RESULTS (cntd.)

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.

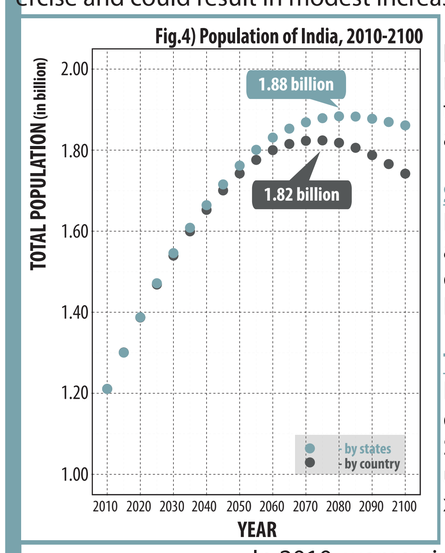
Fig.3) Population of India by Residence, 2010-2100



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.

Fig.4) Population of India, 2010-2100



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)

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.

Fig.5) Education in India, 2010-2100

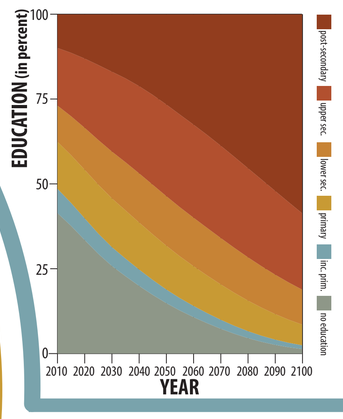
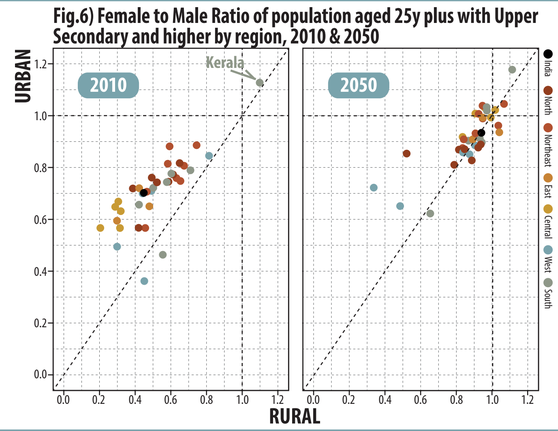


Fig.6) Female to Male Ratio of population aged 25y plus with Upper Secondary and higher by region, 2010 & 2050



#6 CONCLUSIONS

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.

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REFERENCES

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