

“Small-area Population Projections by socio-economic heterogeneity and residence for the state of Gujarat”

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1 Background

The paper is embedded in an interdisciplinary and interinstitutional study at the *International Institute for Applied Systems Analysis (IIASA)*¹ and the *Centre for Excellence in Sustainable Livelihoods at the Institute of Rural Management (IRMA)* that investigates the potential development of social and environmental vulnerability and its impact on the livelihood and resilience of the local and regional population in India. A central part of this project is the modelling of the prospective population development by socioeconomic characteristics at the small-area level, here considered by the district-level. We are considering to refine that spatial level in the project process to the level of sub-districts, but are relying in this question on our project partners on site to provide the needed data. As first case study and spatial unit for illustrating our methodological approach we have chosen the Indian state Gujarat.²

2 Introduction

Gujarat was chosen as case study as it is one of the leading industrialized states of India and is one of the most favored industrial investment destinations of the country. To ensure this economic development the “...state has shifted its industrial policy from cluster and industrial estates’ based industries to **Special Economic Zones (SEZs)** during 2002-2004 and it has now shifted towards **Industrial Regions and Special Investment Regions (SIRs)** expanding the state’s vision to become the largest business hub in Asia and global investment destination.” (IRMA 2012)

The state of Gujarat has planned to construct 60 SEZs and 4 SIRs in the coming years and already acquired or purchased land via public and private enterprises. With these planned actions Gujarat is a core element in currently ongoing political actions to create Mega Industrial zones, high speed freight lines, ports, airports, logistic centers, technological and knowledge hubs, a 4000 megawatt power plant and a six-land intersection-free expressway and railway connection between Mumbai and Delhi. The combined efforts to achieve this industrial investments are combined under the label of the so called **Delhi-Mumbai Industrial Corridor - DMIC** (estimated investment amount: 90 billion USD) (see Figure 1). This corridor offers opportunities for the development of industrial facilities along the alignment of the connecting infrastructure. In the case of Gujarat, five project components have been proposed as Development Nodes for economic development³. (DMIC 2015, IRMA 2012)

These investments will not only require the employment of planners, architects, engineers, workers, and craftsmen to plan and build the infrastructure components, but most likely also attract additional labor

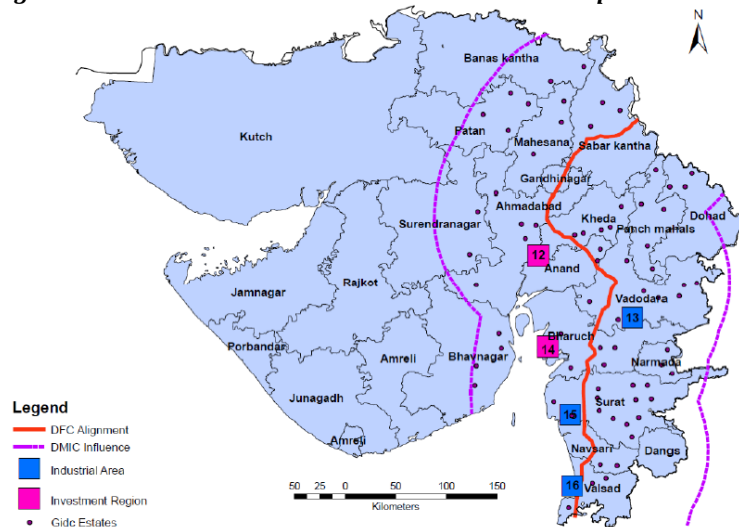
¹ Involved IIASA programs: World Population Program (POP), Water Program (WAT)

² The subproject timeframe to work on the Gujarat case study is scheduled from October 2015 to July 2016.

³ Ahmedabad-Dholera Investment Region, Vadodara-Ankleshwar Industrial Area, Bharuch-Dahej Investment Region, Surat-Navsari Industrial Area, and Valsad-Umbergaon Industrial Area;

force from other districts within the state and from rest of India with certain qualifications and educational levels to work in these facilities and the ancillary industries. (DMIC 2015, IRMA 2012)

Figure 1 - Delhi Mumbai Industrial Corridor with Development Nodes - Gujarat



(Source: Delhi Mumbai Industrial Corridor (DMIC) (2008))⁴

In the context of this proposal we are aiming to refine our projection methodology to conduct district-wise (possible extension to sub-districts) multi-state projections by education for the period 2010 to 2050 to sketch potential impact of the above mentioned policy actions and major economic investments like the DMIC on the prospective population dynamics in Gujarat.

We want to draft potential storylines and integrated development scenarios of the changes in demographic patterns and socioeconomic conditions in Gujarat. Here we aim to answer the following research questions: **(A)** *How will changing patterns in urbanization and migration affect the population projection, depending on the spatial scale (state vs. (sub-)districts)?*; and **(B)** *How does the accounting of socioeconomic heterogeneity, measured by educational attainment, improve population projections for Gujarat on different spatial scales?*

2.1 Administrative Division

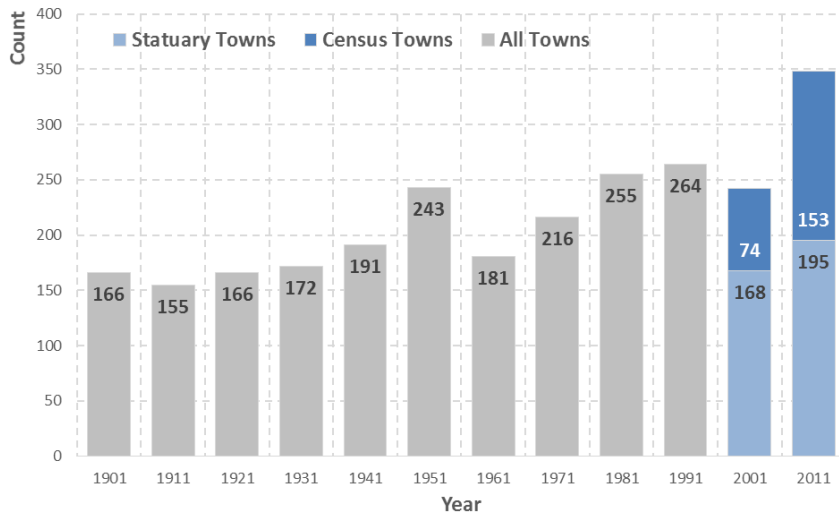
The spatial scale in terms of administrative division of Gujarat contains of 26 districts that can be further divided into 219 sub-districts. According to the 2011 Population and Household Census about 34.7 million people lived in 18,225 villages (rural areas) and 25.8 million in 348 towns (urban areas) that can be divided into **Statutory**⁵ and **Census Towns**⁶. Especially the Census Towns are interesting as they are defined by quantifiable criteria (population size, density, and work force) and have shown a rapid increase in their number between 2001 and 2011. While in total India their number increased from 1362 to 3984 in this period, their number doubled in Gujarat from 74 to 153. (see Figure 2) (Directorate of Census Operations 2011, Pradhan 2013)

⁴ Source: <http://delhimumbaiindustrialcorridor.com/introduction.html>

⁵ **Statutory Towns** are including all places with a municipality, corporation, cantonment board or notified town area committee etc.

⁶ **Census Towns** are places that fulfill certain demographic and economic criteria like **(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;

Figure 2 - Urban Settlements in Gujarat (by Type), 1901-2011



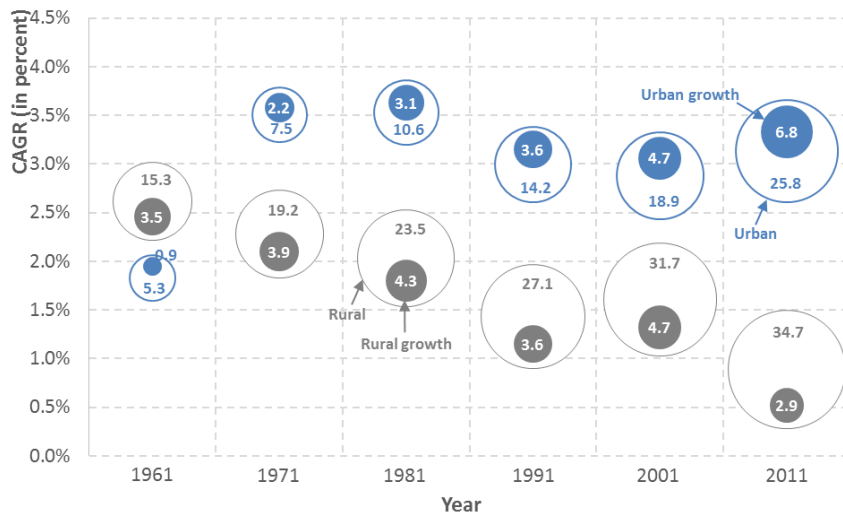
(Source: Government of Gujarat (2005), Census 2001 & 2011; Chart: Authors Illustration)

2.2 (Urban) Population Development

According to Pradhan (2013) this drastic increase in the number of Census Towns in India is contributing about 26.0 to 29.5 percent of the overall growth of the share of population in urban areas. For Gujarat his estimations show that about 9.7 to 11.5 percent of the urban population growth happened between 2001 and 2011 because of the reclassification of villages to Census Towns. As in Gujarat the urban population increased by 6.8 million to 25.8 million in 2011 (see Figure 3), about 10 percent or 680,000 of this additional urban population would have happened because of administrative reclassifications.

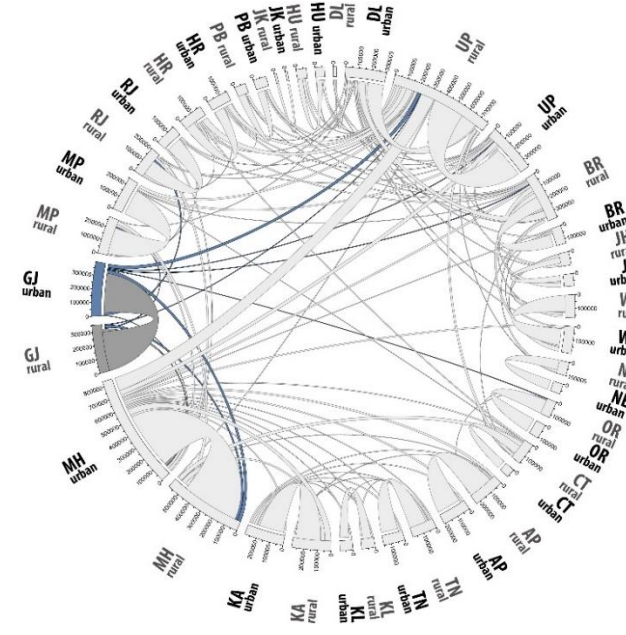
In fact, the relative and absolute growth of urban population in Gujarat has outnumbered the rural growth in the last decades and years. While since the period 1961 to 1971 the urban *Compound Annual Growth Rate (CAGR)* has exceeded the rural ones, only between the last two censuses the total amount of urban gains with 6.8 million plus exceeds the rural gains of 2.9 million. Before it had always been the rural areas.

Figure 3 - Compound Annual Growth Rate (CAGR) in Gujarat by Residence, 1961-2011



(Source: Census of India (2011); Chart: Authors Illustration)

Figure 4 - Internal Migration in India by States & Residence (Focus on Gujarat), 2001



(Source: Census 2001; Chart: Authors Illustration)

Beside this impact of administrative reclassifications, the major driver for the increase of urban population in Gujarat (also for India in general) is migration from rural to urban areas within or between states and districts. For instance, from the 2001 Population and Household Census⁷ we could see a positive net migration balance (+ 415 thousand) for urban areas in Gujarat of which approximately 300.000 were coming from rural areas within Gujarat. (see Figure 4) The net numbers are cushioning the fact that migration is a two-way-system and that therefore there are also emigrants from urban areas in Gujarat back into rural areas or the urban areas in other states (e.g. Mumbai).

As recent census data on internal migration between and within districts and states by residence is not available yet we will estimate the migration patterns in the period 2001 to 2011 from the 2001 Census and the 64th Round of the National Sample Survey with the focus on Migration in India, provided by the Gujarat Census Office. (NSSO 2010)

3 Methodological Approach & Challenges

For this study we will further evolve our multi-dimensional population projection model to project the district-wise population by *three personal characteristics* (age, sex, and educational attainment) and *two spatial characteristics* (26 districts, and residence (rural/urban)) in 5 yearly steps from 2010 to 2050

Based on the **MIGRATION** information estimated for the period 2001 to 2011 we will elaborate age-, sex- and education-specific migration flows for the creation of plausible migration scenarios for the period 2010 to 2050 for the district (and sub-district) level. These will take into account the potential increasing attractiveness of the in the DMIC defined development regions for high-skilled and highly educated workforce and their relatives that might come along with them. *The question we are interested in is hereby not only the question where people might move, but also who these people are in terms of their social heterogeneity?*

The focus of our research project lies hereby on the age, sex and educational composition of the new arrivals. For the projection of the **EDUCATIONAL COMPOSITION** in the districts of Gujarat we will calculate the district-wise education progression ratios (EAPR) for six educational categories (No education; Incomplete Primary; Primary; Lower Secondary; Upper Secondary; e6 – Post-secondary education) and the transition rates between the educational states.

Additionally we will provide district specific **FERTILITY** and **MORTALITY** patterns that will show a convergence to the state average.

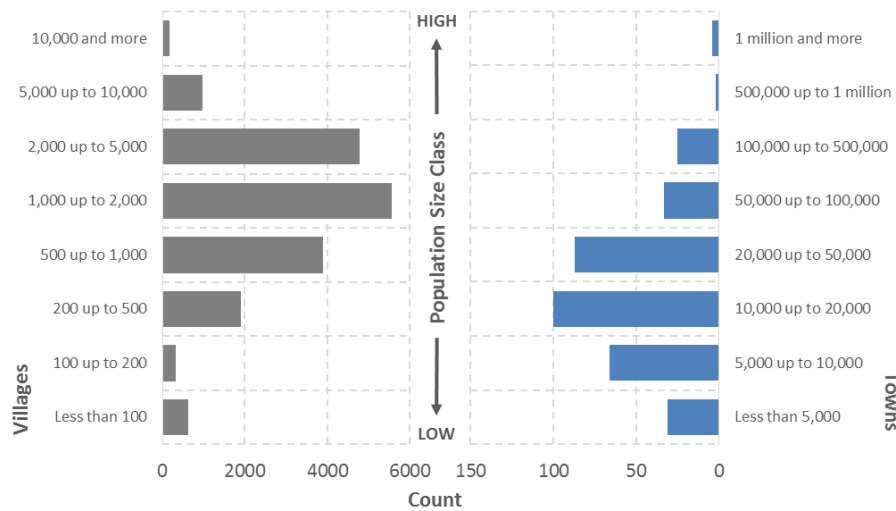
⁷ The 2011 Census migration results are not available yet, but will be implemented in our projection model as soon as they are published.

3.1 Urbanization

In terms of the ongoing increase of urban population in Gujarat (2001: 37.4 percent | 2011: 42.6 percent) we will also introduce an **“urban reclassification scheme”** that provides us with prospective rates of change in the status from villages to (census) towns. As mentioned earlier, Census Towns are defined by a set of demographic and economic conditions. Due to potential investments in the economic infrastructure of defined development regions and the accompanied potential influx of better educated social groups, Gujarat will most likely experience a further population increase that may lead to further reclassifications of villages to towns in the future. As this process contributes a reasonable amount to the urbanization process of Gujarat, it is important to consider this in our model.

When we take a look at the recent settlement structure of Gujarat in terms of population size classes of settlements, we can see that from overall 18,225 villages already 740 have a population size of more than 5,000 inhabitants (see Figure 5), what would already cover one of three urban criteria. These 740 villages inhabit about 8.6 million inhabitants, what is a considerable amount in Gujarat. If we lower the 5,000 inhabitant threshold to 4,000 inhabitants so that we include villages that might be exceeding the 5,000 inhabitant threshold in the future, we would already have 1078 villages with 11.7 million inhabitants, what would equal 34 percent of the current rural population in Gujarat that are at **“risk”** to become urban. At the EPC 2016 we will show how we introduced this urban reclassification scheme into our projection model.

Figure 5 - Count of Villages and Towns in Gujarat by Population Size Class, 2011



(Source: 2011 Census; Chart: Authors Illustration)

4 Expected Results

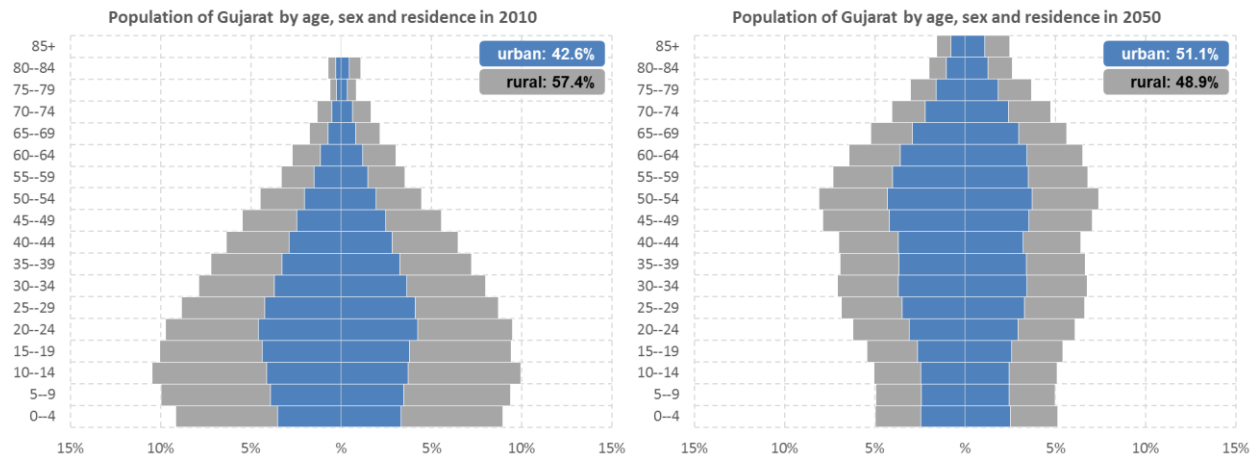
At the EPC we plan to present the outcome of our small-area projection for district and sub-district level in Gujarat as well as the used methodology to produce internal migration and urban reclassification data. We will produce a set of plausible scenarios on different spatial levels (state, district, and sub-district) that consider potential changes in the migration patterns to and from Gujarat’s districts in the context of the ongoing investments into the earlier mentioned development regions. We will be able to show the potential impact of different scenarios on the social heterogeneity (age, sex, and education) of the district-wise population of Gujarat.

By using different spatial levels in our projection we can show the impact of different granularities in the spatial scale of projections on their outcome. Refining the spatial scale in our projection model allows us

to articulate political guidance for regional stakeholders, whom could use this for adapting their political targets for the coming years.

The basis for our scenario development will be a baseline scenario that continues recent trends of the demographic determinants (fertility, mortality, and migration) that we would apply on different spatial scales. In a first step, we already produced such a scenario for the state of Gujarat. This quite simple scenario would cause an increase of the population size in Gujarat from 60.4 million in 2010 to about 80.8 million in 2050, whereby the share of urban population would increase from 42.6 percent to about 51.1 percent. (see Figure 6) In terms of social heterogeneity the age-structure would run through quite some changes as more people would shift to higher age groups, while the youngest cohorts would narrow.

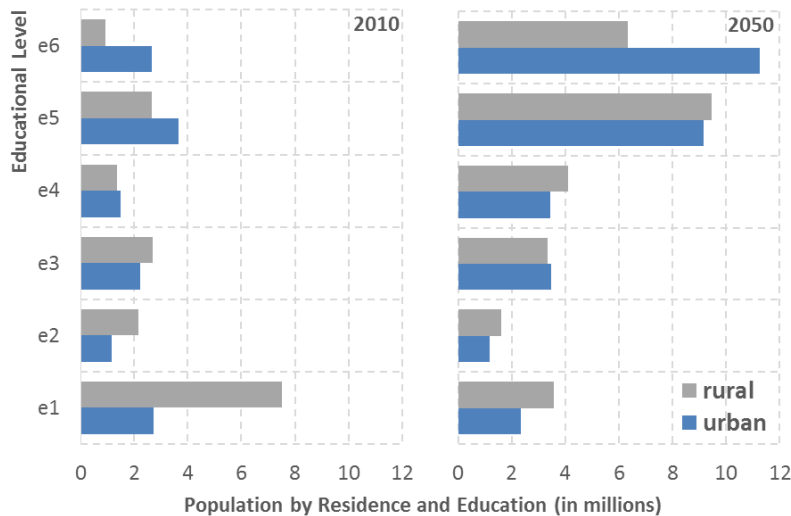
Figure 6 – Population in Gujarat by Age, Sex and Residence, 2010 & 2050



(Source: Authors Calculations; Chart: Authors Illustration)

One major effect that causes this process can be found in the change of educational composition in Gujarat as more and more people would reach higher education levels. (see Figure 7)

Figure 7 - Population in Gujarat aged 25 years plus by education⁸ and residence, 2010 & 2050



(Source: Authors Calculations; Chart: Authors Illustration)

⁸ e1 – No education; e2 – Incomplete Primary; e3 – Primary; e4 – Lower Secondary; e5 – Upper Secondary; e6 – Post-secondary education;

As higher educated women tend to reduce their fertility levels due postponement of fertility and a lower number of desired children, less children would populate Gujarat in this scenario. Without introducing education into the scenario the population would might reach a higher population size in 2050.

When introducing lower administrative levels into the projection this picture will might change as stronger populated (urban) districts like Ahmadabad (7.2 million) or Surat (6.1 million) would have a higher weight in the projection (in the state projection every district or sub-district would theoretically have the same population weight).

Currently, we are working on the inclusion of more recent migration data and the implementation of the urban reclassification scheme to define plausible storylines for the potential future of the regions in Gujarat to answer the in the beginning articulated research questions. What we can definitely state already is that the refinement in the spatial granularity of our projections for Gujarat will might have an impact on the projection outcome that we would present at the EPC 2016.

5 References

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