Demographic Changes in Tamil Nadu: Implications for Human Development Outcomes and Policy

Abhik Banerji

University of Exeter, UK
One Health Trust, Bengaluru, India
banerji@onehealthtrust.org

Deepshikha Batheja
(corresponding author)

Indian School of Business, Hyderabad, India
One Health Trust, Bengaluru, India
deepshikha_batheja@isb.edu

Rishiraj Bhagawati

One Health Trust, Bengaluru, India
rbhagawati@onehealthtrust.org

Srishti Goel

One Health Trust, Bengaluru, India
goel@onehealthtrust.org

Abstract

Unlike the rest of India, Tamil Nadu is at an advanced stage of demographic transition, having evolved from a predominantly rural agrarian society with high fertility rates and low life expectancy, to a largely urban industrial society with low fertility rates and high life expectancy. The rapid increase in the elderly population over the next few decades will necessitate a comprehensive strategy for social insurance and protection for the elderly. A well-developed financial sector will be crucial for the state to harness its remaining demographic dividend and channel savings into productive investments effectively. Tamil Nadu's impressive growth, combined with its expanding pool of skilled labor, presents an opportunity to shift from labour-intensive industries to skill-intensive activities, thereby accelerating technological progress, particularly in green and innovative solutions. Therefore, policymakers must ensure the

 doi: 10.18278/inpp.5.2.4

education system equips graduates with the skills most relevant to current and future industry demands. Reskilling or upskilling the existing workforce, particularly among older demographics, will be critical to enhancing long-term worker productivity and economic growth. Additionally, establishing supportive health systems and creating enabling physical, social, and financial environments will be essential for ensuring a safe, secure, and healthy future for the elderly. Policies addressing aging should also incorporate digital literacy to keep pace with rapid globalization and technological advancements in the state.

Keywords: Tamil Nadu, educational policy, labour policy, demographic transition, skilling, life-expectancy, fertility decline, ageing, elderly population, social protection

Cambios demográficos en Tamil Nadu: Implicaciones para el desarrollo humano resultados y políticas

Resumen

A diferencia del resto de la India, Tamil Nadu se encuentra en una etapa avanzada de transición demográfica, habiendo evolucionado de una sociedad agraria predominantemente rural con altas tasas de fertilidad y baja esperanza de vida, a una sociedad industrial mayoritariamente urbana con bajas tasas de fertilidad y alta esperanza de vida. El rápido aumento de la población de edad avanzada en las próximas décadas requerirá una estrategia integral de seguridad social y protección para la tercera edad. Un sector financiero bien desarrollado será crucial para que el estado aproveche el dividendo demográfico restante y canalice eficazmente el ahorro hacia inversiones productivas. El impresionante crecimiento de Tamil Nadu, sumado a la creciente disponibilidad de mano de obra cualificada, presenta una oportunidad para pasar de industrias con uso intensivo de mano de obra a actividades con uso intensivo de mano de obra cualificada, acelerando así el progreso tecnológico, en particular en soluciones ecológicas e innovadoras. Por lo tanto, los responsables políticos deben garantizar que el sistema educativo dote a los graduados de las competencias más relevantes para las demandas actuales y futuras de la industria. La capacitación o el perfeccionamiento de la fuerza laboral actual, en particular entre los grupos demográficos de mayor edad, será fundamental para mejorar la productividad laboral y el crecimiento económico a lar-

go plazo. Además, establecer sistemas de salud que apoyen la salud y crear entornos físicos, sociales y financieros propicios será esencial para garantizar un futuro seguro y saludable para las personas mayores. Las políticas que abordan el envejecimiento también deben incorporar la alfabetización digital para adaptarse a la rápida globalización y los avances tecnológicos en el estado.

Palabras clave: Tamil Nadu, política educativa, política laboral, transición demográfica, capacitación, esperanza de vida, disminución de la fertilidad, envejecimiento, población de edad avanzada, protección social.

泰米尔纳德邦的人口变化：对人类发展结果和政策的启示

摘要

与印度其他地区不同，泰米尔纳德邦正处于人口结构转型的后期阶段，从一个以农村为主、生育率高、预期寿命低的农业社会，发展成为一个以城市为主、生育率低、预期寿命高的工业社会。未来几十年老年人口的快速增长，将要求为老年人制定全面的社会保险和保障战略。发达的金融部门对于"该邦利用剩余的人口红利并将储蓄有效地引导到生产性投资"一事至关重要。泰米尔纳德邦令人瞩目的经济增长，加上其不断增长的熟练劳动力资源，为从劳动密集型产业转向技能密集型产业提供了机遇，从而加速技术进步，尤其是在绿色和创新解决方案领域。因此，政策制定者必须确保教育系统能够为毕业生提供与当前和未来行业需求最相关的技能。对现有劳动力（尤其是老年人口）进行再培训或技能提升，对于提高长期劳动生产率和经济增长至关重要。此外，建立支持性卫生系统并创造有利的物质环境、社会环境和经济环境，对于确保老年人拥有安全、有保障和健康的未来至关重要。应对老龄化的政策还应纳入数字素养，以跟上该邦快速的全球化步伐和技术进步。

关键词：泰米尔纳德邦，教育政策，劳动力政策，人口转型，技能，预期寿命，生育率下降，老龄化，老年人口，社会保障

Introduction and Background

Tamil Nadu has achieved a remarkable balance between industrial development and social welfare programs, emerging as one of India's most affluent and high-performing states with significant advancements in human and economic development (see Prabhu 2001; Swamy 2003; Mehrotra 2006). Key strengths of the state include robust economic growth, high per capita income, success in attracting foreign direct investment, low poverty rates, a strong focus on education, and a rising urbanization trend. Population projections for Tamil Nadu, currently India's sixth most populous state, signal this significant deceleration in growth. The state's contribution to national population increase between 2011 and 2036 is estimated to be a mere 1.9 percent with growth rates approaching zero by 2031–2036. This slowdown suggests potential population decline in the coming decade unless offset by inward migration. Unlike most of India, Tamil Nadu exhibits an advanced stage of demographic transition (Deolalikar 2024).

In the last four decades, Tamil Nadu has undergone significant social and economic changes. This demographic transition is likely aided by Tamil Nadu's rich history of social activism, combined with strategic investments in education and health infrastructure by the state government (Pande et al. 2020). Rising material and social aspirations were helped realize with a strong policy push for a smaller family size, triggering a fertility decline (Kishor 1994; Savitri 1994; Ramasundaram 1995; Visaria 2009). Since the 1970s, fertility has consistently declined with Tamil Nadu reporting total fertility rate (TFR) lower than the national average for this entire period (Rajan, Kulkarni, and Thenmozhi 2005). National Family Health Survey [NFHS] (2019–21) data reveals a 2021 TFR of 1.8 in the state, falling below the national average of 2.0. Tamil Nadu's fertility decline is unique because it is homogenous across socio-economic characteristics (Nagaraj 1999, 2000), possibly because of caste and class-conscious social movements and state government intervention that contributed to an increase in political, social and economic power of marginalised groups (Racine and Racine 1998).

This demographic shift presents an opportunity to capitalize on a "second dividend." Fertility reduction needs to be complemented with effective distribution of resources to increase the state's potential human capital (Devika 2007). As the working-age population ages, their focus on accumulating assets for retirement creates a potential pool of savings. Channelling these savings into productive investments could lead to increased national income and sustainable development, effectively translating demographic change into a period of economic growth. Further, this decline in fertility rates, coupled with rising life expectancy for both sexes, is projected to elevate the proportion of elderly individuals within Tamil Nadu's population. Currently, the state holds the second-highest share (13.6 percent) of elderly residents, following Kerala (16.5 percent). This demographic shift necessitates adaptations

in healthcare services, with a stronger emphasis on geriatric care provision and reinforcement of social security systems. To achieve sustainable and inclusive growth with high productivity, Tamil Nadu can learn valuable lessons from developed European and South Asian nations. The state's skilled workforce presents a strategic advantage that should be leveraged to pursue technological advancements in green and innovative solutions.

Our study examines Tamil Nadu's demographic trends, including age distribution, fertility rates, infant and maternal mortality, life expectancy, sex-ratios and workforce participation, to identify key policy sectors that need to be addressed to capitalise on the state's ongoing demographic transition towards a sustainable model of economic development. The key priority areas identified for Tamil Nadu to utilize its remaining demographic dividend are education, financial sector, climate change and elderly care. Despite wider available discussion on Tamil Nadu's growth story, there is limited research exploring the interplay of policy, demographics and economics. Through our study, we analyse both historical data and latest available secondary data and, conduct descriptive analyses to address this gap. We produce targeted policy recommendations capitalizing on the state's demographic dividend to enhance the health and well-being of the elderly population, improve learning and productivity outcomes for the young population, strengthen the financial sector, adapt to the changing climate and overall improve social outcomes.

Tamil Nadu's advanced demographic transition—characterised by fertility decline, population ageing, and evolving household structures—has far-reaching effects on labour supply, fiscal stability, and social protection. In our study, we focus on five interlinked policy priorities because they address the most pressing risks and opportunities emerging from these shifts. We examine pension reform and old-age income security because rising dependency ratios and informal employment threaten the adequacy and coverage of current systems. We analyse health system strengthening for ageing populations because the growing burden of non-communicable diseases demands community-based, accessible care models. We explore labour market interventions to boost female and older worker participation because this is vital to offset the projected post-2031 decline in the working-age share. We study climate resilience because agriculture and coastal livelihoods face heightened vulnerability. Finally, we assess education reform because improving learning outcomes and aligning skills with growth sectors is key to unlocking a second demographic dividend.

Long-term Demographic Changes Likely to Occur in Tamil Nadu

Based on forecasts by the National Commission on Population (NCP), India's population is expected to grow from 1.2 billion in 2011 to 1.52 billion by 2036. In contrast, Tamil Nadu's population is predicted

to stabilize, rising by just 1.4 million during this period (refer to figure 1). Tamil Nadu is in the advanced stages of demographic transition, having shifted from a primarily rural agrarian society with high fertility rates and low life expectancy to a mostly urban industrial society with low fertility rates and high life expectancy.

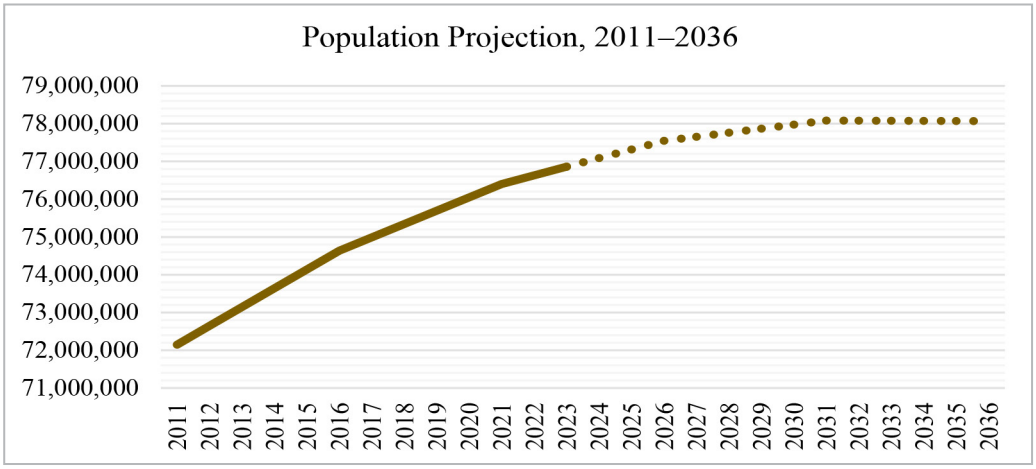


Figure 1: Population projection in Tamil Nadu from 2011 to 2036

Source: National Commission of Planning (2011)

Fertility, mortality, and life expectancy

Public health has been a policy priority of the state government of Tamil Nadu since the early 1900s with significant success in reducing infant, child and maternal mortality (Das Gupta et al. 2009; Padmanaban, Raman, and Mavalankar 2009; Ravindran 2009; World Health Organization 2009). Tamil Nadu is set out to be one of the oldest states in the country by 2036–2040 (See Figure 3). The state is expected to experience notable demographic shifts, resulting in a larger elderly population. According to the latest projections by the Government of India, the population proportion of individuals aged 45 and above will increase, pushing the median age up to 40.5 years in 2036 from 29.9 years in 2022. The proportion of school and college-going individuals will see a significant drop by 2036 (see Figure 2). The working-age population (ages 15-60) will decrease slightly from 66.5 percent to 63.6 percent (see Figure 4), with those aged 40 and above making up around 50 percent of the total population. With rising life expectancy, the proportion of the elderly (60 years and above) will continue to grow, reaching nearly 21 percent. This aligns with projections that 22 percent of the global population will be over 60 by 2050. This aging population will likely depend on the government for social security and healthcare services.

Mortality/death rate in Tamil Nadu has declined in the decade leading up to the COVID-19 related pan-

demic and remains higher than the national average because of the proportionally large old-age population in the state. According to latest available estimates available, mortality rates for both men and women in the state has declined from 2014 to 2020 (SRS Bulletin 2020). The most recent reliable data on deaths per 1,000 people extends only up to the pre-pandemic period, so the impact of COVID-19 on mortality cannot be assessed. As anticipated, women had a lower mortality rate than men in the state, but the overall mortality rate in 2020 was 6.1, which is higher than the national average of six (SRS Bulletin 2020).

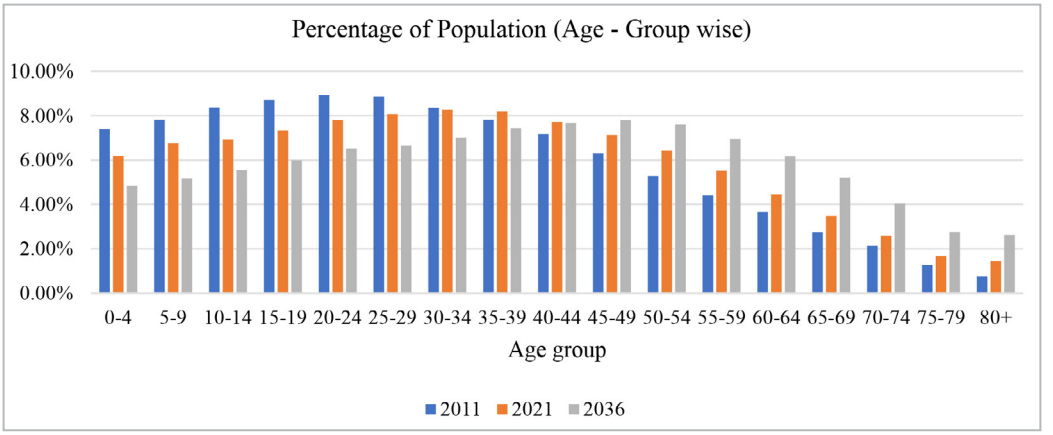


Figure 2: Percentage distribution of population by age-group for 2011, 2021, and 2036

Source: National Commission of Planning (2011)

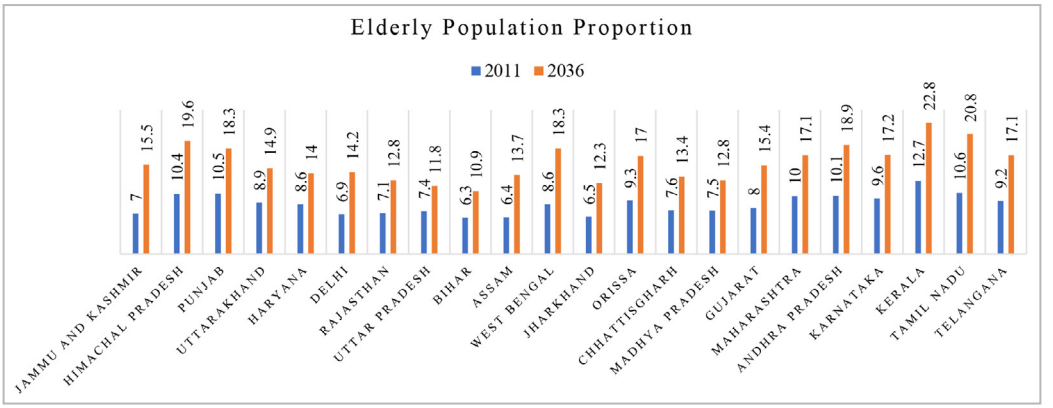


Figure 3: Proportion of elderly population in Tamil Nadu, for years 2011 and 2036

Source: National Commission of Planning (2011)

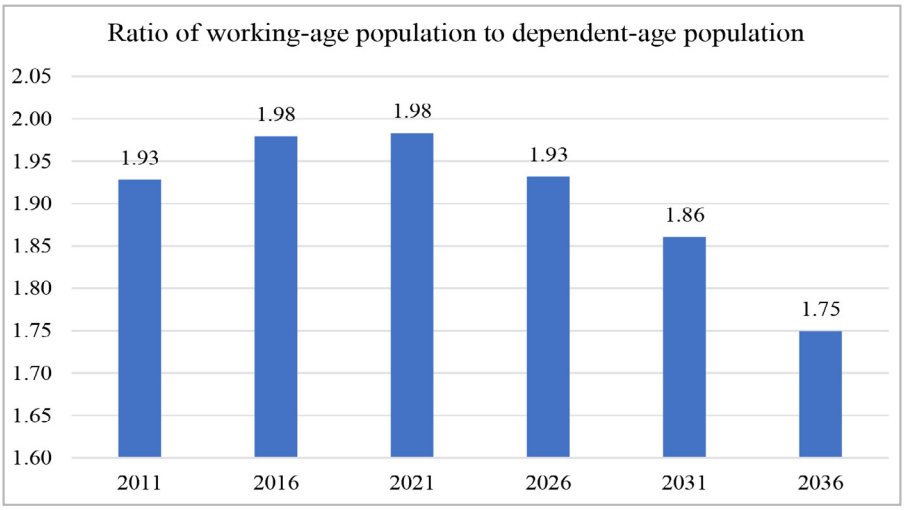


Figure 4: Ratio of working-age population (15-59 years) to dependent age population (0-14 years and above 59 years) in Tamil Nadu from 2011 to 2036

Source: National Commission of Planning (2011)

Low and below replacement level fertility rates were witnessed in the state in the last few decades in both rural and urban areas across education levels. While India has only recently reached below-replacement level fertility, Tamil Nadu has experienced low total fertility rates for over three decades. The fertility rate in Tamil Nadu decreased from 1.7 children per woman in 2011 to 1.5 children per woman in 2019, in both rural and urban areas. Similar fertility rates are seen in high-income and upper-middle-income countries. Below-replacement fertility combines fertility and mortality levels that result in negative population growth and a declining population size. Figure 5 highlights the negative correlation between women's education and fertility in India, showing that the TFR in Tamil Nadu is below replacement level across all education groups. Despite an initial inverse relationship between education and TFR from 2012 to 2018 in the state, in recent years, fertility rates have converged across all education groups (SRS Bulletin 2019).

An increase in fertility was observed across older age groups in the last decade. The General Fertility Rate (GFR), which measures the total number of births per 1,000 women of fertile age, has gradually increased for women over 30 in the past decade. Conversely, it has decreased for women aged 15 to 24 between 2015 and 2019 (SRS Bulletin, 2019). This trend of delayed childbearing may be attributed to higher levels of women's education and employment, changing preferences, advancements in infertility treatments, and greater use of family planning methods.

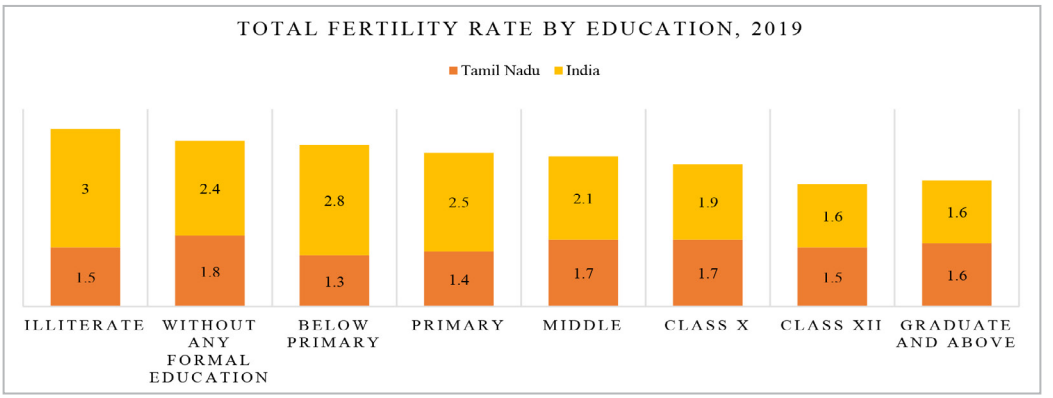


Figure 5: Total Fertility Rate by Education for India and Tamil Nadu (2019)
Source: SRS Bulletin (2019)

Table 1 illustrates that less than 70 percent of married women use any family planning method. Effective contraception allows couples to engage in physical relationships without the risk of unwanted pregnancies and unsafe abortions. It gives couples the freedom to decide when to have children and ensures protection against sexually transmitted diseases. As fertility rates decline, Tamil Nadu is promoting more reversible family planning methods, such as intrauterine devices (IUDs), to meet the needs of women who wish to delay pregnancy without permanently losing their fertility. Another important strategy in family planning involves engaging men through the use of condoms, male sterilization, or vasectomy. Vasectomy, being reversible and having negligible short- and long-term side effects, is particularly emphasized. The National Health Mission has made promoting no-scalpel vasectomy (NSV) a key objective to improve family planning in the state. Unfortunately, female sterilization remains the dominant method of contraception despite Tamil Nadu shifting away from numerical sterilization goals as early as the 1990s (Visaria, Jejeebhoy, and Merrick 1999). This can be attributed to earlier forms of state intervention emphasizing sterilization (after birthing two children) and IUDs (after birthing one child) for women delivering in public health facilities (Ravindran and Mishra 2001; Ravindran and Balasubramanian 2004). According to data from NFHS 2019–21, 58 percent of married women rely on female sterilization, as compared to the national average of 38 percent, while only 0.1 percent rely on male sterilization. Additionally, 7.5 percent of married women reported an unmet need for contraception, a notably high figure for a developed state like Tamil Nadu.

Table 1: Family planning statistics for currently married women between 15 and 49 years of age

	India				**Tamil Nadu**			
Indicators	**(2019-21)**			**(2015-16)**	**(2019-21)**			**(2015-16)**
Current Use of Family Planning Methods (currently married women aged 15–49 years)	Urban	Rural	Total	Total	Urban	Rural	Total	Total
Any method (%)	69.3	65.6	66.7	53.5	67.6	69.5	68.6	53.2
Any modern method (%)	58.5	55.5	56.5	47.8	64	66.8	65.5	52.6
Female sterilization (%)	36.3	38.7	37.9	36.0	55.6	59.9	57.8	49.4
Male sterilization (%)	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.0
Pill (%)	4.4	5.4	5.1	4.1	0.4	0.3	0.3	0.2
Condom (%)	13.6	7.6	9.5	5.6	2.6	1.2	1.8	0.8
Other Method (%)	3.1	2.2	2.5	1.9	4.9	5.0	5.0	2.0
Unmet Need for Family Planning (currently married women aged 15–49 years)								
Total unmet need (%)	8.4	9.9	9.4	12.9	8.1	6.9	7.5	10.1
Unmet need for spacing (%)	3.6	4.3	4	5.7	3.3	2.8	3	4.8

Source: NFHS 5 (2022)

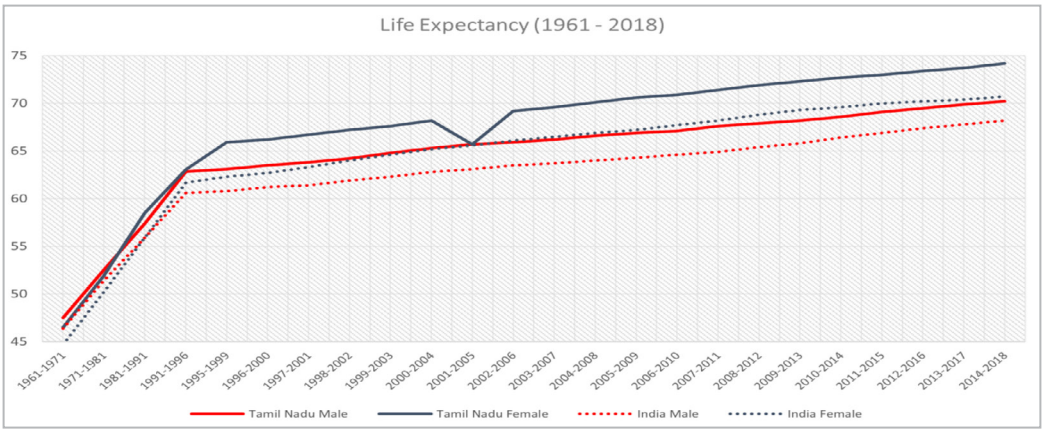


Figure 6: Life expectancy by gender in India and Tamil Nadu, from 1961 to 2018

Source: SRS Bulletin (2019)

There was a consistent increase in life expectancy in the last two decades for both females and males. Life expectancy at birth in Tamil Nadu has consistently surpassed the Indian average. Female life expectancy was approximately 74.2 years, four years higher than that of males (see Figure 6). By 2036, it is projected to rise to 76.6 years for females and 72.5 years for males. This demographic transition highlights substantial advancements in health and, as a result of lower fertility and mortality, has larger implications for shifts in social and gender norms (Pande, 2020). As per the World Bank database, these life expectancy figures are similar to those seen in middle-income and upper-middle-income countries.

Trends in related demographic indicators

Daughter aversion and sex ratios: There was a drastic fall in sex ratios at birth (females per 1,000 males), which raises concerns about prevalence of sex-selections in the state. According to recent survey estimates, the sex ratio at birth in Tamil Nadu for children born in the past five years fell from 954 girls per 1,000 boys in 2015–16 to 878 in 2019–21 (NFHS Reports). This is lower than the national average of 929 girls per 1,000 boys in 2019–21. Figure 7, which includes data from the Census and GOI projections, does not capture this concerning decline. After years of improvement, this sharp drop is troubling. It indicates a preference for sons, likely due to the perceived economic burden of daughters associated with dowry practices. The practice of dowry had become tokenistic in Tamil Nadu as early as the 1950s, but with the breakdown of traditional family networks it became prominent again in the 1990s when marriage market outcomes began being determined by the groom's education and employment status (Bhat and Halli 1999). The increased access to technology, spurred by urbanization, may have led to a rise in sex-selective abortions. The combination of low fertility rates and worsening sex ratios suggests that

sex selection persists at lower birth orders due to a preference for sons and smaller families. This inverse relationship between the total fertility rate (TFR) and the sex ratio (ages 0 to 5) is illustrated in Figure 8 for the periods 2009–11 and 2011–15. Government of India projections indicate that, after these fluctuations, the sex ratio at birth and TFR will both decline and stabilize within the next decade.

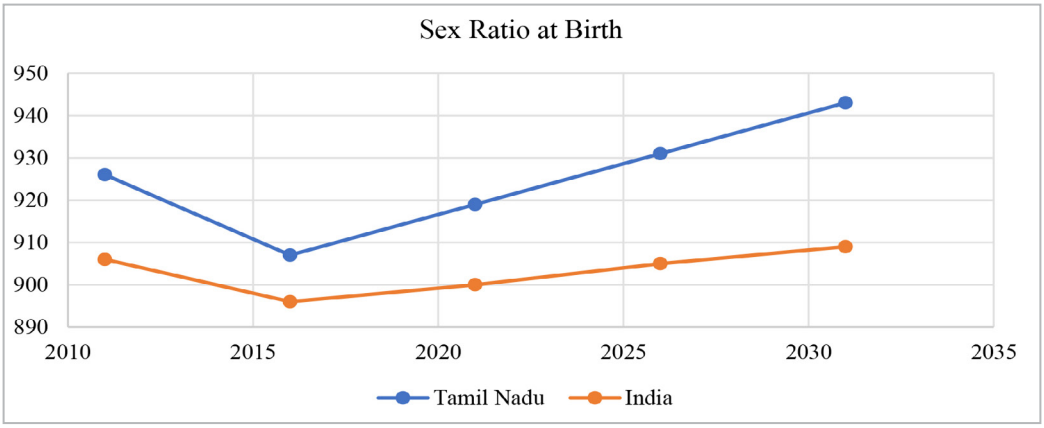


Figure 7: Sex ratio at birth in India and Tamil Nadu, from 2011 to 2031

Source: National Commission of Planning (2011)

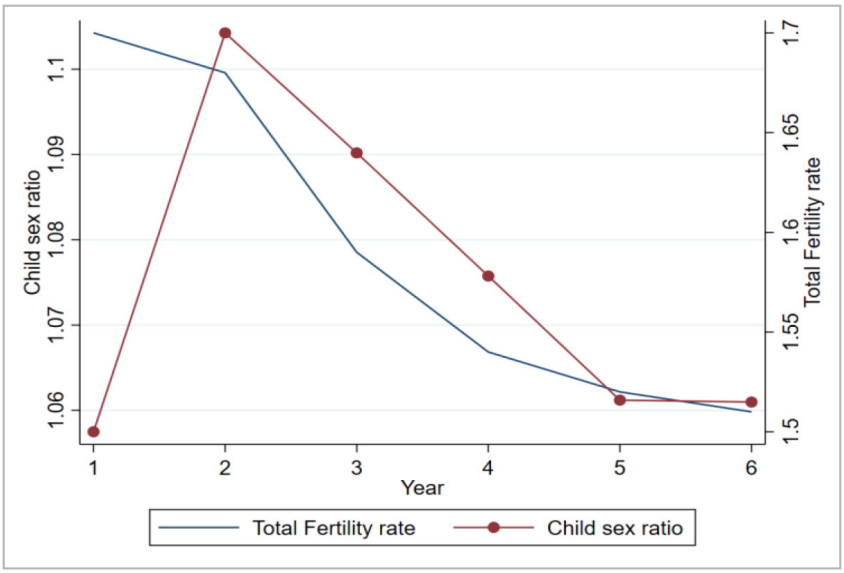


Figure 8: Male to Female child sex ratio (0-5 years) and Total Fertility Rate in Tamil Nadu from 2009–11 to 2031–35

Source: National Commission of Planning (2011)

Infant mortality and maternal mortality: Tamil Nadu has made huge reductions in infant mortality rates (IMR) in the last few decades but is struggling to make further improvements. Figure 9 highlights the spatial disparity in Infant Mortality Rate (IMR) between males and females. As anticipated, IMR is higher in rural areas compared to urban areas, and Tamil Nadu has performed better than most other Indian states in this regard. However, poor nutrition levels and premature deliveries are slowing the rate of IMR decline in rural regions. A troubling trend is the decline in the percentage of children aged 6-23 months receiving an adequate diet, which dropped from 30.7 percent to 16.3 percent between 2015–16 and 2019–21 (NFHS Reports).

Tamil Nadu has made huge improvements in Maternal mortality ratio (MMR) in the last decade, and it now compares to upper middle-income countries.[1] The maternal mortality ratio in Tamil Nadu has been improving, reaching approximately 58 maternal deaths per 100,000 live births (SRS Bulletin 2019). Although the maternal mortality rate has fluctuated over time, it has decreased in recent years, likely due to nearly 99.6 percent of births occurring in medical institutions during 2019–21.

Poor nutrition levels in the state were reflected through prevalence of high anaemia levels among women and children. Data from Table 2 shows a worrying trend of high anaemia rates in Tamil Nadu, mirroring the situation across India. Notably, anaemia in young children (aged 6-59 months) seems to be getting worse. In 2019–21, a staggering 57.4 percent of children in this age group in Tamil Nadu were anaemic. Additionally, 22 percent of children under five were underweight. The same table reveals concerning rates of malnutrition among women. Over half of the adolescent girls (15-19 years old) and women of reproductive age (15-49 years old) suffer from anaemia. While the national average for low body mass index (BMI) in women of reproductive age is 18.7 percent, Tamil Nadu has a lower rate of 12.6 percent. However, this does not necessarily indicate better nutrition, as it could be linked to anaemia itself.

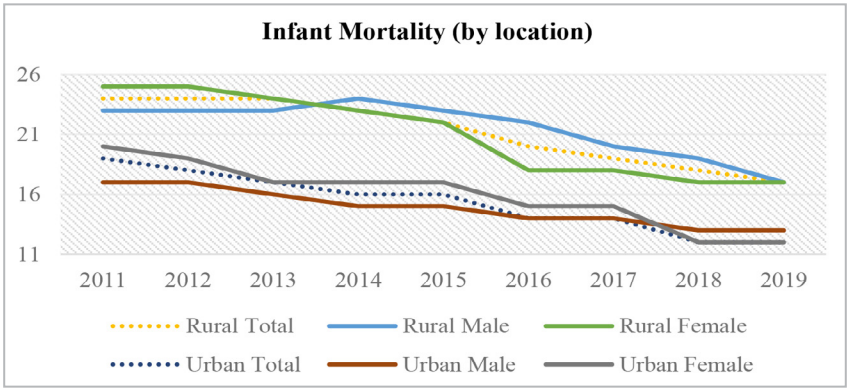


Figure 9: Infant mortality in Tamil Nadu by location, from 2011 to 2019

Source: SRS Bulletin (2019)

Table 2: Maternal and child nutrition in Tamil Nadu and India

	India				**Tamil Nadu**			
Indicators	**(2019-21)**			**(2015-16)**	**(2019-21)**			**(2015-16)**
Nutritional Status of Adults (age 15-49 years)	Urban	Rural	Total	Total	Urban	Rural	Total	Total
Women whose Body Mass Index (BMI) is below normal (BMI <18.5 kg/m^2) (%)	13.2	21.2	18.7	22.9	9.7	15.2	12.6	14.6
Anaemia among Children and Adults								
Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	64.2	68.3	67.1	58.6	53.7	60.4	57.4	50.7
All women age 15-49 years who are anaemic (%)	53.8	58.5	57.0	53.1	51.3	55.3	53.4	55.0
All women age 15-19 years who are anaemic^{22} (%)	56.5	60.2	59.1	54.1	50.6	54.9	52.9	54.2

Source: NFHS 5 (2022)

Economic Implications Of Demographic Changes

Tamil Nadu is at an advanced stage of demographic transition, and a well-developed financial sector can help realize its remaining demographic dividend. However, an ageing population and smaller family sizes may reduce long-run savings and investment rate and slow down long-term economic growth. The demographic transition in Tamil Nadu is anticipated to exert a direct influence on the state's economy through changes in the population's age structure, which will impact labor supply. As noted earlier, the combined effects of declining fertility and mortality rates are expected to shift Tamil Nadu's population from predominantly young to predominantly old in the coming decades. This demographic transition will likely have significant macroeconomic implications by changing the ratio of savers to non-savers over time. Currently, India's savings rate is rising and is expected to continue doing so for the next two decades as the large working-age population saves for retirement. This cohort will have fewer dependent children due to declining fertility rates, allowing Indian households to save more in the short term. However, as seen in Japan, population aging will eventually lead to a decline in the savings rate as a large number of retirees draw down their accumulated assets (Curtis et al. 2017). As dependency ratios increase and the labor force contracts, Tamil Nadu is likely to generate lower tax revenues, threatening the sustainability of social protection systems. These factors combined will affect the aggregate savings rate, capital forma-

tion, the viability of pension schemes, and labour supplies, ultimately defining the state's long-term economic growth. Therefore, a well-developed financial sector will be essential to facilitate the effective utilization of savings into productive investments and to enable consumption and expenditure smoothing.

Policy reforms: strategies for achieving a well-developed financial system

A well-developed financial system in Tamil Nadu will require a stronger banking sector and more dynamic equity and bond markets. The banking system's capacity to extend credit and support investments in productive sectors should be expanded. The corporate bond market must be deregulated to enable its growth, while governance and management at public sector banks should be improved through the recruitment of talented and experienced professionals. Integration across financial markets is essential to remove inefficiencies and eliminate opportunities for regulatory arbitrage.

Financial inclusion reforms are necessary to reduce unequal access to finance. Universal coverage should be ensured so that every individual has access to basic financial services. Financial literacy must be improved through targeted education and awareness programmes. In rural areas and among elderly populations, banking services should be made reliable, trustworthy, secure, and accessible, with door-to-door facilities where necessary.

Tamil Nadu should also work to reduce the dependence on gold as a savings instrument. Many households, particularly low-income families with low financial literacy, invest heavily in gold and even take loans to purchase it. This habit diverts significant funds away from the formal banking system. Attractive savings products and other incentives should be introduced to encourage people to deposit their money in bank accounts instead. Finally, a strong regulatory and supervisory framework must be established to safeguard the financial system. Robust legal mechanisms should be in place to resolve failing financial firms efficiently, ensuring stability and protecting public confidence.

GSDP, Per Capita Income, And Labor Force Participation

Tamil Nadu has the second largest economy in India among all states. According to the 2022–23 state budget, the Gross State Domestic Product (GSDP) of Tamil Nadu for 2022–23 is projected to reach ₹24.84 trillion at current prices. For the fiscal year 2021–22, the GSDP at current prices is estimated to have expanded by 14.6 percent compared to the previous year. Over the period from 2011 to 2021, the GSDP nearly tripled, exhibiting particularly robust growth between 2016–17 and 2019–20, with an average annual growth rate significantly exceeding 10 percent (refer to Figure 10). Furthermore, Tamil Nadu's per capita income has shown a consistent upward trajectory, nearly doubling the national average in 2020–21 (refer to Figure 12). While the growth rate of per capita income in India has been negative in recent years, Tamil Nadu has experienced a positive, albeit declining, growth rate in per capita income.

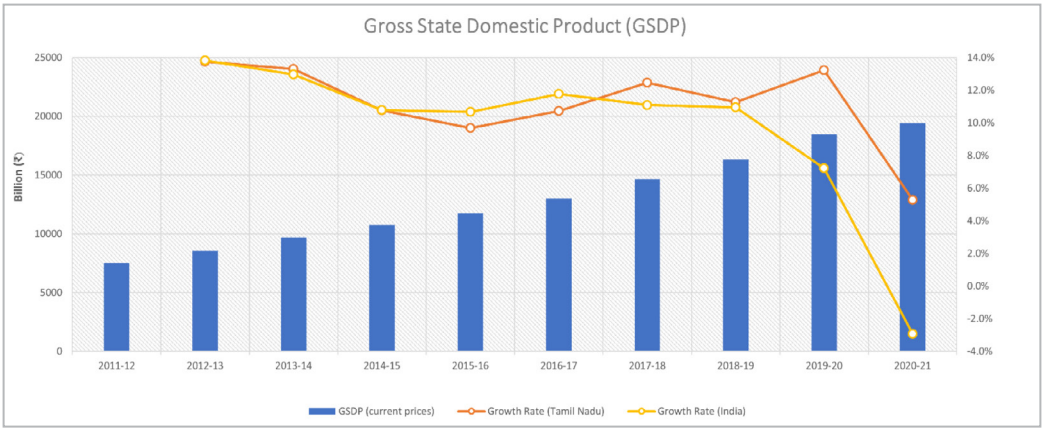


Figure 10: Gross State Domestic Product of Tamil Nadu, from 2011–12 to 2020–21

Source: *Statistics Times* (2021)

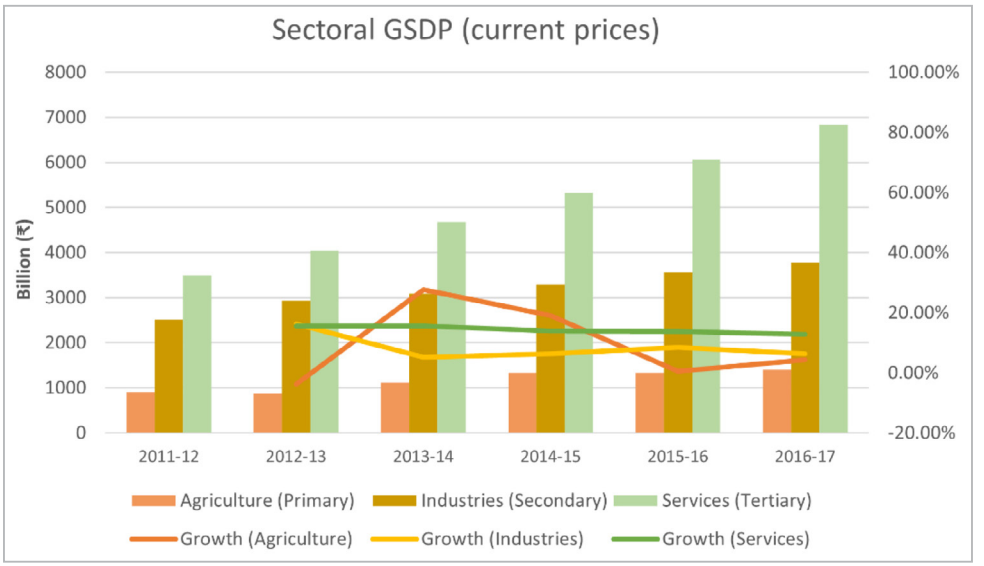


Figure 11: Gross State Domestic Product of Tamil Nadu by sector, from 2011–12 to 2016–17

Source: *Statistics Times* (2021)

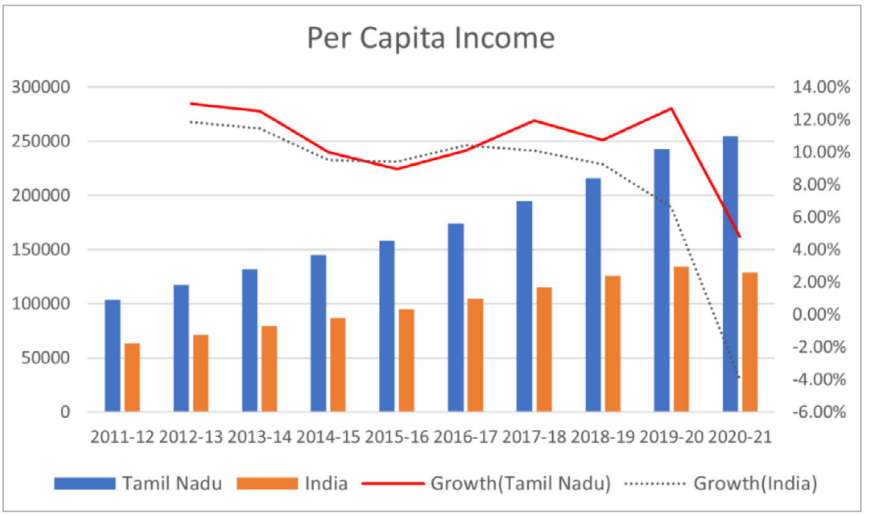


Figure 12: Per-capita income of India and Tamil Nadu, from 2011–12 to 2020–21

Source: *Statistics Times* (2021)

Tamil Nadu is a highly industrialised state where growth is primarily driven by capital-intensive sectors complemented by its sizeable intellectual capital. According to estimates from the Ministry of Statistics and Programme Implementation (MoSPI), as of 2020–21, the tertiary sector contributed 54.26 percent to Tamil Nadu's GDP, with the secondary sector contributing 32.4 percent (see Figure 11). Significant investments in infrastructure and manufacturing have driven high-growth sectors over the past decade, including real estate and professional services, financial services, telecommunications, and other services expected to encompass emerging fields such as IT, ITes, and renewable energy. The steady growth of the manufacturing sector over the last decade, likely accelerated by post-liberalization pro-business policy reforms, has generated substantial formal employment facilitating the absorption of rural-urban migrants and prompting a shift away from agriculture and allied activities in Tamil Nadu. Additionally, large-scale enabling strategies like the Tamil Nadu Urban Flagship Investment Programme are projected to inject approximately ₹81.56 billion into the development of sustainable and resilient blue-green infrastructure, thereby stimulating growth in the construction sector.

Despite being higher than the national average, the labor force participation of women was less than half of that of men in Tamil Nadu. Compared to a 76.8 percent participation rate among men, female labor force participation (FLFP) in Tamil Nadu remained low at 36.9 percent (see Figure 13), significantly below the global average of 46 percent according to World Bank estimates. For urban women in the state, FLFP was even lower at 30.4 percent. The anticipated increase in urbanization and the growing burden of elderly

care are likely to further reduce female labor force participation unless proactive policy measures are implemented to attract women into the workforce. Evidence-based solutions such as creating flexible job opportunities, ensuring safe working environments with robust laws and awareness about domestic violence, reducing the burden of domestic care work through increased public investment in childcare services, and providing safe transportation with gender-based seat reservations on public transit could help integrate more women into the labor force and boost the state's economic growth. Additionally, measures such as re-skilling, retraining, and upskilling programs could facilitate the re-entry of women into the labor force and encourage participation from the elderly population.

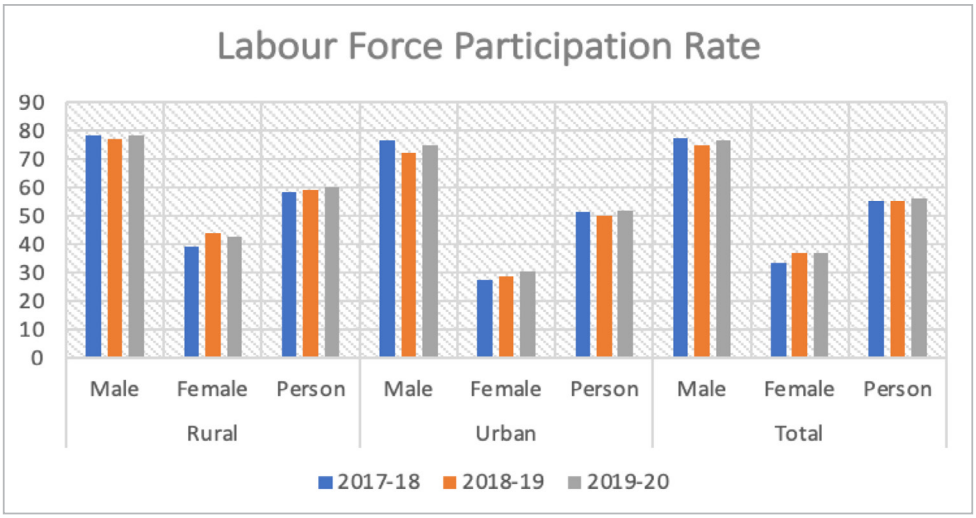


Figure 13: Labour Force Participation Rate in Tamil Nadu, from 2017–18 to 2019–20

Source: (*PLFS*, 2021)

Urbanisation and Inequality

Tamil Nadu is among the most urbanised states in the country, in terms of both geographical area and population size. According to the 2011 census, 48 percent of Tamil Nadu's population resides in urban areas, a figure projected to rise to 63 percent by 2030 (see Figure 14).[2] Consequently, future growth is expected to be driven primarily by urban economic activity. The state has achieved significant income growth in rural areas by attracting foreign investors and establishing special economic zones in poorer rural districts. As highlighted in Figure 15, income growth was not limited to the most urbanized districts. While the state's urbanization efforts and initiatives to improve historically poorer districts are commendable, they also raise concerns about urban poverty. It is estimated that around 6 million people live in urban slums. As urban-

ization increases, greater investments and policy commitments will be required to further reduce urban poverty and inequality. The COVID-19 related lockdowns severely impacted the social and economic well-being, especially of informal workers. One of the primary reasons for high rates of urban poverty and inequality in Tamil Nadu and India as a whole is the large proportion of the population engaged in informal jobs. According to the Economic Survey 2021–2022, approximately 90 percent of the workers who joined the workforce in 2019–2020 were in the informal sector in India. The same survey reported that in 2019–2020, 46 percent of jobs in the organized sector were also informal. These informal workers were severely impacted by the COVID-19 related lockdowns (Estupinan and Sharma 2020).[3] The coronavirus pandemic in 2020 led governments worldwide to implement lockdowns and social distancing norms to contain the virus's spread. The pandemic not only affected public health but also significantly disrupted economies and livelihoods (ILO Monitor 2020). Most economies entered a recession, and a substantial portion of the population became unemployed. In India, unemployment rates more than doubled during the lockdown periods, rising from 8.8 percent in March 2020 to 23.5 percent in April 2020 (CMIE). The high rate of informal employment and the depletion of economic resources during the pandemic have left the poorer sections of the economy at the greatest disadvantage (Estupinan and Sharma 2020; Chen 2020; Sekhar and Mansoor 2020).

There is a need for protection programmes targeted at the informal, migrant and urban poor workers. To ensure a safe, secure, resilient, and productive workforce, it is crucial to address and protect the needs of informal, migrant, and poor workers. The state government should introduce social protection schemes that are both preventive and adaptive. Preventive measures include the provision of social insurance for life, health, and accidents, while adaptive social protection involves investing in the capacity of the poor to build resilience and adapt to future shocks (Bhattacharya and Sinha Roy 2021). Well-planned and effectively implemented social protection policies can reduce poverty and inequalities in developing countries. For instance, social protection programs like MGNREGA mitigated the severe losses caused by the COVID-19 pandemic in rural areas of the country (Afridi et al. 2022). It is essential to introduce and implement similar policies in urban areas to reduce urban poverty and inequality. Additionally, the pandemic caused significant disruptions in the supply of necessities and essential food items.

Indian states are at different stages of the demographic and economic transition and decentralized social protection policies might lead to greater coverage and higher impact in such a scenario. For instance, the Pradhan Mantri Garib Kalyan Yojana (PMGKY) was a policy initiative implemented by the central government of India during the COVID-19 pandemic as a relief measure. Approximately 80 percent of Indian households received some form

of relief, either through cash or food benefits, with 34 percent receiving both. However, the distribution of benefits in urban areas lagged by 12 to 15 percentage points (Chouduri et al. 2020). In Tamil Nadu, only 32 percent of households received both cash and food benefits (Bhattacharya and Sinha Roy 2021). Due to the political non-alignment between the ruling parties of the State and Central Government, mismatches may arise in the allocation of resources. Granting state governments greater flexibility would allow them to develop tailored social protection schemes that are context- and demography-specific, effectively addressing the needs of their poor and vulnerable populations.

Tamil Nadu's overall population will start declining during 2031–36 with a huge decline in the working age population, unless it is neutralized by inward migration from other states. Changes in the size of the working-age population play a critical role in estimating workforce size. As previously discussed, Tamil Nadu's working-age population is projected to decline from 2021 onwards, accompanied by an increase in the dependent-age population. To ensure sustained economic growth and stability, it is imperative for the government to facilitate inward migration. Inward migration not only increases the proportion of the working-age population but also stimulates economic growth and enhances tax revenue.[4] According to the most recent data from the 2011 Census, only 2.6 percent of Tamil Nadu's population comprised migrants from other states. To attract a larger influx of migrants, the Tamil Nadu government must invest in policies that promote trade and industrial growth while also rolling out social protection schemes that appeal to individuals from diverse social and economic backgrounds. Leveraging decentralization and existing programs will be crucial for implementing these policies effectively and ensuring their scalability.

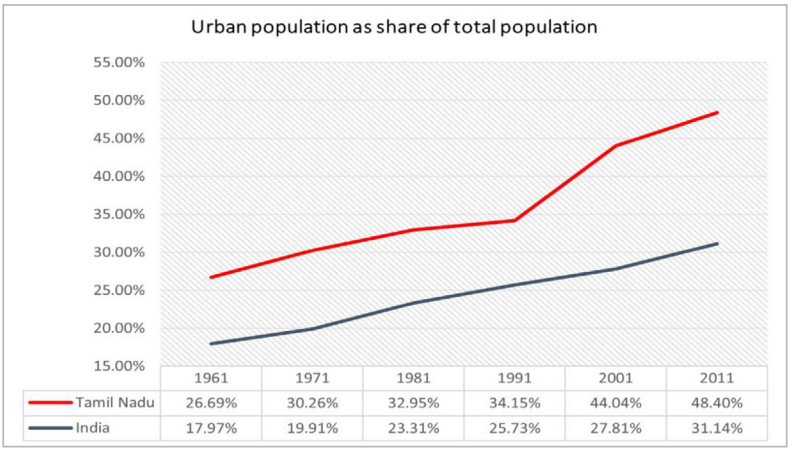


Figure 14: Urban population as share of total population in Tamil Nadu, from 1961 to 2011

Source: Census of India (2011)

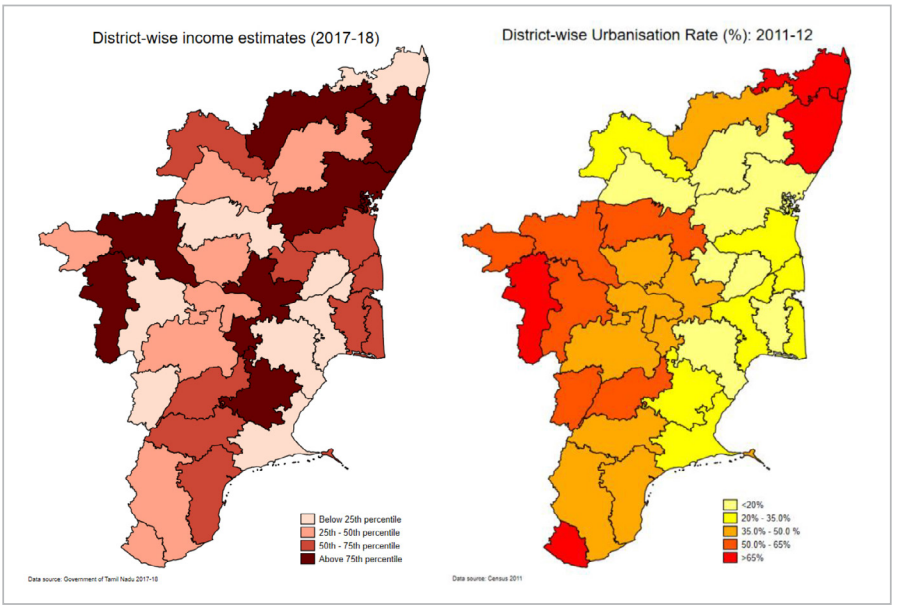


Figure 15: District-wise income estimates and rate of urbanization in Tamil Nadu

Source: Census of India (2011)

Implications for the Environment

In the recent past, climate change has increasingly become a policy priority for the state of Tamil Nadu, especially following studies predicting livelihood-threatening sea level rise along the state's coast and a significant increase in average temperatures in the coming decades (Khan et al. 2012; Bal et al. 2016). In response, the Tamil Nadu State Action Plan on Climate Change was introduced in 2015, resulting in the release of two draft action plans on climate change (Government of Tamil Nadu, 2019). Although neither plan has been enacted into policy yet due to recurrent delays (Chaitanya, 2021), seven areas of action have been identified, including sustainable agriculture, water resources, coastal area management, and renewable energy. In the state budget for the financial year 2022–23, the government also announced the establishment of the Tamil Nadu Green Climate Change fund to mobilize resources from development institutions and international funds for climate change mitigation projects (Government of Tamil Nadu 2022). This note outlines the nature and extent of the threat that climate change poses to Tamil Nadu's population.

Climate change threatens to intensify and increase the frequency of extreme weather events in Tamil Nadu. The state already experiences harsh weather at both ends of the rainfall spectrum, from extreme rainfall to severe droughts, and these phenomena are likely to be worsened by climate change. Tamil Nadu is one of the most drought-prone states, experiencing

droughts every 2.5 years on average, the highest frequency in the country after western Rajasthan (NRAA 2013). District-level vulnerability mapping has revealed that 12 districts in Tamil Nadu are highly vulnerable to drought, 8 are moderately vulnerable, and 10 are less vulnerable (Balaganesh et al. 2020; see Figure 16). Moreover, these extreme weather events have been increasing in both frequency and intensity in recent years. One study found rising trends in drought areas and maximum drought intensity and severity, while simultaneously finding a rise in the frequency and intensity of heavy rainfall events in Tamil Nadu over the last few years (Rajkumar et al. 2020).

Extreme weather events like droughts have a direct and adverse effect on the livelihoods and occupations in the state. For instance, the agricultural sector in Tamil Nadu faces significant challenges due to a high proportion of dryland farming and a heavy reliance on rainfall for irrigation. In years of severe drought, around 1.5 million hectares of cultivable land in Tamil Nadu are abandoned and left uncultivated (Balaganesh et al. 2020). Over 80 percent of dryland farmers have reported experiencing climate change in terms of low and unpredictable rainfall, higher temperatures, and delayed onset of the rainy season—perceptions that have been validated through analysis of climatic trends (Varadan and Kumar 2014). Farmers face numerous challenges in adapting to climate change, such as adjusting sowing dates, regulating fertilizer application, and selecting alternate crops (Ibid). Additionally, the district of Tiruchirappalli has been identified as having the highest agricultural vulnerability to climate change, with Madurai, Coimbatore, Tirunelveli, and North Arcot categorised as "vulnerable" (Varadan and Kumar 2015).

Such disruptions in the agricultural sector impact the state's economic output and, consequently, its population. In Tamil Nadu, agriculture is a primary occupation, contributing 7 percent to the gross state domestic product (GSDP). It engages 31 percent of the state's labour force and affects the livelihoods of about 70 percent of the population (Varadan and Kumar 2015; see Figure 17). Besides affecting agricultural output, climate change-driven extreme heat also results in a loss of annual milk production due to heat stress in cattle and buffaloes, placing Tamil Nadu among the states with the highest losses in milk production due to global warming (Balaganesh et al. 2020). Collectively, these climate change-induced weather phenomena negatively influence the total economic output of the state, significantly pulling down the GSDP.

Simultaneously, away from regions facing severe droughts, parts of Tamil Nadu also face the dangers of coastal inundation. Tamil Nadu's coast spans 13 districts along with the Union Territory of Puducherry and stretches for about 1,076 km. This extensive coastline includes three major ports, seven government captive ports, 16 non-major ports, fishing harbors, and a range of coastal industries. India's lower-lying east coast, a significant portion of which lies in Tamil Nadu, is more

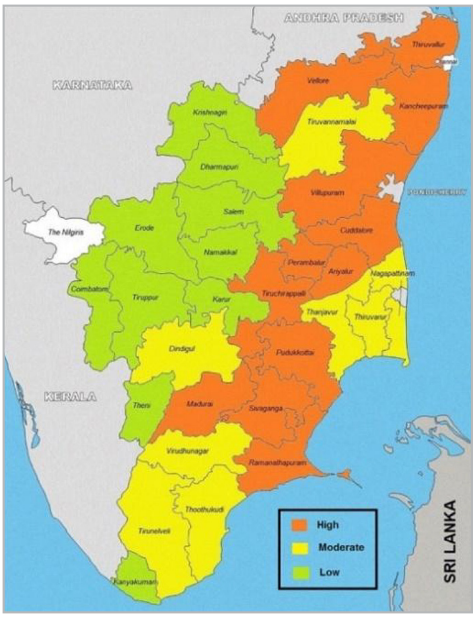


Figure 16: Mapping of drought vulnerability in Tamil Nadu

Source: Balaganesh et al. (2020)

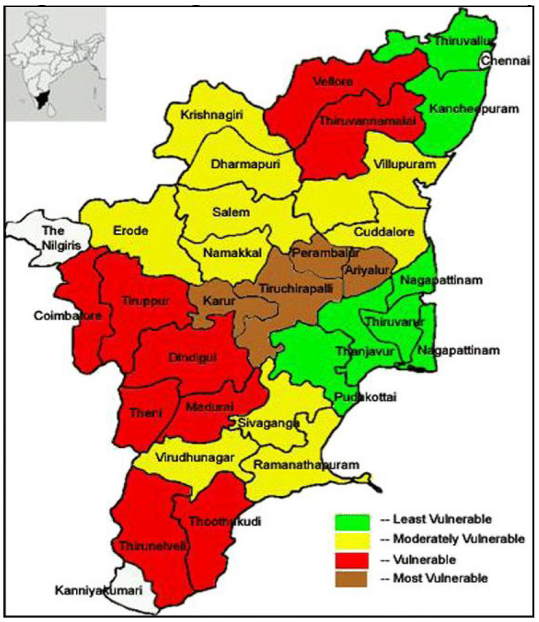


Figure 17: Agricultural vulnerability mapping of Tamil Nadu to climate change

Source: Varadan and Kumar (2015)

vulnerable to cyclones, extreme rainfall events, and inundation than the country's west coast (Saxena et al. 2012). Tamil Nadu also bore the brunt of the 2004 Tsunami surge, which left a lasting impact on the state's geography and habitation (Saxena et al. 2012; Sheth et al. 2006). Now, climate change threatens to further endanger the already-vulnerable coastal regions of Tamil Nadu. It is estimated that the state's coast will experience a significant rise in sea level over the next several decades due to climate change, posing serious threats to coastal ecosystems, coastal communities, and other coastal resources along the state's border on the east (Ramachandran et al. 2017). Unabated coastal degradation will pose increasing risks to the lives and livelihoods of coastal populations in Tamil Nadu. The state's coastal districts are often densely populated, with densities ranging from 320 people per square km to over 3,000 people per square km (Ramachandran et al. 2017). Marine fishing is the primary occupation for most small-scale households along the coast, with no viable livelihood options other than fishing. Coastal fishermen have reported noticing several climate anomalies in recent decades, especially after the 2004 Indian Ocean Tsunami disaster. Notably, they feel that their local or traditional knowledge is no longer relevant in the face of climate change (Madhanagopal and Pattanaik 2020).

In the face of climate challenges, Tamil Nadu excels in renewable and clean energy production. Despite the potential challenges and natural threats mentioned above, Tamil Nadu stands out as one of India's leading states in

renewable energy capacity and generation. The state boasts significant reserves of renewable energy sources, accounting for 14.6 percent of the country's total installed capacity in renewable energy, trailing only Rajasthan and Gujarat (Government of India 2022). At close to 10 GW, Tamil Nadu has the highest wind power capacity in India, representing almost a quarter of the country's total wind capacity. It is also among the top five states in solar power capacity (Government of India 2022). In addition to solar and wind power, Tamil Nadu has also made progress in other forms of renewable energy such as small hydro, biomass, and waste-to-energy projects. Currently, the state has 123.05 MW of installed small hydro power capacity, with potential for significant future expansion (Elavarasan et al. 2020). It is also a leader in biomass power generation in India, with rising consumption in the state's rural areas (Nesamalar et al. 2017). These efforts provide hope for alternative and clean energy generation mechanisms in Tamil Nadu and support the state's ever-growing power demand. Policy barriers remain when it comes to the state's renewable energy sector. Among the challenges are the high prices for using solar-powered appliances such as cookers, lanterns, and geysers, which discourage consumers from opting for renewable power despite recognizing the benefits (Nesamalar et al. 2017). Other practical roadblocks include the lack of private sector investments in renewable energy projects and the underutilization of wind energy generation capacity, leading to losses for wind farm owners (Ibid). In terms of state policy, the Government of Tamil Nadu established the Tamil Nadu Energy Development Agency in 1985 to implement and oversee renewable energy projects and promote clean energy use. The state government also released its solar power policy in 2019, with timelines for expanding the state's solar capacity and outlining the transition to clean energy (Government of Tamil Nadu 2019).

Policy reform: strategies for climate action in Tamil Nadu

Tamil Nadu should formulate a dedicated state action plan on climate change. Such a policy will raise awareness about the impacts of climate change, including sea level rise and increasing temperatures, and prepare the most vulnerable communities for future extreme weather events. It will enable ministries, departments, and other stakeholders to integrate climate-friendly measures into their respective areas of work. The policy will also articulate the state's priorities and attract investments in sectors such as new and renewable energy. Over time, Tamil Nadu could adopt a long-term climate action plan with broader objectives for the coming decades, similar to Germany's Climate Action Plan 2050 (Federal Government of Germany 2016).

A formal state-level institution for coastal weather updates should be established to provide accurate information at sub-district or taluk levels. Such an institution could help fishermen respond to and adapt to climate change-induced extreme weather events (Madhanagopal and Pattanaik

2020). It could work in collaboration with existing agencies, such as the Indian National Centre for Ocean Information Services, to reduce the impacts of climate change and protect coastal livelihoods. Operational lessons can also be drawn from other countries with extensive coastlines, such as the Indonesian Coastal Inundation Forecasting Demonstration Project (CIFDP) (WMO 2019).

Districts with high agricultural vulnerability to extreme weather events should receive special attention. Research and development efforts must be concentrated in regions most susceptible to climate change. Area-specific agricultural adaptation strategies should be devised, including the identification of more suitable crop varieties, establishment of early drought weather warning systems, promotion of innovative farm resource management techniques, and implementation of targeted crop insurance programmes (Varadan and Kumar 2015). Tamil Nadu should also focus on effectively leveraging its renewable energy resources. As the state expands its installed renewable energy capacity, it is essential to ensure maximum utilization for end users. Valuable insights can be gained from countries such as China on strategies to expand and promote renewable energy, attract investments, minimise transmission losses, implement efficient resource allocation policies, and construct transformation facilities (Zhao et al. 2016; Dong et al. 2016).

Implications for Health and Old-Age Security in Tamil Nadu

Tamil Nadu needs to enhance its efforts in improving the quality of life for its elderly population and requires strong policy commitment in this regard. With increasing life expectancy and decreasing mortality rates, it is crucial to understand the needs of the elderly and empower them to lead healthy, dignified, and productive lives. Ageing often leads to decline in both mental and physical capacities, increased vulnerability to infections, disabilities, illnesses, and premature death. Establishing supportive health systems and creating enabling physical, social, and financial environments will be essential for ensuring a safe, secure, and healthy future for the elderly in the state. Furthermore, policies addressing ageing should incorporate digital literacy to keep pace with rapid globalization and technological advancements in this progressive state.

Tamil Nadu ranked poorly at 28th on the index of quality of life for the elderly, which considers income security, financial well-being, social well-being, and healthcare systems (Economic Advisory Council to the Prime Minister 2021). It only fared better than Karnataka, Uttar Pradesh, Andhra Pradesh, West Bengal, Telangana, and Arunachal Pradesh. Among the ten states with over five million people aged 60 and above, Tamil Nadu ranked fourth, highlighting the significant challenge the state faces in protecting and supporting its elderly population.

Significant gender disparities in financial security among the elderly population in the state underscore the need for establishing an affordable, sustainable, adequate, and robust retirement income system for all (Holzmann 2005). According to a recent survey of the elderly in the state, only 30 percent had applied for public old-age, widow, or disability pensions, and just 16 percent were current recipients of these pensions (Duflo et al. 2022). The report also emphasizes the importance of education and digital literacy, noting that only 17 percent of the elderly applied for pensions without assistance, with even lower rates among women, at approximately 12 percent. Figure 18 illustrates how women in both rural and urban Tamil Nadu are more vulnerable and reliant on others for financial support compared to men. Less than 15 percent of women reported financial independence, whereas 50-60 percent of men in rural and urban areas did. Women often rely on husbands and sons for financial assistance while contributing to unpaid care work at home. Given that women tend to outlive men, their lack of financial independence or formal employment leads to financial strain and dependence on children for support in old age. Therefore, a gender equity perspective is crucial in designing any pension or old-age income support programs.

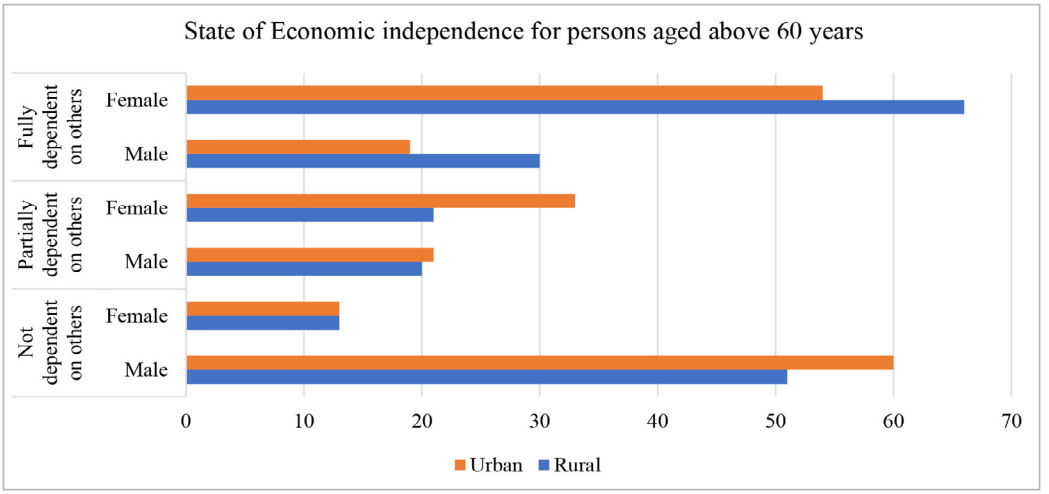


Figure 18: Economic independence of persons above 60 years of age in Tamil Nadu

Source: Social Statistics Division (2021)

Tamil Nadu faces significant gaps in addressing elder abuse and providing mental health support for its elderly population. The state ranked fourth highest in India for crimes against senior citizens according to the National Crime Records Bureau (2020). Elder abuse, often rooted in ageism, encompasses various forms of violence including physical, sexual, psychological, and emotional abuse, as well as financial exploitation, neglect, and abandonment (WHO). In addition to these forms of abuse, the elderly population also ex-

periences loneliness and depression. Geriatric depression is more prevalent among women than men in Tamil Nadu, with its likelihood increasing with age for those 55 years and older (Duflo et al. 2022). According to a survey across five districts in Tamil Nadu, involving 5,000 households, 25 percent of women and 17 percent of men aged 80 and above exhibited geriatric depression scores typically indicative of depression, which is significantly higher than the global average of 1-5 percent (Duflo et al. 2022). Additionally, approximately 30 percent of men and 25 percent of women in Tamil Nadu suffer from hypertension (high blood pressure), exceeding the national average (See Table 3).

Tamil Nadu is seeing an increase in non-communicable diseases like stroke, type 2 diabetes, cancer, and heart diseases. Tamil Nadu accounted for nearly 6 percent of India's total burden of cancer patients (Press Information Bureau, 2014). According to data from the Tamil Nadu Cancer Registry Project, approximately 69,517 new cancer cases were diagnosed in 2017, with an estimated increase of 12,297 cases by 2021. A recent report by the Cancer Institute of India noted a higher prevalence of cancer in women compared to men, with breast, cervix, ovary, large bowel, and Corpus uteri being the most common cancers among women. Among men, stomach, lung, mouth, large bowel, and tongue cancers were the most prevalent. The reported mortality-to-incidence ratio was 13 percent in 2017.[5]

Particularly prevalent in southern states, diabetes is a significant contributor to mortality in India. Table 3 indicates that approximately 20-22 percent of the population in Tamil Nadu suffers from diabetes, a rate notably higher than the national average. Among individuals aged 60 and above, about 25 percent reported diagnosed diabetes, with 90 percent of them receiving treatment. According to the Longitudinal Ageing Study in India (LASI)[6] report for 2017–2018, around 3.4 percent of people in Tamil Nadu had heart diseases, 1.3 percent experienced stroke, and 28.4 percent had cardiovascular diseases (CVDs) (see Figure 19). NCDs accounted for 63 percent of total deaths in India in 2016, with 27 percent attributed to CVDs, including sudden cardiac deaths. As the elderly population increases, managing NCDs becomes crucial for Tamil Nadu, as CVDs alone cause nearly half of the deaths among 40–69 year olds in India (WHO).[7] Additionally, a notable 37–40 percent of the population in Tamil Nadu was overweight or obese, significantly elevating the risk of Type 2 diabetes, heart disease, and stroke (Table 3).

The emergence and spread of antibiotic resistance are expected to increase hospital stays, out-of-pocket health expenditures, and mortality rates among the elderly population. Antibiotics have played a crucial role in revolutionising modern medicine (Holmes et al. 2016). However, their overuse or misuse has contributed to the rise of antimicrobial resistance, a biological phenomenon that allows bacteria to survive against antibiotics (Aslam et al. 2018).

Antimicrobial resistance poses one of the greatest threats to global health, economic systems, and development (Lodato 2013). According to the latest Global Antimicrobial Surveillance System (GLASS) by the World Health Organization, approximately 5,00,000 people across 22 countries were suspected to have bacterial infections showing signs of antimicrobial resistance (World Health Organization 2020). India is profoundly affected by antimicrobial resistance, largely due to its status as the largest consumer of antibiotics, amounting to 12.9 million units (Gandra et al. 2017; Klein et al. 2018). Despite a prescription-only policy stipulated by the Drugs and Cosmetics Act of 1940 and Rules of 1945, a significant portion of antibiotics are sold over the counter to treat symptoms like diarrhoea and respiratory ailments (Vashishtha 2010). Additionally, factors such as self-medication, the consumption of leftover medications, and the inappropriate prescription of antibiotics for viral infections and non-therapeutic purposes contribute to the overuse of antibiotics in India. Poor health infrastructure has been identified as a major factor driving this excessive sale and consumption of antibiotics, necessitating improvements to reduce consumption and mitigate the risk of antimicrobial resistance. A systematic approach to educate healthcare practitioners is crucial to enhance antibiotic prescribing practices and address the persistent issue of prescribing antibiotics for non-bacterial infections.

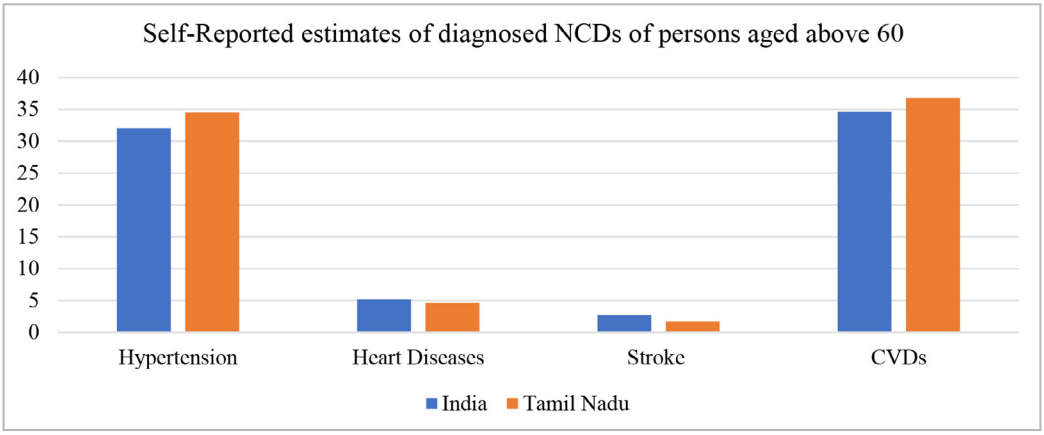


Figure 19: Self-reported estimates of diagnosed NCDs of persons above 60 years of age in India and Tamil Nadu

Source: (LASI, 2020)

Table 3: Nutrition status of and hypertension among adults in India and Tamil Nadu

	India				**Tamil Nadu**			
Indicators	**(2019-21)**			**(2015-16)**	**(2019-21)**			**(2015-16)**
Nutritional status of adults (age 15-49 years)	Urban	Rural	Total	Total	Urban	Rural	Total	Total
Women who are overweight or obese (BMI ≥25.0 kg/m^2) (%)	33.2	19.7	24.0	20.6	46.1	35.4	40.4	30.9
Men who are overweight or obese (BMI ≥25.0 kg/m^2) (%)	29.8	19.3	22.9	18.9	43.1	31.6	37.0	28.2
Blood-sugar level among adults (age 15 years and above)								
Women: Blood sugar level - high or very high (>140 mg/dl) or taking medicine to control blood sugar level (%)	16.3	12.3	13.5	na	23.8	18.0	20.7	na
Men: Blood sugar level - high or very high (>140 mg/dl) or taking medicine to control blood sugar level (%)	17.9	14.5	15.6	na	23.7	20.6	22.1	na
Hypertension among adults (age 15 years and above)								
Women: Elevated blood pressure (Systolic ≥140 mm of Hg and/or Diastolic ≥90 mm of Hg) or taking medicine to control blood pressure (%)	23.6	20.2	21.3	na	26.4	23.4	24.8	na
Men: Elevated blood pressure (Systolic ≥140 mm of Hg and/or Diastolic ≥90 mm of Hg) or taking	26.6	22.7	24.0	na	31.5	29.0	30.2	na

Source: NFHS 5 (2022)

Policy reform: strengthening elderly care in Tamil Nadu

Improving digital literacy among the elderly is essential in a rapidly digitising world, especially given the generational digital divide that widened during the COVID-19 pandemic. Globally, from Europe to South America, countries are working to bridge this gap (Alcobendas 2019; UNESCO 2021). In Tamil Nadu, enhancing digital and technological literacy would enable older adults

to make independent online decisions, including those concerning their health and finances.

The state should also expand subsidised and targeted healthcare services for its elderly population. Under the National Programme for the Health Care of Elderly, the Government of India provides specialised services such as cardiovascular and diabetes care (Government of India 2021). Building on these efforts, Tamil Nadu could develop a comprehensive elderly care programme supported by state initiatives, drawing on lessons from countries such as Japan, Germany, Sweden, and Italy (Watanabe et al. 2018; Theobald and Luppi 2018). Ensuring income security for older adults is another critical priority. Measures could include raising the retirement age, increasing monthly pension allowances, offering livelihood training, and supporting financial stability among the elderly (Government of Tamil Nadu 2022). Programmes in Canada and Sweden provide useful models for designing these policies (Government of Canada n.d.; Stahlberg 2018). Given the size of Tamil Nadu's informal economy, it is vital to include informal sector workers in pension schemes. Revising and expanding the eligibility criteria for state pensions to cover both men and women in informal employment would address a major gap in income security. Experiences from social protection schemes in African countries with similar economic structures offer valuable insights for such reforms (Guven et al. 2021). Urban development in Tamil Nadu must be made more age-friendly to support the wellbeing of older residents. As cities expand, they should create physically accessible environments, including well-defined and well-lit footpaths, benches, public parks, priority parking, elevators, and safer neighbourhoods (Barnett et al. 2017; Miralles-Guasch et al. 2019; Parida et al. 2022). Examples from Australia's local councils and Japan's major cities demonstrate how this can be achieved (Municipal Association of Victoria n.d.; WHO 2019). Finally, reducing crimes against the elderly should be addressed through systemic reforms in response mechanisms (Government of Tamil Nadu 2022). In addition to strengthening legal remedies and rehabilitation centres, strategies should include awareness campaigns, community engagement, violence prevention in healthcare settings, and specialised training for police and healthcare personnel (Rosen et al. 2020; Drommi et al. 2021).

Implications for Education

Historically, Tamil Nadu's social and political activism has defined the state's egalitarian approach to education. Schooling has been made available to all through education subsidies, including marginalised groups, for the past few decades (Visaria 2000). While the public education infrastructure has succeeded in raising literacy levels, for both sexes, quality of learning has remained low. Poor performance of students on all learning outcomes demands the need for an overhaul of the education system in the state. Tamil Nadu prioritizes education through significant investments,

but these focus more on resources than learning outcomes. As a result, schools boast better facilities compared to the national average (Figure 21). However, student achievement lags behind. On the resource side, over 75 percent of schools are government-run or supported (UDISE 2021), with most having basic amenities like water, sanitation, libraries, and computers. However, learning outcomes paint a different picture. Only half of rural eighth graders in Tamil Nadu can perform division, and a mere 26.2 percent can do basic subtraction (ASER Reports). Shockingly, just 12 percent of third graders can read at a second-grade level, compared to 21 percent nationally (Figure 22). Performance varies across districts, with Kanyakumari leading in subtraction and division (Figure 23). Notably, the gender gap in higher secondary enrollment is wider in Tamil Nadu compared to India (Figure 20). While the gender ratio in lower education levels is similar for both regions, with India having a slightly lower gap, Tamil Nadu struggles to bridge the gap in higher education.

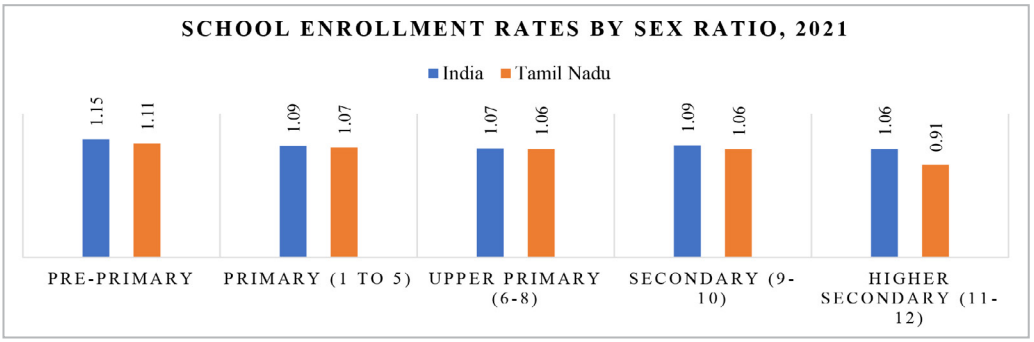


Figure 20: School enrollment rates by sex ratio in 2021 in India and Tamil Nadu

Source: UDISE (2021)

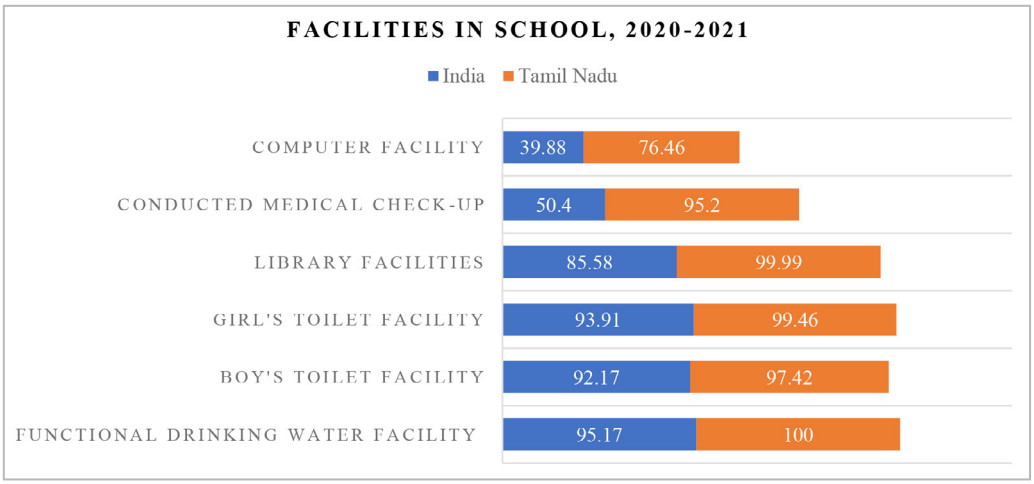


Figure 21: Overview of facilities in schools in India and Tamil Nadu

Source: UDISE (2021)

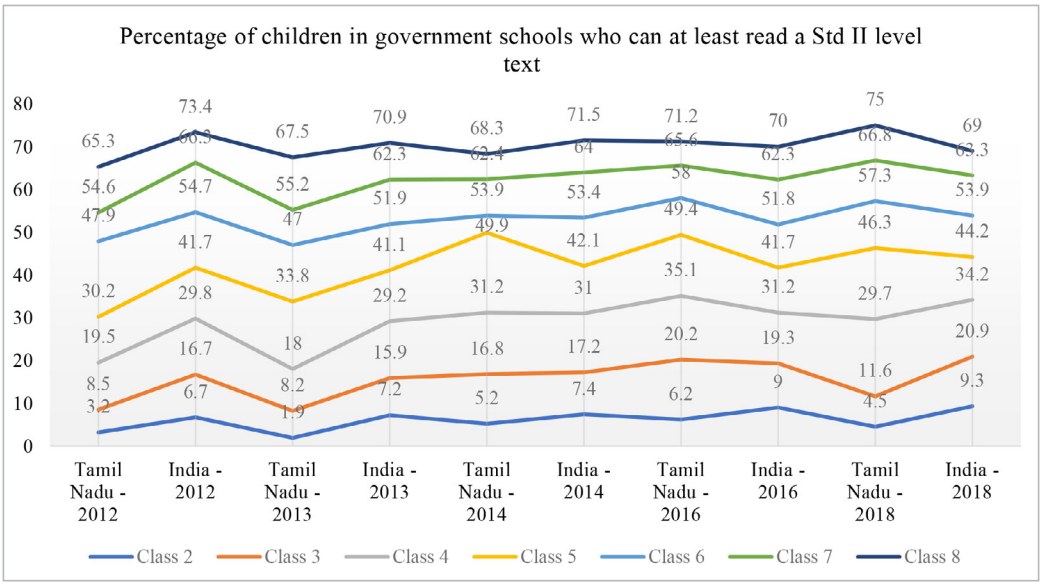
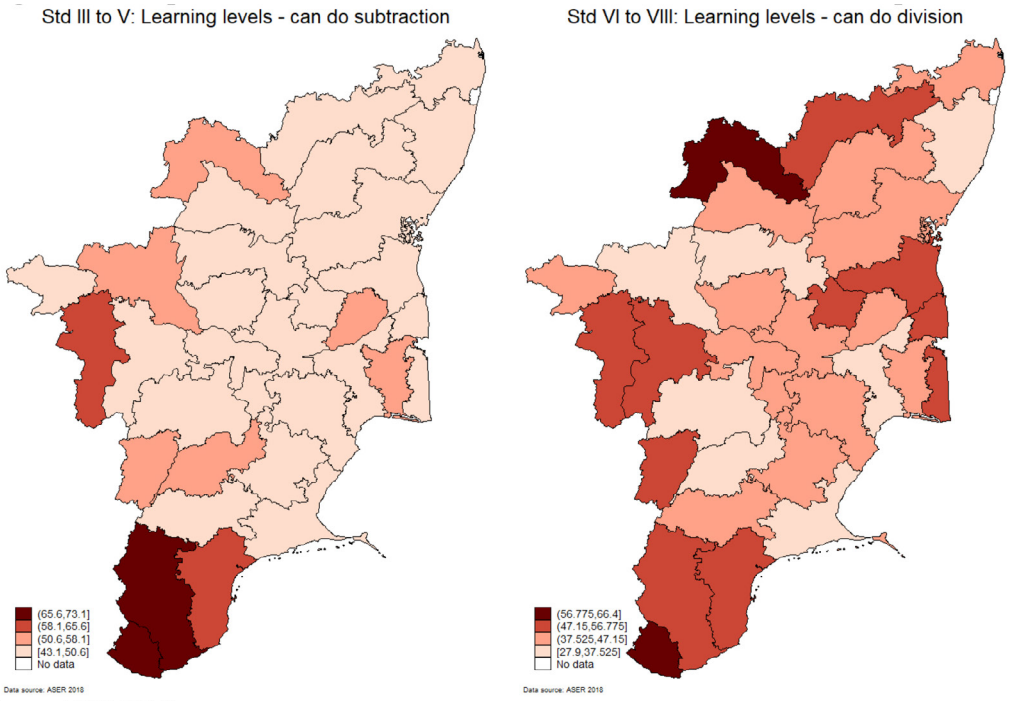


Figure 22: Proportion of children in government schools who can read Class 2-level text, from 2012 to 2018

Source: ASER (2020)



Source: ASER (2018)

Figure 23: Proportion of students who can solve subtraction and division problems

Source: ASER (2018)

Low level of education was observed among the independent population in Tamil Nadu, with a concentration on M.Phil. and Ph.D. degrees among those pursuing tertiary education. Education levels in Tamil Nadu vary greatly between rural and urban areas, and across genders. In rural areas, a significant gap exists: one-third of women are illiterate compared to only 15.6 percent in urban areas. Primary education is the most common achievement for both rural men and women over 15, with only 11-13 percent reaching high school. Urban men are more likely to be graduates, while urban women typically complete secondary education (Figure 24). There's a concerning trend in higher education. Less than 10 percent of the population pursues tertiary education, with a surprising number focusing on advanced degrees (M.Phil. and Ph.D.) rather than undergraduate programs. Currently, only 8 percent of students in higher education are enrolled in undergraduate studies. To maximize its remaining demographic advantage, Tamil Nadu should consider shifting its education focus. Investments and policies need to prioritize strengthening the undergraduate level in tertiary education.

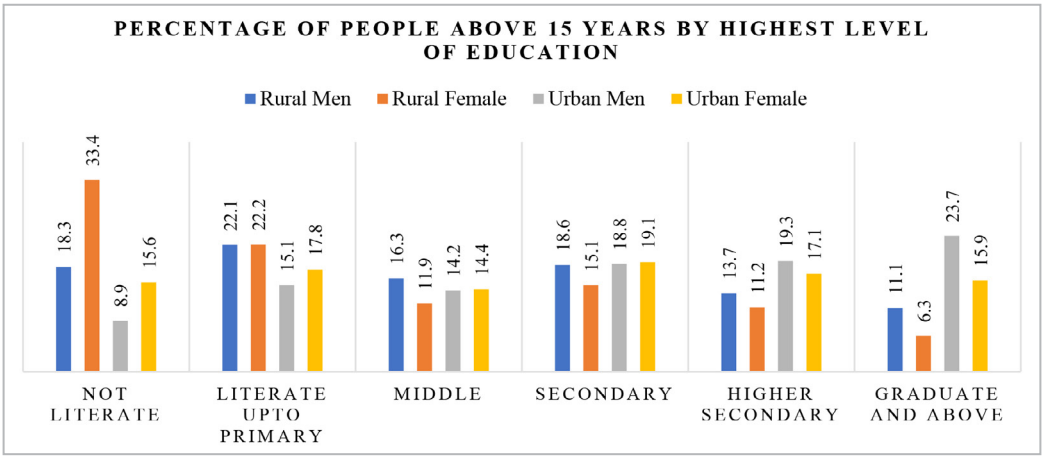


Figure 24: Percentage of people above 15 years of age by highest level of education and location in Tamil Nadu

Source: National Sample Survey (2018)

Policy reform: strengthening learning outcomes in schools and college

Tamil Nadu's curriculum should be reformed to emphasize practical skills rather than rote memorisation. The current system, like much of India's, prioritises memorisation over critical thinking and hands-on abilities, which undermines the quality of graduates and raises questions about whether degrees reflect actual competencies. Introducing job-oriented, skill-based courses in government schools and colleges can bridge this gap. Areas such as computer science, advertising, and communication English could be included, bene-

fitting not only students but also older adults seeking to upskill.

Reforms should also focus on outputs such as learning outcomes instead of inputs like infrastructure and enrolment figures. Many states invest heavily in expanding facilities and increasing enrolment, yet student performance remains weak. A better approach would streamline coursework and prioritise comprehension over rote learning. Maharashtra's Pragat Shaikshanik (Progressive Learning) programme provides a model. It aimed to ensure students achieved basic literacy and numeracy skills by grade three and ranked schools based on student performance in learning assessments, encouraging targeted support for struggling students.

The state should strengthen its regulatory and monitoring framework for both public and private schools to ensure all students have access to high-quality education. Stronger oversight will help standardise educational standards and protect against disparities in teaching quality. Improving teacher quality will require greater transparency in recruitment. The selection process in representative colleges should be monitored from the initial advertisement to the final appointment. Analysing the process in its entirety can lead to comprehensive guidelines that ensure a fair chance for qualified candidates from all genders and social backgrounds. Teacher training modules must be redesigned to prioritise practical pedagogy over theory. This applies to both pre-service and in-service teachers, enabling them to adopt more effective teaching methods (Muralidharan 2015). Online training modules with short quizzes can be piloted to prepare teachers and assess their readiness.

Monitoring teacher presence and performance is another cost-effective measure for improving educational delivery. Research shows that school-level monitoring is more effective in improving teacher attendance than hiring additional staff (Muralidharan et al. 2014). Telangana's use of biometric systems for tracking teacher attendance reflects this approach, helping to reduce absenteeism. However, attendance alone does not capture teacher effectiveness. "Value-added" performance measures, such as those proposed by Hanushek and Hoxby (2005), should be considered. These would track student learning progress over time, comparing improvement to their starting skills and background. Building a panel of such data would provide a more complete picture of teacher performance and its impact on learning outcomes.

Conclusion and Policy Agenda

Tamil Nadu's advanced demographic transition presents both immediate risks and long-term opportunities. Fertility decline, population ageing, and changes in household structure are not isolated trends; they directly influence labor supply, fiscal sustainability, social protection needs, and sectoral growth (Deolalikar 2024). Evidence from other countries suggests that proactive and targeted reforms can turn such demographic shifts into en-

gines of growth, whereas inaction risks prolonged economic and social strain (Holzmann 2005; Curtis et al. 2017). The following integrated policy priorities respond to these challenges by linking demographic causes to their policy implications, situating them in national and global comparative contexts, and identifying actionable reform pathways.

A first priority is ensuring sustainable old-age income security. By 2036, one in five residents will be over 60 (National Commission on Population 2011), sharply increasing dependency ratios and putting existing pension schemes under strain. This pressure is compounded by the fact that a large share of the workforce is employed in the informal sector, limiting contributory pension coverage (Guven et al. 2021). International experience offers cautionary lessons: Japan's delayed reforms in the late 1990s resulted in fiscal stress, whereas Sweden's adoption of a notional defined contribution system preserved both adequacy and affordability (Stahlberg 2018). Tamil Nadu's state pension program and the Indira Gandhi National Old Age Pension Scheme (Government of India 2021; Government of Tamil Nadu 2022) provide a foundation but need expansion to cover informal workers through contributory micropension models. Benefits should be indexed to inflation while gradually raising the retirement age to reflect longer life expectancy (Holzmann 2005). Improving digital literacy among older adults, particularly women, would also facilitate access to entitlements and reduce financial dependence (Alcobendas 2019).

Second, the state must strengthen its health systems to meet the needs of an ageing population. Rising life expectancy has coincided with an increase in non-communicable diseases such as diabetes, which affects 20–22 percent of the population, and hypertension, which affects nearly one in four adults (NFHS 5 2022; LASI 2020). The experience of Kerala's decentralised geriatric care network and Japan's community-based integrated care system shows the value of embedding elderly health services close to communities (Watanabe et al. 2018). Tamil Nadu's participation in the National Programme for Health Care of the Elderly (Government of India 2021) could be complemented by state-led expansion of community health worker training for NCD management, the introduction of elderly-specific insurance riders, and telehealth integration for rural areas (Theobald and Luppi 2018). In parallel, the state should address antimicrobial resistance through stronger monitoring and prescribing standards (Holmes et al. 2016).

Third, boosting labor force participation and skills—especially among women and older workers—will be essential to offset the impending decline in the working-age share after 2031 (PLFS 2021; National Commission on Population 2011). Female labor force participation (FLFP) remains low at 36.9 percent, with caregiving burdens and limited childcare contributing to the gap. South Korea's childcare expansion helped reverse FLFP declines, while Germany's re-skilling programs

have kept older workers productive (OECD 2019). Tamil Nadu can build on its Skill Development Mission and existing childcare subsidies (Government of Tamil Nadu 2022) by expanding affordable childcare in urban and peri-urban areas, developing re-skilling tracks for older workers in high-demand sectors, and offering employer tax credits for flexible work arrangements (Glewwe and Muralidharan 2016).

Climate-resilient economic planning is a fourth priority. Tamil Nadu faces climate threats on two fronts: recurrent droughts, with a frequency second only to western Rajasthan, and coastal inundation risks from rising sea levels (Balaganesh et al. 2020; Ramachandran et al. 2017). Agriculture, which employs 31 percent of the workforce, is especially vulnerable, as are coastal fishing communities (Madhanagopal and Pattanaik 2020). Vietnam's Mekong Delta adaptation plan illustrates the benefits of integrating agricultural and coastal resilience into a single policy framework (World Bank 2016). Tamil Nadu should finalise and operationalise its State Action Plan on Climate Change, complete district-level vulnerability mapping (Varadan and Kumar 2015), incentivise drought-resistant crop adoption, strengthen coastal defences, and invest in grid infrastructure to maximise utilisation of its substantial renewable energy capacity (Elavarasan et al. 2020).

Finally, education reform is critical to securing the next demographic dividend. While enrolment rates are high, learning outcomes remain weak—only 12 percent of Grade 3 students can read at a Grade 2 level—and undergraduate participation is low (ASER 2020; MHRD 2019). Maharashtra's *Pragat Shaikshanik* program demonstrates how early learning interventions can yield quick gains (Pratham 2018). Tamil Nadu should shift emphasis from infrastructure provision to measurable learning outcomes (Muralidharan 2015), expand access to undergraduate education through community college models (Becker 1962), and align tertiary curricula with high-growth sectors such as renewable energy, healthcare, and IT (Banerjee et al. 2019).

Taken together, these priorities reflect Tamil Nadu's unique demographic profile, which is closer to upper-middle-income countries than to most Indian states. By reforming pensions, reorienting healthcare, mobilising under-utilised labour, embedding climate resilience, and targeting educational outcomes, the state can transform demographic headwinds into a second dividend of inclusive and sustainable growth.

Acknowledgements

The authors would like to thank Anil Deolalikar, Elina Pradhan, Camilla Holmemo, Rifat Hasan, Sharanya Bhattacharya and Qaiser M. Khan for their detailed and helpful comments.

Notes

1 Maternal mortality ratio = (Number of maternal deaths / Number of live births) × 100,000. It indicates the risk of death once a woman becomes pregnant and does not take fertility levels in a population into consideration. The maternal mortality rate is the number of maternal deaths in a population divided by the number of women of reproductive age. It reflects not only the risk of maternal death per pregnancy or birth, but also the level of fertility in the population.

2 Government of Tamil Nadu. 2012. *Twelfth Five-Year Plan Tamil Nadu, 2012–2017*. Chennai; Government of Tamil Nadu. 2017. *Tamil Nadu State Annual Action Plan (2017–2020)*. Chennai; Government of Tamil Nadu. 2012. *Vision Tamil Nadu 2023: Strategic Plan for Infrastructure Development in Tamil Nadu*. Chennai; and Government of Tamil Nadu. 2014. *State Action Plan on Climate Change: Towards Balanced Growth and Resilience*. Chennai. See also, https://www.gtai.de/resource/blob/211286/1425e7c2ea266f253bea0aa6cfa22231/pro202001105001-data.pdf

3 See also, https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---travail/documents/briefingnote/wcms_743534.pdf

4 https://www.oecd.org/migration/OECD%20Migration%20Policy%20Debates%20Numero%202.pdf

5 See, http://www.cancerinstitutewia.in/CIWIA/download/TNCRP%20REPORT%202017.pdf

6 See, https://www.iipsindia.ac.in/sites/default/files/LASI_India_Report_2020_compressed.pdf

7 See, https://www.who.int/india/health-topics/cardiovascular-diseases

References

Alcobendas, N. 2019. *Breaking digital barriers: Building digital literacy for elderly*. Online report.

Alderman, Harold, Jooseop Kim, and Peter F. Orazem. 2003. "Design, evaluation, and sustainability of private schools for the poor: The Pakistan urban and rural fellowship school experiment." *Economics of Education Review* 22: 265–74.

Ariely, Dan, and Klaus Wertenbroch. 2002. "Procrastination, deadlines, and performance: Self-control by precommitment." *Psychological Science* 13(3): 219–24.

ASER. 2018. *ASER—Tamil Nadu district scores*. ASER Centre. http://img.asercentre.org/docs/ASER%202018/Release%20Material/District%20Estimates/tamilnadudistrictestimates.pdf.

ASER. 2020. *ASER—Trends over time: Tamil Nadu*. ASER Centre. http://img.asercentre.org/docs/ASER%202021/ASER%20TOT%202012-18/tamilnadu.pdf.

Bal, P. K., et al. 2016. "Climate change projections for Tamil Nadu, India: Deriving high-resolution climate data by a downscaling approach using PRECIS." *Theoretical and Applied Climatology* 123: 523–53.

Balaganesh, G., et al. 2020. "Development of composite vulnerability index and district level mapping of climate change induced drought in Tamil Nadu, India." *Ecological Indicators* 113: 106229.

Banerjee, Abhijit, Arun G. Chandrasekhar, Esther Duflo, and Matthew O. Jackson. 2019. "Using gossips to spread information: Theory and evidence from two randomized controlled trials." *Review of Economic Studies* 86(6): 2453–90.

Barnett, Daniel W., et al. 2017. "Built environmental correlates of older adults' total physical activity and walking: A systematic review and meta-analysis." *International Journal of Behavioral Nutrition and Physical Activity* 14: 103.

Becker, Gary S. 1962. "Investment in human capital: A theoretical analysis." *Journal of Political Economy* 70(5, Part 2): 9–49.

Behagel, Luc, Bruno Crépon, Marc Gurgand, and Thomas Le Barbanchon. 2015. "Please call again: Correcting nonresponse bias in treatment effect models." *Review of Economics and Statistics* 97: 1070–80.

Bhat, P. N. Mari, and Shiva S. Halli. 1999. "Demography of brideprice and dowry: Causes and consequences of the Indian marriage squeeze." *Population Studies* 53(2): 129–48.

Blumenstock, Joshua, Gabriel Cadamuro, and Robert On. 2015. "Predicting poverty and wealth from mobile phone metadata." *Science* 350(6264): 1073–76.

Bryan, Gharad, Dean Karlan, and Scott Nelson. 2010. "Commitment devices." *Annual Review of Economics* 2(1): 671–98.

Census of India. 2011. *Census of India*. Government of India. https://censusindia.gov.in/census.website/data/census-tables.

Chaitanya, S. K. 2021. "After eight years, Tamil Nadu set to finalise climate change action plan." *The New Indian Express* (Chennai), September 8.

Chen, Martha. 2020. "COVID-19, cities and urban informal workers: India in comparative perspective." *Indian Journal of Labour Economics* 63(1): 41–46.

Choudhuri, Pallavi, Shantanu Pramanik, and Sonalde Desai. 2020. "Urban challenges of the COVID-19 pandemic." *NCAER National Data Innovation Centre Measurement Brief* 2020-03. https://www.ncaer.org/free-download.php?pID=339.

Clark, Damon, David Gill, Victoria Prowse, and Mark Rush. 2016. "Using goals to motivate college students: Theory and evidence from field experiments." *Review of Economics and Statistics* 102(4): 648–63.

Curtis, Chadwick C., Steven Lugauer, and Nelson C. Mark. 2015. "Demographic patterns and household saving in China." *American Economic Journal: Macroeconomics* 7(2): 58–94.

Das Gupta, Monica, B. R. Desikachari, T. V. Somanathan, and P. Padmanaban. 2009. "How to improve public health systems: Lessons from Tamil Nadu." Policy Research Working Paper 5073. Washington, DC: World Bank.

Deolalikar, Anil. 2024. "Demographic changes in India: Implications for policy." *Indian Politics and Policy* 6(1): 1–15.

Devika, J. 2007. *En-gendering individuals: The language of reforming in early twentieth-century Keralam*. Hyderabad: Orient Longman.

Djankov, Simeon, Dorina P. Georgieva, and Rita Ramalho. 2019. *Business regulations and poverty*. Washington, DC: World Bank.

Dong, L., et al. 2016. "Spatial distribution of China's renewable energy industry: Regional features and implications for a harmonious development future." *Renewable and Sustainable Energy Reviews* 58: 1521–31.

Drommi, M., A. Ponte, F. Ventura, and A. Molinelli. 2021. "Elder abuse in Europe's 'most elderly' city: An update of the phenomenon based on the cases reported to the Penal Court of Genoa from 2015 to 2019 and literature review." *Aging Clinical and Experimental Research* 33(10): 2865–71.

Duflo, Esther. 2001. "Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment." *American Economic Review* 91(4): 795–813.

Duflo, Esther, Abhijit Banerjee, Madeline McKelway, Frank Schilbach, Garima Sharma, and Girija Vaidyanathan. 2023. "Tamil Nadu Aging Panel." *Journal of Economic Perspectives* 37(2): 179–202.

Elavarasan, R. M., et al. 2020. "A comprehensive review on renewable energy development, challenges, and policies of leading Indian states with an international perspective." *IEEE Access* 8: 74432–57.

Estupinan, Xavier, and Mahesh Sharma. 2020. "Job and wage losses in informal sector due to the COVID-19 lockdown measures in India." *SSRN Working Paper* 3680379.

Falk, Armin, and Andrea Ichino. 2006. "Clean evidence on peer effects." *Journal of Labor Economics* 24(1): 39–57.

Federal Government of Germany. 2016. *Climate Action Plan 2050*. Berlin: Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection.

Glewwe, Paul, and Karthik Muralidharan. 2016. "Improving education outcomes in developing countries: Evidence, knowledge gaps, and policy implications." In *Handbook of the Economics of Education*, vol. 5, edited by Eric A. Hanushek, Stephen Machin, and Ludger Woessmann, 653–743. Amsterdam: Elsevier.

Government of Canada. n.d. *Financial planning*. https://www2.gov.bc.ca/gov/content/family-social-supports/seniors/financial-legal-matters/income-security-programs. Accessed June 17, 2022.

Government of India. 2021. *Health care facilities for elderly*. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1777644. Accessed June 17, 2022.

Government of India. 2022. *Programme/scheme-wise cumulative physical progress as on May 2022*. New Delhi: Government of India.

Government of Tamil Nadu. 2019. *Draft Tamil Nadu State Action Plan on Climate Change 2.0*. Chennai: Government of Tamil Nadu.

Government of Tamil Nadu. 2019. *Tamil Nadu Solar Energy Policy*. Chennai: Government of Tamil Nadu.

Government of Tamil Nadu. 2022. *Draft Tamil Nadu State Policy on Senior Citizens—2022*. Chennai: Government of Tamil Nadu.

Government of Tamil Nadu. 2022. *Tamil Nadu Budget 2022–23*. Chennai: Government of Tamil Nadu.

Guven, M. Ümit, Harish Jain, and Christian J. E. Joubert. 2021. *Social protection for the informal economy: Operational lessons for developing countries in Africa and beyond*. Washington, DC: World Bank Group.

Handa, Sudhanshu. 2002. "Raising primary school enrolment in developing countries: The relative importance of supply and demand." *Journal of Development Economics* 69: 103–28.

Hanushek, Eric A., and Caroline M. Hoxby. 2005. "Developing value-added measures for teachers and schools." In *Reforming Education in Arkansas*, 99–104.

Holmes, Alison H., et al. 2016. "Understanding the mechanisms and drivers of antimicrobial resistance." *The Lancet* 387(10014): 176–87.

Holzmann, Robert. 2005. *Old-age income support in the 21st century: An international perspective on pension systems and reform*. Washington, DC: World Bank.

ILO (International Labour Organization). 2020. *ILO Monitor: COVID-19 and the*

world of work—Updated estimates and analysis. Geneva: ILO.

Jaume, David, and Alex Willén. 2019. "The long-run effects of teacher strikes: Evidence from Argentina." *Journal of Labor Economics* 37(4): 1097–1139.

Katz, Michael B., Mark J. Stern, and Jamie J. Fader. 2005. "Women and the paradox of economic inequality in the twentieth century." *Journal of Social History* 39(1): 65–88.

Kaur, Supreet, Michael Kremer, and Sendhil Mullainathan. 2015. "Self-control at work." *Journal of Political Economy* 123(6): 1227–77.

Khan, A. S., et al. 2012. "Predicted impact of sea-level rise at the Vellar–Coleroon estuarine region of the Tamil Nadu coast in India: Mainstreaming adaptation as a coastal zone management option." *Ocean and Coastal Management* 69: 327–39.

Kishor, Sunita. 1994. "Fertility decline in Tamil Nadu, India." In *Understanding reproductive change: Kenya, Tamil Nadu, Punjab, Costa Rica*, edited by Bertil Egerö and Mikael Hammarskjöld, 65–100. Lund: Lund University Press.

Kremer, Michael, Edward Miguel, and Rebecca Thornton. 2009. "Incentives to learn." *Review of Economics and Statistics* 91(3): 437–56.

LASI. 2020. *An investigation of health, economic, and social well-being of India's growing elderly population—Longitudinal Ageing Study in India*. Ministry of Health and Family Welfare, Government of India.

Lee, David S. 2009. "Training, wages, and sample selection: Estimating sharp bounds on treatment effects." *Review of Economic Studies* 76(3): 1071–1102.

Macpherson, David A., and Barry T. Hirsch. 1995. "Wages and gender composition: Why do women's jobs pay less?" *Journal of Labor Economics* 13(3): 426–71.

Madhanagopal, D., and S. Pattanaik. 2020. "Exploring fishermen's local knowledge and perceptions in the face of climate change: The case of coastal Tamil Nadu, India." *Environment, Development and Sustainability* 22: 3461–89.

Spence, Michael. 1973. "Job market signaling." *Quarterly Journal of Economics* 87(3): 355–74.

Millan, Teresa Molina, and Karen Macours. 2017. "Attrition in randomized control trials: Using tracking information to correct bias." *IZA Discussion Paper* 10711.

Ministry of Human Resource Development (MHRD). 2019. *All India Survey on Higher Education (AISHE) 2018–2019*. Department of Higher Education, Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/statistics-new/AISHE%20Final%20Report%202018-19.pdf.

Miralles-Guasch, Carmen, et al. 2019. "Natural landscape, infrastructure, and health:

The physical activity implications of urban green space composition among the elderly." *International Journal of Environmental Research and Public Health* 16(20): 3891.

Municipal Association of Victoria. n.d. *Age-friendly cities and communities*. https://www.mav.asn.au/what-we-do/policy-advocacy/social-community/positive-ageing/age-friendly-cities-and-communities. Accessed June 17, 2022.

Muralidharan, Karthik. 2015. *A new approach to public sector hiring in India for improved service delivery*. La Jolla, CA: UC San Diego.

Muralidharan, Karthik, Venkatesh Sundararaman. 2011. "Teacher performance pay: Experimental evidence from India." *Journal of Political Economy* 119(1): 39–77.

Muralidharan, Karthik, Paul Niehaus, Sandip Sukhtankar, and Jeffrey Weaver. 2018. *Improving last-mile service delivery using phone-based monitoring*. NBER Working Paper 25298.

Muralidharan, Karthik, Abhijeet Singh, and Alejandro J. Ganimian. 2019. "Disrupting education? Experimental evidence on technology-aided instruction in India." *American Economic Review* 109(4): 1426–60.

Murnane, Richard, and Alejandro Ganimian. 2014. "Improving educational outcomes in developing countries: Lessons from rigorous evaluations." NBER Working Paper 20284.

National Commission of Planning. 2011. *Population projections for India and states, 2011–2036*. Ministry of Health and Family Welfare, Government of India. https://main.mohfw.gov.in/sites/default/files/Population%20Projection%20Report%202011-2036%20-%20upload_compressed_0.pdf.

Nagaraj, K. 1999. "Extent and nature of fertility decline in Tamil Nadu." *Review of Development and Change* 4(1): 89–120.

Nagaraj, K. 2000. *Fertility decline in Tamil Nadu: Social capillarity in action?* Chennai: Madras Institute of Development Studies.

Nesamalar, J. J. D., P. Venkatesh, and S. C. Raja. 2017. "The drive of renewable energy in Tamil Nadu: Status, barriers and future prospect." *Renewable and Sustainable Energy Reviews* 73: 115–24.

NFHS-5. 2019. *National Family Health Survey—V: Rajasthan Factsheet*. Ministry of Health and Family Welfare, Government of India. http://rchiips.org/nfhs/NFHS-5_FCTS/Rajasthan.pdf.

NFHS-5. 2022. *NFHS-5 Factsheet—Tamil Nadu*. Ministry of Health and Family Welfare, Government of India. http://rchiips.org/nfhs/NFHS-5_FCTS/Tamil_Nadu.pdf.

NRAA (National Rainfed Area Authority). 2013. *Contingency and compensatory agriculture plans for droughts and floods*. New Delhi: NRAA.

NSS. 2018. *Household consumption on education in India—NSS Report, 75th round*. Ministry of Statistics and Programme Implementation. http://164.100.161.63/sites/default/files/publication_reports/Report_585_75th_round_Education_final_1507_0.pdf.

Padmanaban, P., Parvathy Sankara Raman, and Dileep V. Mavalankar. 2009. "Innovations and challenges in reducing maternal mortality in Tamil Nadu, India." *Journal of Health, Population, and Nutrition* 27(2): 202–19.

Pande, Rohini P., Sophia Namy, and Anju Malhotra. 2020. "The demographic transition and women's economic participation in Tamil Nadu, India: A historical case study." *Feminist Economics* 26(1): 179–207.

Parida, D., R. R. Khan, and K. N. Lavanya. 2022. "Urban built environment and elderly pedestrian accessibility: Insights from South Asia." *SN Social Sciences* 2: 86.

PLFS. 2021. *Periodic Labour Force Survey Annual Report, 2020–2021*. Ministry of Statistics and Programme Implementation, Government of India. https://www.mospi.gov.in/documents/213904/301563//Annual%20Report%20PLFS%202020%20211655184532664.pdf/a2787b2e-254f-3d4f-c796-3032f3c70216.

Pratham. 2018. *Maharashtra Pragat Shaikshanik Programme: Evaluation report*. Mumbai: Pratham.

Press Information Bureau. 2014. *Cases of cancer*. Government of India. https://pib.gov.in/newsite/PrintRelease.aspx?relid=106424.

Racine, Jean-Luc, and Josiane Racine. 1998. "Dalit identities and the dialectics of oppression and emancipation in a changing India: The Tamil case and beyond." *Comparative Studies of South Asia, Africa and the Middle East* 18(1): 5–19.

Rajkumar, R., C. S. Shaijumon, B. Gopakumar, and D. Gopalakrishnan. 2020. "Extreme rainfall and drought events in Tamil Nadu, India." *Climate Research* 82(2): 175–88.

Ramachandran, A., et al. 2017. "Projection of climate change-induced sea-level rise for the coasts of Tamil Nadu and Puducherry, India using SimCLIM: A first step towards planning adaptation policies." *Journal of Coastal Conservation* 21: 731–42.

Ramasundaram, S. 1995. "Causes for the rapid fertility decline in Tamil Nadu: A policy planner's perspective." *Demography India* 24(1): 13–22.

Ravi, Shamika, Neelanjana Gupta, and Prerna Nagaraj. 2019. *Reviving higher education in India*. New Delhi: Brookings India.

Ravindran, T. K. Sundari, and Udaya Shankar Mishra. 2001. "Unmet need for reproductive health in India." *Reproductive Health Matters* 9(18): 105–13.

Ravindran, T. K. Sundari, and P. Balasubramanian. 2004. "'Yes' to abortion but 'No' to sexual rights: The paradoxical reality of married women in rural Tamil Nadu, India." *Reproductive Health Matters* 12(23): 88–99.

Ravindran, T. K. Sundari. 2009. *Health system reform initiatives in Tamil Nadu: Contribution to improvements in sexual and reproductive health services*. Chengalpattu, Tamil Nadu: Rural Women's Social Education Centre.

Rosen, T., L. K. Makaroun, Y. Conwell, and M. Betz. 2020. "Violence in older adults: Scope, impact, challenges, and strategies for prevention." *Health Affairs* 39(10): 1630–37.

Savitri, R. 1994. "Fertility rate decline in Tamil Nadu: Some issues." *Economic and Political Weekly* 29: 1850–52.

Saxena, S., R. Purvaja, G. M. D. Suganya, and R. Ramesh. 2012. "Coastal hazard mapping in the Cuddalore region, South India." *Natural Hazards* 64: 1519–36.

Sheth, A., S. Sanyal, A. Jaiswal, and P. Gandhi. 2006. "Effects of the December 2004 Indian Ocean tsunami on the Indian mainland." *Earthquake Spectra* 22(S3): S435–S473.

Sekhar, K. C., and K. Mansoor. 2020. "COVID-19: Lockdown impact on informal sector in India." *Transport* 33(6): 13–14.

Social Statistics Division. 2021. *Elderly in India 2021*. Ministry of Statistics and Programme Implementation, Government of India. http://www.indiaenvironmentportal.org.in/files/file/Elderly%20in%20India%202021.pdf.

SRS Bulletin. 2019. *Sample Registration System Bulletin*. Registrar General & Census Commissioner, India. https://censusindia.gov.in/census.website/data/SRSSTAT.

Ståhlberg, Ann-Charlotte. 2018. "11 lessons from the Swedish pension system." In *The state and social welfare: The objectives of policy*, edited by D. Wilson and T. Wilson, —. London: Routledge.

Statistics Times. 2021. *Economy of Tamil Nadu*. https://statisticstimes.com/economy/india/tamil-nadu-economy.php.

Theobald, Hildegard, and Monica Luppi. 2018. "Elderly care in changing societies: Concurrences in divergent care regimes—A comparison of Germany, Sweden and Italy." *Current Sociology* 66(4): 629–47.

UDISE. 2021. *UDISE+ report*. Department of School Education and Literacy, Ministry of Education, Government of India. https://udiseplus.gov.in/#/page/publications.

UNESCO. 2021. "Digital literacy for older persons." https://en.unesco.org/news/digital-literacy-older-persons. Accessed June 17, 2022.

Varadan, R. J., and P. Kumar. 2014. "Indigenous knowledge about climate change: Validating the perceptions of dryland farmers in Tamil Nadu." *Indian Journal of Traditional Knowledge* 13(2): 390–97.

Varadan, R. J., and P. Kumar. 2015. "Mapping agricultural vulnerability of Tamil Nadu, India, to climate change: A dynamic approach to take forward the vulnerability assessment methodology." *Climatic Change* 129: 159–81.

Visaria, Leela, Shireen Jejeebhoy, and Tom Merrick. 1999. "From family planning to reproductive health: Challenges facing India." *International Family Planning Perspectives* 25(Supplement): 44–49.

Visaria, Leela. 2000. "From contraceptive targets to informed choice: The Indian experience." In *Women's reproductive health in India*, edited by Radhika Ramasubban and Shireen J. Jejeebhoy, 331–82. Jaipur: Rawat.

Visaria, Leela. 2009. "Fertility transition: Lessons from South India." In *Handbook of population and development in India*, edited by A. K. Shiva Kumar, Pradeep Panda, and Rajani R. Ved, 111–18. New Delhi: Oxford University Press.

Watanabe, S., S. Kodama, and H. Hanabusa. 2018. "Longevity and elderly care: Lessons from Japan." *Global Health Journal* 2(4): 5–10.

WHO. 2019. *Case study: The age-friendly programme in Akita City*. Online.

WMO. 2019. *Coastal flooding forecast strengthened in Indonesia*. Online.

World Bank. 2017. *Tamil Nadu—Poverty, growth and inequality*. Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/380971504177733539/pdf/119267-BRI-P157572-Tamil-Nadu-Poverty.pdf.

World Health Organization (WHO). 2009. *Safer pregnancy in Tamil Nadu: From vision to reality*. New Delhi: WHO.

Zhao, Z. Y., Y. L. Chen, and R. D. Chang. 2016. "How to stimulate renewable energy power generation effectively? China's incentive approaches and lessons." *Renewable Energy* 92: 147–56.