PROJECTION OF SUBNATIONAL SOCIAL HETEROGENEITY IN INDIA

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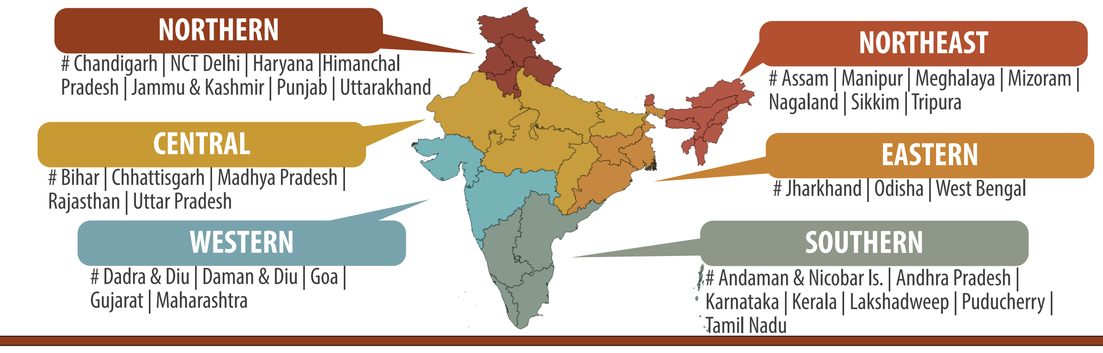
#1 BACKGROUND & RESEARCH QUESTION

The work 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)**. Research question:

"How does the accounting of socioeconomic heterogeneity, measured by educational attainment, and spatial heterogeneity (by place of rural/urban residence and States) improve population projections for India?"

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



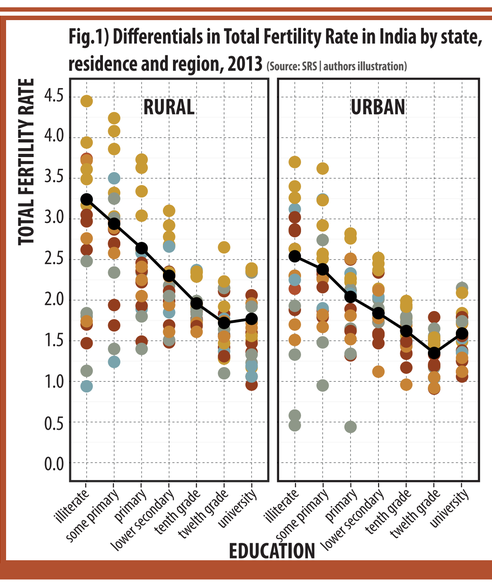
#2 POPULATION HETEROGENEITY IN INDIA

- Demographic rates differ greatly by educational attainment and place of residence in India.
- Educational attainment rates as well differ by place of residence.

Differential Fertility (see Fig. 1)

- A visible negative association between education and fertility with a slight positive slope for university degree.
- Visible for both, urban and rural areas, but on different levels.
- A large deviation within and between States, for e.g. 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 MULTI-DIMENSIONAL MULTI-STATE POPULATION MODEL

- Developed a multi-dimensional population **PROJECTION MODEL** that projects the population of India by five dimensions (see Fig. 1)
- Three personal characteristics: age, sex, and educational attainment
- Two spatial characteristics: 35 States/Union Territories (UT) by rural and urban place of residence
- In total 70 sets of subnational populations are projected in 5 yearly steps from 2010 up to 2100.
- Data from Census (2001 and 2011) and Sample Registration Survey (1970-2013)
- 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.
- **ESTIMATES and PROJECTION for 70 spatial units**

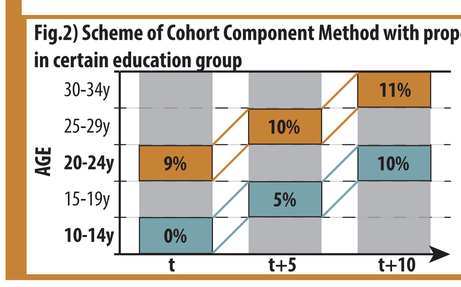
FERTILITY (age & edu)

MORTALITY (age & sex)

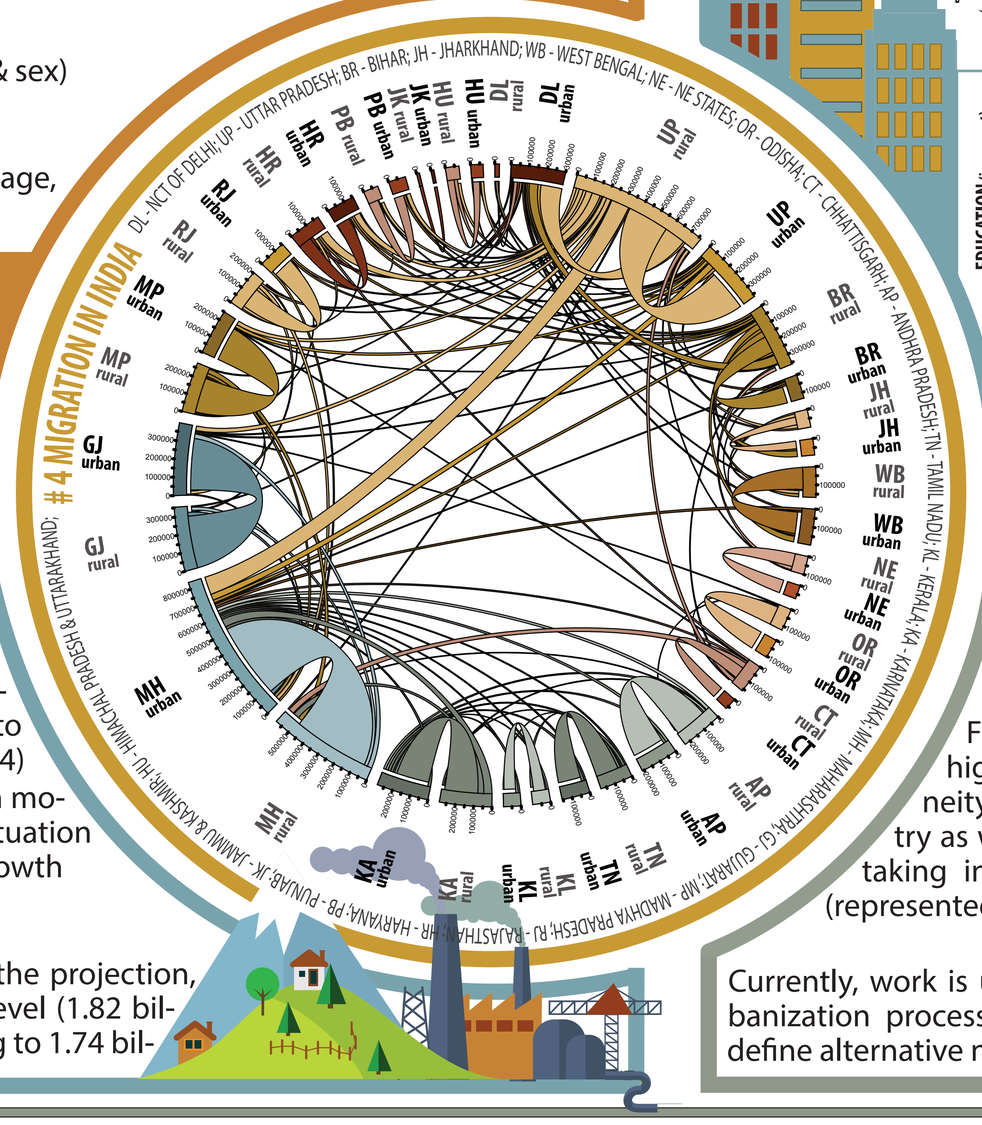
INTERNAL MIGRATION FLOWS (age & sex) (see Circos plot)

EDUCATION PROGRESSION RATIO (age, sex & edu)

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



#4 MIGRATION IN INDIA



#5 RESULTS

Population growth and decline in the 21st Century

- When spatial heterogeneity considered, population of India expected to peak in 2080 at 1.88 billion (see Fig. 4)
- In addition to births and population momentum, better future mortality situation is contributing to the population growth

Spatial Heterogeneity matters in India

- When States/UT NOT considered in the projection, the population will peak at lower level (1.82 billion) earlier by 2075 before declining to 1.74 billion by 2100 (similar to UN and IIASA/WIC projection).
- Explained by **"population weight"** and ignoring large portion of domestic migration flows between States

#5 RESULTS (cntd.)

Maintaining of internal migration slows rate of urbanization

- Proportion urban population increased from 31 percent in 2010 to 34 percent in 2050 and 35 percent in 2100.
- Much lower than UN's expectation
- Source of urbanization due to reclassification of rural to urban region is not yet implemented
- Preliminary result (under final internal review) shows significant increase in proportion urban.

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

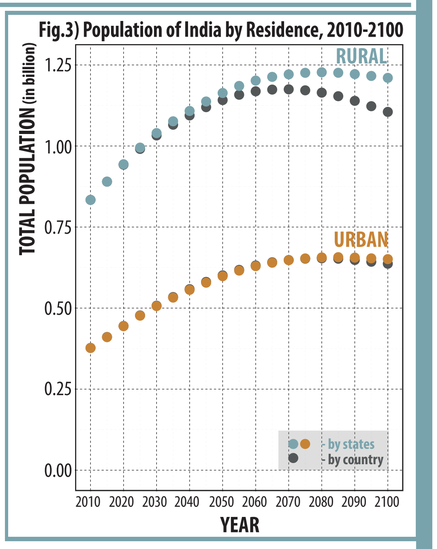
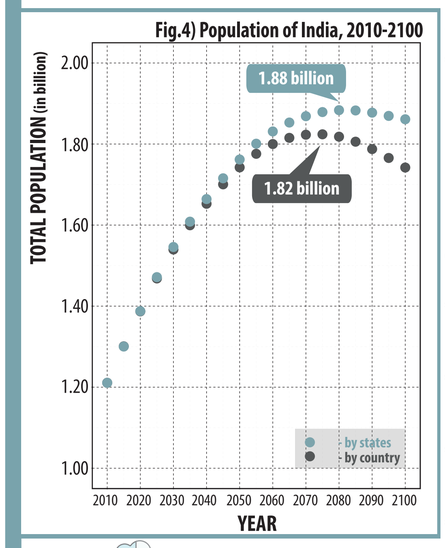


Fig.4) Population of India, 2010-2100



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 (see Fig. 6)

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

Fig.5) Education in India, 2010-2100

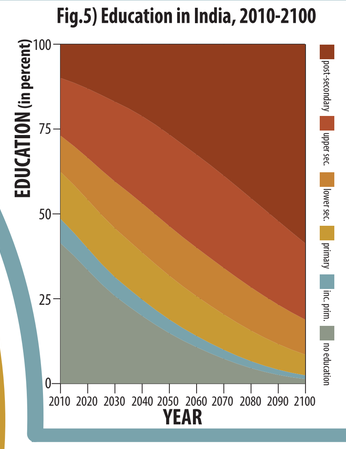
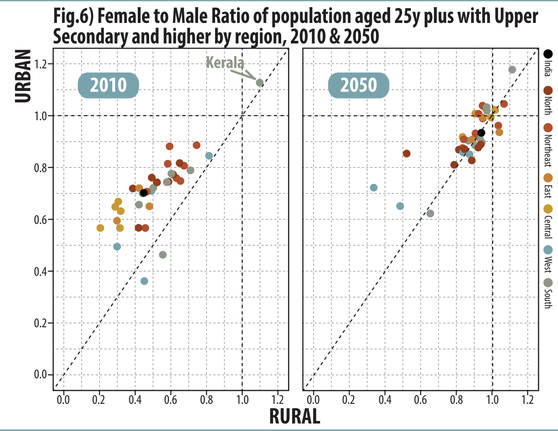


Fig.6) Female to Male Ratio of population aged 25y plus with Upper Secondary and higher by region, 2010 & 2050



#6 CONCLUSIONS

Preliminary results show 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 in the projection model and to define alternative narratives for the future.

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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