



# MONITORING CHINA'S HUMAN DEVELOPMENT

Assessing economic and social progress, as well as  
environmental costs, across Chinese regions and cities

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## EXECUTIVE SUMMARY

**As China concluded the 14th Five-Year Plan period (2021-2025), comprehensively assessing human development progress, and how it can be sustained, is vital to informing future development priorities.**

As China transitions towards people-centered “high-quality development” as affirmed in the 15th Five-Year Plan (2026-2030), the country faces multiple opportunities and challenges, including shifting growth drivers, demographic changes, regional imbalances, and growing environmental pressures.

**To inform pathways towards sustainable development, this report applies a human development lens to assess progress.** Within this broader framework, it uses the Human Development Index (HDI) and related indicators as practical tools for measurement and comparison.

**Its value addition is twofold.** First, it estimates HDI values not only at the national level, but also at the provincial, and prefectural levels for a more granular map of progress and challenges. Second, this report for the first time introduces estimates for the Planetary Pressures-adjusted Human Development Index (PHDI) at the provincial level, evaluating the balance between human development gains and environmental costs. Building on the country’s historical achievements, the report also examines key constraints and proposes policy recommendations for promoting sustainable human development.

**China was one of the first countries to advance from low to high human development, and is rapidly approaching the threshold of very high human**

**development.** According to UNDP estimates, China’s HDI reached 0.797 in 2023, just shy of 0.800, the lower bound for very high human development.

**Economic growth and educational advancement have been the main drivers of China’s HDI growth over the past decade.** Disposable income per capita also increased from RMB 12,500 to RMB 39,200, with real growth of about 1.4 times. This created the world’s largest middle-income group of over 400 million people.<sup>1</sup> The average years of schooling for citizens aged 25 and above reached 8 years, and gross tertiary enrolment increased from 26.5 percent in 2010, to 60.2 percent. This marks a leap from higher education being accessible to a significant portion of the population, in the direction of universal access. Not least, life expectancy rose steadily from 74.8 years in 2010, to 78.6 years in 2023, surpassing the average for upper-middle-income countries.

**As a vast and populous developing country, China exhibits significant spatial disparities in human development levels.** Building on the 2019 *Special Edition of the China National Human Development Report*<sup>2</sup>, this report updates provincial and prefectural HDI estimates up to 2020, offering an updated detailed and granular picture of development outcomes. The findings indicate overall progress, with upward shifts in development categories and a trend towards narrowing disparities:

- At the provincial level, the vast majority of provinces have reached high levels of human development, and some municipalities, such as Beijing and

Shanghai, have attained HDI levels comparable to those of developed countries.

- At the prefectural level, the number of cities reaching high or very high human development levels also increased significantly, showing a clear trend of diffusion from eastern to central and western regions, and from core cities to surrounding areas.
- Cities with very high human development now account for a population of 442 million, or 31.7 percent of the national total, while cities with high human development account for 916 million people, or 65.7 percent, reflecting a notable expansion in the inclusiveness of development outcomes.
- The Theil index of HDI among prefectures – used as a proxy measure of inequality, continues to decline, indicating a steady reduction in regional development gaps.

**Amid the intertwined challenges of human development and environmental sustainability, this report also introduces the Planetary pressures-adjusted Human Development Index (PHDI) at the provincial level in China for the first time.** The PHDI systematically quantifies the “deduction effect” of environmental costs on human development. By incorporating two key indicators—carbon emissions and material footprint per capita, the index adjusts HDI scores to reflect planetary pressures exerted by development. Key findings are as follows:

- Based on 2015 data, high material footprints are observed not only in developed coastal provinces, but also in western provinces, where infrastructure investment has grown rapidly.

- While regional policies have effectively improved development foundations, they have also led to rising pressures on resources and energy, with some regions incurring significant environmental costs.
- Unlike the east-west disparities highlighted by the HDI, the PHDI reveals a more evident north-south divide. Northern provinces have experienced faster growth in material footprint and carbon emissions, leading to widespread declines in their PHDI rankings. In some areas, the gap between HDI and PHDI rankings exceeds ten places.
- Global comparisons show that Beijing and Shanghai already outperform some high-income countries in resource efficiency, while northern provinces reliant on resource-intensive industries continue to incur a substantial “development discount.”

**Following from the data analysis, the report identifies five structural challenges to sustainable human development in China:**

- Slowing economic growth may constrain further improvements in human development. Tightened global conditions, weak domestic consumption, and mounting pressure to improve productivity all play a role generating a more subdued outlook than in the past.
- Educational attainment remains a key shortfall. Compared with developed countries, China still lags in average and expected years of schooling, as well as in public education spending.
- Regional disparities in human development remain relatively high. Absolute differences across regions persist, while intra-provincial gaps, especially within

1. The data point on mean years of schooling is sourced from UNDP (2025); all other data are from the National Bureau of Statistics of China.

2. UNDP (2019). *Special Edition of the China National Human Development Report*, available at <https://hdr.undp.org/content/national-human-development-report-2019-china>

the western region, are also notable. Some eastern provinces are also showing increasing divergence across prefectures.

- Imbalances remain across different human development dimensions. Although significant progress has been made in health, education, and income, development across these areas is still uneven. In many cases, regional disparities are increasingly manifested as economic development gaps.
- Environmental pressures are structural, deep-rooted, and long-term. Problems such as inefficient and extensive energy use, low resource efficiency, groundwater pollution and serious waste have yet to be fully resolved.

To address these challenges and accelerate advancement towards comprehensive very high human development, aligned with the Government's vision of "high-quality" development and socio-economic and environment commitments, the report proposes five policy recommendations to advance sustainable human development:

- Anchor progress in healthy life expectancy and continue improving population-wide health outcomes. For example, by strengthening long-term care and health insurance systems.
- Expand years of schooling and enhance workers' adaptive skills, such as promoting 12-years' compulsory education and universalizing higher education.
- Focus on improving income distribution and sustaining household income growth. For instance, by advancing direct taxation reforms and diversifying household income sources.
- Optimize regional development policies to reduce disparities in human development across regions,

such as increasing transfer payments to areas depleted by outbound migration, along with resource-dependent regions.

- Foster a greener, more inclusive, and more sustainable environment. For example, by promoting the circular economy and strengthening ecological compensation, as well as carbon market mechanisms.

## CHAPTER 1

## INTRODUCTION

### 01 BACKGROUND

**In the thirty years after the Human Development Index (HDI) was introduced in 1990, both China and the world saw steady progress on the indices it tracks.**

**Globally, human development has achieved new heights, at 0.756 in 2023.** At the same time, progress has weakened, following the lingering impact of COVID-19 and slower economic advancements thereafter. Based on pre-pandemic trends, the world as a whole would have reached a very high level of human development by 2030. Amid current trends, this is likely to be delayed by decades.<sup>3</sup>

**China is one of five countries that moved from the low to high HDI category.** In 2023, China's HDI rose to 0.797 from 0.710 in 2010, recording substantial advancements across the human development indicators. This was especially pronounced in improving living standards, health, and education (see Table 2.1). China's progress is closely linked to the government's people-centered vision of development and associated policies. This includes the aim announced in 2012 of achieving a moderately prosperous society by 2020, as well as measures under the country's targeted poverty alleviation campaign to eliminate extreme rural poverty by the same year.<sup>4</sup> Furthermore, the government also introduced a series of strategic

plans to reduce disparities between urban and rural areas. These included its rural revitalization strategy, aiming at advancing sustainable growth and reducing regional divergences.<sup>5</sup>

**However, China's past growth model – relying on investment and manufacturing powered by fossil-fuels to drive economic activity – has also come at a cost.** In 2010, China's GDP surpassed Japan's in nominal terms, accounting for 8.5 percent of the global total and making China the world's second-largest economy. By 2023, China's share of global GDP had doubled to 17 percent.<sup>6</sup> Its rapid growth made China an economic superpower, but also the world's biggest emitters of greenhouse gases, accounting for 30 percent of global emissions.<sup>7</sup> The significant environmental costs and their impact on socio-economic conditions prompted a policy shift towards green development. This is exemplified by China's dual carbon targets and increasing focus on building an "ecological civilization".<sup>8</sup>

**Overcoming the environmental costs of human activities is not a China-specific challenge, but one that developed countries have – and continue to – experienced before, and that developing countries pursuing prosperity face now.** To assess such impacts, the 2020 Human Development Report proposed a

3. UNDP (2025). Human Development Report 2025. United Nations Development Programme. Available at: <https://hdr.undp.org/content/human-development-report-2025>

4. At the time, the poverty line was a per person annual income of CNY 2,300 at 2010 prices.

5. For a detailed overview of best practices adopted to align China's rural development with the 2030 Agenda for Sustainable Development, see <https://www.undp.org/china/publications/rural-revitalization-china>

6. Calculated from the World Bank's World Development Indicators.

7. United Nations Environment Programme (2024) Emissions Gap Report 2024. United Nations Environment Programme <https://www.unep.org/resources/emissions-gap-report-2024>

8. "Ecological civilization" is a Chinese concept that envisions harmonizing economic development with environmental protection, aiming to build a society where human activity and nature coexist in harmony. It promotes green production, sustainable lifestyles, and systemic reforms to achieve long-term ecological balance.

new measure of human development: the Planetary pressures-adjusted Human Development Index (PHDI).<sup>9</sup> This accounts for humanity's impact on the environment, and how this constrains human development. The global PHDI was 0.680 in 2023, 10.05 percent below the unadjusted HDI value. The average loss in very high human development countries is actually larger, at 18.9 percent. This drags 55 countries and territories

out of 62 countries with available data out of the 'very high' HDI category, reflecting negative consequences of overreliance on fossil fuels and natural resources for human development.<sup>10</sup> Amid this context, the United Nations Development Programme (UNDP) and Tsinghua University have jointly produced this report further exploring human development in China.

## 02 RESEARCH OBJECTIVE AND SCOPE

**This study features two main innovations:**

**1) HDI values for prefecture-level administrations,** providing a more granular, and rich view of human development progress in China.<sup>11</sup> This draws on a new dataset published by Gong et al. (2025)<sup>12</sup> building on data from the 2020 National Census and other sources to calculate HDI values for 335 administrative jurisdictions of prefecture level or higher, in 2010 to 2020. The dataset includes HDI for 291 prefectural cities and 40 regions, leagues and autonomous prefectures, along with four directly-administered municipalities, i.e., Beijing, Chongqing, Shanghai, and Tianjin.

**2) For the first time, provincial-level PHDI values are also estimated,** revealing how China's development landscape changes when carbon emissions and material footprints are taken into account. PHDI exposes losses to wellbeing caused by environmental pressures, allowing policymakers to take a more comprehensive view of how climate change affects

human development. China's provinces differ hugely in their resource endowments, energy mix, and economic structures. An overall assessment of environmental and social measures at the provincial level aims to help policymakers designing fairer development strategies, ensuring China enjoys more balanced and coordinated growth.

**The report is structured as follows: Chapter 2** discusses China's human development advances since 2010 at the national, provincial and prefectural-city level, summarizing progress on a regional and sectoral basis. **Chapter 3** delves into the interdependence between human development and the environment, presenting provincial-level PHDI values. **Chapters 4** follows on from the preceding analysis to identify key challenges China faces in further advancing human development and an "ecological civilization". **Chapter 5** concludes with targeted recommendations for achieving sustainable development throughout the country.

## CHAPTER 2

## TRENDS IN CHINA'S HUMAN DEVELOPMENT AT THE NATIONAL, PROVINCIAL AND PREFECTURAL-CITY LEVELS

### 01 CHINA'S NATIONAL HDI

**China is rapidly approaching the very high HDI range, defined at 0.800 and above.**

**China was among the first countries to move from a low HDI value to the high tier.** Figure 2.1 shows China's HDI value from 1990 to 2023, as well as the three indicators that comprise the overall index.<sup>13</sup> In 1990, China's HDI value was only 0.491, ranking 106th among the 141 economies measured, placing it in the bottom 30 percent. By 1996, its HDI value had risen to 0.555, entering the medium HDI grouping; in 2009, with an HDI value of 0.7, it joined the high HDI grouping.

**China was also one of a small number of countries that saw HDI increases even during COVID-19.** Global HDI fell from 0.745 in 2019 to 0.742 in 2020 and held steady at that level in 2021, before finally surpassing its pre-pandemic peak in 2022. However, 67 of 193 economies saw HDI values rise between 2019 and 2021. China's increase, of 0.013, was the third-largest rise. The very high HDI group, in comparison, saw HDI fall collectively by 0.006 on average; the high HDI group saw an increase of 0.001.

**In 2023, China's HDI climbed to 0.797,** ranking 78th of the 193 economies measured, in the top 40

percent overall and 4<sup>th</sup> of the 50 countries in the high HDI grouping. The latest HDI readings reflect global trends, with Chinese HDI increasing at a slower pace compared to the past, and in 2023 at a pace lower than the average recorded by countries in the high human development category. The recent weaker performance may also be attributed to data availability and statistics methods. These resulted in no contribution to the last two year's headline index by the education sub-index, and a negative contribution of the life expectancy sub-index (see Figure 2.3).<sup>14</sup>

**For more than a decade, China has seen large improvements in all HDI components - life expectancy, average and expected years of schooling, along with GNI per capita.** As Table 2.1 shows, life expectancy grew by 2.3 years from 2010 to 2023, or from 55th place globally to 52nd. Mean years of schooling completed for those aged 25 or above rose by 0.9 years; expected years of schooling rose by 2.5 years. Combined, this elevated China's ranking on the educational index from 116th, to 104th.<sup>15</sup> GNI per capita, meanwhile, doubled, boosting China's ranking from 109th, to 71st.

9. UNDP (2020). *Human Development Report 2020: The Next Frontier – Human Development and the Anthropocene*. United Nations Development Programme. Available at: <https://hdr.undp.org/content/human-development-report-2020>

10. UNDP (2025). *Human Development Report 2025*. United Nations Development Programme. Available at: <https://hdr.undp.org/content/human-development-report-2025>

11. It is important to note that this assessment is based on geographic regions and reflects only the average human development level within each area. It does not distinguish between urban and rural populations within a region.

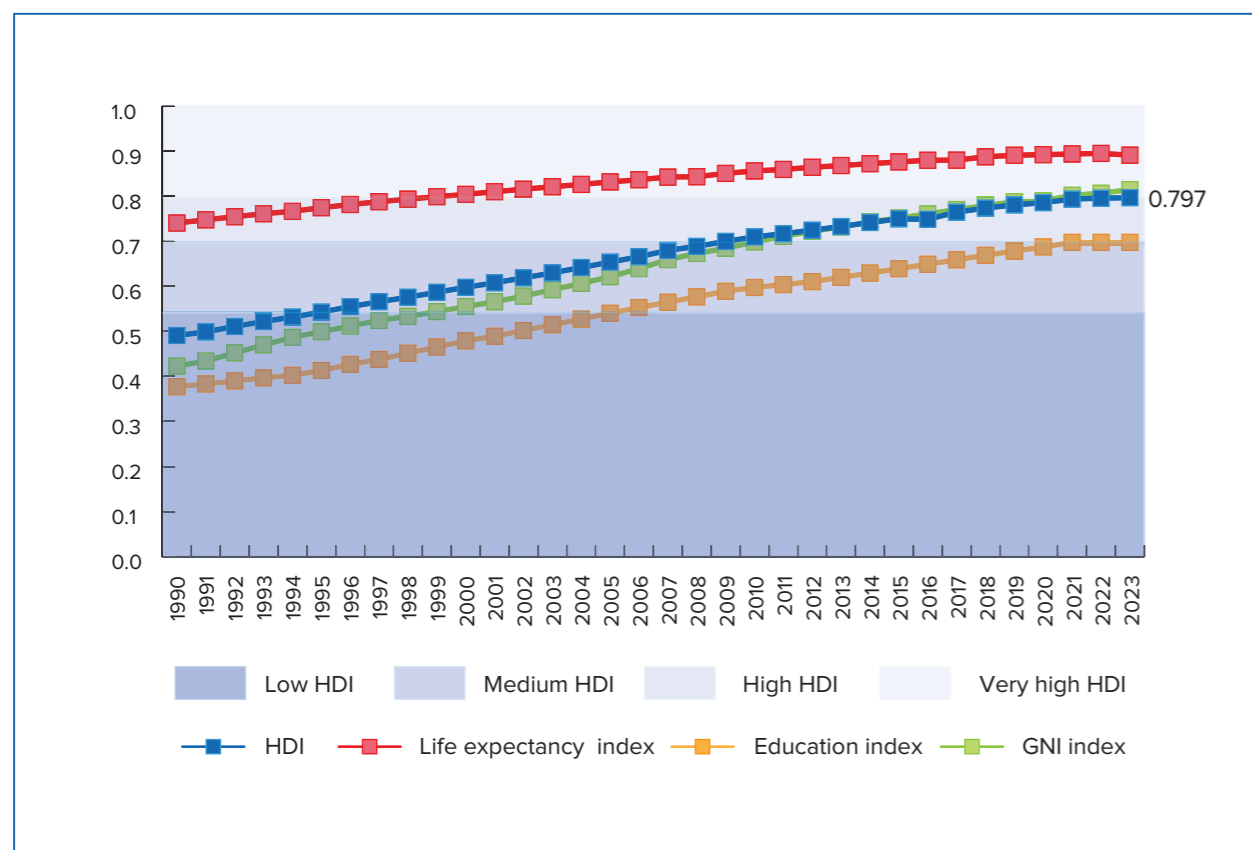
12. Gong, P., Zhu, S., Jiang, M. et al. (2025). A new dataset of province- and prefecture-level human development index in China. *Scientific Data*, 12, 1453. <https://doi.org/10.1038/s41597-025-05745-8>

13. Changes in methodology, threshold values and data sources mean historical HDI values may be revised. This report refers to the UNDP's 2025 Human Development Report dataset. Following the convention of the UNDP's human development reports, values for China do not include data for Hong Kong, Special Administrative Region of China, Macao, Special Administrative Region of China or Taiwan, Province of China.

14. Statistical limitations concerning HDI calculation are as following: (1) Due to data availability, the 2025 Human Development Report makes the conservative assumption that the education index remains unchanged from 2021 through 2023, possibly underestimating its contribution to the headline HDI. (2) Life expectancy data used for the calculation of the indices are from the UNDESA/World Population Prospects. These record a fall in 2023 compared to 2022, reflected in the negative contribution of the life expectancy index to the overall HDI (Figure 2.3). The UNDESA data, however, are inconsistent with national sources. According to the China's National Health Commission, life expectancy in 2023 was higher than in 2022, possibly further underestimating the level of China's HDI in 2023.

15. Yang, Y., & Gong, P. (2025). *Assessing China's Human Development: Pathways to a Sustainable Future*. Science Press. Beijing. [2025-02-18]

Figure 2.1 China's HDI values and sub-indicators, 1990–2023



Data: UNDP (2025).

Table 2.1 Comparison of China and the high and very high HDI groupings

GROUP	CHINA		HIGH HDI		VERY HIGH HDI	
	2010	2023	2010	2023	2010	2023
LIFE EXPECTANCY (YEARS)	75.7	78.0	73.5	75.7	78.0	80.0
MEAN YEARS OF SCHOOLING (YEARS)	7.1	8.0	7.5	8.7	11.8	12.5
EXPECTED YEARS OF SCHOOLING (YEARS)	13.0	15.5	13.1	14.6	15.7	16.4
GNI PER CAPITA (CONSTANT 2021 PPP USD)	10,233	22,029	11,702	18,405	44,042	53,014

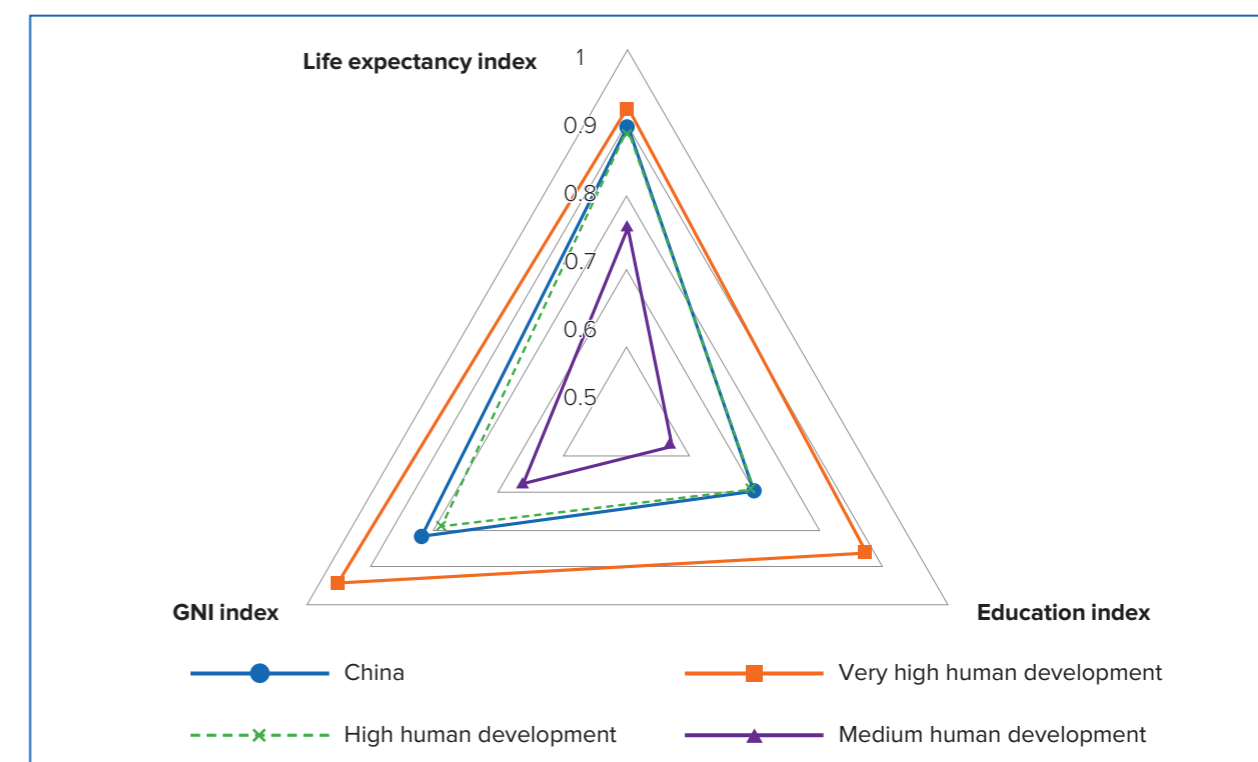
Data: UNDP (2025).

As Figure 2.2 shows, China's score on life expectancy (at 0.892) is the highest of three components for the overall HDI, higher than the average for the high HDI grouping (0.857) and approaching the very high grouping average (0.923). In contrast, China's per capita GNI score (0.815) remains closer to the average of the high HDI grouping (0.788) than the average for the very high grouping (0.948). The educational index, at 0.698, is again slightly higher than the high HDI grouping (0.695), and records the largest difference (0.174 points) versus the average for very high group (0.872).

**The main drivers of China's steadily increasing HDI values over the past decade have been economic growth and educational improvements.** The GNI per capita index saw the biggest increase, raising

from 0.699 in 2010 to 0.815 in 2023, up 0.116 points. Next came the educational index, climbing from 0.598 to 0.698 over the same period, up 0.1 points.<sup>16</sup> Life expectancy rose by 0.036 points, from 0.856 to 0.892. In terms of contributions, educational index contributed 44 percent to HDI growth on average between 2010 and 2023, followed by the GNI index at 44 percent. Life expectancy contributed the least, 12 percent on average. At the same time, the contribution of income growth to future HDI gains is likely to diminish, not only because overall economic growth is slowing, but also because the GNI per capita is entered in the index's calculation in logarithmic form. This ensures that increases at high income levels have smaller effects, in line with the idea that income contributes to human development at a decreasing rate.

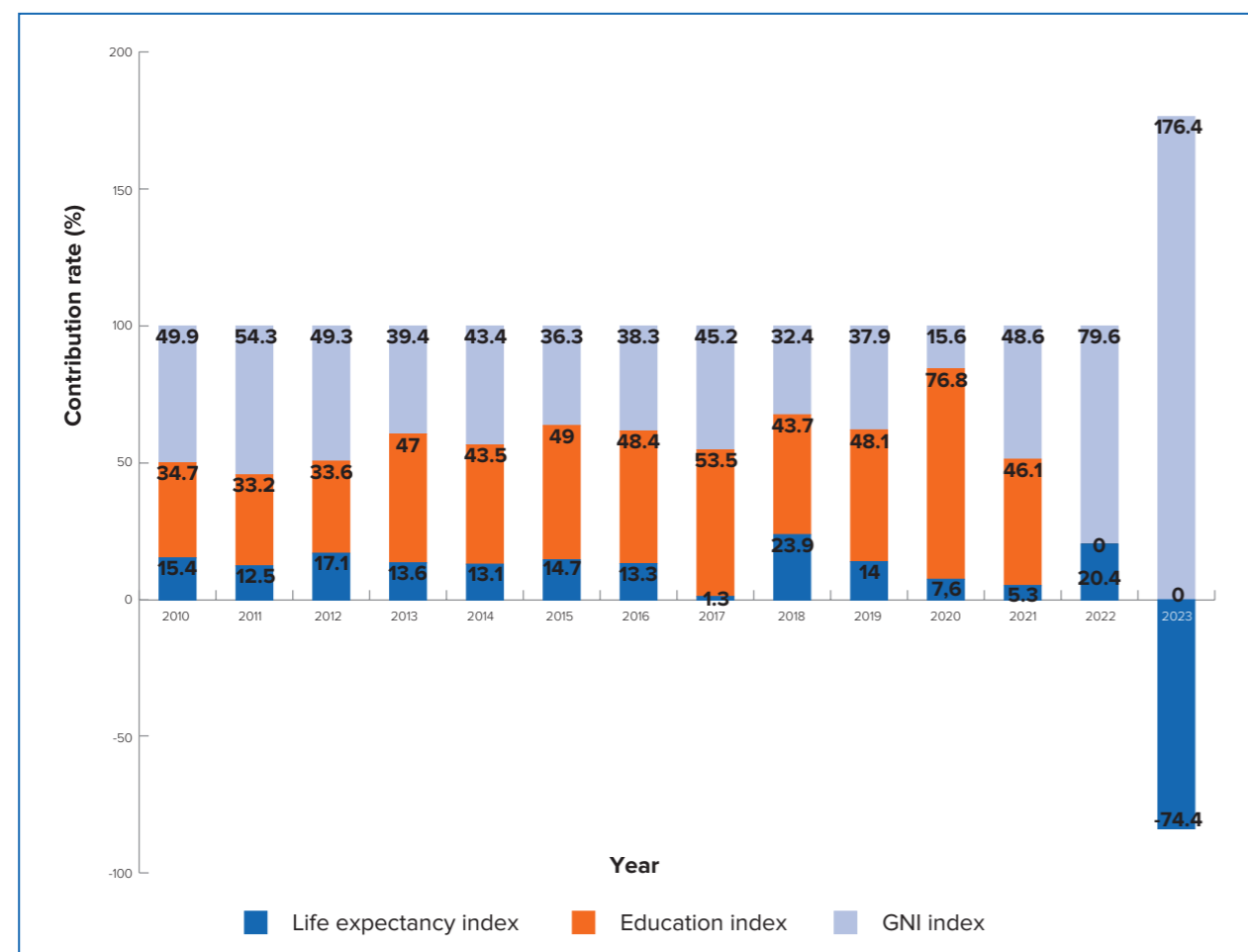
Figure 2.2 Comparison of HDI three component indices for China and grouping averages (2023)



Data: UNDP (2025).

16. In the 2025 dataset, HDRO assumes no change in the estimated years of schooling between 2021 and 2023; as a result, the education index remains the same over this period.

Figure 2.3 Changes in contributions to HDI increases (2010–2023)



Data: UNDP (2025). Note: In UNDP (2025) calculations, educational indices were kept unchanged between 2021 and 2023, implying no contribution to the headline index.

## 02 CHINA'S SUB-NATIONAL HDIS

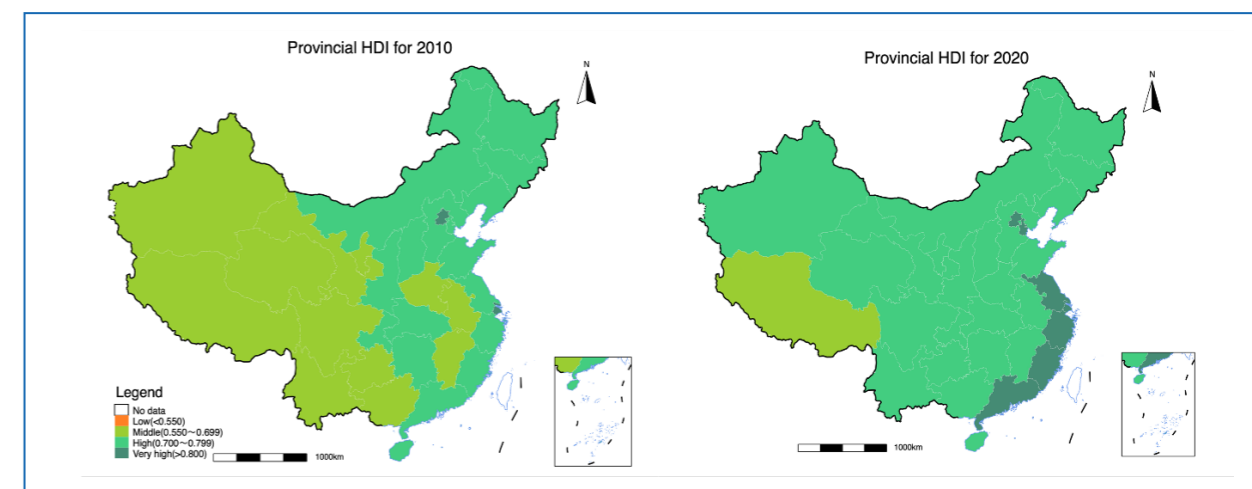
### A. Provincial-level human development

China is a vast country with a huge population, and progress on human development differs considerably across its provincial-level administrations (provinces, autonomous regions, and the four directly administered municipalities). These differences are clearly depicted in Figure 2.4.

By 2020<sup>17</sup>, most provinces reached a high level of human development, while some already surpassed the very high human development threshold. In 2010 only Beijing and Shanghai had very high HDI values. Seventeen provincial-level administrations fell into the high grouping and twelve into the medium grouping. By 2020, 11 of those in the medium group had risen to the high HDI group, leaving only Tibet,

17. The sub-national analysis in this report spans 2010 to 2020, given data availability.

Figure 2.4 Provincial HDI values across China, 2010 vs 2020



Data: Gong et al (2025)

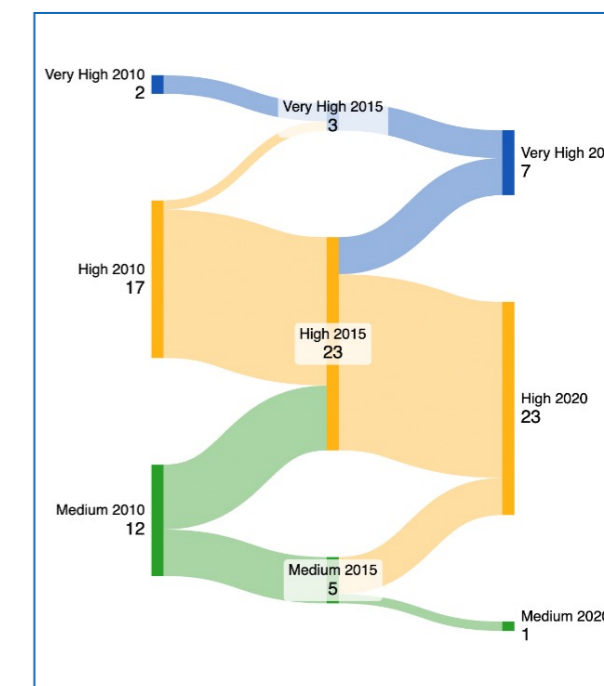
Note: No data is available for Hong Kong (SAR, China), Macau (SAR, China) and Taiwan (Province of China).

though its HDI of 0.699 puts it very close to the higher tier. As of 2020, seven provincial-level administrations were in the very high HDI category, mainly on China's economically developed eastern coast.

Compared with major countries and regions around the world, all Chinese provinces—except Tibet, Gansu, Guizhou, Qinghai, and Yunnan, have HDI values higher than the global average and some are on par with developed nations. Figure 2.6 compares China's very high HDI provinces against a selection of global points of reference. In 2020, Beijing and Shanghai had China's highest HDI values, at levels between countries such as Greece and Poland (ranked 33rd and 37th globally, respectively). Tianjin and Jiangsu were found between Oman (49th) and Bulgaria (58th), with Zhejiang, Guangdong and Fujian below Russia (62nd), but above Barbados (67th).

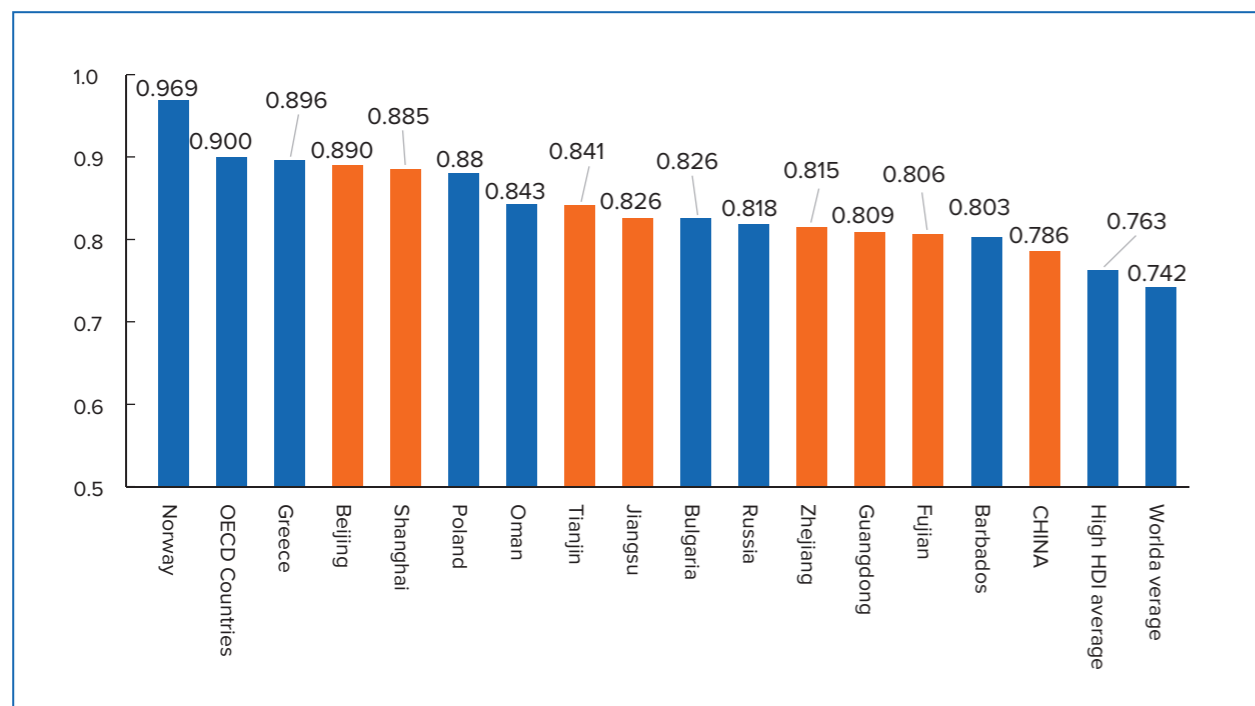
Figure 2.7 compares provinces with an HDI between 0.7 and 0.8 against a selection of international benchmarks. HDI values for Hubei, Shandong, Liaoning, Chongqing, Shaanxi, Inner Mongolia, and Jilin sit between Thailand

Figure 2.5 Changes in provincial HDI groupings over time



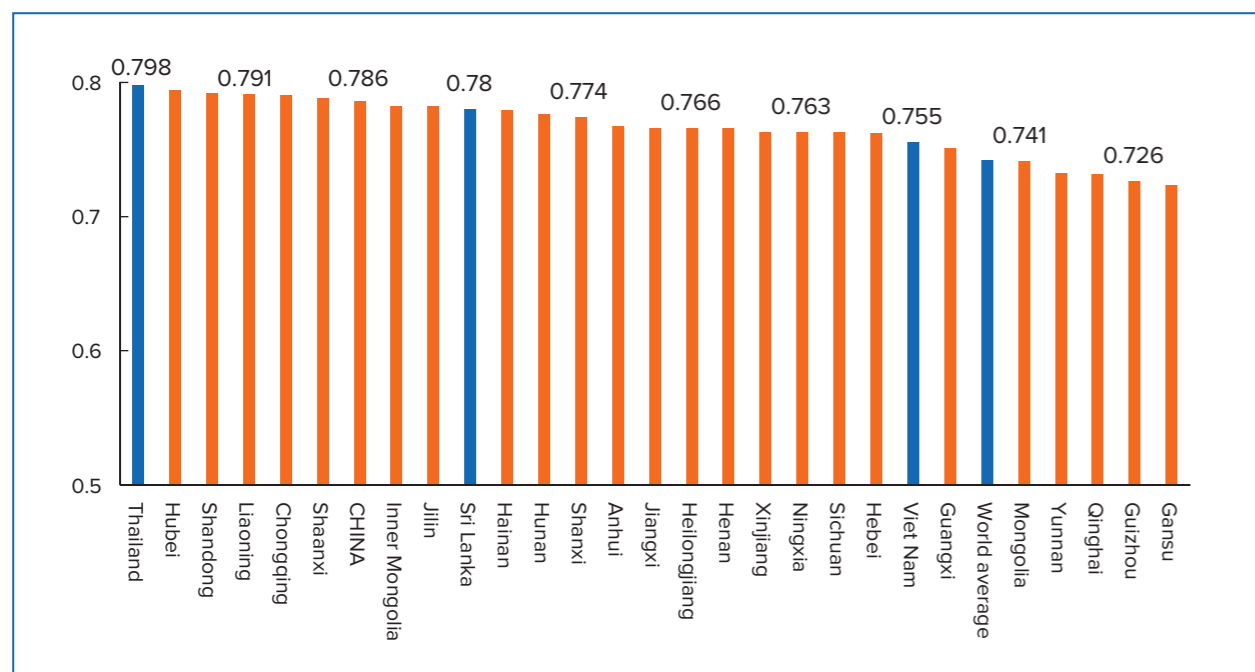
Data: Gong et al (2025). Note: An HDI value of 0.800 or over is considered very high; 0.700 to 0.799 high, 0.550 to 0.699 medium and under 0.550 low.

**Figure 2.6 Comparison of 2020 HDI values for Chinese provinces and global points of reference (HDI > 0.800)**



Data: Gong et al. (2025), UNDP (2025).

**Figure 2.7 Comparison of 2020 HDI values for Chinese provinces and global points of reference (0.700<HDI<0.800)**



Data: Gong et al. (2025), UNDP (2025).

(70th) and Sri Lanka (80th). Hainan, Hunan, Shanxi, Anhui, Jiangxi, Heilongjiang, Henan, Xinjiang, Ningxia, Sichuan and Hebei are above countries like Viet Nam (92nd). Guangxi's HDI value is slightly above the global average HDI, while Yunnan, Qinghai, Guizhou and Gansu were slightly below it. Tibet, the only province in the medium human development group as of 2020, had an HDI comparable to that of the Philippines (119th).

**B. China's Prefectural-city level HDIs**

For a richer, more nuanced picture of human development trends, we also examined prefectural-level data, zooming-in beyond the provincial level analysis in section A.

Since 2010, a growing number of cities have reached high, or very high, levels of human development.

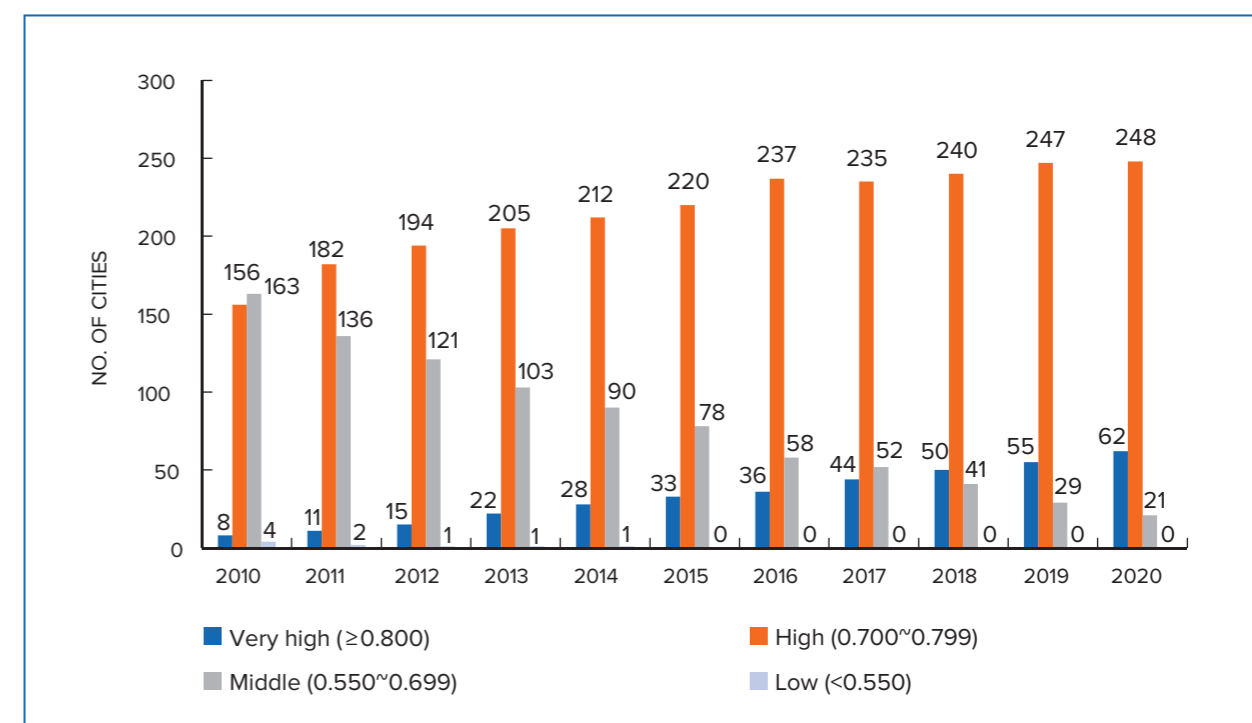
Figure 2.8 shows how HDI levels in 331 prefectural

cities<sup>18</sup> have changed from 2010 to 2020. The number of prefectural cities with a very high HDI value rose from eight to 62. The high grouping expanded from 156 to 248, while the medium grouping shrank from 163 to 21. In 2010, only four (Naqu and Changdu in Tibet, Yushu and Guoluo in Qinghai) fell into the low HDI group (HDI<0.550), while all entered the medium HDI group by 2015.

Higher levels of human development have extended from east to west, and from historically more advanced cities to peripheral ones, as shown in Figure 2.9.

In 2010, prefectural cities with very high HDI values were concentrated in the Pearl and Yangtze deltas. Across the Pearl River Delta, Shenzhen (0.838), Zhuhai (0.816), and Guangzhou (0.807) led the rankings.

**Figure 2.8 Changes in HDI grouping for prefectural cities**



Data: Gong et al. (2025)

18. This section, unless specified, excludes the four directly administered municipalities (Beijing, Shanghai, Tianjin and Chongqing), as considered provincial level administrations and thus included in the analysis in Section 2.A.

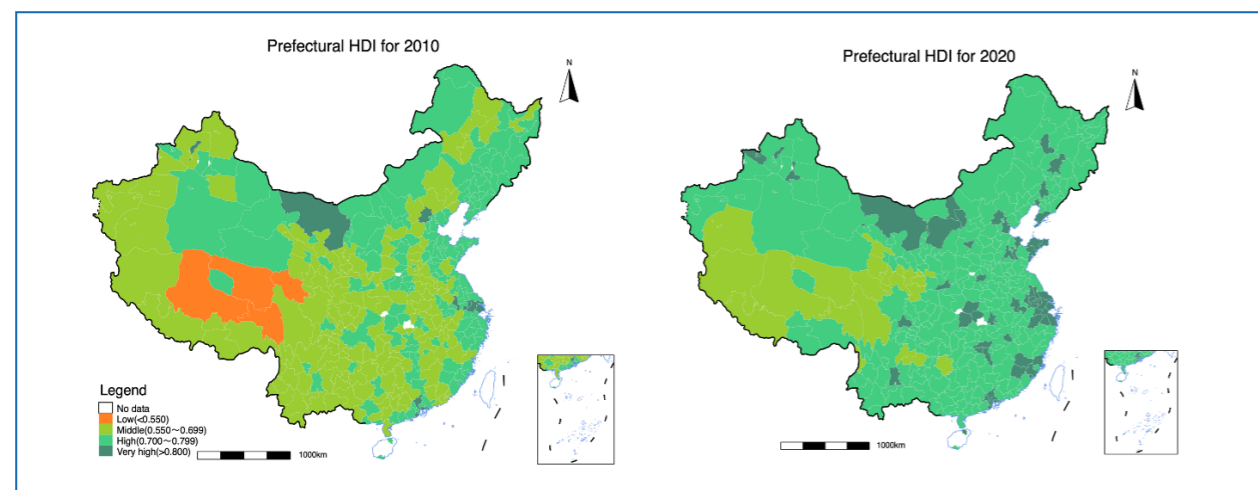
Along the Yangtze River Delta, Suzhou (0.809), Wuxi (0.802), and Nanjing (0.801) stood out. Those two areas were among the vanguard of China's reform and opening-up, building solid economies, as well as robust public services and infrastructure. Consequently, they recorded among the highest levels of education and life expectancy in China. Other prefectural cities that recorded very high level HDIs located in the northwest - Karamy in Xinjiang (0.810) and Alashan League in Inner Mongolia (0.808) - did so with strong economic performance based on their areas' richness in minerals or oil. Higher GDP (the two locations named were among the top three prefectural cities in terms of GDP in 2010) resulted in higher HDIs.

By 2020, the 54 additional prefectural cities that joined the very high grouping were mostly on the eastern coast. Examples include Hangzhou (0.860), Changzhou (0.858), Xiamen (0.845), and Qingdao (0.844). Some provincial capitals and regional central cities in

western and central China also joined the very high group, including Wuhan (0.860), Zhengzhou (0.832), Xi'an (0.826), and Yichang (0.827). Meanwhile, many surrounding those regional central cities successfully moved from medium to high HDI values.

**A significant number of people benefitted from China's development progress.** In 2020, the population living in areas covered by the 331 prefectural-level administrations and the four directly-administered municipalities recording very high HDI values amounted to 442 million, 31.9 percent of the total — up 25 percentage points from 2010. The high HDI grouping covered a population of 916 million, 65.5 percent of the total, rising 17 percentage points over the same period. In total, regions reaching high and very high levels of HDI in China covered 1.35 billion people,<sup>19</sup> or 30 percent of the world's population in those groups, contributing significantly to global development.<sup>20</sup>

Figure 2.9 Prefectural-level HDI values across China, 2010 vs 2020

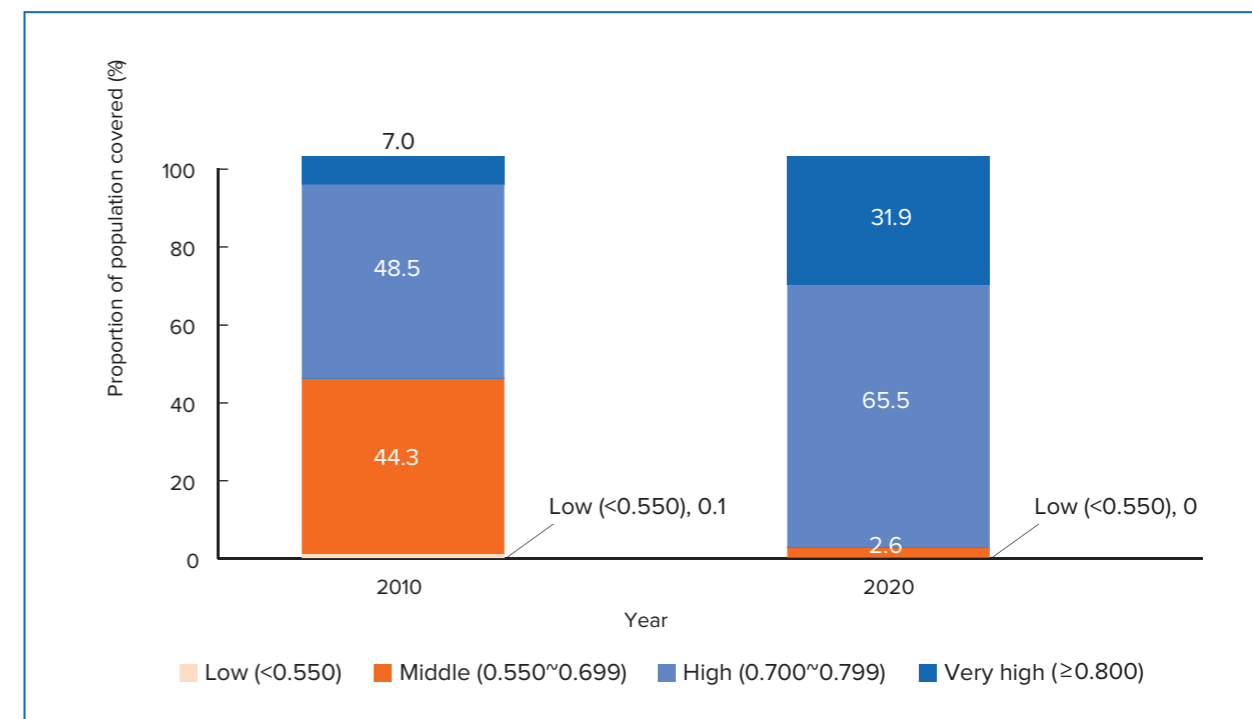


Data: Gong et al (2025). Note: This includes areas covered by the 331 prefectural-level cities and the four directly administered municipalities. No data is shown for Hong Kong (SAR, China), Macau (SAR, China) and Taiwan (Province of China), or for some regions directly administered by a provincial government.

19. The fact that more than 90% of China's population lives in areas classified as having – on average, high or very high HDI is largely due to generally strong performance in health and education—especially in health. Taking a narrower definition of wellbeing based solely on monetary indicators, i.e., GNI per capita, vulnerabilities are higher. As of 2021, for example, 21% of the population lives below the \$8.30/day World Bank's poverty threshold for upper-middle-income countries. Data accessed in July 2025: <https://data.worldbank.org/indicator/SI.POV.UMIC?locations=CN>

20. According to the UNDP, countries and regions at the high HDI level cover a population of 1.63 billion, while countries and regions at the very high HDI level cover a population of 2.73 billion.

Figure 2.10 Percentage of China's population in each HDI grouping



Data: Gong et al (2025).

**The human development gap between prefectural cities is narrowing, both nationally and within regions.** Specifically:

- Since 2010, the Theil index<sup>21</sup> for China's 335 prefectural cities (331 prefectural-level administrations and four directly administered municipalities) gradually reduced, indicating that differences in HDI values are narrowing as development levels even out.
- Disparities in human development levels are narrowing within regions.<sup>22</sup> Gaps within the eastern, central and northeastern regions are all smaller

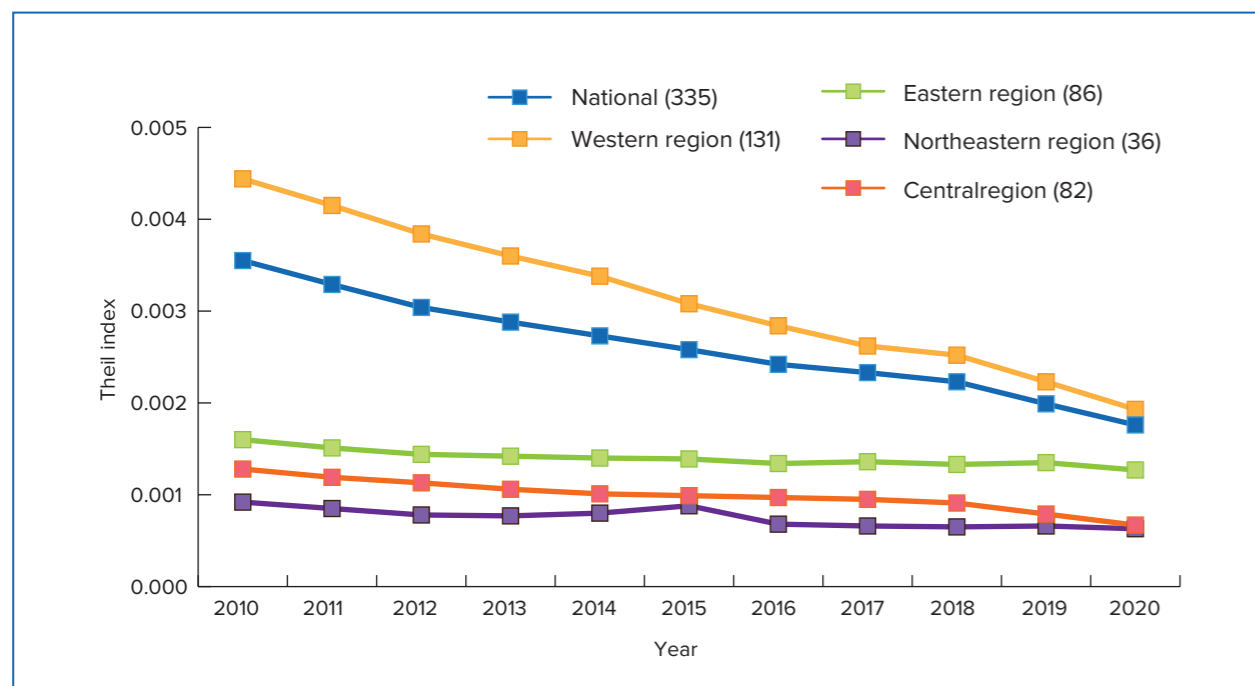
than the national average and remain stable. Western China has the biggest intra-regional gap, but that gap is closing faster than elsewhere.

- When looking at the three component indices of the HDI, gaps between prefectural cities on life expectancy, education, and GNI per capita (as measured by Theil Index) have shrunk by varying degrees since 2010, with per capita GNI gaps closing the most.

21. The Theil index is a statistic primarily used to measure inequality, with 0 reflecting perfect equality and higher values greater level of inequality.

22. The National Bureau of Statistics divides China into four regions. Eastern China covers: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan. Central China covers: Shanxi, Anhui, Henan, Hubei and Hunan. Western China covers: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang. Northeastern China covers: Liaoning, Jilin and Heilongjiang. This report covers 86 prefectural cities in central China, 82 in eastern China, 131 in western China, and 36 in northeastern China.

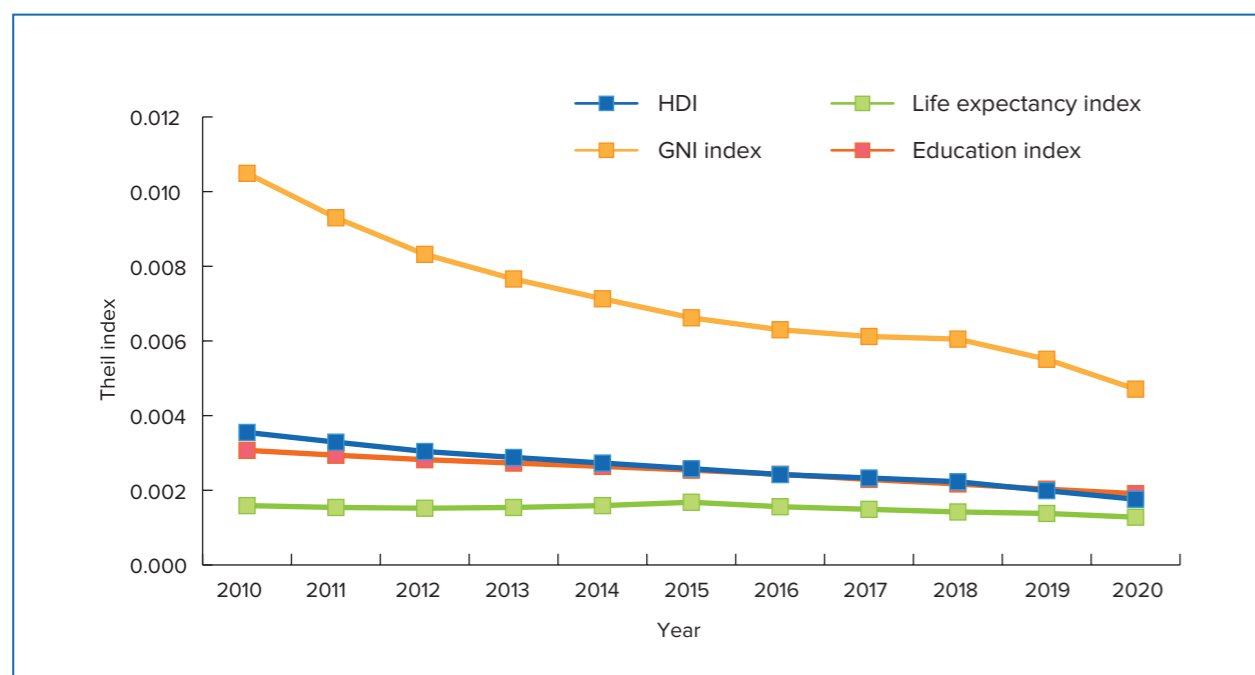
Figure 2.11 National and regional Theil index figures (2010–2020)



Data: Yang and Gong (2025).

Note: Sample of 331 prefectural-level administrations and four directly administered municipalities, same below. Bracketed figures are the number of cities in each region.

Figure 2.12 Theil index for prefectural cities on life expectancy, education and income (2010–2020)



Data: Yang and Gong (2025).

**C. Spotlighting the more vulnerable: Significant human development progress has been recorded in formerly poor areas**

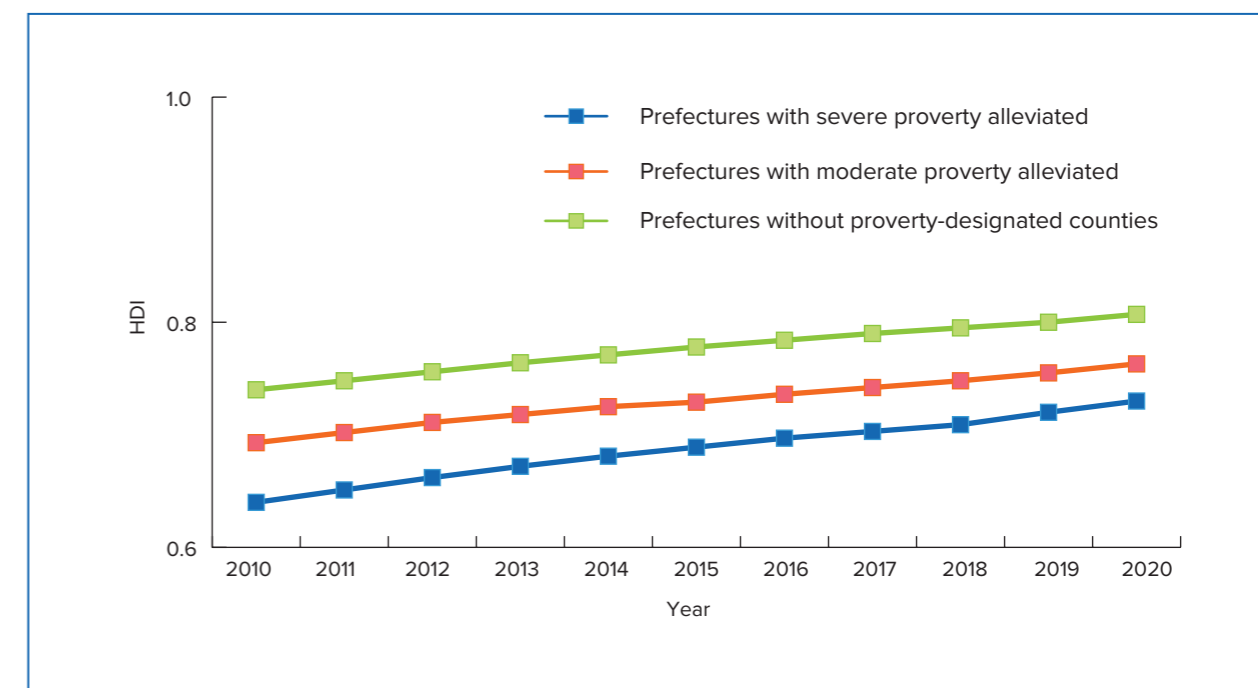
**In this section, the analysis focuses on areas that have been affected by extreme poverty until recently.**

Since 1979, China has lifted 770 million people out of extreme rural poverty,<sup>23</sup> significantly contributing to global efforts to eradicating poverty. By the end of 2020, 832 poverty-stricken counties were removed from the poverty list. To enhance our understanding of development progress in these areas - beyond the narrower definition of extreme rural poverty levels, we looked at prefectural cities with jurisdiction over counties formerly on the poverty list as “formerly poor prefectural cities.” This is because calculating HDI values for county-level administrations is not yet feasible. The 832 poverty-stricken counties fell under

the jurisdiction of 169 prefectural cities. Based on the proportion of poor counties within their jurisdictions, China’s 331 prefectural cities are categorized into three groups<sup>24</sup>:

- (i) Prefectures with severe poverty alleviated: Prefecture-level cities in which formerly designated poverty counties accounted for more than half of all county-level jurisdictions (81 in total);
- (ii) Prefectures with moderate poverty alleviated: those in which such counties made up less than half (88 in total);
- (iii) Prefecture-level cities that have never administered a designated poverty county (162 in total).

Figure 2.13 HDI values for formerly poor prefectural cities and other cities (2010–2020)



23. Lifting 800 Million People Out of Poverty – New Report Looks at Lessons from China’s Experience <https://www.worldbank.org/en/news/press-release/2022/04/01/lifting-800-million-people-out-of-poverty-new-report-looks-at-lessons-from-china-s-experience>

24. For example, the Enshi Tujia and Miao Autonomous Prefecture in Hubei had jurisdiction over two county-level cities and six counties designated as poor.

Figure 2.14 GNI scores for formerly poor prefectural cities and other cities (2010–2020)

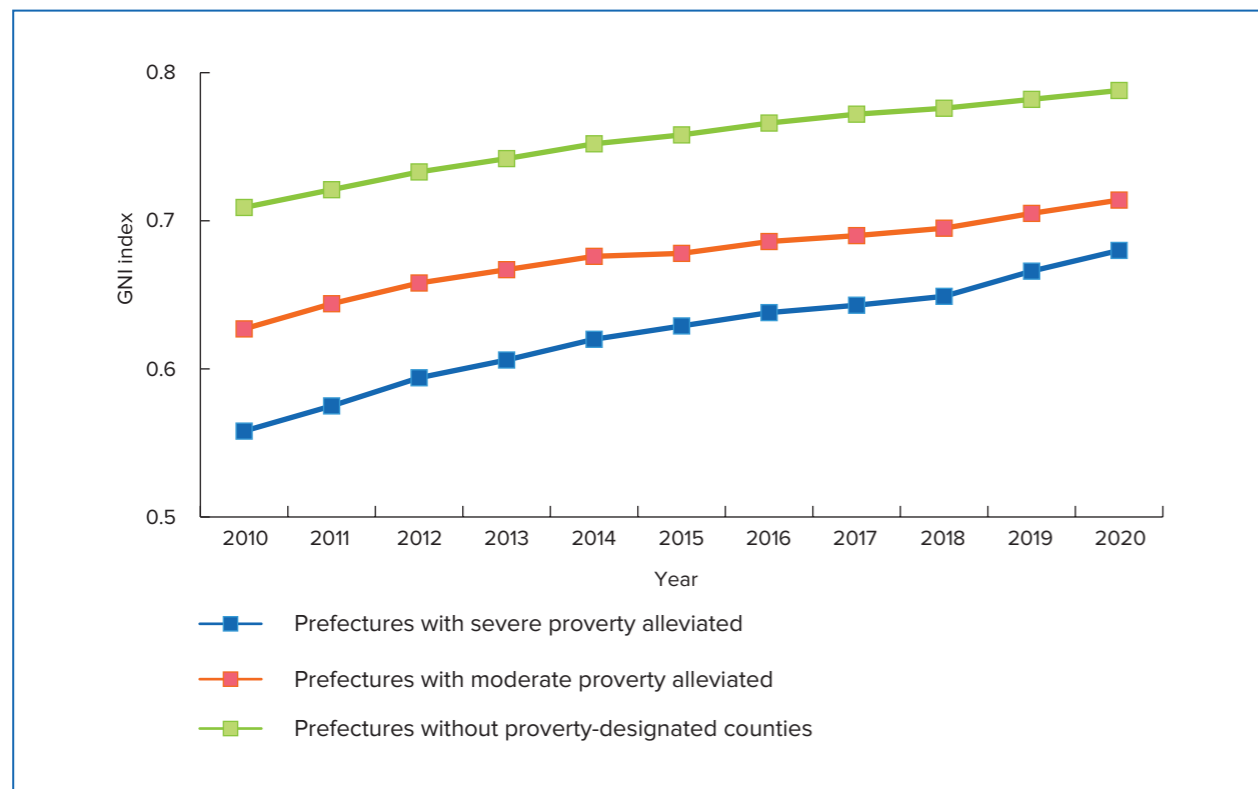
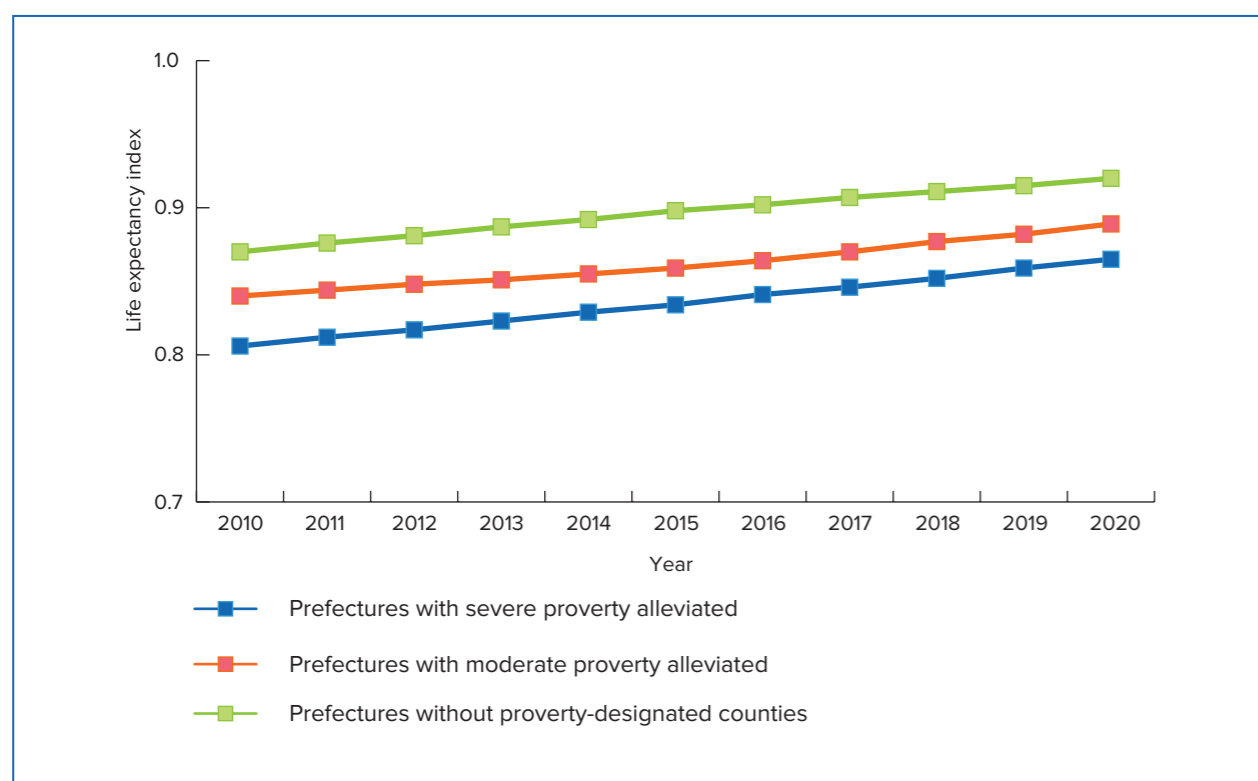
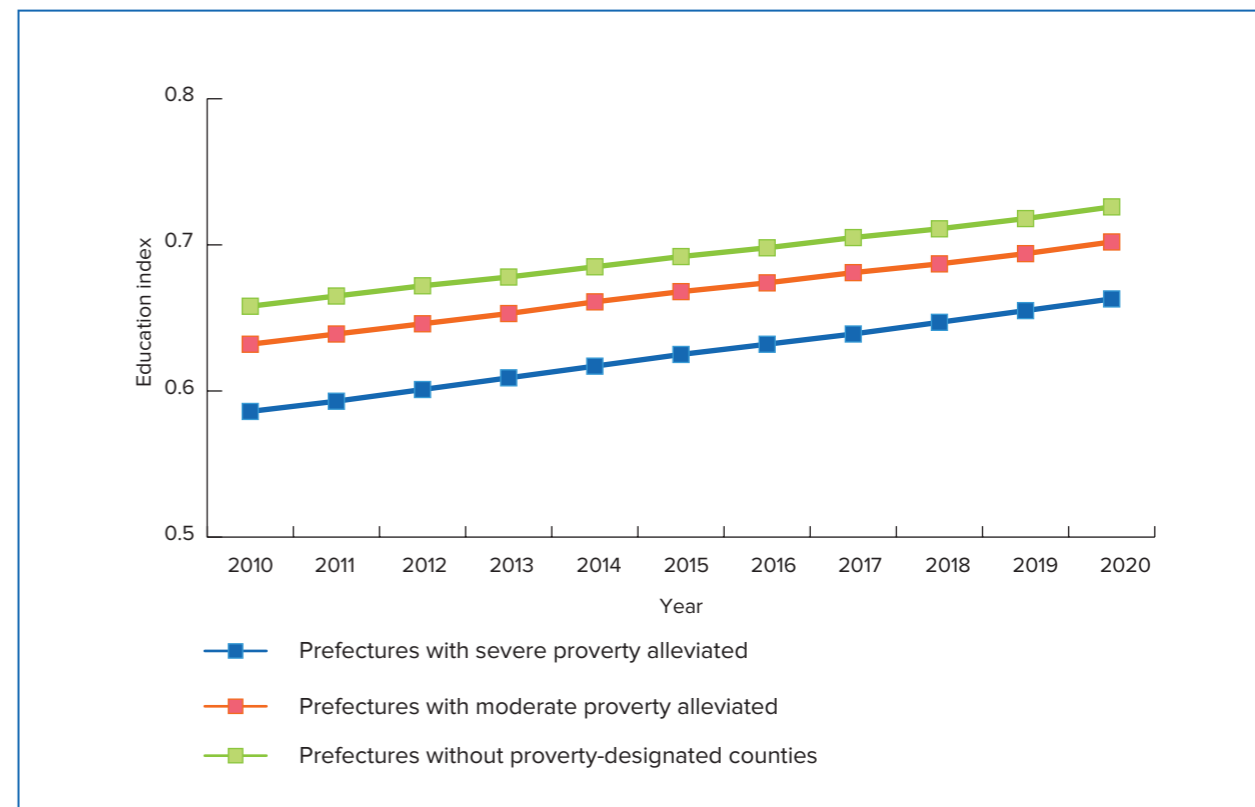


Figure 2.15 Life expectancy scores for formerly poor prefectural cities and other cities (2010–2020)



Data: Yang and Gong (2025).

Figure 2.16 Educational scores for formerly poor prefectural cities and other cities (2010–2020)



Note: Weighted for population.  
Source: Yang and Gong (2025).

Figures 2.13 to 2.16 compare HDI values and its three component indices for these three groups of cities. HDI values in cities with formerly poor counties are lower, but continue to rise, closing the gap with cities that have never administrated poor counties. In particular, the income gap shrank substantially between 2010 and 2020—increasing incomes being the core focus of poverty eradication. Scores for life expectancy

and education have also been steadily increasing in formerly poor prefectural cities. However, the gap with other cities has not closed significantly. This is likely to reflect a delay between income gains and progress in health and education, indicating that improving health and education in formerly poor areas is crucial for their sustainable future development and resilience, ensuring no area slides back into poverty.

## CHAPTER 3 HUMAN DEVELOPMENT CONSIDERING PLANETARY PRESSURES

**The Planetary pressures-adjusted Human Development Index (PHDI), introduced by UNDP in 2020, builds upon the traditional HDI by incorporating two environmental indicators:** carbon emissions per capita and material footprints per capita. By applying a “discounting” adjustment to HDI values based on these indicators, the PHDI reflects not only achievements in health, education, and income, but also the environmental costs associated with such progress. The higher the emissions and resource use, the greater the discount, providing a more comprehensive picture of human development and its trade-offs.

**This chapter presents analysis of China’s PHDI at both national and provincial levels.** At the national level, it draws on the latest PHDI data released by UNDP, covering up to 2023. The provincial-level analysis relies on model-based estimates for China's provincial administrative regions from 2007 to 2015, as calculated by the research team. The construction of the provincial PHDI involves modeling indicators across multiple dimensions, which includes integrating results from two primary sources: (1) material footprint data obtained from the China Provincial Material Footprint Assessment Model<sup>25</sup> and (2) carbon dioxide emission data derived from the RUC-MESSAGEix-China model<sup>26</sup>. These are then combined with the provincial Human

Development Index (HDI) data compiled by the China Institute for Development Planning, Tsinghua University<sup>27</sup>. Due to the high complexity of conducting an integrated assessment of material footprints and carbon emissions at the provincial scale, coupled with the unavailability of some foundational data, the model has not yet been systematically extended to more recent years.

**It is important to note that while this analysis offers valuable insights into the quality of development and associated environmental costs across Chinese provinces during 2007–2015, China’s socioeconomic landscape has undergone significant changes since 2015,** including in its industrial layout, consumption patterns, and resource use efficiency. Thus, PHDI estimates presented here primarily reflect the situation from 2007 to 2015, and not necessarily current trends. With improvements ongoing in data systems and modelling frameworks – particularly for updating data, refining indicators and enhancing methodologies – the scope and frequency of future PHDI estimates are expected to improve significantly. This will enable more timely, dynamic assessments of sustainable development in China. It would also enhance policy solution designs, as the PHDI helps identify areas with low resource efficiency and high environmental

pressure, offering a new perspective and tool for balancing human development with environmental sustainability.

**Two other points are also worth noting. Firstly, due to methodological and data constraints, the PHDI relies heavily on production-based indicators.** This, for example, reflects the spatial concentration of carbon emissions, while overlooking the relationship between the location of emissions and location of consumption. In many cases, high emissions in a given region are driven by consumption elsewhere, making production-side indicators insufficient for fully assessing environmental costs. This limitation

is buffered by incorporating material footprint, which captures consumption-side responsibility, making it a more comprehensive measure of sustainable development.

**A second limitation of the analysis stems from the fact that the PHDI - reflecting resource use at a specific point in time - does not capture historical responsibilities or cumulative contributions** of regions at different stages of development. Its interpretation should therefore be context-specific, and considered alongside regional development trajectories (see the box on Flow vs. Stock for further discussion).

### 01 INTERACTIONS BETWEEN HUMAN DEVELOPMENT AND THE ENVIRONMENT

**The last century of human activity has profoundly altered our planetary environment.** Huge quantities of energy and natural resources have been consumed to power social and economic expansion. That consumption creates vast quantities of waste and pollutants, putting ecosystems worldwide under huge pressure. As a consequence, the world now faces triple planetary crises: climate change, biodiversity loss, and pollution, threatening ecological security and human welfare globally.

- **Climate change is caused by the long and intensive use of fossil fuel energy, which releases carbon dioxide and other greenhouse gases.** This warms the planet, resulting in more frequent extreme weather events and rising sea levels, among others, damaging ecosystems and making it increasingly hard to sustain life on earth.
- **Biodiversity loss is mostly caused by changes in land use and the overexploitation of natural**

**resources,** including deforestation, the loss of wetlands, and overfishing. These activities destabilize ecosystems and reduce their ability to sequester carbon, as well as affecting the regulation of water resources and the supply of bioresources.

- **Pollutants from industrial, agricultural and urban activities contaminate the atmosphere, water and soil.** This harms human health and worsens ecological damage, making ecosystems less able to self-repair.

**Together, these three crises affect the global flow of resources and ecological balance, exacerbating inequalities and health risks, reducing educational and livelihood opportunities as well as eroding social equality.** These grave challenges require systemic reforms in how we use energy and resources, cutting carbon emissions and shifting to a greener, more sustainable way of life.

25. Main sources including: (1) Jiang, M., Behrens, P., Wang, T., Tang, Z., Yu, Y., Chen, D., Liu, L., Ren, Z., Zhou, W., Zhu, S., He, C., Tukker, A., and Zhu, B. (2019). Provincial and Sector-level Material Footprints in China. *Proceedings of the National Academy of Sciences*, 116(52), 26484–26490. <https://www.pnas.org/doi/full/10.1073/pnas.1903028116>; (2) Jiang, M., Liu, L., Behrens, P., Wang, T., Tang, Z., Chen, D., Yu, Y., Ren, Z., Zhu, S., Tukker, A., and Zhu, B. (2020). Improving Sub-national Input-Output Analyses Using Regional Trade Data: A Case-Study and Comparison. *Environmental Science & Technology*, 54(19), 12732–12741. <https://pubs.acs.org/doi/10.1021/acs.est.0c04728>; (3) Jiang, M., Behrens, P., Yang, Y., Tang, Z., Chen, D., Yu, Y., Liu, L., Gong, P., Zhu, S., Zhou, W., Zhu, B., and Tukker, A. (2022). Different Material Footprint Trends between China and the World in 2007–2012 Explained by Construction- and Manufacturing-associated Investment. *One Earth*, 5(1), 109–119. [https://www.cell.com/one-earth/fulltext/S2590-3322\(21\)00729-6](https://www.cell.com/one-earth/fulltext/S2590-3322(21)00729-6); (4) Jiang, M., Behrens, P., Lyu, L., Tang, Z., Chen, D., Cao, Y., Gong, P., Zhou, W., Yang, Y., Tukker, A., Hertwich, E., & Zhu, B. (2023). Additional north-south differences in China revealed by the Planetary Pressure-Adjusted Human Development Index. *Resources, Conservation, and Recycling*, 198, 107191

26. Renmin University of China School of Applied Economics RUC-MESSAGEix-China (RMC) Model Documentation (2024) <http://ae.ruc.edu.cn/docs/2024-12/34c27719b59942d6aae1ae93879045cd.pdf>

27. United Nations Development Programme China. (2019, December 19). *National Human Development Report – Special Edition*. UNDP China. <https://www.undp.org/china/publications/national-human-development-report-special-edition>

**A. Climate change and human development**

Climate change has a significant impact on a number of sustainable development goals (Figure 3.1) and human development, including the economy, health, education and social inequality (Figure 3.2).

Extreme weather events driven by climate change—such as floods, droughts, heatwaves, and wildfires—have caused severe economic losses and heightened uncertainty in economic activities. Between 1970 and 2019, the number of disasters recorded rose from

711 for the years 1970–1979, to 3,165 for 2010–2019. Economic losses rose from USD 175.4 billion for 1970–1979 to USD 1.4 trillion for 2010–2019.<sup>28</sup> These extreme weather events increase costs for businesses, leaving less finance for investment and research. Rising sea levels also pose a growing threat to coastal areas. Over the past thirty years, the number of people with high vulnerability to this has climbed from 1.6 billion to 2.6 billion,<sup>29</sup> forcing many coastal residents and businesses to relocate, raising costs further. In the long term, industries reliant on a stable climate - such as agriculture, forestry and fishing - will be severely affected. Declining agricultural productivity may further exacerbate poverty. The World Bank estimates that by 2050, climate-induced income losses could push an additional 41 million people into extreme poverty worldwide. When accounting for potential increases in inequality, this could rise to as many as 148.8 million.<sup>30</sup>

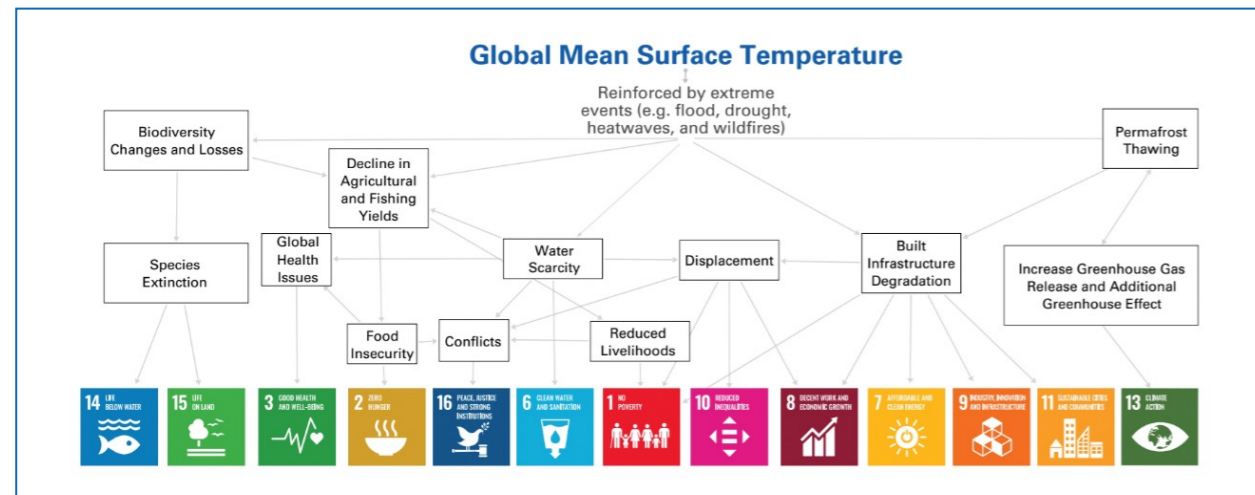
with consequences for mental health.<sup>32</sup> Those psychological effects of climate disasters are coming under greater scrutiny, particularly in regions where extreme weather events are frequent and cause long-term stress. Despite its significance, mental health has not yet been measured within human development. However, its importance is gaining attention, and it was extensively discussed in recent Global Human Development Reports.<sup>33</sup>

**When it comes to education, the direct adverse effects of climate change are primarily seen through the destruction of educational facilities and infrastructure, as well as the displacement of people.** According to UNESCO, those displaced by disasters are likely to face difficulties accessing education, including language problems, administrative barriers, discrimination, and limited resources in the recipient region.<sup>34</sup> Climate change reduces household incomes, making it harder to pay for education. Children who miss out on education as a result will be less likely to break the cycle of poverty.

**Climate change worsens inequality around the world, with the worst effects felt in lower-income countries and by vulnerable populations.** Research has found potential welfare losses due to climate change of as much as 15 percent<sup>35</sup> in parts of Africa and Latin America, although northern regions in Canada, Alaska,

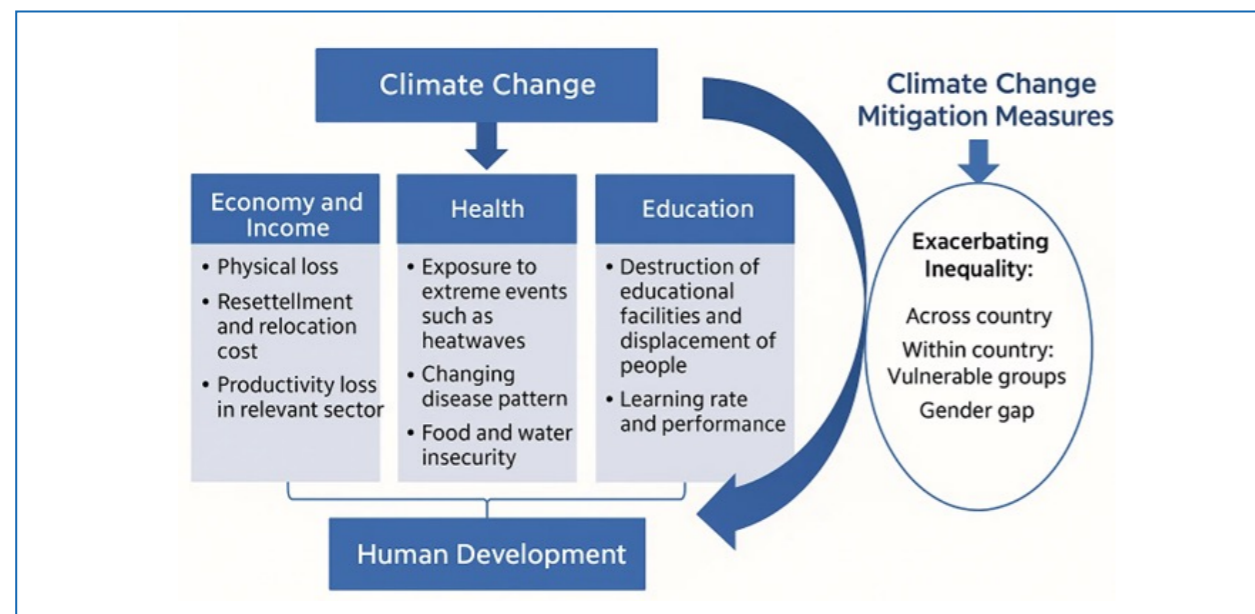
**Climate change negatively affects health, by creating immediate risks to life through heatwaves and flooding, as well as increasing the spread of disease.** It also disrupts health systems and triggers food and water shortages. Between 2030 and 2050, climate change is expected to cause an additional 250,000 additional deaths per year from malnutrition, malaria, diarrhea, and heat stress alone.<sup>31</sup> In addition, climate-related disasters cause psychological harm,

**Figure 3.1 How global warming affects human development**



Source: World Meteorological Organization (2024), State of the Global Climate 2024. Available at: <https://library.wmo.int/records/item/69455-state-of-the-global-climate-2024>

**Figure 3.2 Ways climate change affect human development**



Source: Authors

28. World Meteorological Organization. (2021). WMO Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes (1970–2019) (WMO-No.1267 p19). World Meteorological Organization PDF. [https://library.wmo.int/viewer/57564/download?file=1267\\_Atlas\\_of\\_Mortality\\_en.pdf&type=pdf&navigator=1](https://library.wmo.int/viewer/57564/download?file=1267_Atlas_of_Mortality_en.pdf&type=pdf&navigator=1)

29. United Nations Framework Convention on Climate Change. (n.d.). Work of the Climate High-Level Champions. <https://climatechampions.unfccc.int/climate-refugees-the-worlds-forgotten-victims/>

30. Fajardo-Gonzalez, J., Nguyen, M.C., & Corral Rodas, P.A. (2025). The Future of Poverty: Projecting the Impact of Climate Change on Global Poverty through 2050. Washington, D.C.: World Bank. Available at: <https://openknowledge.worldbank.org/handle/10986/41700>

31. World Health Organization (n.d.). Climate Change World Health Organization. <https://www.who.int/health-topics/climate-change>

32. Beaglehole, B., Roger, M.T., Frampton, C. M., Boden, J.M., Newton-Howes, G., & Bell, C. J. (2018). Psychological distress and psychiatric disorder after natural disasters: systematic review and meta-analysis The British Journal of Psychiatry, 213(6), 716–722. <https://doi.org/10.1192/bjp.2018.210>

33. UNDP (2022). Human Development Report 2021/22: Uncertain Times, Unsettled Lives – Shaping our Future in a Transforming World. New York: United Nations Development Programme. Available at: <https://hdr.undp.org/content/human-development-report-2021-22>

34. United Nations Educational, Scientific and Cultural Organization. (n.d.). How climate change and displacement affect the right to education. UNESCO.org. <https://www.unesco.org/en/right-education/climate-change-displacement>

35. Cruz, J. L., & Rossi-Hansberg, E. (2021). The Economic Geography of Global Warming. National Bureau of Economic Research. Working Paper 28466. <http://www.nber.org/papers/w28466>

and Siberia may benefit from rising temperatures. More people die from climate disasters in poorer countries, due to a lack of resources and capacities.<sup>36</sup> Historical data shows over 90 percent of disaster-related deaths have occurred in developing countries.<sup>37</sup> The response to climate change, such as the green energy transition, will boost sustainable development in the long term but may, without appropriate social safeguards, worsen inequality.<sup>38</sup> According to the International Labor Organization, the energy transition may create 25 million new jobs, but also cause the loss of 7 million, requiring major investment in skills training and support.<sup>39</sup>

### **B. Unsustainable use of resources and human development**

**Climate change is only one of the main impacts of the traditional economic model based on “extract, make and dispose”,<sup>40</sup> the other being the unsustainable use of natural resources.** Global resource extraction has tripled over the last half-century, while human welfare (as measured by the Inequality-adjusted Human Development Index) has improved far more slowly.<sup>41</sup> Those living in high-income countries have a material footprint six times the size of those in low-income countries, while the environmental cost of that footprint

is exported to developing nations through international trade. If current trends continue, global resource use could increase by 60 percent by 2060 compared to 2020 levels—far exceeding planetary capacity, posing risks to agriculture, energy and manufacturing.<sup>42</sup>

**Resource extraction and processing are major drivers of greenhouse gases, pollution, as well as biodiversity loss.** These activities account for 55 percent of greenhouse gas emissions and 40 percent of health harms associated with particulate pollution. For instance, PM2.5 pollution from burning fossil fuels is directly linked to respiratory illnesses, while heavy metal pollution from mining threatens water safety and supply for hundreds of millions of people. Low-income countries disproportionately bear the environmental burden of resource exploitation, with regions outside Europe and North America accounting for over 90 percent of global water stress and biodiversity loss, despite generating less than half of global value-added.<sup>44</sup> The degradation of ecosystems in these regions undermines their resilience to public health crises.

**Excessive resource extraction also contributes to land degradation and water scarcity.** In impoverished areas, such conditions often force children to drop

out of school to support household livelihoods, further widening inequalities in access to education. Globally, nearly 50 percent of GDP depends on natural resources and ecosystem services. Sectors such as agriculture, fishing, forestry and tourism provide 1.2 billion jobs.<sup>45</sup> Environmental damage caused by resource-intensive

industries puts those jobs at risk, exacerbating economic marginalization of vulnerable people. Moreover, competition over natural resources frequently leads to conflicts. For example, disputes over land rights triggered by mining operations often involve indigenous communities, undermining social cohesion.<sup>46</sup>

## **02 ADJUSTING HDI VALUES TO ACCOUNT FOR PLANETARY PRESSURES**

**UNDP created the PHDI to reflect the stress on global resources arising from human development.** The core idea is that if a country or region achieves human development at the cost of high **carbon emissions** or substantial resource consumption, its HDI should be discounted accordingly. The PHDI captures this trade-off by reflecting the environmental costs behind development gains.

Carbon emissions represent the pressure placed on the global climate by economic activity; **material footprint**, a lifecycle-based resource indicator, captures the resource use (including biomass, fossil fuels, metals and non-metallic minerals) driven by final consumption. The modern economy relies heavily on global supply chains, so material footprints offer strong cross-country comparability and reveals the resource dependence embedded in imported goods.

A PHDI value is calculated by multiplying an adjustment factor A ( $\text{PHDI} = \text{HDI} \times A$ ), where A is the arithmetic mean of two standardized measures of carbon emissions per capita and material footprint per capita, falling between 0 and 1. The corresponding discount is expressed as  $(1 - A)$ : the higher carbon emissions and material footprints resulting in a bigger discount to and thus lower HDI. This reflects the substantive impact of environmental

pressures on human development. For more details on the calculation method, see Appendix 2.

**China's national PHDI rose steadily** from 0.470 in 1990 to 0.606 in 2012. During this period, the discount applied to its HDI increased from 4 percent to 16 percent, reflecting the growing influence of environmental pressures in its development process. Between 2012 and 2023, China's PHDI continued to rise, reaching 0.644, while the discount rate stabilised between 17 percent and 19 percent.

**China demonstrates a degree of structural progress in its development transition.** First, while the country continues to face environmental pressures in pursuit of human development, its resource consumption and carbon emissions remain relatively contained by international comparison and in per capita terms. In addition, while in some cases environmental pressures may shift across regions, existing studies suggest that improvements in environmental quality in some places are often also associated with industrial upgrading, technological progress, and a range of pollution control policies, suggesting that improvements are not necessarily the result of pollution being transferred elsewhere.

36. Soergel, B., Kriegl, E., Bodirsky, B. L., Bauer, N., Leimbach, M., & Popp, A. (2021). Combining ambitious climate policies with efforts to eradicate poverty. *Nature Communications*, 12(2342), 1-12. <https://doi.org/10.1038/s41467-021-22315-9>

37. World Meteorological Organization (2023). *Atlas of Mortality and Economic Losses from Weather, Climate and Water-related Hazards (1970–2021)*. Available at: <https://wmo.int/publication-series/atlas-of-mortality-and-economic-losses-from-weather-climate-and-water-related-hazards-1970-2021>

38. Ngcamu, B. S. (2023). *Climate Change Effects on Vulnerable Populations in the Global South: A Systematic Review*. *Natural Hazards*, 1-15.

39. Mahmud, T. (2019). *Skills for a greener future: A global view*. [https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed\\_emp/documents/publication/wcms\\_732214.pdf](https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/documents/publication/wcms_732214.pdf)

40. Bruyninckx, Hans Hatfield-Dodds, et al. "Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes." *United Nations Environment Programme* (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

41. Bruyninckx, Hans Hatfield-Dodds, et al. "Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes." *United Nations Environment Programme* (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

42. Bruyninckx, Hans Hatfield-Dodds, et al. "Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes." *United Nations Environment Programme* (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

43. Bruyninckx, Hans Hatfield-Dodds, et al. "Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes." *United Nations Environment Programme* (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

44. Bruyninckx, Hans Hatfield-Dodds, et al. "Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes." *United Nations Environment Programme* (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

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### 03 CALCULATING CHINA'S PROVINCIAL-LEVEL PHDI VALUES

**For major economies like China, vast territorial size and complex regional structures lead to significant differences in development patterns and environmental pressures across provinces.** To better understand cross-provincial PHDI differences, more detailed and data-driven analyses are essential to support targeted policy responses.

**To calculate China's provincial PHDI, two key datasets are required:** material footprints and carbon emissions. In this report, the material footprint data is derived from the China Provincial Material Footprint Assessment Model<sup>47</sup> led by Tsinghua University, while the carbon emission data comes from the RUC-MESSAGEix-China model<sup>48</sup> led by Renmin University of China. The provincial HDI data compiled by the China Institute for Development Planning, Tsinghua University<sup>49</sup>.

**It is important to recall the data limitation of the report:** the PHDI estimates presented in this report are based on data from 2007 to 2015, a timeframe determined by the availability and feasibility of reliable data. These estimates rely on a multi-level, cross-scale data integration system—particularly the construction of China's provincial material footprint model.<sup>50</sup> This includes linking China's national Multi-Regional Input-Output (MRIO) model with a global MRIO model<sup>51</sup>, as well as compiling high-resolution global and provincial data on the extraction of biomass, fossil fuels, metals, and non-metallic minerals<sup>52</sup>. As such, results presented here offer a snapshot of basic development–environment dynamics across China's provinces between 2007 and 2015.

47. Main sources including: (1) Jiang, M., Behrens, P., Wang, T., Tang, Z., Yu, Y., Chen, D., Liu, L., Ren, Z., Zhou, W., Zhu, S., He, C., Tukker, A., and Zhu, B. (2019). Provincial and Sector-level Material Footprints in China. *Proceedings of the National Academy of Sciences*, 116(52), 26484–26490. <https://www.pnas.org/doi/full/10.1073/pnas.1903028116>; (2) Jiang, M., Liu, L., Behrens, P., Wang, T., Tang, Z., Chen, D., Yu, Y., Ren, Z., Zhu, S., Tukker, A., and Zhu, B. (2020). Improving Subnational Input-Output Analyses Using Regional Trade Data: A Case-Study and Comparison. *Environmental Science & Technology*, 54(19), 12732–12741. <https://pubs.acs.org/doi/10.1021/acs.est.0c04728>; (3) Jiang, M., Behrens, P., Yang, Y., Tang, Z., Chen, D., Yu, Y., Liu, L., Gong, P., Zhu, S., Zhou, W., Zhu, B., and Tukker, A. (2022). Different Material Footprint Trends between China and the World in 2007–2012 Explained by Construction- and Manufacturing-associated Investment. *One Earth*, 5(1), 109–119. [https://www.cell.com/one-earth/fulltext/S2590-3322\(21\)00729-6](https://www.cell.com/one-earth/fulltext/S2590-3322(21)00729-6); (4) Jiang, M., Behrens, P., Lyu, L., Tang, Z., Chen, D., Cao, Y., Gong, P., Zhou, W., Yang, Y., Tukker, A., Hertwich, E., & Zhu, B. (2023). Additional north-south differences in China revealed by the Planetary Pressure-Adjusted Human Development Index. *Resources, Conservation, and Recycling*, 198, 107191

48. Renmin University of China School of Applied Economics RUC-MESSAGEix-China (RMC) Model Documentation (2024) <http://ae.ruc.edu.cn/docs/2024-12/34c27719b59942d6aae1ae93879045cd.pdf>

49. United Nations Development Programme China. (2019, December 19). *National Human Development Report – Special Edition*. UNDP China. <https://www.undp.org/china/publications/national-human-development-report-special-edition>

50. The primary constraint on data availability lies in the high dependency of Material Footprint (MF) accounting on multi-model integration and high-quality foundational data. Particularly in a country like China, with its complex inter-regional economic ties, calculating the MF necessitates the use of an Environmentally-Extended Multi-Regional Input-Output (EE-MRIO) model. This methodology involves integrating cross-industry and cross-regional input-output analyses with environmental parameters, and thus relies on detailed data for industrial output, consumption, trade, and environmental pressures. The long update cycles of publicly available Multi-Regional Input-Output tables and their accompanying environmental satellite accounts present a significant challenge. Currently, the latest available version only covers the period up to 2015. This technically and directly limits the ability to update the provincial-scale PHDI, thereby affecting its timeliness. It is crucial to further note that between 2015 and 2025, China's socio-economic structure and regional development patterns have undergone profound transformations, with notable changes in industrial layout, consumption patterns, and resource utilization efficiency. Consequently, the PHDI results presented in this report primarily reflect the development status from 2007 to 2015 and are not representative of current trends. As data systems continue to improve and modeling frameworks are further optimized, the analytical scope and update frequency of the PHDI are expected to be significantly enhanced. This will provide more robust technical support for conducting more real-time, dynamic, and policy-oriented sustainable development assessments in the future.

51. Jiang, M., Liu, L., Behrens, P., Wang, T., Tang, Z., Chen, D., Yu, Y., Ren, Z., Zhu, S., Tukker, A., and Zhu, B. (2020). Improving Subnational Input-Output Analyses Using Regional Trade Data: A Case-Study and Comparison. *Environmental Science & Technology*, 54(19), 12732–12741. <https://pubs.acs.org/doi/10.1021/acs.est.0c04728>

52. Jiang, M., Behrens, P., Wang, T., Tang, Z., Yu, Y., Chen, D., Liu, L., Ren, Z., Zhou, W., Zhu, S., He, C., Tukker, A., and Zhu, B. (2019). Provincial and Sector-level Material Footprints in China. *Proceedings of the National Academy of Sciences*, 116(52), 26484–26490. <https://www.pnas.org/doi/full/10.1073/pnas.1903028116>

#### A. Material footprint per capita

**Material footprint per capita across Chinese provinces depends on levels of economic development, industrial structure, and regional development models.** Improvements in living standards are often accompanied by larger material footprints,<sup>53</sup> but calculations of these for Chinese provinces (see Figure 3.3) show there are exceptions. In 2015, the highest material footprints were seen in economically advanced coastal provinces, but also in some less-developed, rapidly growing western provinces. Beijing and Tianjin had the highest material footprint per capita on the eastern seaboard, at 34.2 tons and 36.8 tons respectively, reflecting characteristics typical of high-consumption urban centres. However, western provinces such as Qinghai and Shaanxi, which have seen rapid development and increasing investment in fixed assets, had material footprints of 45 tons and 33.4 tons, comparable to or even exceeding some eastern regions. By comparison, most central and northeastern parts of China had lower footprints, generally at 16–24 tons. This shows economic development is not the only determiner of material footprint. Stage of development, investment structure, and population density are also crucial.

**This regional variation is closely linked to China's national development strategies.** Policies such as the Western Development Strategy<sup>54</sup> significantly increased investment intensity in western provinces, spurring large-scale construction of infrastructure and industrial facilities. Nevertheless, in 2015, investment

accounted for as much as 67 percent of China's total material footprint, twice that of consumption. In some western provinces, the share of investment-driven material use exceeded 80 percent.<sup>55</sup> China's western areas are also sparsely populated, meaning higher resource use per capita for infrastructure construction and resource extraction, which again increases material footprint per capita. In conclusion, regional development policies have increased investment and created the foundation for economic development and rising living standards, in turn contributing to overall national development. However, rapid development consumes huge amounts of resources and energy, causing environmental problems in some areas.

#### B. Carbon dioxide emissions per capita

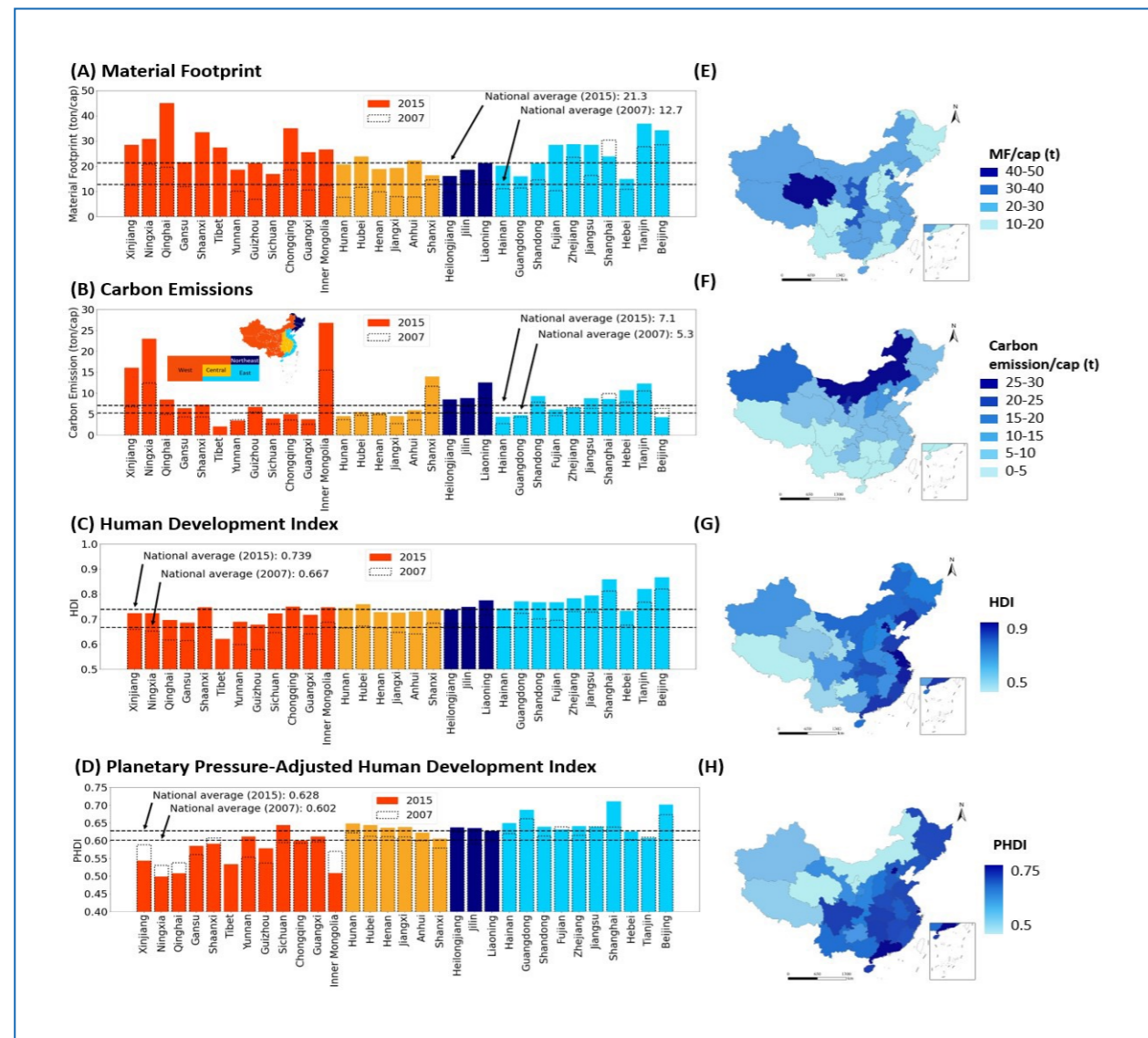
**Provincial level-figures for direct carbon emissions in 2015 show emissions per capita were highest in China's north.** In these coal-rich, heavy-industrial areas - such as Inner Mongolia, Ningxia, Xinjiang, and Shanxi - carbon dioxide emissions per capita ranged from 13-27 tons. Elsewhere, per capita carbon emissions were on average below 10 tons.

53. Jiang, M., Behrens, P., Yang, Y., Tang, Z., Chen, D., Yu, Y., Liu, L., Gong, P., Zhu, S., Zhou, W., Zhu, B., and Tukker, A. (2022). Different Material Footprint Trends between China and the World in 2007–2012 Explained by Construction- and Manufacturing-associated Investment. *One Earth*, 5(1), 109–119. [https://www.cell.com/one-earth/fulltext/S2590-3322\(21\)00729-6](https://www.cell.com/one-earth/fulltext/S2590-3322(21)00729-6)

54. The Western Development Strategy was China's first centrally coordinated initiative to promote development in the western region. It involved infrastructure investment, natural resource development, and market liberalization to stimulate regional economic growth. For the original policy document, see State Council of the People's Republic of China (2000), Notice on Implementing the Western Development Strategy. Available at: [https://www.gov.cn/gongbao/content/2001/content\\_60854.htm](https://www.gov.cn/gongbao/content/2001/content_60854.htm).

55. Jiang, M., Behrens, P., Yang, Y., Tang, Z., Chen, D., Yu, Y., Liu, L., Gong, P., Zhu, S., Zhou, W., Zhu, B., and Tukker, A. (2022). Different Material Footprint Trends between China and the World in 2007–2012 Explained by Construction- and Manufacturing-associated Investment. *One Earth*, 5(1), 109–119. [https://www.cell.com/one-earth/fulltext/S2590-3322\(21\)00729-6](https://www.cell.com/one-earth/fulltext/S2590-3322(21)00729-6)

**Figure 3.3. Provincial-level material footprints, carbon dioxide emissions and HDI values (the solid bars represent 2015; the dashed bars represent 2007)**



Data: Jiang et al. (2023).

Note: (a) Material footprint per capita; (b) Carbon emissions per capita; (c) HDI value; (d) PHDI value. (e) 2015 material footprint per capita; (f) 2015 carbon dioxide emissions per capita; (g) 2015 HDI values; (h) 2015 PHDI values. No data is available for Hong Kong (SAR, China), Macau (SAR, China) and Taiwan (Province of China). For the bar charts, provinces in red are from the west of China, in orange from the central provinces, in light blue from the east and in blue from the north-east.

### 04 TRENDS IN CHINA'S PROVINCIAL PHDI VALUES

In 2015, provincial HDI ranged from 0.621 (Tibet) to 0.867 (Beijing), while PHDI ranged from 0.500 (Ningxia) to 0.711 (Shanghai), with all provinces recording lower PHDI scores compared to their HDI values. The discount rates range from 11 percent (Sichuan) to 32 percent (Inner Mongolia). For comparison, at the national level, China's overall human development level decreased from 0.750 to 0.620 when taking into account environmental considerations (see Figure 3.4A), reflecting an average discount of 17 percent<sup>56</sup>.

Shanghai recorded the highest PHDI (0.711), despite a 17 percent discount from its HDI of 0.859. Although Beijing had the highest HDI in the country, its PHDI dropped to 0.702—a 19 percent discount—due to its relatively high material footprint per capita of 34.2 tons, resulting in a slightly lower PHDI than Shanghai.

Western provinces generally had lower PHDI scores. In 2015, Inner Mongolia, Ningxia, and Qinghai each had PHDI values close to 0.5, among the lowest in the country. Their corresponding HDI discounts were 32 percent, 31 percent, and 27 percent, respectively. These provinces had significantly higher carbon emissions per capita than the national average—26.8 tons in Inner Mongolia, 23.0 tons in Ningxia, and 8.4 tons in Qinghai—far above those in economically developed provinces like Beijing (4.3 tons) and Guangdong (4.7 tons). At the same time, their material footprints per capita were also relatively high, further lowering the environmental adjustment factor A and leading to steeper HDI discounts, as well as greater HDI-PHDI gaps. These outcomes reflect two main factors. Firstly, western provinces were still in the phase of infrastructure accumulation, with high investment intensity and

resource consumption, along with relatively low HDI baselines. Secondly, their economies were largely dominated by energy, mining, and heavy industry, resulting in much higher carbon emissions per capita and material footprints per capita compared to coastal regions. Although this capital and resource-intensive development model contributed to local economic growth, it also intensified environmental burdens, pushing PHDI discount rates in some provinces above 30 percent.

Looking at data trends between 2007 and 2015, PHDIs increased slowly, but regional variation was significant. In particular, three distinctive patterns emerged as human development increased across the board:

- **Regions recording higher human development accompanied by modest increases in environmental pressures.** Meanwhile, several central and western provinces such as Guizhou, Yunnan, and Sichuan showed notable PHDI growth, while recording relatively low discount rates, showcasing potential for more sustainable development models. Their discount rates rose only modestly—by 4 percent to 8 percent—and most remained below 15 percent by 2015, suggesting relatively moderate environmental pressures.
- **Regions recording higher human development accompanied by moderate decreases in environmental pressures.** For example, Shanghai and relatively developed provinces, like Guangdong and Zhejiang, maintained high

<sup>56</sup>Due to ongoing improvements in data quality, the United Nations Development Programme makes minor annual revisions to HDI values. Consequently, the provincial HDI results presented in this report may exhibit slight discrepancies compared to the most recently published national-level HDI figures.

and stable PHDI levels between 2007 and 2015. In the latter provinces, the discount factor was lower than Shanghai's in 2007 and changed only slightly. In Zhejiang, it remained between 16 percent and 18 percent, while in Guangdong it rose from 8.4 percent to 10.9 percent, suggesting relatively stronger capacity for environmental management, as well as different economic models.

• **Regions recording lower human development accompanied by high environmental pressures.**

Resource-based provinces, such as Ningxia, Inner Mongolia, and Qinghai, experienced PHDI stagnation or decline over the same period, remaining in the 0.50–0.54 range, the lowest nationally. These provinces had persistently high carbon emissions per capita and material footprints per capita, resulting in consistently low environmental adjustment factors and higher discount rates. Ningxia's discount rate rose from 19 percent to 31 percent, Inner Mongolia's from 17 percent to 32 percent, and Qinghai's from 13 percent to 27 percent. This trend largely reflects the rapid expansion in construction and concentration of heavy industry during that period, imposing substantial resource and environmental pressures.

**Our analysis shows two innovations, when incorporating sustainability concerns into human development analysis in China: a sharper north-south divide and greater regional divergences.**

**A. PHDI rankings highlight north-south differences**

**Provincial PHDI rankings in China shifted systematically compared to HDI rankings,** as environmental pressures influence human development levels through a discounting mechanism. This makes environmental performance an important variable in assessing development patterns. Northern provinces generally saw a decline, while some southern provinces exhibited a relative upward trend (see Figure 3.4C),

different than the well-known east-west gap.

**The downward shift in rankings was mainly concentrated in resource-intensive and heavy industry-led provinces,** including Inner Mongolia, Shaanxi, Ningxia, and Liaoning, along with Tianjin municipality. These regions recorded carbon emissions per capita and material footprints per capita significantly above the national average, resulting in higher discount rates, and correspondingly lower PHDI values. This pattern was particularly evident in the early 2010s and before, reflecting a development phase characterised by energy-intensive construction and heavy industry expansion. Notably, as China advances its “dual carbon” goals, accelerates green energy adoption, and sees construction slow, environmental discounts are expected to stabilise, marking a shift towards adjustment and transition.

**In contrast, some southern provinces saw improvements in their PHDI rankings,** including Sichuan, Hainan, Jiangxi, Hunan, and Yunnan. Although these provinces did not stand out in terms of HDI, their relatively low carbon emissions per capita and resource consumption resulted in smaller discounts and stronger performance in PHDI rankings. Model results indicate that regions characterised by green industries, service-based economies, or low-carbon industrial structures may have greater potential for balancing development with environmental pressures.

**B. PHDI highlights greater regional divergence**

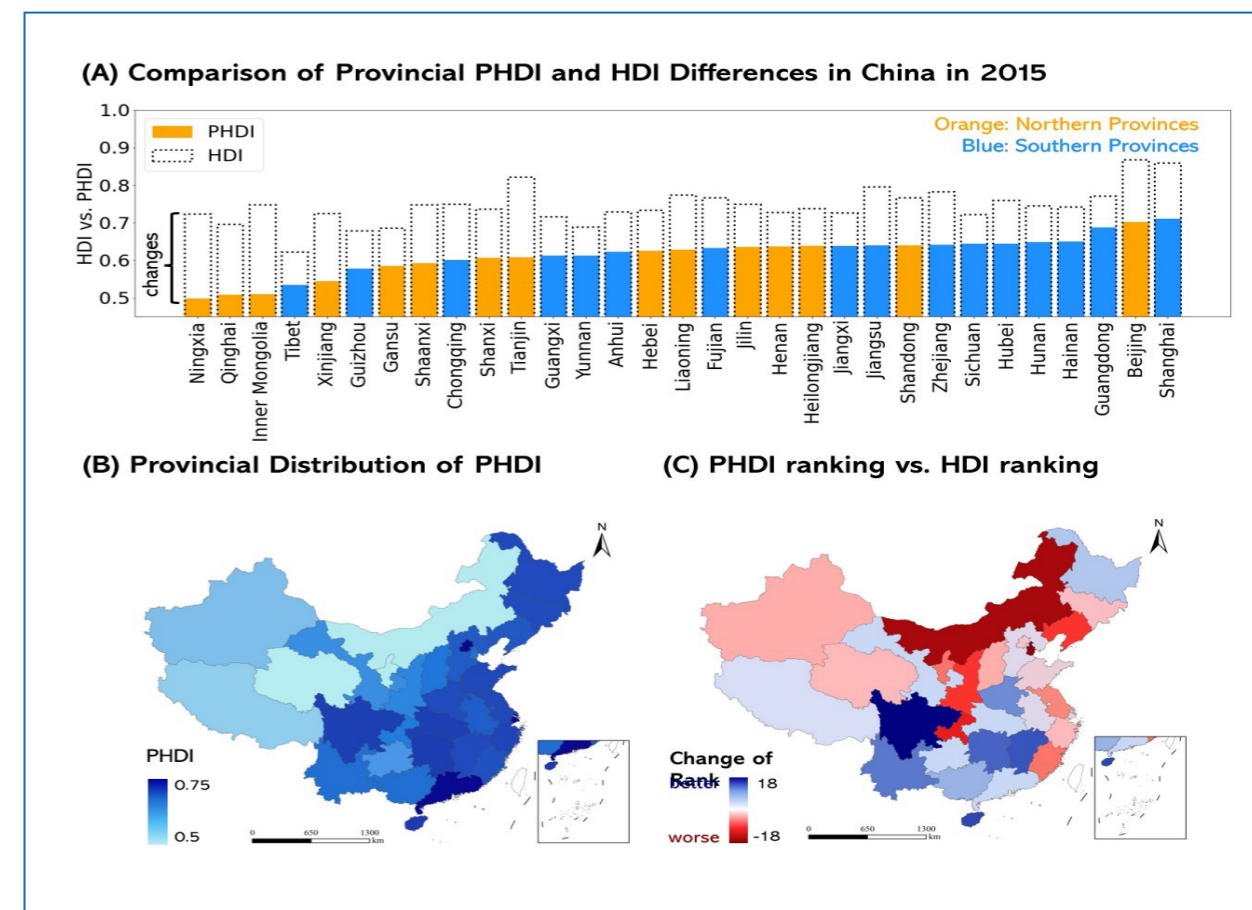
**Regional differences in PHDI values increased between 2007 and 2015 and are now larger than the HDI differences. Furthermore, the HDI shows a degree of regional convergence, while PHDI reveals more pronounced imbalances and inadequacies in the dimension of sustainability.**

**B. PHDI highlights greater regional divergence**

**Regional differences in PHDI values increased between 2007 and 2015 and are now larger than the HDI differences. Furthermore, the HDI shows a degree of regional convergence, while PHDI reveals more pronounced imbalances and inadequacies in the dimension of sustainability.**

This stems from a unique characteristic of China's PHDI trends. Globally, less developed regions tend

**Figure 3.4. Comparison of PHDI and HDI values**



Data: Jiang et al. (2023).

Note: (a) Orange: northern provinces; blue: southern provinces. (b) Provincial PHDI values. (c) Change in ranking from HDI to PHDI. Blue indicates an increase in ranking, red a fall. No data is available for Hong Kong (SAR, China), Macau (SAR, China) and Taiwan (Province of China).

to record less environmental pressure due to lower levels of production and consumption, as well as smaller differences and discount factors between HDI and PHDI values. As economic growth accelerates and carbon emissions and resource consumption increase, the HDI-PHDI gap usually opens up. However, model estimates for China reveal a different trend. In western provinces with weaker economic foundations, the PHDI discount was even greater than in more developed regions. The main reason is that during this period, substantial capital investment was directed towards infrastructure construction in the west, which temporarily boosted

HDI, but also significantly increased carbon dioxide emissions and material footprints, leading to lower PHDI values.

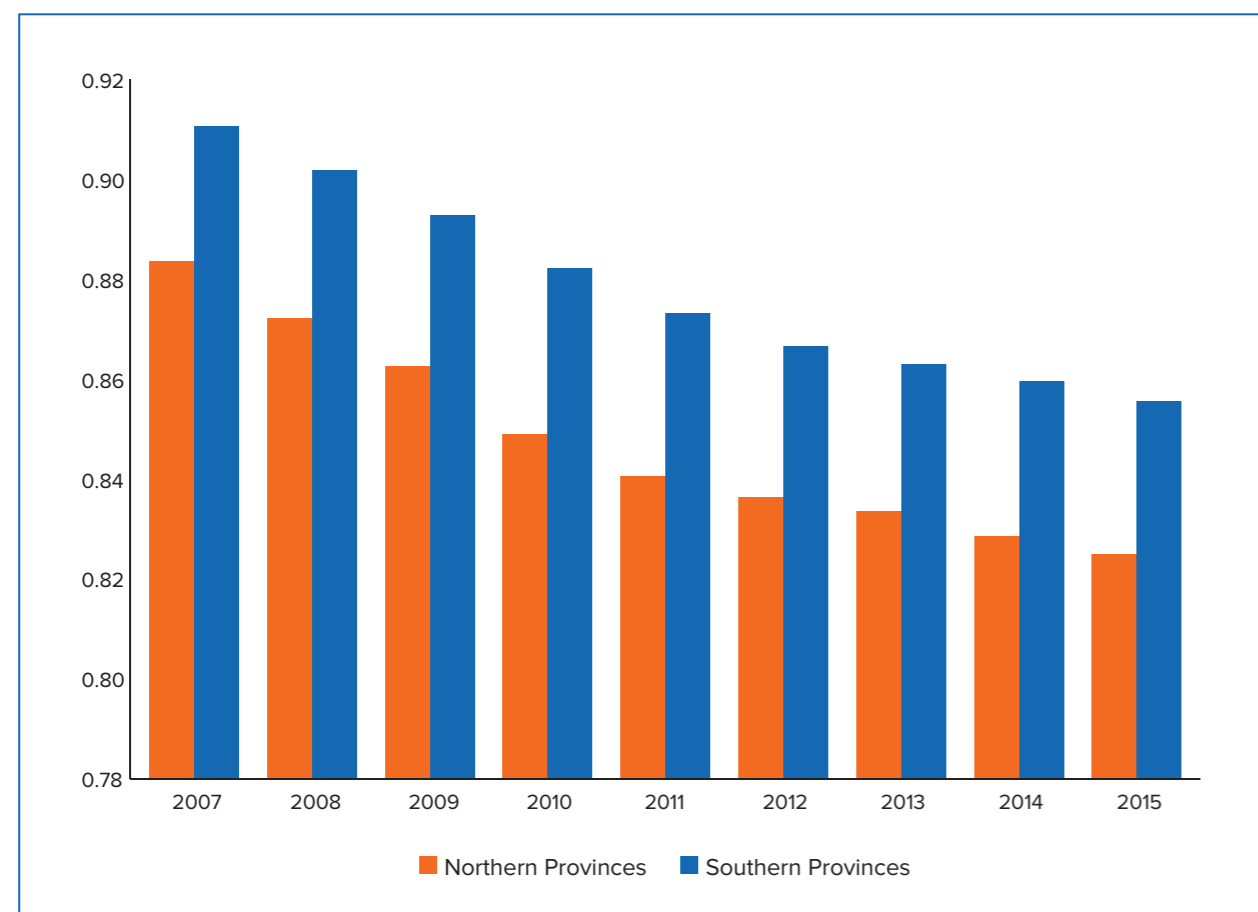
In 2007 the standard deviation for PHDI values was 0.034, far lower than the 0.054 for HDI, indicating that regional disparities in environmental performance were not yet substantial. However, by 2015, the HDI standard deviation had fallen to 0.048, while for PHDI, it rose to 0.053.

**The gap between provinces also widened.** In 2007, the highest and lowest PHDI values differed by 27

percent. By 2015, that gap had widened to 43 percent, while the difference for HDI values narrowed from 42 percent to 39 percent over the same period. Regionally, Northern provinces saw a sharper decrease in their adjustment factors (Figures 3.5). As highlighted above, this reflects faster growth in carbon emissions and

resource consumption in these areas, highlighting differences in development stages and industrial structures. Overall, once environmental and resource dimensions are incorporated, regional disparities in PHDI across China are fundamentally reshaped.

**Figure 3.5. Comparison of changes in adjustment factor (A) for northern and southern provinces**



Data: Jiang et al. (2023).

**Box 1: Flow vs Stock: Stages of development and historical environmental responsibilities**

Rapidly growing economies often undergo rapid material stock build-up, including, for example, extensive infrastructure construction and the expansion of industrial systems. This stage is often accompanied by environmental impacts, particularly in an investment-driven economic model. At the same time, benefits in human development may take longer to materialize. This may even imply that PHDI values could actually decrease over a certain period of time, as HDI increases, due to a reduction in the adjustment factor caused by environmental impact outweighing HDI gains.

In China, given the period under consideration, this means that environmental pressures generated greater PHDI losses compared to the headline HDI. This was particularly evident in western provinces, where material footprint per capita was higher than along the advanced east coastal, reflecting their development stage.

This highlights a key issue in calculating environmental indices: an overlooking of historical factors. This is often termed a “stock-flow” problem or a matter of “historical responsibilities”.

Material flow refers to the resources an economy inputs, consumes or emits over a period of time: for example, annual input of construction materials, energy consumption, and carbon emissions.

Material stock, meanwhile, includes the lasting infrastructure, buildings, and durable goods remaining within the economic system. Unlike annual flow, stock builds up over an extended period of time and forms the foundation of economic development. For example, rapidly growing economies often invest heavily, resulting in high short-term material flows (resources in and carbon out). But the material stock created—infrastructure and industrial facilities—will provide value for decades to come, allowing future development to take place with less investment and lower annual material flows of resources and carbon.

Current measures of environmental pressures (including the PHDI) use annual “snapshots” and do not account for the long-term accumulation of material stock. Research has found that the carbon footprint per capita of infrastructure in industrialized nations tends to be significantly higher than that of developing nations.<sup>57</sup> The infrastructure and industry which developed nations rely on took many years of resource consumption and carbon dioxide emissions to build—historical responsibilities rarely reflected in environmental and sustainability indices. China now has 22 percent of the world’s material stock, but its material stock per capita remains less than half that of industrialized nations.<sup>58</sup> This shows that the link between the environment and development in industrializing economies cannot be assessed on annual numbers alone.

In future, measures of sustainable development could take better account of historical responsibilities,<sup>59</sup> to support more informed policy-making.

57Muller, D.B., Liu, G., Løvik, A.N., Modaresi, R., Pauliuk, S., Steinhoff, F.S. and Brattebø, H., 2013. Carbon emissions of infrastructure development. *Environmental science & technology*, 47(20), pp.11739-11746. <https://pubs.acs.org/doi/10.1021/es402618m>

58Krausmann, F., Wiedenhofer, D., Lauk, C., Haas, W., Tanikawa, H., Fishman, T., Miatto, A., Schandl, H. and Haberl, H., 2017. Global socioeconomic material stocks rise 23-fold over the 20th century and require half of annual resource use. *Proceedings of the national academy of sciences*, 114(8), pp.1880-1885, <https://www.pnas.org/doi/10.1073/pnas.1613773114>; Jiang, M., Wang, R., Wood, R., Rasul, K., Zhu, B. and Hertwich, E., 2023. Material and carbon footprints of machinery capital. *Environmental Science & Technology*, 57(50), pp.21124-21135, <https://pubs.acs.org/doi/10.1021/acs.est.3c06180>

59Wang, R., Hertwich, E.G., Fishman, T., Deetman, S., Behrens, P., Chen, W.Q., de Koning, A., Xu, M., Matus, K., Ward, H. and Tukker, A., 2023. The legacy environmental footprints of manufactured capital. *Proceedings of the National Academy of Sciences*, 120(24), p.e2218828120. <https://www.pnas.org/doi/abs/10.1073/pnas.2218828120>

## 05 A COMPARATIVE ANALYSIS OF PHDI TRENDS IN CHINA AND GLOBALLY

Developed countries tend to have large gaps between HDI and PHDI, with important consequences on people's wellbeing, highlighting the sustainability challenges inherent in current global development pathways. Out of the 62 very-high HDI countries for which PHDI values are available, 55 fell out of that group when PHDI values were used, including the United States and most European countries. The HDI value for the United States in 2023 was 0.938, ranking it 17th globally. But its PHDI ranking was 57 places lower, with a value of 0.686, equivalent to a loss of 27 percent. Singapore and Australia also saw big falls between HDI and PHDI values—35 percent and 27 percent respectively. This compares with a 19 percent fall for China, from an HDI of 0.797 in 2023 to a PHDI of 0.644—less of a change than for the Netherlands (23 percent) and Switzerland (25 percent), but more than Brazil (11 percent) and the Russian Federation (15 percent).

**Dynamics have also changed with time** (Figure 3.6). Between 1990 and 2023, the adjustment factor for countries such as the United States, Australia, and Germany remained between 0.70 to 0.79, corresponding to a discount rate of between 21 and 30 percent, with PHDI significantly lower than HDI. Although the discount rate has narrowed in some countries in recent years due to declining carbon emissions, the real impact on human development by environmental factors, particularly when estimated on a consumption basis, is not fully reflected. The PHDI's use of a production-based accounting approach (see Technical Appendix 2 for more details) means that emissions may be transferred to other countries through industrial outsourcing—partially obscuring environmental costs incurred domestically. This

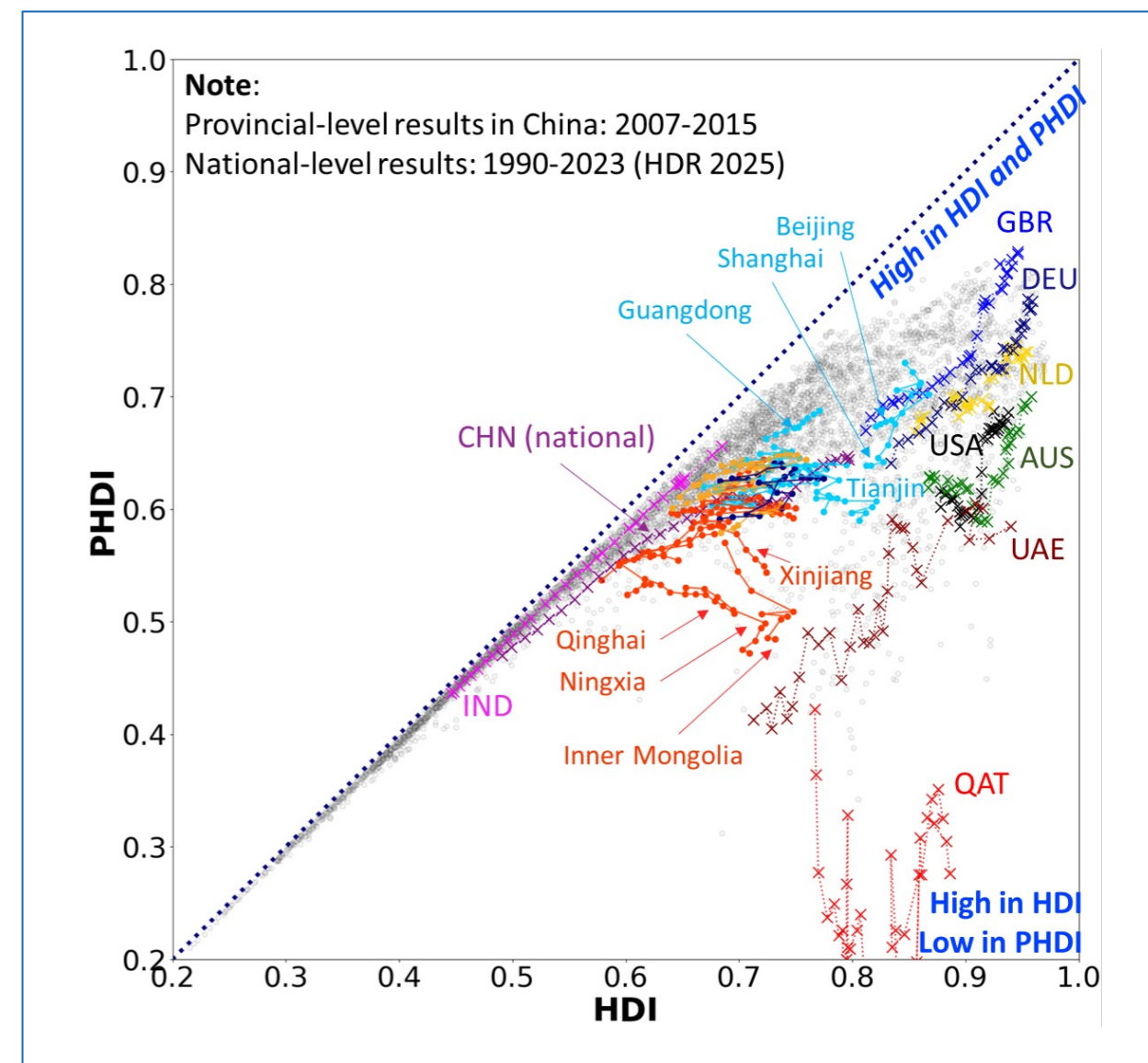
underscores the complexity of redistributing global environmental responsibility.

**In comparison, developing nations tend to have smaller HDI to PHDI differences, due to lower environmental costs per capita**, such as 6 percent in Indonesia and 4 percent in India, reflecting their relatively low levels of resource consumption per capita.

**Resource-intensive economies dominated by energy-intensive industries on the other hand, saw larger reductions in PHDI**, at about half the level of their HDI. Qatar for instance records a larger discount rate of 69 percent and the United Arab Emirates of 38 percent, highlighting a significant gap between their PHDI and HDI.

**Compared to international benchmarks, Chinese provinces show different patterns.** Beijing and Shanghai had adjustment factors of 0.82 and 0.817 respectively in 2015, both higher than the US at 0.747. This indicates that the two cities had higher resource-use and carbon-emission efficiency. Provinces along China's north-west, meanwhile, have lower adjustment factors, due to higher levels of resource extraction and carbon dioxide emissions per capita, as well as material footprint per capita, raising environmental costs and driving a larger wedge between the HDI and PHDI. Those cases are similar to oil exporters of the Middle East: reliant on resource-based industries, which come with higher environmental costs.

Figure 3.6 Relationship between HDI and PHDI over time



Data: UNDP (2025) and Jiang et al. (2023)  
 Dotted line: Selected national economies, 1990–2023. Solid line: Chinese provinces, 2007–2015. Orange: Western provinces; Light blue: Eastern provinces; Light orange: Central provinces; Dark blue: North-eastern provinces; Grey dots: Other data sets not currently emphasized.

## 06 CONCLUSIONS AND THE WAY FORWARD

**The complex relationships between material footprints, carbon dioxide emissions and human development require further research.** The dynamic triangular balancing act between economic growth, resource consumption and environmental pressures presents both opportunities and challenges for future routes to sustainable development.

**The current economic growth model continues to rely on high levels of resource inputs,** meaning global resource use and carbon emissions continue to rapidly rise, with growing impacts on human development. This calls for solutions that reduce material footprints and carbon emissions, by improving efficiency in production and consumption systems, particularly in essential areas, such as housing, transportation, food and energy. Promoting a circular economy, optimizing industrial structures, and advancing energy-saving and emissions-reducing technologies are critical paths to improving production and consumption efficiency. Unlike the conventional linear extractive model, circular principles aim to close resource loops by reusing and recycling across the entire supply chain. By extending the lifespan of materials and redesigning products through recycling and upcycling, the circular economy seeks to decouple consumption from development, reducing resource use while driving growth. Supportive policies can encourage this, by curbing material use and environmental impacts, while promoting circular and low carbon technologies.<sup>60</sup>

**Such solutions align with emerging principles of just transitions, sufficiency and pathways to sustainable resource use.** Scenario modelling in UNEP's *Global Resources Outlook 2024* shows it is possible to shrink resource use in such ways that even as economies

expand, inequality falls and well-being rises, while environmental pressures ease dramatically. The Outlook shows, for example, that a full transition to a circular economy by 2060 would cut resource use by 30 percent and greenhouse gas emissions by 80 percent, while making GDP 3 percent higher under historical trends, and reducing inequality between nations.<sup>61</sup>

**However, in the short-term, responding to climate change and the low-carbon transition will require enormous investment, leading towards more demand for natural resources.** Investment in renewable energy infrastructure, electric vehicles and grid upgrades will all require huge quantities of metals, minerals and building materials, potentially bringing new resource pressures.

**This calls for a systematic assessment and comprehensive understanding of the trade-offs involved,** ensuring supply and demand-side considerations are included for effective environmental governance.

**Sustainable development requires a balance between cutting material footprints and carbon dioxide emissions on one hand, and meeting the investment needs of the low-carbon transition on the other, while leaving no one behind.** More efficient use of resources, a circular economy, and technological innovation will all reduce our reliance on natural resources as a source of economic growth, while curbing environmental costs. It is vital that such transitions also involve re-skilling and supporting those most affected by them, so those most vulnerable – including the elderly and youth – are fully included in a sustainable future globally.

60. United Nations Environment Programme, *Global Resources Outlook 2024*, UNEP (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

61. United Nations Environment Programme, *Global Resources Outlook 2024*, UNEP (2024). <https://www.unep.org/resources/Global-Resource-Outlook-2024>

## CHAPTER 4

## LOOKING FORWARD: CHALLENGES AND OPPORTUNITIES IN ADVANCING HUMAN DEVELOPMENT IN CHINA

**Building on China's human development progress presented in previous sections, this Chapter focuses on challenges and opportunities for further advancing comprehensive human development in China,** in support of the Government's vision and goals, including of an "ecological civilization" and carbon neutrality before 2060. Our analysis focuses around risks to progress stemming from a weaker economic context, opportunities around closing the education gap, as well as reducing divergences, both at the regional level as well as across different components of human development. Last but not least, we focus on environmental challenges.

**Given its size, China's efforts to address planetary challenges will have a significant impact globally,** by helping to advance progress for the Sustainable Development Goals, nearly half of which directly relate to protecting the planet. This includes goals for clean water and sanitation (SDG 6), affordable clean energy (SDG 7) and sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), climate action (SDG 13), life below water (SDG 14) and life on land (SDG 15).

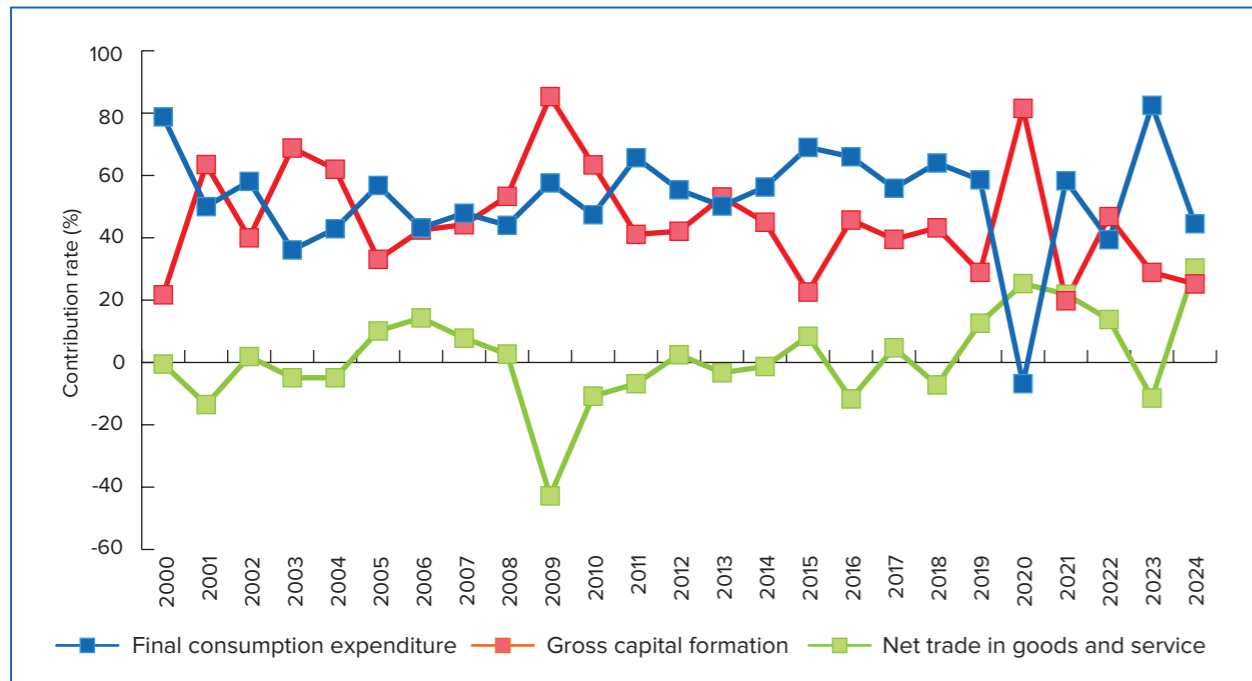
### 01 GROWTH RISKS MAY HAMPER HUMAN DEVELOPMENT

**As the Chinese economy navigates structural changes internally, along with a complex, rapidly evolving and increasingly uncertain external environment, its economic outlook is more subdued than in the past.** This will likely mean slower increases in GNI per capita – and possibly human development. In October 2025, the IMF predicted that the global economy would grow by 3.2 percent and 3.1 percent in 2025 and 2026, respectively. China's growth is expected at 4.8 percent this year and 4.2 percent in 2026. Slower growth, particularly if coupled with less investment in health and education, risks limiting the speed at which further improvements in human development can be achieved.

**As China's growth composition evolves, with investment becoming less important and final**

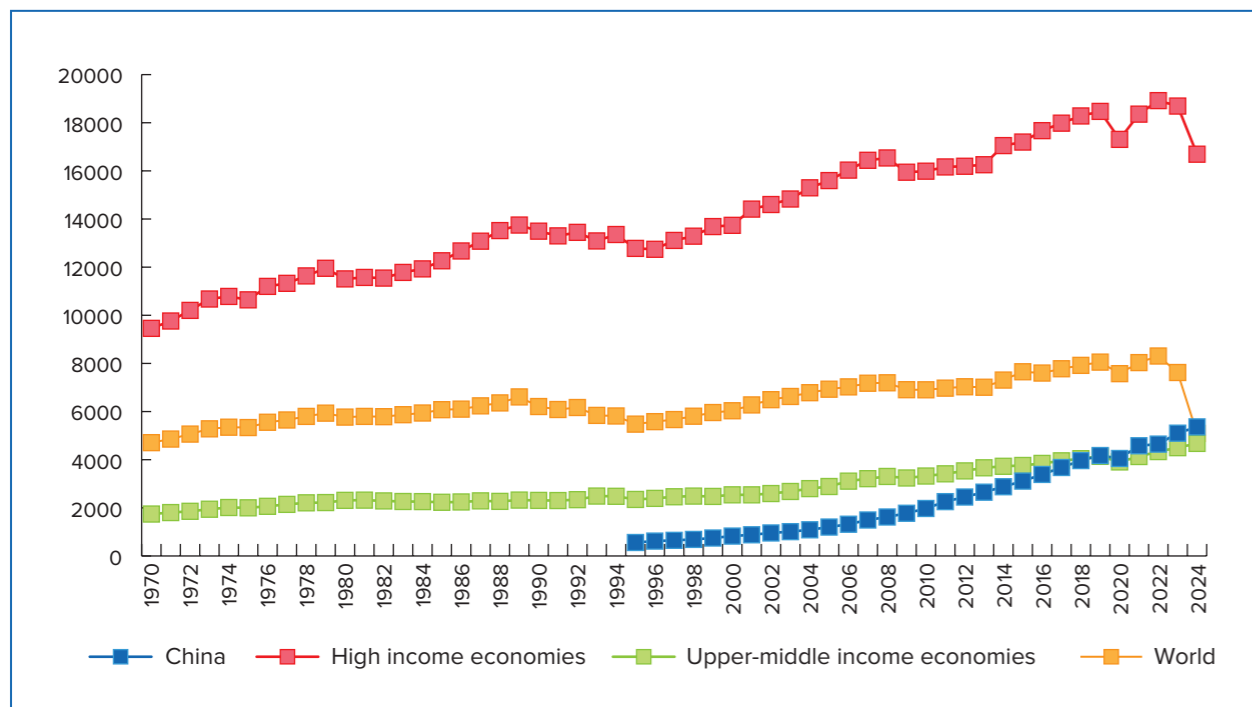
**consumption playing a larger role, the population's low spending power remains a major economic challenge.** Excluding the sharp drop due to COVID-19 in 2020, final consumption has, in most recent years, contributed more to economic growth than capital formation. In 2024, capital formation contributed 25.2 percent of economic growth, compared to 44.5 percent for final consumption. Final consumption also accounted for 56.6 percent of GDP in 2024, or CNY 76.3 trillion. Breaking that down, household spending accounted for 39.9 percent of GDP (CNY 53.9 trillion), and government expenditure for 16.6 percent (CNY 22.4 trillion). Overall, despite its growing importance, China's consumer spending remains low as a percentage of GDP, compared to other economies (Figure 4.2).

Figure 4.1 Contribution of the three drivers of GDP growth (2000–2024)



Data: National Bureau of Statistics

Figure 4.2 International comparison of consumer spending (Households and NPISHs final consumption expenditure per capita; constant 2015 US\$; 1970 - 2024)



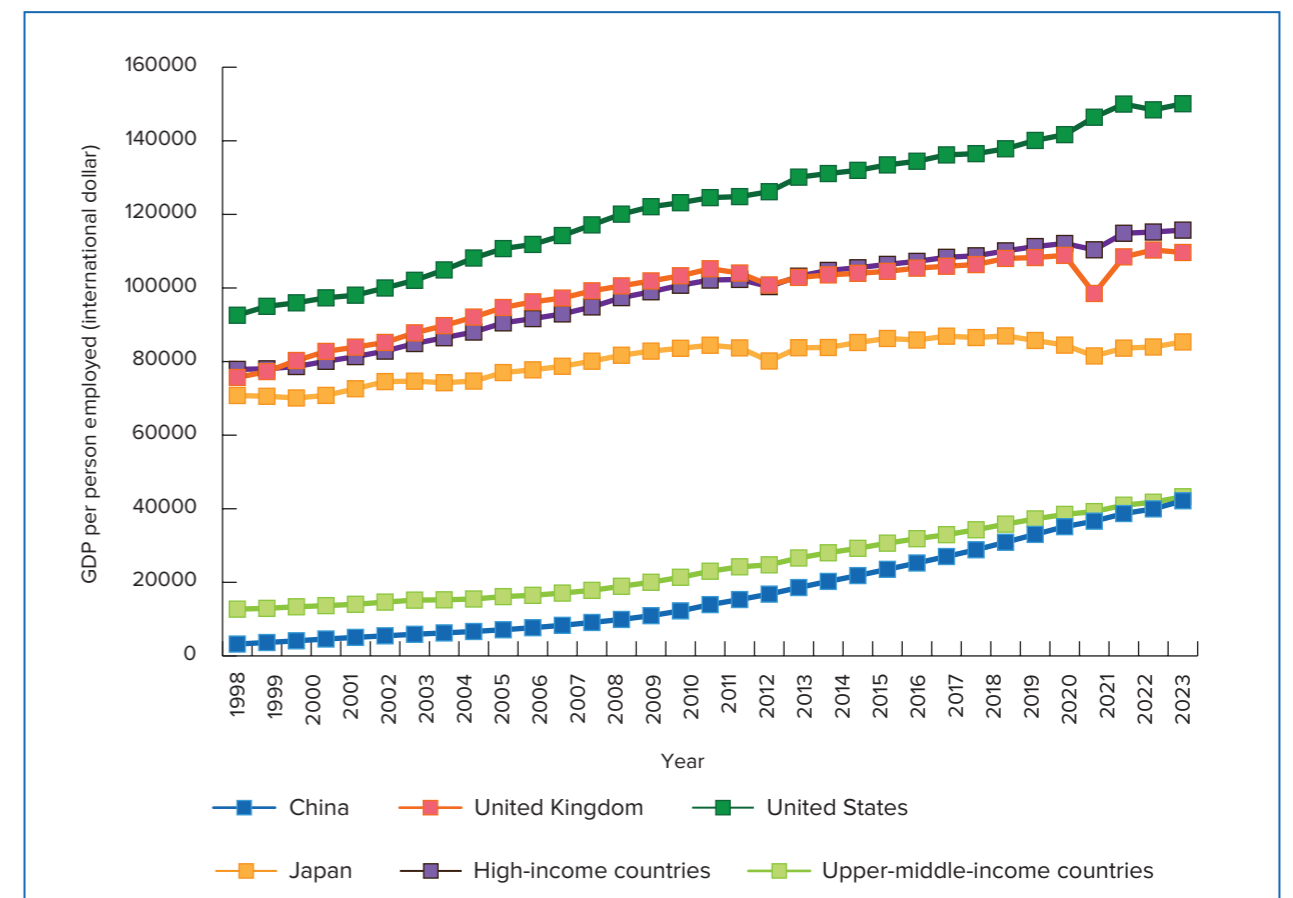
Data: China data from the National Bureau of Statistics, other data from the World Bank.

When focusing on growth inputs - capital, labor, and total factor productivity (TFP) - opportunities for further improvements exist. TFP is an important measure of the efficiency of resource allocation and usage, which can help drive high-quality economic growth. Researchers have calculated that between 2000 and 2019, capital, labor and TFP contributed to 60.5 percent, 15.2 percent and 24.3 percent of economic growth, respectively.<sup>62</sup> Compared with more advanced economies, the contribution of TFP to China's growth remains relatively low. From 2001

to 2017, TFP accounted for 35.9 percent of growth in the United States and 32.4 percent in the United Kingdom. From 2001 to 2015, it contributed to 49.1 percent of Japan's growth.<sup>63</sup>

Increasing labor productivity – i.e., GDP generated per person employed – is also critical to long-term economic growth, with China behind on this indicator, too.<sup>64</sup> China's 14th Five Year Plan (2021–2025) set a goal of having growth in labor productivity outstrip growth in GDP. In 2023, China's GDP per person employed was CNY 161,615 (at 2020 prices), up 5.7 percent on

Figure 4.3 Comparison of GDP per person employed across key countries (1991–2023)



Data: World Bank GDP per person employed is given in 2021 prices at purchasing power parity, same below.

62. See: Chen Menggen, Hou Yuanyuan. 2024 Structural changes in drivers of China's economic growth: 2000-2019 Economic Research, 59(01):53-71.

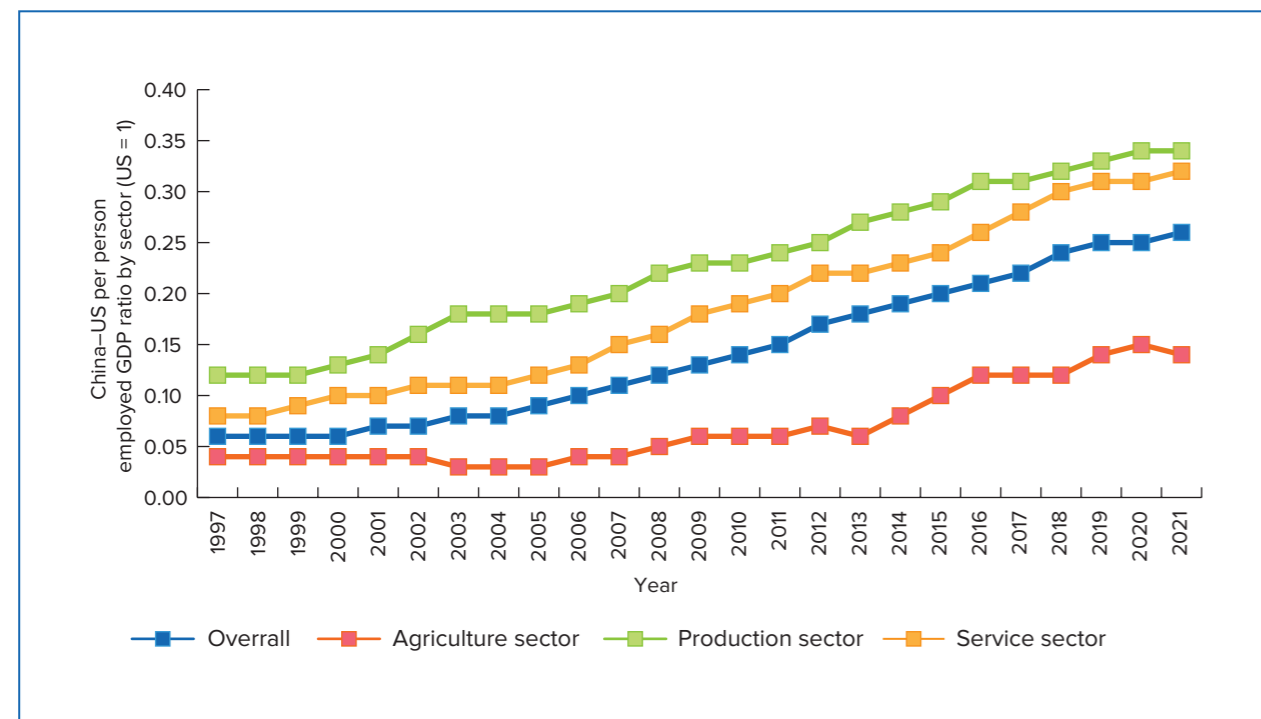
63. See: Chen Menggen, Hou Yuanyuan. 2024 Structural changes in drivers of China's economic growth: 2000-2019 Economic Research, 59(01):53-71.

64. International comparison shows labor productivity in China is increasingly quickly. [https://www.stats.gov.cn/sj/sjjd/202302/t20230202\\_1895768.html](https://www.stats.gov.cn/sj/sjjd/202302/t20230202_1895768.html)

the previous year.<sup>65</sup> Despite that rapid growth, the actual level remains low. Figure 4.3 compares GDP per person employed in terms of purchasing power across key countries. In 2023, China's was USD 42,000 (2021 PPP). That was far below developed nations such as the United States, United Kingdom and Japan, and 36.4 percent of the average for high-income countries. Academics have predicted that, under a mid-range

scenario, China will see 4.75 percent annual growth in labor productivity between 2021 and 2035 and, at the end of that period, reach about 70 percent of the average for high-income countries.<sup>66</sup> Sector wise, China lags further on GDP per person employed in agriculture and services than in the industrial sector (Figure 4.4).

Figure 4.4 Comparison of sectoral GDP per person employed in China and the US (1997–2021)



Data: World Bank

65.Data from: 2023 PRC Statistical Bulletin of National Economic and Social Development, [https://www.stats.gov.cn/sj/zxfb/202402/t20240228\\_1947915.html](https://www.stats.gov.cn/sj/zxfb/202402/t20240228_1947915.html)  
 66.See: Guo Kaiming, Luo Zhangquan, Hang Jing. 2023. Labor productivity in China (1992-2035): International comparison and outlook. China Economic Quarterly, 23 (06): 2914-2212

## 02 EDUCATION: A WEAK SPOT DUE TO HISTORICAL LEGACY

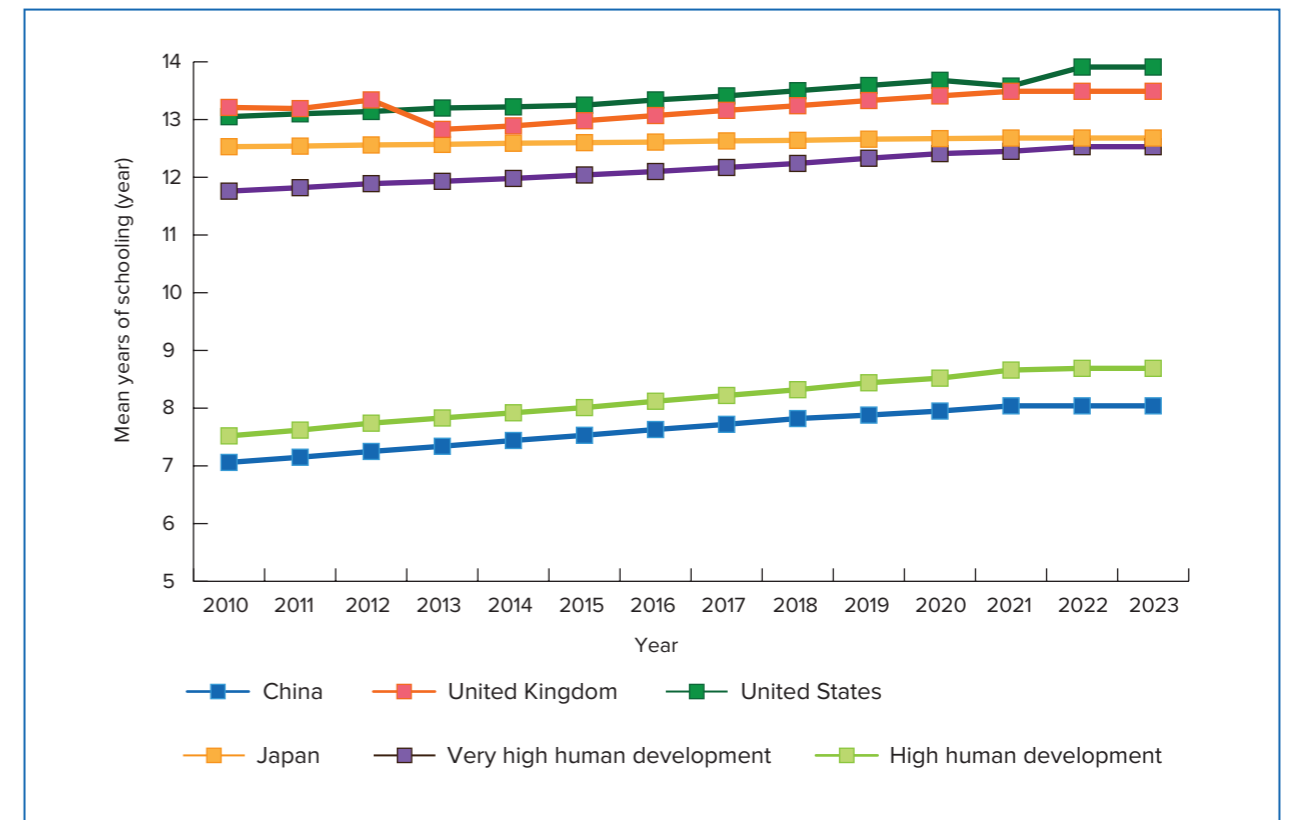
**Mean years of schooling has increased quickly in past years, but historical factors make this still the weaker aspect of China's human development.**

Although the average years of schooling for people of working age (16 to 59 years old) was 10.8 in 2020, and 13.8 for those newly entering the workforce,<sup>67</sup> the figure for those over the age of 25 was only 8. This is far below the 13.7 years for the United States and 13.4 for the United Kingdom, and also lower than the average for the high HDI grouping, at 8.5 years.<sup>68</sup> This gap is largely due to relatively late implementation of compulsory

education in China, and lower educational attainment among older generations and rural populations, which continues to weigh down the national average.

**As of 2023, a child entering education in China can expect to have 15.5 years of schooling, roughly the average for the high HDI grouping** but lower than the 17.8 years in the United Kingdom, 15.9 years in the United States, and in line with Japan. These differences are due both to different educational systems and enrollment rates at different stages. In 2023, the gross enrollment rate for higher education in China reached

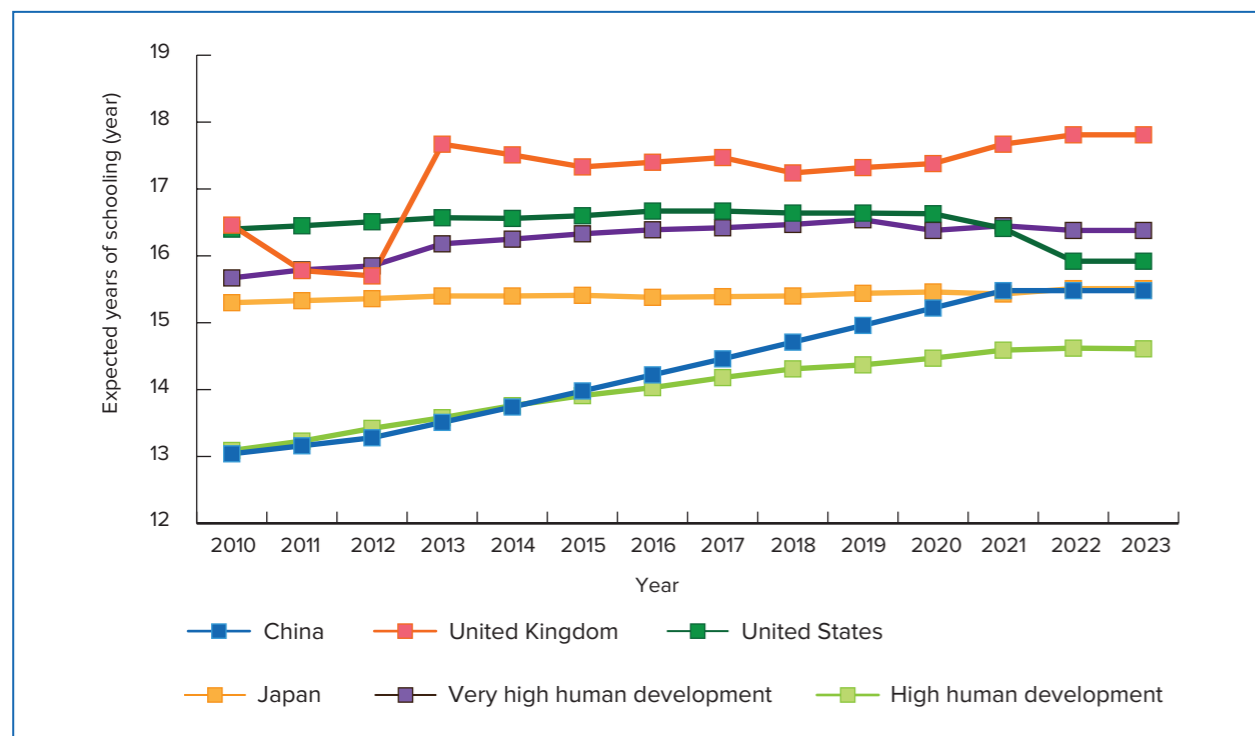
Figure 4.5 Mean years of schooling in China and other key countries (2010–2023)



Data from: UNDP (2025).

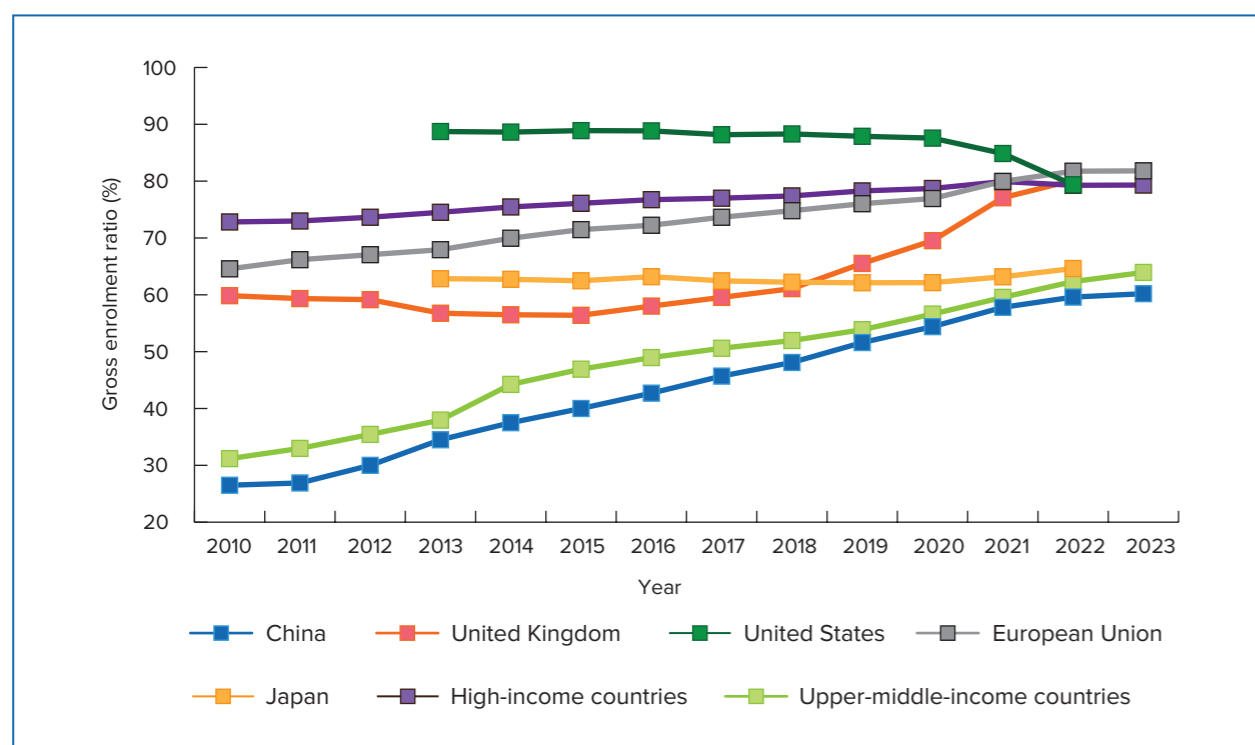
67.Data from: Ministry of Education.  
 68.According to the UNDP (2025).

Figure 4.6 Expected years of schooling for China and key countries (2010–2023)



Data: UNDP (2025).

Figure 4.7 Higher education gross enrollment rates for China and key countries (2010–2023)



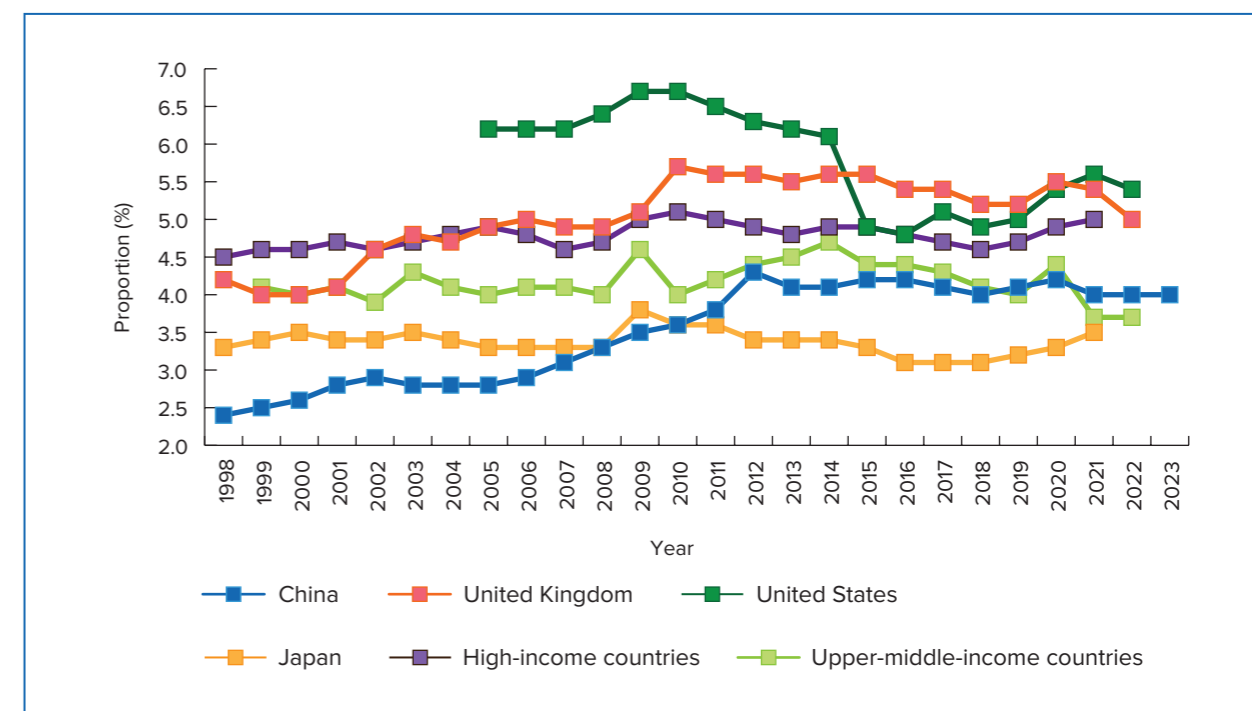
Data: Chinese data from the Chinese Ministry of Education, other data from the UNESCO Institute for Statistics.

60.2 percent, twice as high as in 2010.<sup>69</sup> However, it still lags behind averages for upper-middle-income countries (63.9 percent) and high-income countries (79.3 percent), remaining significantly lower than that of countries with well-established higher education systems, such as the United States and the United Kingdom.

**Government expenditure on education remains lower than in high-income countries.** In China, it stood at 4 percent of GDP in 2022, versus a global average of 4.2 percent (2021) and the high-income countries' average of 5 percent. For example, as the 2019 China Human Development Report called for extending compulsory education from nine to twelve years, the greatest challenge lies in securing sustainable financial support. Over the past decade, several regions—

including special zones, ethnic minority areas, and provinces like Zhejiang, Guangdong, and Hebei—have piloted free senior high school education. Regions such as Xinjiang, Tibet, Inner Mongolia, the Daliang Mountains (Sichuan), and developed eastern coastal areas have gone further, implementing 15 years of free education (including preschool), as well as free secondary vocational school. While these trials have accumulated valuable experience, rolling out 12 years of compulsory education nationwide would be a bigger challenge, requiring both funding and qualified teaching staff. This challenge is further compounded by a slowing economy and tighter fiscal conditions. Developing a comprehensive policy framework to mobilize and allocate sufficient resources for extending compulsory education is crucial to making this vision a reality.

Figure 4.8. Government expenditure on education as a percentage of GDP



Data: Chinese data from the Chinese Ministry of Education, other data from the World Bank (<https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS>)

<sup>69</sup>The gross enrollment rate for China here is taken from national statistics and differs from the UNESCO figure of 74.8%.

### 03 REGIONAL DIFFERENCES IN HUMAN DEVELOPMENT ARE STILL SIGNIFICANT

**While development gaps between different regions have shrunk, they remain significant, with northern and western areas of China among the most vulnerable, showcasing slower human development.**

Here we highlight two main findings:

**Firstly, slower development in northern China reversed the north-south gap in the decade to 2020.**

Looking at the Human Development Index, both the north and south<sup>70</sup> of China saw annual increases from 2010 to 2020, but improvements in the south were faster. While in 2010, the average HDI value for provinces in the north was higher than in the south, the south caught up in 2017 and has been in the lead since (see Figure 4.10). This has been driven by increasing changes in GNI per capita in the south, which has become China's economic heartland. With economic development slowing in the north and populations shifting south, preventing a further widening of the human development gap between north and south will be a major challenge.

At the HDI sub-component level, the south of China has also gradually gained a growing advantage over the north in life expectancy (excluding Xinjiang and Tibet), as shown in Figure 4.11. As for education, expected years of schooling increased in both the north and south between 2010 and 2020, with the north consistently ahead of the south (Figure 4.12). The situation for mean years of schooling was the same, with the north maintaining an advantage (Figure 4.13). Overall, the north has maintained a relatively high

level of education, thanks to its historical head start. However, as the south's progress has outpaced the north's, the educational gap between the two regions is gradually narrowing.

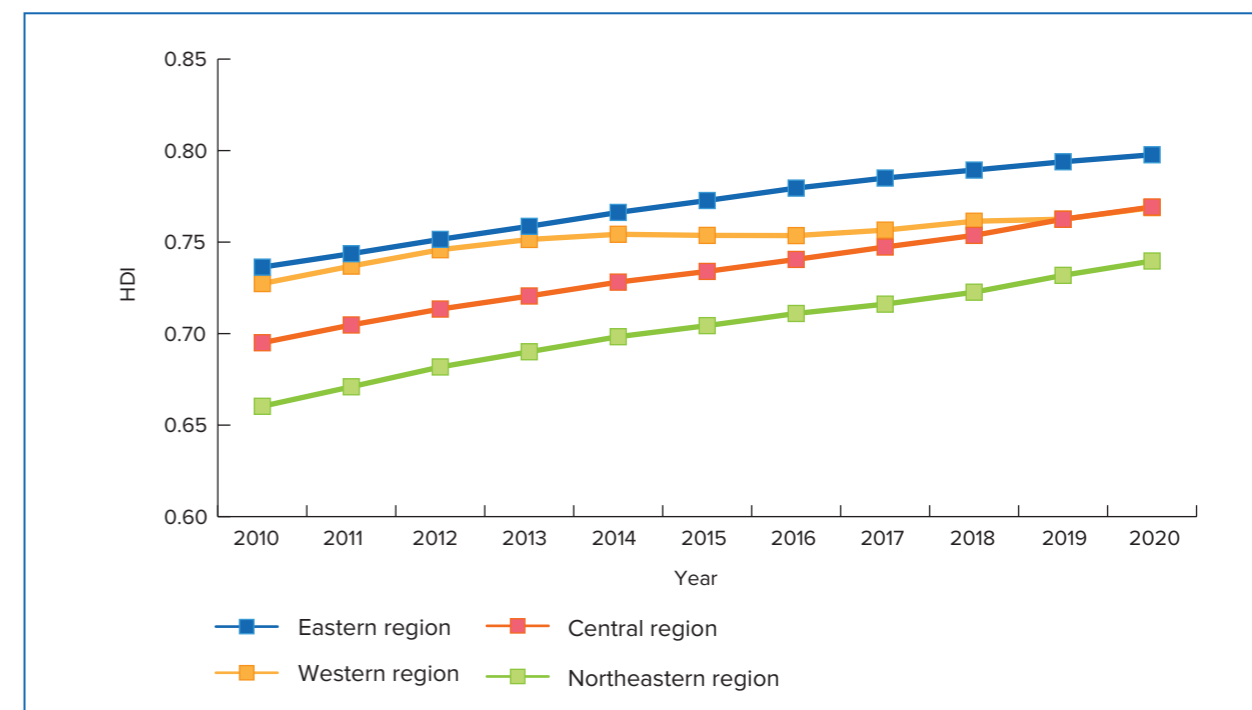
**Second, western China, along with Guangdong province, continues to record persistent uneven development** (see Figure 4.14). To analyse divergences in development at the local level, we use the inequality-adjusted human development index (IHDI), calculated for 26 provinces for 2010 and 2020.<sup>71</sup> By calculating the degree of inequality between a province's prefectural cities on life expectancy, years of schooling and GNI per capita, an adjustment factor can be obtained, converting HDI values to IHDI values. The closer those two values are, the more balanced development is across its cities. The degree of reduction from HDI to IHDI reflects the overall losses in human development caused by intra-provincial inequality.

In Guangdong, a developed province in eastern China, for example, the IHDI value for 2020 was 0.776, a drop of 0.041 from its HDI level (0.809). Within the province, Shenzhen had the highest HDI (0.880), placing it at the top end of the very high HDI grouping, while Shanwei, with the lowest HDI (0.738) value, reached a mid-level within the high HDI grouping and slightly above the global average.

70.The south includes 16 province-level administrations: Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Yunnan, Guizhou and Tibet. The north includes 15 province-level administrations: Beijing, Tianjin, Hebei, Shanxi, Shandong, Henan, Liaoning, Jilin, Heilongjiang, Shaanxi, Gansu, Qinghai, Inner Mongolia, Ningxia and Xinjiang.

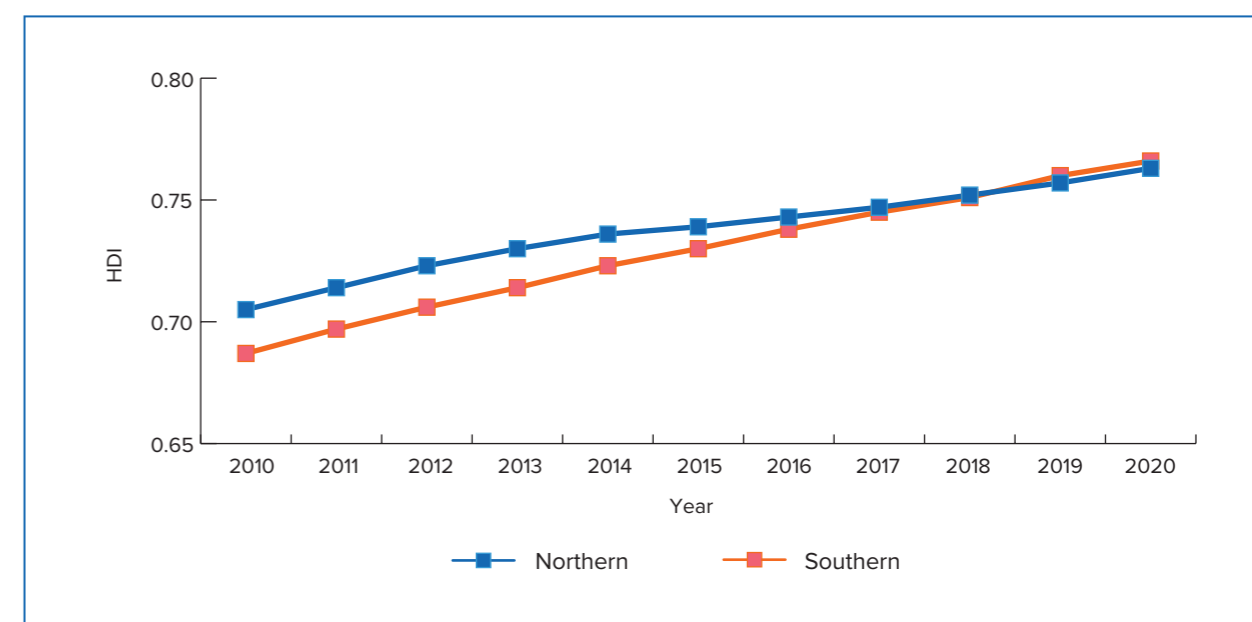
71.Due to data availability, calculations were not carried out for the four directly administered municipalities and the province of Hainan.

Figure 4.9. Regional HDI values (2010–2020)



Data from: Gong et al (2025).

Figure 4.10 North-south HDI gap (2010–2020)



Data: Yang and Gong (2025).

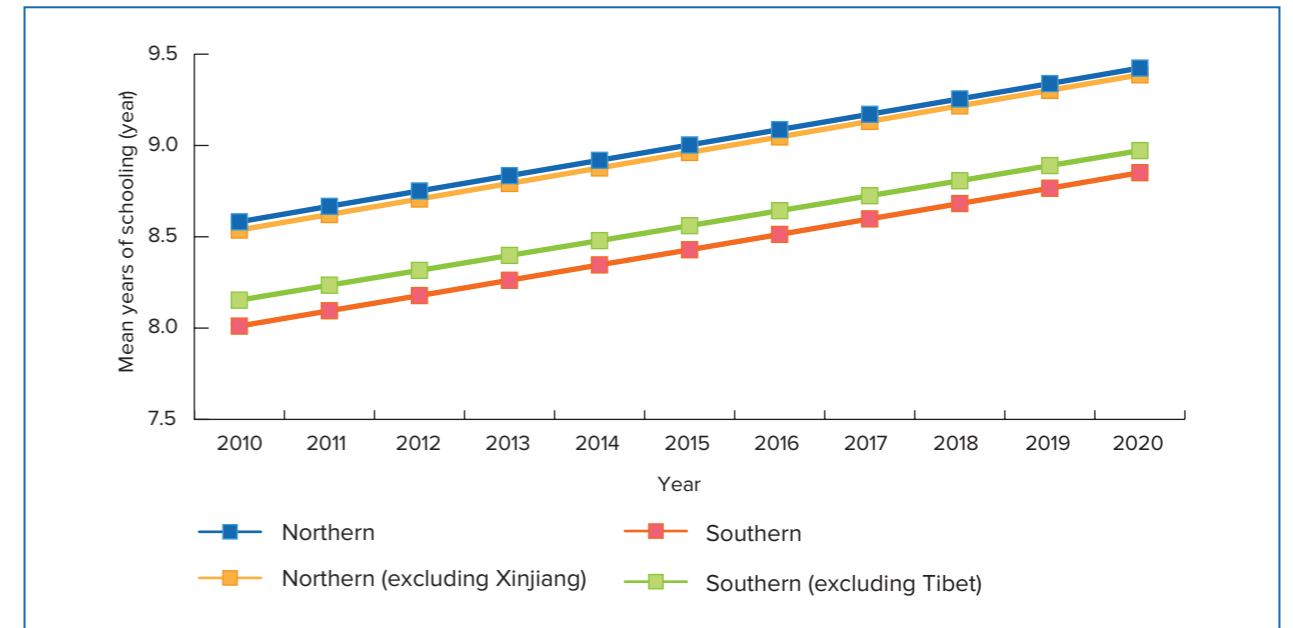
Note: Calculated by an unweighted average, same below.

Figure 4.11 North-south life expectancy gap (2010–2020)



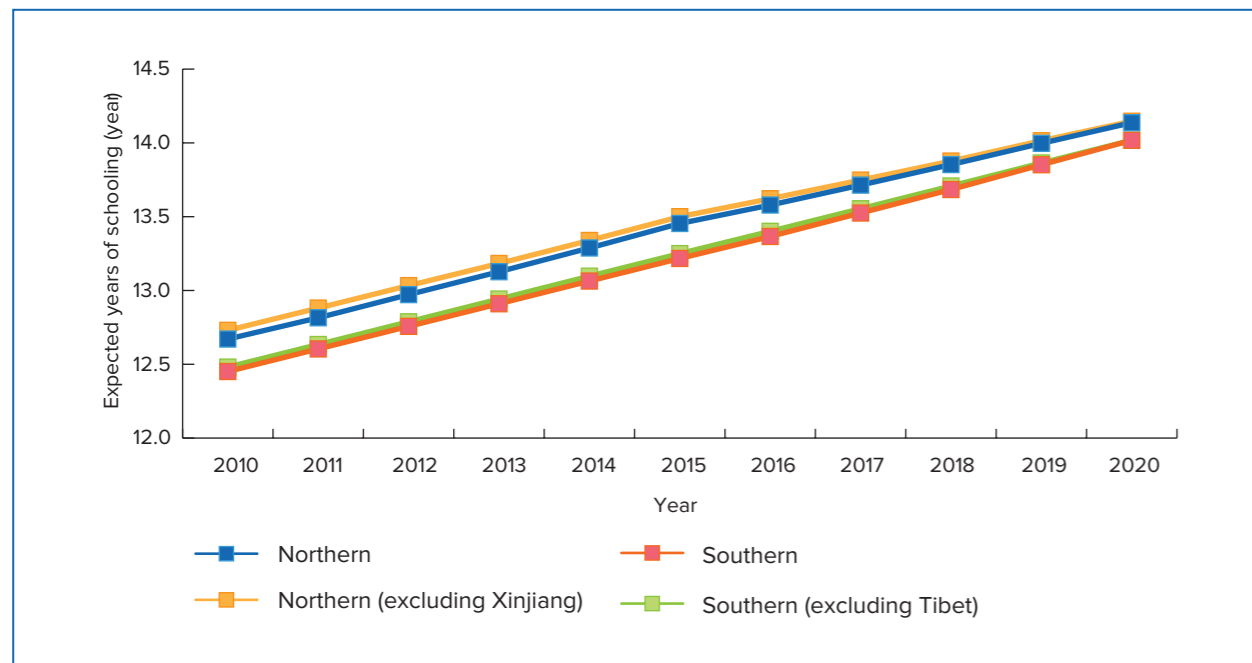
Data: Yang and Gong (2025).

Figure 4.13 North-south mean years of schooling gap (2010–2020)



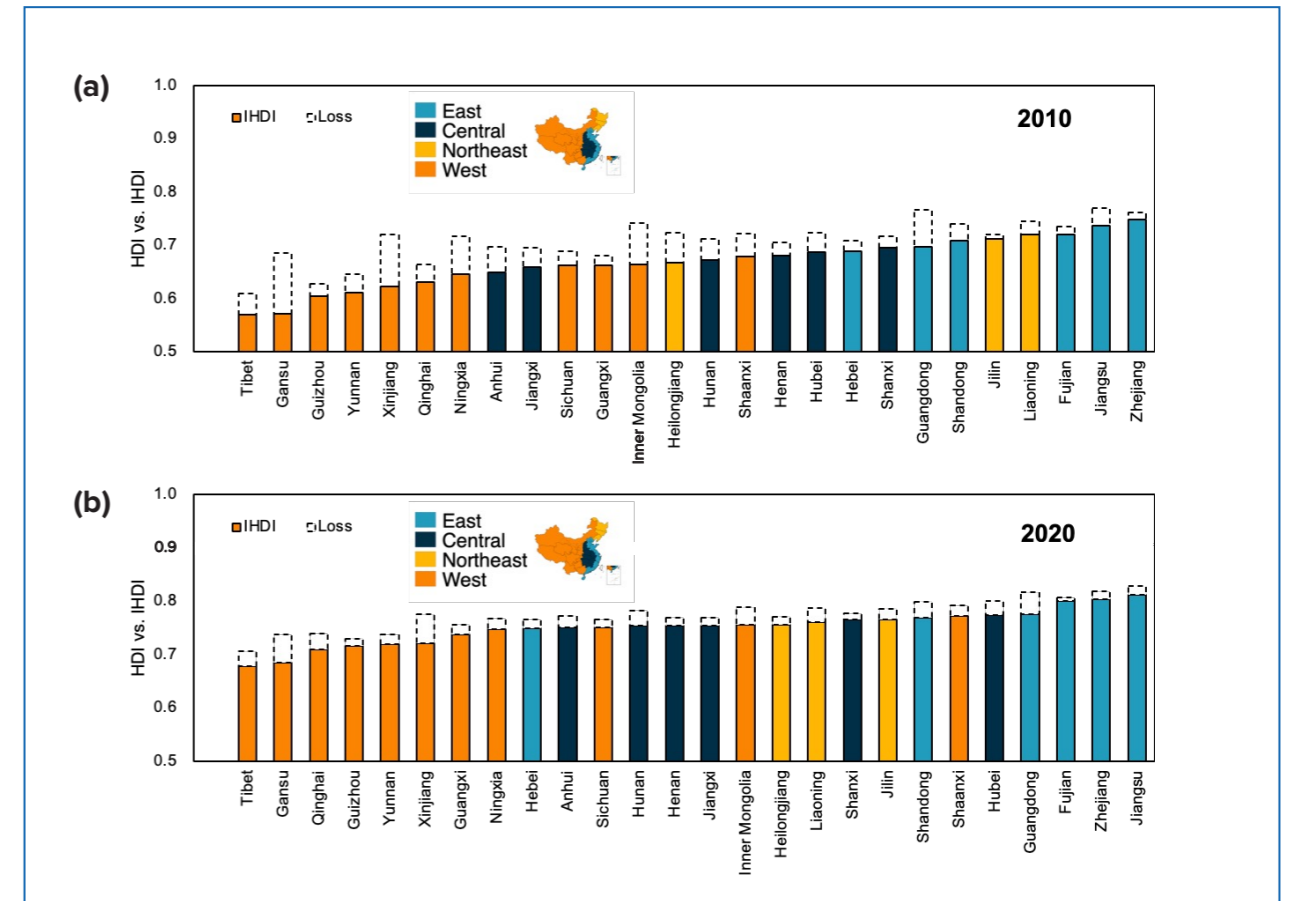
Data: Yang and Gong (2025).

Figure 4.12 North-south expected years of schooling gap (2010–2020)



Data: Yang and Gong (2025).

Figure 4.14 Comparison of HDI and IHDI values for 26 provinces



Data: Yang and Gong (2025).

## 04 PROGRESS ON DIFFERENT INDICATORS REMAINS UNEVEN

### Pockets of uneven progress across different pillars of human development are also evident, particularly in northern China.

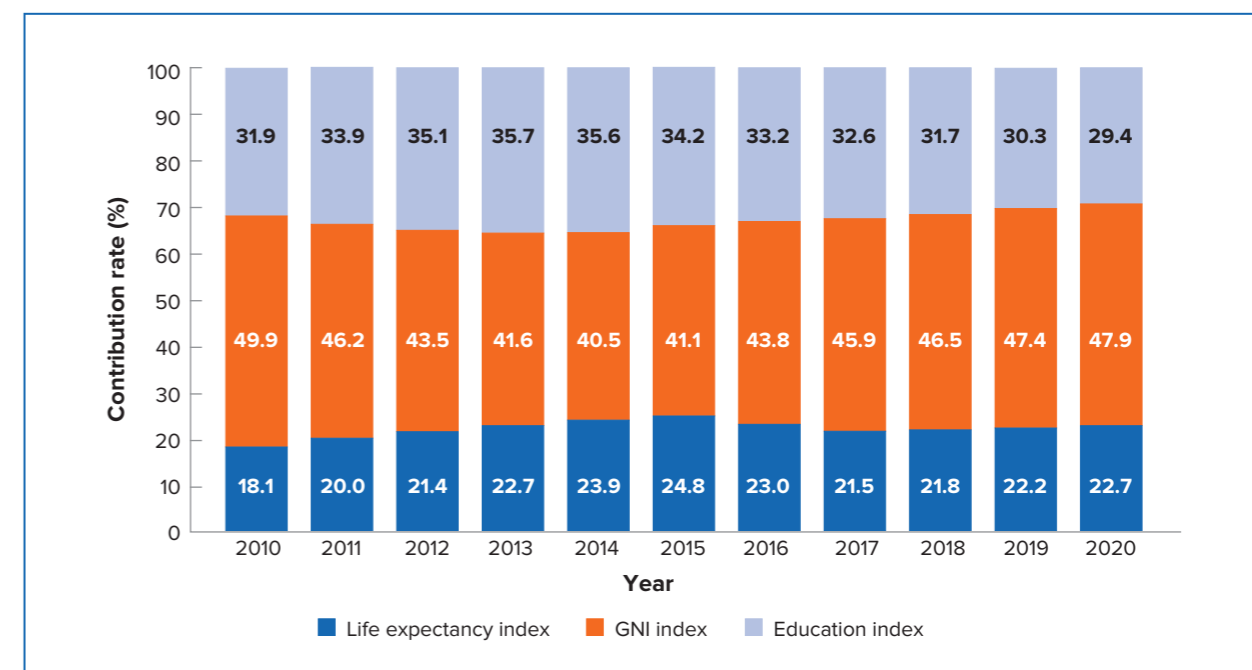
For example, certain areas have struggled to translate strong economic performance into solid advancements for education and health, before structural changes in their economic models led to slower progress in overall human development. This is the case for some resource-based cities. Alashan League (Inner Mongolia) recorded relatively high average incomes, but lagged behind on health and education earlier on. In the 2010s, reliance on a single industry meant slower overall human development progress, dropping from the 5<sup>th</sup> to 40<sup>th</sup> place in 2020 in the HDI ranking among China's 331 prefectural cities.

### Focusing on which dimension would be primarily responsible for human development disparities across different provinces, data points to income gaps, then education differences, and finally life expectancy.

In 2010, the income gap accounted for 49.9 percent of overall HDI gaps, the education gap for 31.9 percent and life expectancy for 18.1 percent (see Figure 4.15). Differences between the three sub-indices tended to shrink between 2010 and 2015. However, those differences widened again after 2015, mostly due to the economic dimension, exhibiting a new trend of divergence. Economic growth in northern regions began slowing earlier than in southern regions, leading to a renewed widening of interprovincial income gaps. As a result, the income dimension has once again increased in its relative contribution to overall differences in the HDI.

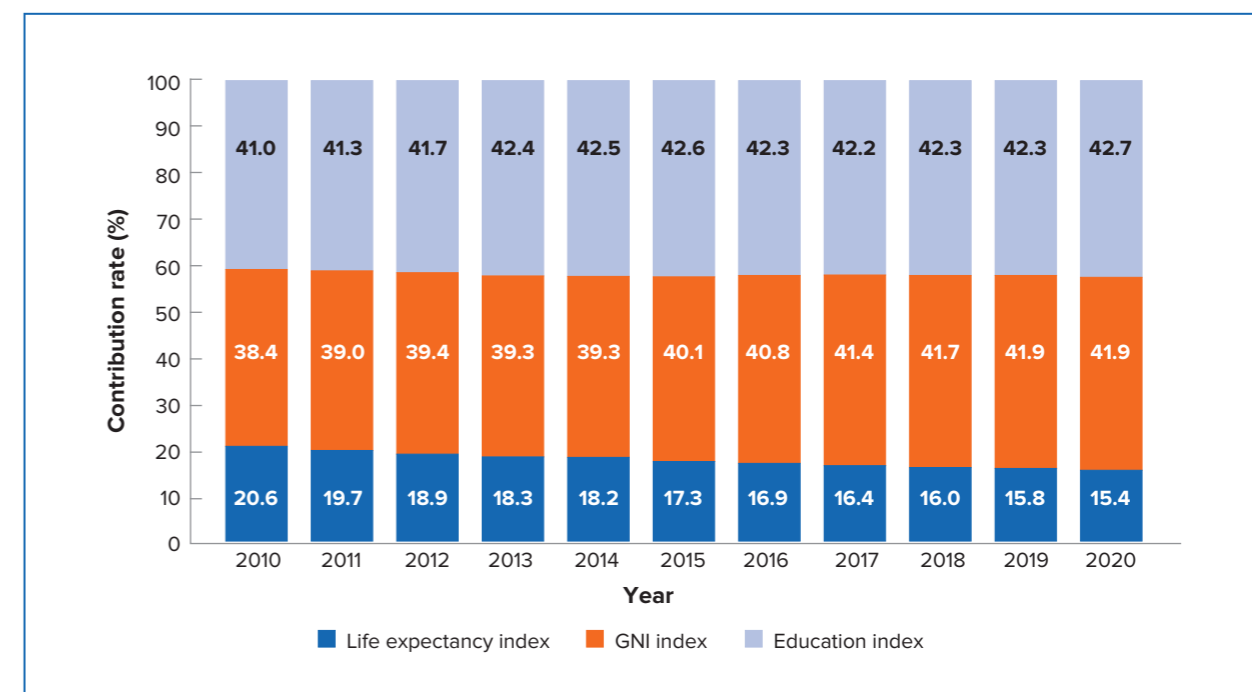
Figure 4.16 shows globally how differences across the three sub-indicators contribute to gaps in overall HDI. As can be seen, in China, income differences contribute significantly more to overall HDI disparities among provinces than the global average. This pattern of interprovincial HDI differences in China differs markedly from the global trend. Globally, education and income are typically the main sources of HDI variation, with roughly equal contributions. In contrast, in China, income plays a significantly larger role than education and health, making it the dominant factor in explaining interprovincial disparities in human development.

Figure 4.15 Contribution of health, education, and income differences to overall HDI differences for Chinese provinces (2010–2020)



Data: Yang and Gong (2025).

Figure 4.16 Contribution of health, education, and income differences to overall HDI differences globally (2010–2020)



Data: UNDP (2025)

## 05 MOVING TOWARDS LOW-CARBON DEVELOPMENT, THE ENVIRONMENT CONTINUES TO FACE MULTIPLE STRESSORS

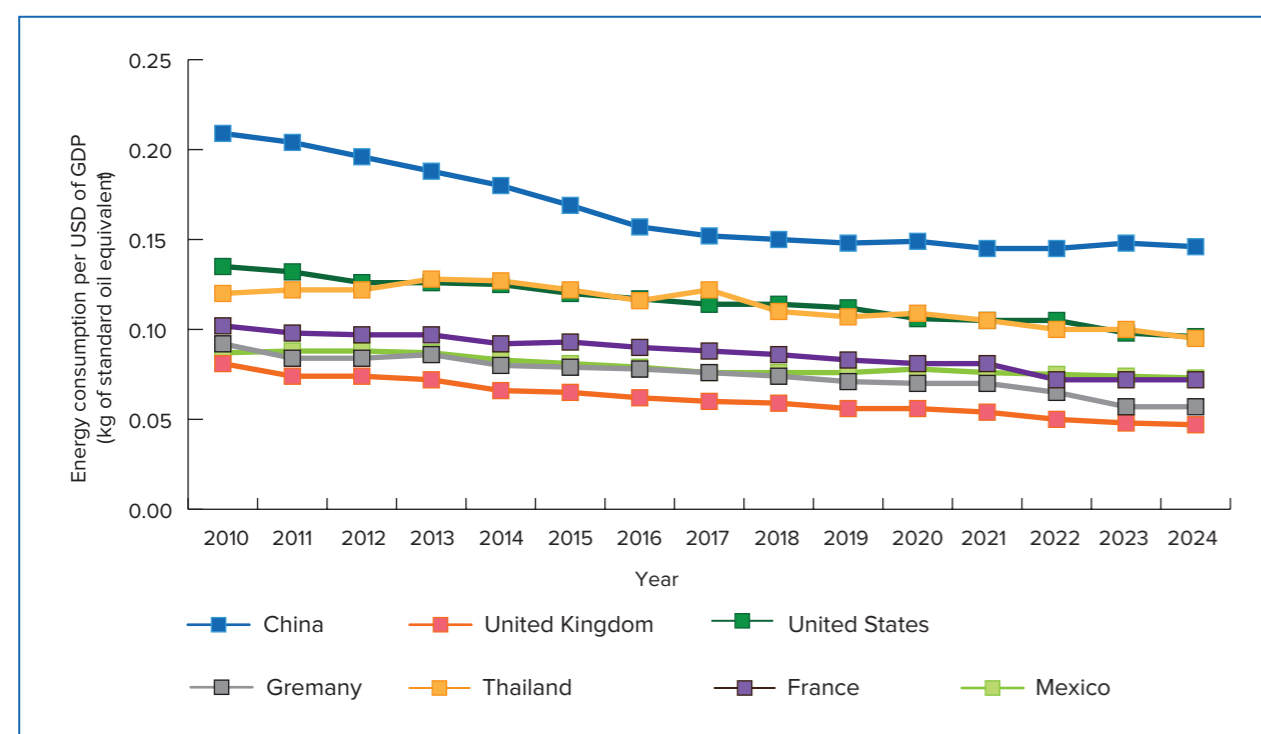
**China is now the world's biggest producer and consumer of energy, having grown to the second-largest economy and largest manufacturing hub in the world.** The energy mix is changing, with coal's share falling from 69.2 percent in 2010,<sup>72</sup> to 53.2 percent in 2024<sup>73</sup> and renewable energy installed capacity having surpassed fossil fuel.

**However, long-standing problems with extensive expansion, low efficiency, and wasted resources remain.** As Figure 4.17 shows, energy intensity of GDP has trended downwards in recent years, reflecting China's successes on energy saving and emissions reduction. However, that trend has slowed and energy

intensity is still higher than in key developed nations. In 2024, China burned the equivalent of 0.146 kg standard oil per USD of GDP, about 1.5 times as much as the United States, 2.6 times as much as Germany, 2.0 times as much as Mexico, and 1.5 times as much as Thailand. This highlights the resource-intensive nature of China's current economic development, contrary to high-quality development requirements.

While China has made continued progress in ecological and environmental protection, its ecosystems still face deep-rooted, long-term structural and fundamental pressures, closely tied to the country's current stage of development. During periods of rapid development,

**Figure 4.17 Comparison of energy-intensity of GDP across key countries (2010–2024)**



Data: <https://yearbook.enerdata.net/total-energy/world-energy-intensity-gdp-data.html>. GDP in 2015 USD.

72. China Statistical Yearbook 2024, NBS, <https://www.stats.gov.cn/sj/ndsj/2024/indexch.htm>

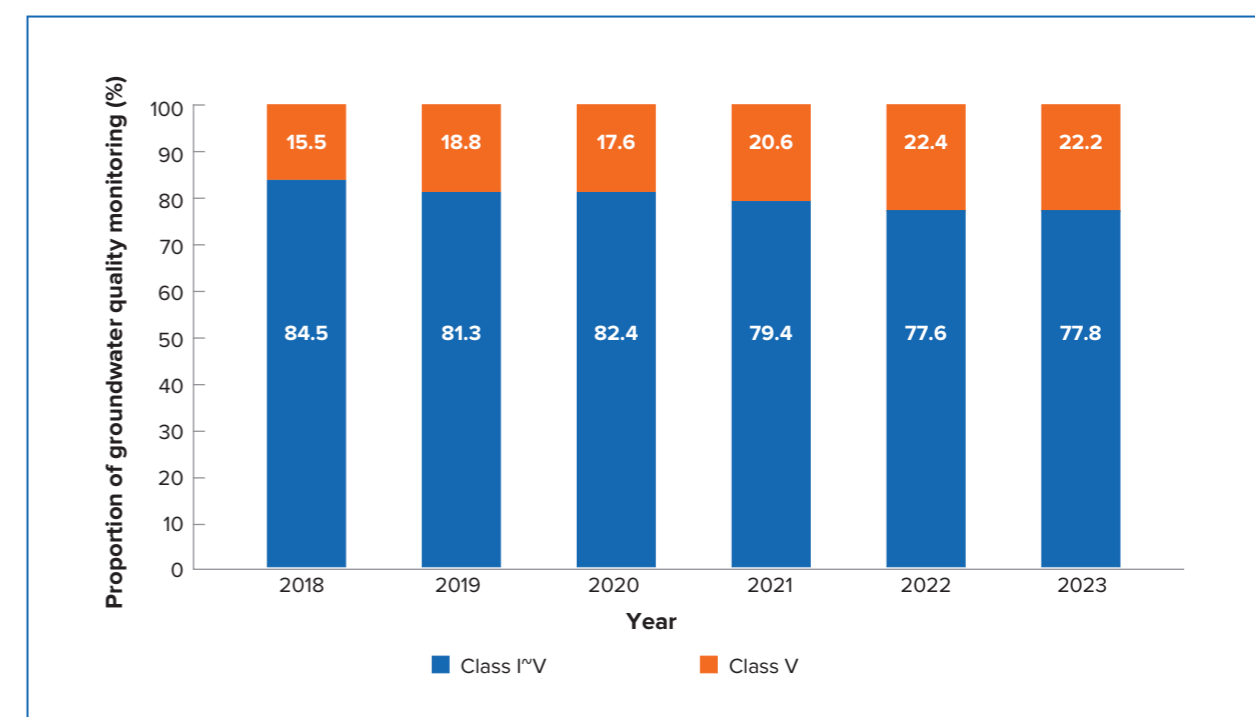
73. [https://www.stats.gov.cn/sj/zxfb/202502/t20250228\\_1958817.html](https://www.stats.gov.cn/sj/zxfb/202502/t20250228_1958817.html)

substantial investments and material inputs have inevitably led to a sustained increase in material footprint, carbon emissions, and pollutant discharge. This has significantly intensified the overall burden on ecosystems and highlighted the persistent, long-standing nature of legacy environmental issues. Groundwater pollution serves as a typical example. Groundwater pollution is a long-term, complex and largely invisible problem, and much harder to resolve than surface water pollution. As Figure 4.18 shows, the proportion of monitoring sites recording groundwater quality of Class V – the lowest quality in a I to V classification, rose both from 2018 to 2020 and 2021

to 2023.<sup>74</sup> The 14th Five-Year Plan for the Protection of Soil, Groundwater and Rural Ecological Environment, published in 2022, stressed soil and groundwater pollution remained serious problems and tended to be concentrated in certain areas, that prevention at source was difficult, and that monitoring capabilities remained weak.<sup>75</sup>

Water-intensity of GDP (at constant price)<sup>76</sup> fell 84 percent from 1997 to 2020, but remains high. As Figure 4.19 shows, China used 57.2 cubic meters of water per USD 10,000 of GDP in 2020. This is lower than the middle-upper income countries, but much higher than key developed nations.

**Figure 4.18 Groundwater quality in China (2018–2023)**



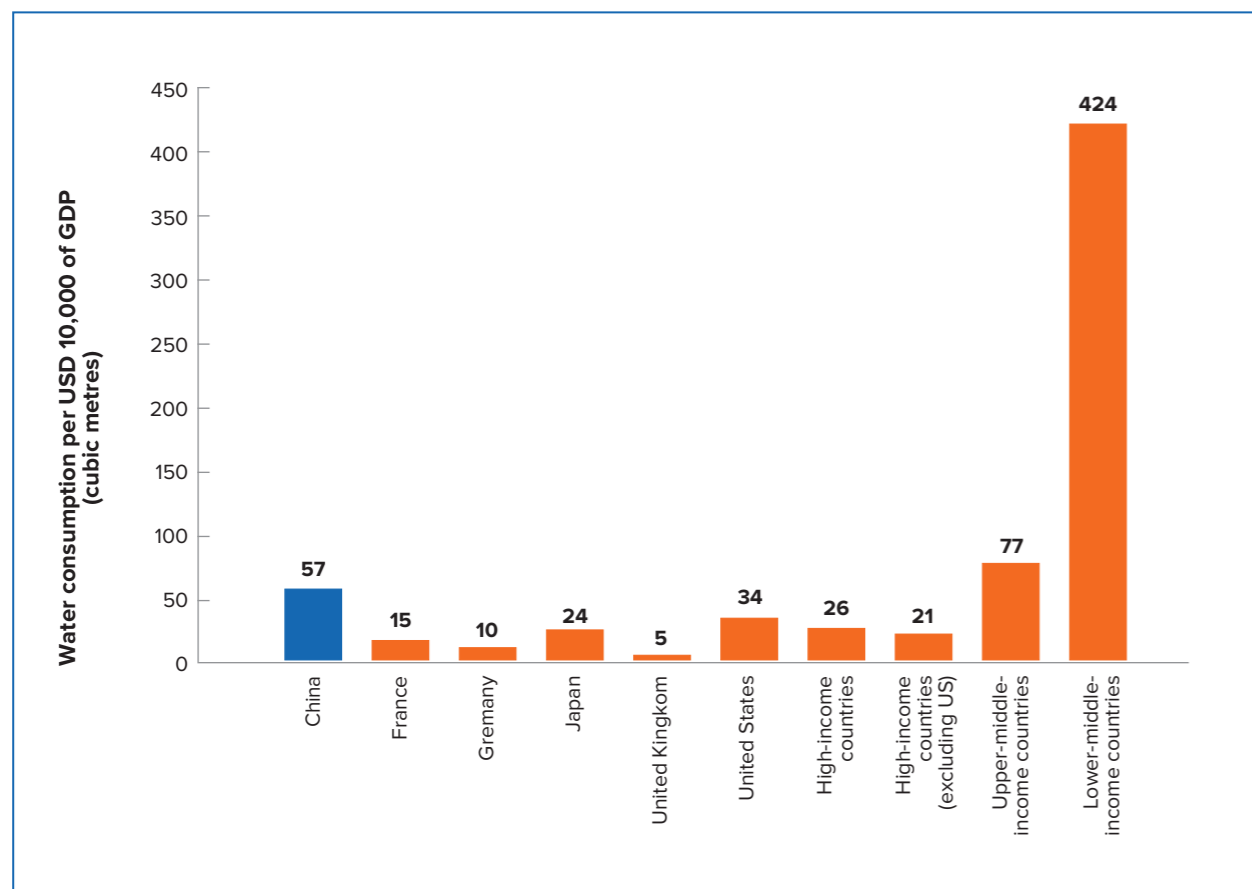
Data: Historical China Ecological and Environmental Reports

74. National standards for groundwater were changed in 2017 and pre-2017 data is no longer comparable. The 2018-2020 data comes from Ministry of Natural Resources monitoring points, the 2021-2023 data from separate monitoring points run by the Ministry of Ecology and Environment MEE. The two data sets are not comparable. Also, the MEE only released a total figure for monitoring points finding Grade I to Grade IV groundwater quality for 2021-2023, not a more detailed breakdown.

75. See: [https://www.gov.cn/zhengce/zhengceku/2022-01/04/content\\_5666421.htm](https://www.gov.cn/zhengce/zhengceku/2022-01/04/content_5666421.htm)

76. 2020 China Water Resources Bulletin, <http://slqjd.mwr.gov.cn/szygb/2022-09-23/332.html>

Figure 4.19 Water intensity of GDP in China and other key countries



Data: Geng Siming, Liu Dingxiang, Xia Peng An international comparison of water use efficiency in China and elsewhere [J]. *Water Resources Development Research*, 2022,22(08):77-82. Data for China is from 2020. Other data is the most recent available.

## CHAPTER 5 RECOMMENDATIONS

China is already near the top of the high HDI tier and on the verge of entering the very high grouping. Doing so would be of great significance, not only for achieving common prosperity within China, but also as an important contribution to global human development: the population of the very high HDI

grouping would increase from 20 percent of the global total, to 40 percent. Building on the evidence and insights from this study, the China’s 2019 Human Development Report and the new challenges and trends which have since emerged, we recommend prioritizing efforts in the five areas, detailed below.

### 01 FOCUS ON HEALTHY LIFE EXPECTANCY TO FURTHER IMPROVE POPULATION HEALTH

**‘Healthy life’ expectancy indicators are recommended<sup>77</sup> (e.g., the average number of years a person can expect to live in “full health”) to better reflect health levels in an aged society, as a marker of development.**

First of all, China’s average life expectancy has reached a relatively high level, above the average of upper-middle income countries. Thus, further improvements will be more challenging than in the past. Meanwhile, with rising life expectancy and declining birth rates, China officially became an aged society, generally defined as a country with 14% or more of its population above 65 years or older. By 2023, the proportion of the population aged 65 and above had reached 15.4 percent.<sup>78</sup>

**To increase healthy life expectancy, we recommend accelerating the development of a comprehensive, life-course health service system,** promoting better integration of medical care and disease prevention, controlling chronic disease risk factors, standardizing

medical treatment practices, and improving both health outcomes and quality of life.

**At the same time, designing a sustainable health insurance system is also critical for further improvements in healthy life expectancy.**

With economic growth slowing, an aging population, and insurance coverage improving, China’s health insurance funds are expected to remain under pressure. We recommend further improvements to how funds are raised; better unifying management of basic health insurance; promoting provincial-level pooling reforms for both employee and resident health insurance; and reducing differences in insurance coverage across different schemes, different regions, and between urban and rural areas. Finally, China should accelerate setting-up a national long-term care insurance scheme, based on trial scheme findings, to meet the needs of those unable, or partially unable, to care for themselves.<sup>79</sup>

<sup>77</sup>According to WHO Global Health Observatory data for 2021, healthy life expectancy (HALE) at age 60 is estimated at 17.4 years in high-income countries, 15.0 years in upper-middle-income countries, and 16.2 years in China.

<sup>78</sup>The usual international definition of an aged society is one where 14% or more of the population is aged 65 or over.

<sup>79</sup>According to data from the 5th Survey of Living Conditions for the Elderly, in 2021 4.5% of elderly people in China could not look after themselves, while 7.1% faced some difficulty doing so, 13.2% self-reported as needing help with daily life.

## 02 EXPAND COMPULSORY EDUCATION AND INCREASE WORKFORCE ADAPTABILITY

**Education remains China's weak point in its pursuit of very high human development—and also holds the key to further progress.** Although mean years of schooling for those entering the workforce have gradually increased annually, overall population average and expected mean years of schooling remain low.

**To raise levels of scientific education, along with workforce knowledge and skills, it is necessary to expand compulsory education to include senior high school, bringing the number of years of compulsory schooling up to twelve.** Shorter periods of compulsory education result in injustices in education, with many children in rural areas and migrant workers' children leaving school after junior high school, limiting their future employment opportunities. We therefore recommend setting up a full lifespan education system, extending outwards from current provisions to cover pre-school, senior high school and vocational training,

while also continuing to increase gross enrollment rates for higher education.

**It is also essential to optimize the curriculum in higher education, develop a multi-tiered vocational education system, promote integration between education and industry, and strengthen non-degree vocational and skill training.** Although education in China has been improving, there's an increasingly apparent mismatch between what is taught in the education system, and the skills needed in the workplace. The rapid development of modern technologies—particularly artificial intelligence—demands that workers possess the ability to adapt to, learn, and apply new tools. Thus, the steps highlighted above would give workers both the skills needed now and the ability to learn those needed in the future. Lastly, fostering a culture of lifelong learning across society will be key to enhancing people's knowledge and resilience in the face of ongoing change.

## 03 IMPROVE INCOME DISTRIBUTION AND SUSTAIN HOUSEHOLD INCOME GROWTH

In 2024, GNI per capita (Atlas method) in China was USD 13,660,<sup>80</sup> nearing the threshold for high income countries.<sup>81</sup> Since 2012, the Gini coefficient for disposable income per capita has been at about 0.47, slightly off the peak of 0.491 in 2008, but still high when compared internationally.<sup>82</sup> Household income accounts for about 60 percent of China's

GNI, lower than in the United States (>75 percent) and the United Kingdom (about 65 percent),<sup>83</sup> indicating that the benefits of economic growth have not been fully translated into gains in household income and wealth. Income distribution therefore remains an area for improvement.

80. <https://data.worldbank.org/indicator/NY.GNP.PCAP.CD>

81. The World Bank's 2024 threshold for high income countries is GNI per capita of USD 14,005. <https://blogs.worldbank.org/en/opendata/world-bank-country-classifications-by-income-level-for-2024-2025>

82. Data from: National Bureau of Statistics

83. China data from capital flow tables in past editions of the China Statistical Yearbook. Other data from the OECD.

**In terms of primary distribution, a larger share of national income should go to workers in the form of wages.** Research has found that labor's share of income has followed a U-shaped pattern since 2000: falling initially, then recovering. However, it remains somewhat below that in developed nations.<sup>84</sup> To increase labor's share of income, greater attention should be paid to the institutional factors determining wages, reducing differences in human capital between different groups, and eliminating employment discrimination based on *hukou* (household registration) status, age, and gender.

**Income from assets should also be increased.** Surveys indicate that housing assets account for 50-60 percent of total household wealth,<sup>85</sup> while holdings of financial assets, such as shares or funds, are low. With the property sector in a downturn, capital market reforms should be deepened to improve transparency and enhance returns on financial assets for residents.

**There should be a greater emphasis on fairness in secondary distribution.** Empirical research shows that changes to basic pension provisions and the government's transfer payment policy have significantly improved income distribution, but individual income tax reforms have had limited impact.<sup>86</sup> This means further reform of direct taxes is needed, both in individual income taxation and potentially in inheritance taxes and property taxes, to prevent wealth inequalities being passed down generation to generation.

**In recent years, the Chinese government has emphasized the role of the "third distribution"—charitable giving and philanthropy—in promoting social equity.**<sup>87</sup> To maximize its redistributive impact, it is important to both foster a social culture of mutual support and improve tax incentives that encourage enterprises and social organizations to support low-income and vulnerable groups through donations and other means.

## 04 STRENGTHEN TARGETED REGIONAL POLICIES TO REDUCE DEVELOPMENT GAPS

The analysis in previous chapters shows there are still significant gaps in human development across China's regions. These are not just due to differing levels of economic development — health and education inequalities also play a role. China now has top-level policies to tackle this, including coordinated regional

development strategies, major regional strategies and major function-orientated zonal plans.

**More targeted and refined regional policy measures are needed going forward to further strengthen the gains.** A combination of people-centered and place-

84. Zhang Jun, Zhang Xibin, Zhang Lina. 2022. A Dynamic General Equilibrium Analysis of the Evolution of China's Labor Income Share. *Economic Research*, 57(07): 26-44.

85. Rasid, R., & Qiu, J. A Dive into Chinese Households' Balance Sheets. J.P. Morgan Asset Management, 30 October 2024. Available at: <https://am.jpmorgan.com/au/en/asset-management/adv/insights/market-insights/market-updates/on-the-minds-of-investors/a-dive-into-chinese-households-balance-sheets/>

86. Tang Gaojie, Yan Dongyi, Feng Shuaizhang. 2023. A Path Towards Common Prosperity: The Effect of Redistribution Policies on Income Distribution. *Economic Research*, 58(03):23-39.

87. See more in the policy document: Decision of the Central Committee of the Communist Party of China on Upholding and Improving Socialism with Chinese Characteristics and Modernizing the System and Capacity for Governance, adopted at the Fourth Plenary Session of the 19th CPC Central Committee in October 2019. Available at: [https://www.gov.cn/zhengce/2019-11/05/content\\_5449023.htm](https://www.gov.cn/zhengce/2019-11/05/content_5449023.htm).

based policy tools could be used to narrow economic disparities between regions, while ensuring more equitable access to public services and comparable living standards for all.<sup>88</sup>

**In terms of specific policy design, it is essential to remove institutional barriers that restrict population mobility.** This would include designing a system that allocates local government resources by actual permanent population rather than by hukou registration figures and decouples access to public services from hukou status to overcome urban-rural divide. Additionally, large-scale interregional migration has created notable “spatial spillover effects” in public services, such as education and healthcare—where the benefits of human capital investments by out-migration

regions are captured by in-migration regions. This results in weak incentives for local governments in outflow areas to invest in these sectors.<sup>89</sup> To address this, the central government should shoulder more fiscal responsibility and enhance transfer payments to support education and healthcare in less developed regions. Finally, regional development planning should encourage local governments to tailor strategies to their unique conditions and comparative advantages, avoiding redundant infrastructure and industrial investments. The allocation of infrastructure and public services should be aligned with population shifts to improve the spatial efficiency of public resource distribution.

## 05 CREATE A GREENER AND MORE SUSTAINABLE ENVIRONMENT

Building a green, low-carbon, and inclusive economy is fundamental to achieve sustainable human development and enhance long-term well-being. In recent years, China has made good progress towards an inclusive, low-carbon transition and an “ecological civilization”. To maintain that progress, the following three areas need close focus.

**First, continue to enhance the energy mix, phase-out fossil fuels, and speed up the circular economy’s development.** China’s renewable energy generating capacity continues to grow. According to the International Renewable Energy Agency, the country accounted for 64 percent of global growth in

renewables in 2024.<sup>90</sup> However, renewables still have room to grow in their share of electricity supply, reflecting bottlenecks in grid integration that hinder efficient utilization. To address this, China should accelerate its investments in grid infrastructure and storage technologies to enhance system flexibility and cross-regional transmission capacity. At the same time, electricity market reforms should be advanced to improve market mechanisms and facilitate the efficient integration and dispatch of renewable energy. Alongside this, the circular economy’s development should be accelerated, with particular attention to recycling wind power equipment and electric vehicle

batteries, in order to reduce resource use and pollution arising from action on climate change.

**Second, take account of the multiple impacts of climate change and promote fairness, as well as regional coordination.** Climate change and measures taken in response will affect human development in numerous ways. When setting development strategies, policymakers should consider how society and the environment interact and ensure social justice and regional coordination are considered during the green and low-carbon transitions. As shown in Chapter 3, northern China’s HDI rankings fall when environmental factors are taken into account, as the region has long been reliant on resources, investment and heavy industry for economic growth. Environmental constraints have increasingly become a barrier to human development in these regions. In practice, more developed areas often shift pollution- and resource-intensive production to less developed regions, exacerbating their environmental burden and regional disparities. Policymakers should therefore give the necessary support to regions which are home to energy-, resource-, and pollution-intensive industries, including policy support during economic transitions and funding for environmental restoration to leave no one behind.

**Third, improve coordination on climate change and biodiversity.** These two issues are closely linked and should be jointly planned for and managed to ensure balance and positive interactions. Green energy reduces climate risks, but may increase reliance on crucial minerals and bring new environmental pressures. For example, mining for lithium used in electric vehicle batteries may intensify biodiversity losses.<sup>91</sup> We recommend that green development strategies include comprehensive assessments of

potential trade-offs among different environmental goals, promoting the integration of climate and nature agendas, to better support each other.

To conclude, based on the human development indices analysis focusing on the aforementioned five areas will support China in strengthening advancement in the coming years. Namely: i) ensuring the quality of longer lives; ii) expanding the duration and workplace relevance of education; iii) enabling more equal income distributions, iv) addressing regional barriers to equal development and v) investing for a low carbon, nature-positive economy. Achieving this in its next stage of development would allow the country and the world a far greater chance of delivering on the SDGs by 2030, for a planet that can sustain everyone, while leaving no one behind.

88. Place-centered policies focus on methods such as infrastructure improvements to create better conditions for development in underdeveloped regions. People-centered policies focus on reducing the costs of mobility and encouraging movement from underdeveloped to more developed regions. See: Niang Meng, Zhang Haipeng, Wang Yao Contribution of China’s Coordinated Regional Development Strategy to Growth And The Debate Over Regional Policy Pathways [J]. *Social Sciences in China*, 2024, (04): 24 -45+ 204 - 205.

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## APPENDIX

## 01 PROVINCIAL AND PREFECTURE-LEVEL HUMAN DEVELOPMENT INDEX AND SUB-INDICES IN CHINA (2020)

Table 1: Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<b>Beijing</b>	<b>0.890</b>	<b>0.961</b>	<b>0.820</b>	<b>0.893</b>	<b>2189.31</b>
<b>Tianjin</b>	<b>0.841</b>	<b>0.943</b>	<b>0.769</b>	<b>0.820</b>	<b>1386.60</b>
<b>Hebei Province</b>	<b>0.762</b>	<b>0.888</b>	<b>0.703</b>	<b>0.708</b>	<b>7461.02</b>
Shijiazhuang	0.778	0.892	0.731	0.722	1123.51
Tangshan	0.799	0.886	0.712	0.808	771.80
Qinhuangdao	0.778	0.904	0.720	0.725	313.69
Handan	0.745	0.886	0.693	0.675	941.40
Xingtai	0.732	0.888	0.689	0.641	711.11
Baoding	0.740	0.886	0.696	0.657	924.26
Zhangjiakou	0.742	0.874	0.694	0.675	411.89
Chengde	0.751	0.877	0.690	0.701	335.44
Cangzhou	0.757	0.878	0.689	0.716	730.08
Langfang	0.780	0.889	0.717	0.744	546.41
Hengshui	0.743	0.886	0.695	0.668	421.29
<b>Shanxi Province</b>	<b>0.774</b>	<b>0.891</b>	<b>0.726</b>	<b>0.717</b>	<b>3491.56</b>
Taiyuan	0.822	0.915	0.776	0.781	530.41
Datong	0.761	0.882	0.718	0.695	310.56

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Yangquan	0.775	0.874	0.728	0.732	131.85
Changzhi	0.766	0.860	0.721	0.725	318.09
Jincheng	0.779	0.862	0.730	0.753	219.45
Shuozhou	0.786	0.891	0.715	0.762	159.34
Jinzhong	0.761	0.882	0.723	0.692	337.95
Yuncheng	0.749	0.882	0.725	0.657	477.45
Xinzhou	0.748	0.883	0.704	0.674	268.97
Linfen	0.748	0.865	0.721	0.672	397.65
Lvliang	0.756	0.878	0.705	0.699	339.84
<b>Inner Mongolia Autonomous Region</b>	<b>0.782</b>	<b>0.886</b>	<b>0.703</b>	<b>0.768</b>	<b>2404.92</b>
Hohhot	0.802	0.882	0.743	0.788	344.61
Baotou	0.817	0.912	0.726	0.823	270.94
Wuhai	0.805	0.874	0.729	0.820	55.66
Chifeng	0.738	0.851	0.681	0.693	403.60
Tongliao	0.745	0.862	0.691	0.695	287.32
Ordos	0.818	0.858	0.713	0.893	215.36
Hulun Buir	0.761	0.866	0.709	0.719	224.29
Bayannur	0.763	0.880	0.688	0.732	153.87
Ulanqab	0.746	0.878	0.668	0.707	170.63
Hinggan League	0.735	0.863	0.682	0.674	141.69

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Xilingol League</i>	0.784	0.882	0.704	0.777	110.71
<i>Alxa League</i>	0.817	0.878	0.738	0.842	26.24
<b>Liaoning Province</b>	<b>0.791</b>	<b>0.903</b>	<b>0.742</b>	<b>0.738</b>	<b>4259.14</b>
<i>Shenyang</i>	0.826	0.938	0.779	0.771	902.78
<i>Dalian</i>	0.835	0.946	0.759	0.810	745.08
<i>Anshan</i>	0.785	0.914	0.735	0.720	332.54
<i>Fushun</i>	0.761	0.865	0.733	0.695	173.19
<i>Benxi</i>	0.798	0.923	0.742	0.742	132.60
<i>Dandong</i>	0.761	0.926	0.720	0.661	218.84
<i>Jinzhou</i>	0.776	0.951	0.726	0.677	270.39
<i>Yingkou</i>	0.778	0.888	0.724	0.733	232.86
<i>Fuxin</i>	0.753	0.910	0.735	0.639	164.73
<i>Liaoyang</i>	0.781	0.908	0.730	0.719	160.46
<i>Panjin</i>	0.822	0.915	0.751	0.808	138.97
<i>Tieling</i>	0.738	0.911	0.708	0.624	238.83
<i>Chaoyang</i>	0.737	0.885	0.709	0.638	287.29
<i>Huludao</i>	0.748	0.908	0.717	0.644	243.42
<b>Jilin Province</b>	<b>0.782</b>	<b>0.899</b>	<b>0.743</b>	<b>0.715</b>	<b>2407.35</b>
<i>Changchun</i>	0.817	0.919	0.761	0.780	906.69
<i>Jilin</i>	0.765	0.908	0.744	0.662	362.37

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Siping</i>	0.737	0.908	0.726	0.606	181.47
<i>Liaoyuan</i>	0.762	0.914	0.725	0.669	99.69
<i>Tonghua</i>	0.755	0.892	0.735	0.657	130.28
<i>Baishan</i>	0.772	0.892	0.741	0.694	95.19
<i>Songyuan</i>	0.731	0.877	0.714	0.623	225.30
<i>Baicheng</i>	0.730	0.880	0.712	0.622	155.14
<i>Yanbian Korean Autonomous Prefecture</i>	0.777	0.938	0.755	0.661	198.63
<b>Heilongjiang Province</b>	<b>0.767</b>	<b>0.896</b>	<b>0.731</b>	<b>0.689</b>	<b>3185.01</b>
<i>Harbin</i>	0.793	0.937	0.742	0.718	1000.99
<i>Qiqihar</i>	0.746	0.915	0.719	0.632	406.75
<i>Jixi</i>	0.758	0.896	0.725	0.671	150.21
<i>Hegang</i>	0.757	0.881	0.732	0.671	89.13
<i>Shuangyashan</i>	0.758	0.882	0.724	0.681	120.88
<i>Daqing</i>	0.810	0.906	0.745	0.789	278.16
<i>Yichun</i>	0.774	0.966	0.737	0.651	87.89
<i>Jiamusi</i>	0.757	0.886	0.731	0.670	215.65
<i>Qitaihe</i>	0.742	0.891	0.723	0.635	68.96
<i>Mudanjiang</i>	0.757	0.896	0.731	0.663	229.02
<i>Heihe</i>	0.770	0.892	0.727	0.705	128.64
<i>Suihua</i>	0.730	0.877	0.697	0.638	375.62

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Daxing'anling Prefecture</i>	0.775	0.901	0.749	0.690	33.13
<b>Shanghai</b>	<b>0.885</b>	<b>0.962</b>	<b>0.813</b>	<b>0.886</b>	<b>2487.09</b>
<b>Jiangsu Province</b>	<b>0.826</b>	<b>0.913</b>	<b>0.729</b>	<b>0.848</b>	<b>8474.80</b>
<i>Nanjing</i>	0.879	0.983	0.779	0.889	931.47
<i>Wuxi</i>	0.868	0.972	0.751	0.895	746.21
<i>Xuzhou</i>	0.795	0.900	0.712	0.786	908.38
<i>Changzhou</i>	0.858	0.966	0.744	0.877	527.81
<i>Suzhou</i>	0.865	0.974	0.748	0.888	1274.83
<i>Nantong</i>	0.841	0.972	0.715	0.858	772.66
<i>Lianyungang</i>	0.790	0.885	0.727	0.767	459.94
<i>Huai'an</i>	0.794	0.888	0.706	0.798	455.62
<i>Yancheng</i>	0.792	0.889	0.697	0.800	670.96
<i>Yangzhou</i>	0.818	0.890	0.713	0.861	455.98
<i>Zhenjiang</i>	0.829	0.904	0.733	0.860	321.04
<i>Taizhou</i>	0.811	0.894	0.708	0.843	451.28
<i>Suqian</i>	0.780	0.887	0.709	0.754	498.62
<b>Zhejiang Province</b>	<b>0.815</b>	<b>0.926</b>	<b>0.715</b>	<b>0.819</b>	<b>6456.76</b>
<i>Hangzhou</i>	0.860	0.968	0.759	0.865	1193.60
<i>Ningbo</i>	0.840	0.953	0.723	0.861	940.43
<i>Wenzhou</i>	0.797	0.951	0.693	0.768	957.29

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Jiaxing</i>	0.825	0.963	0.708	0.822	540.09
<i>Huzhou</i>	0.823	0.974	0.707	0.812	336.76
<i>Shaoxing</i>	0.832	0.957	0.717	0.838	527.10
<i>Jinhua</i>	0.795	0.930	0.712	0.759	705.07
<i>Quzhou</i>	0.788	0.920	0.691	0.769	227.62
<i>Zhoushan</i>	0.830	0.931	0.715	0.858	115.78
<i>Taizhou</i>	0.797	0.936	0.689	0.784	662.29
<i>Lishui</i>	0.786	0.938	0.693	0.746	250.74
<b>Anhui Province</b>	<b>0.767</b>	<b>0.892</b>	<b>0.678</b>	<b>0.747</b>	<b>6102.72</b>
<i>Hefei</i>	0.822	0.919	0.728	0.831	936.99
<i>Wuhu</i>	0.806	0.932	0.684	0.823	364.44
<i>Bengbu</i>	0.767	0.885	0.680	0.749	329.64
<i>Huainan</i>	0.747	0.885	0.679	0.695	303.35
<i>Ma'anshan</i>	0.799	0.912	0.681	0.820	215.99
<i>Huai'bei</i>	0.760	0.877	0.682	0.733	197.03
<i>Tongling</i>	0.774	0.900	0.662	0.778	131.17
<i>Anqing</i>	0.761	0.882	0.676	0.739	416.53
<i>Huangshan</i>	0.773	0.901	0.682	0.751	133.06
<i>Chuzhou</i>	0.788	0.900	0.700	0.777	398.71
<i>Fuyang</i>	0.723	0.885	0.651	0.656	820.03

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Suzhou</i>	0.745	0.888	0.691	0.674	532.45
<i>Lu'an</i>	0.737	0.885	0.673	0.672	439.37
<i>Bozhou</i>	0.717	0.857	0.647	0.665	499.68
<i>Chizhou</i>	0.761	0.885	0.661	0.753	134.28
<i>Xuancheng</i>	0.770	0.908	0.668	0.752	250.01
<b>Fujian Province</b>	<b>0.806</b>	<b>0.900</b>	<b>0.704</b>	<b>0.826</b>	<b>4154.01</b>
<i>Fuzhou</i>	0.827	0.915	0.729	0.847	829.13
<i>Xiamen</i>	0.845	0.937	0.756	0.851	516.40
<i>Putian</i>	0.795	0.931	0.685	0.789	321.07
<i>Sanming</i>	0.809	0.923	0.689	0.831	248.65
<i>Quanzhou</i>	0.807	0.899	0.696	0.840	878.23
<i>Zhangzhou</i>	0.788	0.899	0.680	0.802	505.43
<i>Nanping</i>	0.784	0.908	0.684	0.775	268.06
<i>Longyan</i>	0.802	0.894	0.698	0.826	272.36
<i>Ningde</i>	0.785	0.903	0.676	0.791	314.68
<b>Jiangxi Province</b>	<b>0.766</b>	<b>0.887</b>	<b>0.690</b>	<b>0.734</b>	<b>4518.86</b>
<i>Nanchang</i>	0.815	0.926	0.724	0.807	625.50
<i>Jingdezhen</i>	0.760	0.868	0.685	0.739	161.90
<i>Pingxiang</i>	0.770	0.900	0.702	0.723	180.48
<i>Jiujiang</i>	0.763	0.838	0.692	0.765	460.03

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Xinyu</i>	0.794	0.909	0.696	0.791	120.25
<i>Yingtian</i>	0.784	0.862	0.703	0.794	115.42
<i>Ganzhou</i>	0.744	0.877	0.689	0.683	897.00
<i>Ji'an</i>	0.750	0.880	0.676	0.708	446.92
<i>Yichun</i>	0.749	0.838	0.688	0.729	500.77
<i>Fuzhou</i>	0.742	0.880	0.672	0.692	361.49
<i>Shangrao</i>	0.741	0.880	0.678	0.681	649.11
<b>Shandong Province</b>	<b>0.792</b>	<b>0.910</b>	<b>0.711</b>	<b>0.768</b>	<b>10152.75</b>
<i>Jinan</i>	0.830	0.917	0.749	0.833	920.24
<i>Qingdao</i>	0.844	0.945	0.749	0.851	1007.17
<i>Zibo</i>	0.806	0.916	0.733	0.781	470.41
<i>Zaozhuang</i>	0.750	0.869	0.696	0.697	385.56
<i>Dongying</i>	0.845	0.939	0.743	0.865	219.35
<i>Yantai</i>	0.829	0.932	0.733	0.833	710.21
<i>Weifang</i>	0.788	0.912	0.717	0.747	938.67
<i>Jining</i>	0.773	0.910	0.699	0.725	835.79
<i>Taian</i>	0.770	0.908	0.703	0.715	547.22
<i>Weihai</i>	0.833	0.953	0.736	0.824	290.65
<i>Rizhao</i>	0.785	0.915	0.697	0.759	296.84
<i>Linyi</i>	0.747	0.892	0.674	0.694	1101.84

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Dezhou	0.765	0.878	0.700	0.727	561.12
Liaocheng	0.751	0.895	0.699	0.676	595.21
Binzhou	0.774	0.892	0.693	0.751	392.86
Heze	0.748	0.923	0.668	0.679	879.59
<b>Henan Province</b>	<b>0.765</b>	<b>0.886</b>	<b>0.696</b>	<b>0.727</b>	<b>9936.55</b>
Zhengzhou	0.832	0.932	0.760	0.812	1260.06
Kaifeng	0.750	0.869	0.682	0.711	482.40
Luoyang	0.789	0.888	0.717	0.771	705.67
Pingdingsha	0.763	0.896	0.696	0.712	498.71
Anyang	0.750	0.890	0.688	0.688	547.76
Hebi	0.772	0.882	0.698	0.748	156.60
Xinxiang	0.764	0.883	0.713	0.708	625.19
Jiaozuo	0.784	0.898	0.724	0.742	352.11
Puyang	0.750	0.888	0.685	0.694	377.21
Xuchang	0.783	0.885	0.694	0.782	438.00
Luohe	0.782	0.901	0.701	0.756	236.75
Sanmenxia	0.786	0.885	0.715	0.768	203.49
Nanyang	0.740	0.882	0.675	0.681	971.31
Shangqiu	0.737	0.889	0.673	0.670	781.68
Xinyang	0.740	0.875	0.664	0.697	623.44

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Zhoukou	0.729	0.886	0.658	0.665	902.60
Zhumadian	0.745	0.897	0.675	0.683	700.84
<b>Hubei Province</b>	<b>0.794</b>	<b>0.892</b>	<b>0.728</b>	<b>0.772</b>	<b>5775.26</b>
Wuhan	0.859	0.929	0.792	0.860	1232.65
Huangshi	0.791	0.911	0.719	0.757	246.91
Shiyan	0.783	0.908	0.713	0.740	320.90
Yichang	0.829	0.932	0.738	0.827	401.76
Xiangyang	0.801	0.898	0.717	0.798	526.10
Ezhou	0.809	0.900	0.728	0.808	107.94
Jingmen	0.803	0.903	0.742	0.772	259.69
Xiaogan	0.767	0.894	0.703	0.718	427.04
Jingzhou	0.765	0.909	0.705	0.699	523.12
Huanggang	0.748	0.908	0.691	0.668	588.27
Xianning	0.776	0.893	0.713	0.734	265.83
Suizhou	0.771	0.885	0.715	0.724	204.79
Enshi Tujia and Miao Autonomous Prefecture	0.742	0.892	0.706	0.648	345.61
<b>Hunan Province</b>	<b>0.776</b>	<b>0.890</b>	<b>0.702</b>	<b>0.747</b>	<b>6644.49</b>
Changsha	0.840	0.923	0.756	0.850	1004.79
Zhuzhou	0.803	0.920	0.717	0.784	390.27
Xiangtan	0.804	0.911	0.717	0.795	272.62

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Hengyang	0.759	0.883	0.687	0.721	664.52
Shaoyang	0.734	0.878	0.688	0.656	656.35
Yueyang	0.790	0.877	0.719	0.782	505.19
Changde	0.781	0.892	0.696	0.766	527.91
Zhangjiajie	0.754	0.940	0.683	0.667	151.70
Yiyang	0.757	0.892	0.688	0.707	385.16
Chenzhou	0.766	0.892	0.695	0.724	466.71
Yongzhou	0.745	0.893	0.682	0.679	528.98
Huaihua	0.737	0.883	0.681	0.666	458.76
Loudi	0.748	0.865	0.698	0.694	382.70
Xiangxi Tujia and Miao Autonomous Prefecture	0.716	0.871	0.668	0.632	248.81
<b>Guangdong Province</b>	<b>0.809</b>	<b>0.912</b>	<b>0.725</b>	<b>0.800</b>	<b>12601.25</b>
Guangzhou	0.863	0.968	0.768	0.864	1867.66
Shaoguan	0.764	0.898	0.702	0.706	285.51
Shenzhen	0.880	0.977	0.784	0.889	1756.01
Zhuhai	0.864	0.969	0.761	0.875	243.96
Shantou	0.761	0.897	0.688	0.713	550.20
Foshan	0.839	0.959	0.734	0.838	949.89
Jiangmen	0.796	0.931	0.716	0.758	479.81
Zhanjiang	0.754	0.886	0.695	0.696	698.12

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Maoming	0.761	0.882	0.692	0.723	617.41
Zhaoqing	0.768	0.889	0.695	0.732	411.36
Huizhou	0.794	0.909	0.719	0.765	604.29
Meizhou	0.749	0.931	0.702	0.641	387.32
Shanwei	0.738	0.892	0.655	0.687	267.28
Heyuan	0.750	0.896	0.699	0.675	283.77
Yangjiang	0.767	0.902	0.694	0.721	260.30
Qingyuan	0.753	0.889	0.689	0.697	396.95
Dongguan	0.815	0.915	0.734	0.806	1046.66
Zhongshan	0.805	0.937	0.725	0.768	441.81
Chaozhou	0.748	0.898	0.677	0.689	256.84
Jieyang	0.739	0.898	0.671	0.670	557.78
Yunfu	0.762	0.933	0.689	0.687	238.34
<b>Guangxi Zhuang Autonomous Region</b>	<b>0.751</b>	<b>0.893</b>	<b>0.683</b>	<b>0.695</b>	<b>5012.68</b>
Nanning	0.776	0.888	0.724	0.727	874.16
Liuzhou	0.782	0.877	0.701	0.778	415.79
Guilin	0.757	0.905	0.695	0.692	493.11
Wuzhou	0.741	0.889	0.679	0.673	282.10
Beihai	0.792	0.923	0.705	0.763	185.32
Fangchenggang	0.775	0.877	0.693	0.766	104.61

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Qinzhou</i>	0.739	0.877	0.670	0.687	330.22
<i>Guigang</i>	0.721	0.868	0.672	0.643	431.63
<i>Yulin</i>	0.729	0.892	0.680	0.638	579.68
<i>Baise</i>	0.730	0.885	0.656	0.669	357.15
<i>Hezhou</i>	0.741	0.911	0.665	0.670	200.79
<i>Hechi</i>	0.713	0.891	0.654	0.621	341.79
<i>Laibin</i>	0.732	0.885	0.676	0.655	207.46
<i>Chongzuo</i>	0.707	0.885	0.591	0.675	208.87
<b>Hainan Province</b>	<b>0.779</b>	<b>0.908</b>	<b>0.714</b>	<b>0.729</b>	<b>1008.12</b>
<i>Haikou</i>	0.801	0.906	0.757	0.749	287.34
<i>Sanya</i>	0.794	0.892	0.736	0.762	103.14
<i>Chongqing</i>	0.790	0.901	0.701	0.781	3205.42
<b>Sichuan Province</b>	<b>0.762</b>	<b>0.889</b>	<b>0.677</b>	<b>0.736</b>	<b>8367.49</b>
<i>Chengdu</i>	0.821	0.946	0.735	0.796	2093.78
<i>Zigong</i>	0.758	0.886	0.667	0.736	248.93
<i>Panzhuhua</i>	0.790	0.901	0.687	0.795	121.22
<i>Luzhou</i>	0.751	0.903	0.656	0.716	425.41
<i>Deyang</i>	0.770	0.892	0.669	0.763	345.62
<i>Mianyang</i>	0.776	0.928	0.674	0.746	486.82
<i>Guangyuan</i>	0.739	0.883	0.661	0.692	230.57

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<i>Suining</i>	0.749	0.892	0.660	0.712	281.42
<i>Neijiang</i>	0.743	0.885	0.661	0.702	314.07
<i>Leshan</i>	0.767	0.895	0.673	0.749	316.02
<i>Nanchong</i>	0.735	0.880	0.656	0.689	560.76
<i>Meishan</i>	0.749	0.895	0.664	0.708	295.52
<i>Yibin</i>	0.762	0.889	0.668	0.744	458.88
<i>Guang'an</i>	0.731	0.882	0.653	0.680	325.49
<i>Dazhou</i>	0.738	0.895	0.662	0.677	538.54
<i>Ya'an</i>	0.756	0.892	0.671	0.721	143.46
<i>Bazhong</i>	0.722	0.897	0.672	0.626	271.29
<i>Ziyang</i>	0.719	0.874	0.647	0.659	230.86
<i>Aba Tibetan and Qiang Autonomous Prefecture</i>	0.724	0.846	0.628	0.713	82.26
<i>Garzê Tibetan Autonomous Prefecture</i>	0.694	0.846	0.591	0.668	110.74
<i>Liangshan Yi Autonomous Prefecture</i>	0.704	0.868	0.606	0.663	485.84
<b>Guizhou Province</b>	<b>0.726</b>	<b>0.849</b>	<b>0.643</b>	<b>0.702</b>	<b>3856.21</b>
<i>Guiyang</i>	0.775	0.849	0.713	0.769	598.70
<i>Liupanshui</i>	0.719	0.840	0.635	0.695	303.16
<i>Zunyi</i>	0.738	0.846	0.650	0.732	660.67
<i>Anshun</i>	0.707	0.831	0.629	0.677	247.06
<i>Bijie</i>	0.717	0.846	0.641	0.681	329.85

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Tongren	0.729	0.877	0.633	0.697	301.51
Qianxinan Buyei and Miao Autonomous Prefecture	0.686	0.846	0.603	0.633	689.96
Qiandongnan Miao and Dong Autonomous Prefecture	0.698	0.838	0.629	0.645	375.86
Qiannan Buyei and Miao Autonomous Prefecture	0.721	0.846	0.633	0.700	349.44
<b>Yunnan Province</b>	<b>0.733</b>	<b>0.831</b>	<b>0.657</b>	<b>0.720</b>	<b>4720.93</b>
Kunming	0.805	0.923	0.720	0.786	846.01
Qujing	0.736	0.858	0.647	0.717	576.58
Yuxi	0.782	0.890	0.667	0.805	224.95
Baoshan	0.730	0.868	0.647	0.692	243.12
Zhaotong	0.680	0.831	0.621	0.610	509.26
Lijiang	0.726	0.846	0.661	0.683	125.39
Puer	0.711	0.837	0.636	0.677	240.50
Lincang	0.704	0.834	0.629	0.665	225.80
Chuxiong Yi Autonomous Prefecture	0.744	0.850	0.663	0.732	241.67
Honghe Hani and Yi Autonomous Prefecture	0.744	0.882	0.645	0.725	447.84
Wenshan Zhuang and Miao Autonomous Prefecture	0.700	0.830	0.632	0.654	350.32
Xishuangbanna Dai Autonomous Prefecture	0.720	0.826	0.642	0.703	130.14

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Dali Bai Autonomous Prefecture	0.736	0.868	0.662	0.696	333.76
Dehong Dai and Jingpo Autonomous Prefecture	0.721	0.831	0.649	0.694	131.57
Nujiang Lisu Autonomous Prefecture	0.673	0.725	0.624	0.673	55.27
Diqing Tibetan Autonomous Prefecture	0.721	0.791	0.621	0.762	38.75
<b>Tibet Autonomous Region</b>	<b>0.699</b>	<b>0.803</b>	<b>0.589</b>	<b>0.720</b>	<b>364.81</b>
Lhasa	0.735	0.778	0.652	0.781	86.79
Shigatse	0.659	0.785	0.560	0.652	76.10
Chamdo	0.705	0.778	0.605	0.743	35.40
Nyingchi	0.671	0.786	0.565	0.682	79.82
Shannan	0.611	0.682	0.510	0.655	50.48
Nagqu	0.645	0.621	0.588	0.734	12.33
Ngari Prefecture	0.729	0.786	0.629	0.785	23.89
<b>Shaanxi Province</b>	<b>0.788</b>	<b>0.889</b>	<b>0.729</b>	<b>0.755</b>	<b>3952.90</b>
Xi'an	0.826	0.921	0.782	0.783	1295.29
Tongchuan	0.773	0.882	0.726	0.722	69.83
Baoji	0.787	0.890	0.720	0.759	332.19
Xianyang	0.771	0.877	0.718	0.729	395.98
Weinan	0.752	0.883	0.713	0.677	468.87
Yan'an	0.777	0.865	0.710	0.764	228.26

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
Hanzhong	0.750	0.862	0.688	0.711	321.15
Yulin	0.799	0.872	0.698	0.837	362.48
Ankang	0.733	0.851	0.668	0.692	249.34
Shangluo	0.720	0.822	0.685	0.661	204.12
<b>Gansu Province</b>	<b>0.723</b>	<b>0.856</b>	<b>0.666</b>	<b>0.663</b>	<b>2501.98</b>
Lanzhou	0.778	0.838	0.742	0.757	435.94
Jiayuguan	0.817	0.895	0.758	0.804	31.27
Jinchang	0.783	0.862	0.707	0.788	43.80
Baiyin	0.724	0.851	0.687	0.649	151.21
Tianshui	0.687	0.849	0.647	0.591	298.47
Wuwei	0.723	0.856	0.668	0.662	146.50
Zhangye	0.728	0.834	0.677	0.684	113.10
Pingliang	0.690	0.831	0.647	0.613	184.86
Jiuquan	0.764	0.855	0.698	0.747	105.57
Qingyang	0.727	0.881	0.662	0.658	217.97
Dingxi	0.663	0.820	0.642	0.554	252.41
Longnan	0.663	0.852	0.604	0.565	240.73
Linxia Hui Autonomous Prefecture	0.642	0.831	0.590	0.539	210.98
Gannan Tibetan Autonomous Prefecture	0.656	0.708	0.620	0.645	69.18

Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<b>Qinghai Province</b>	<b>0.731</b>	<b>0.830</b>	<b>0.657</b>	<b>0.716</b>	<b>592.40</b>
Xining	0.761	0.848	0.711	0.730	246.80
Haidong	0.707	0.851	0.618	0.672	135.85
Haibei Tibetan Autonomous Prefecture	0.689	0.820	0.616	0.647	26.53
Huangnan Tibetan Autonomous Prefecture	0.693	0.828	0.593	0.678	27.62
Hainan Tibetan Autonomous Prefecture	0.697	0.789	0.628	0.682	44.70
Golog Tibetan Autonomous Prefecture	0.640	0.738	0.597	0.594	21.56
Yushu Tibetan Autonomous Prefecture	0.600	0.751	0.543	0.531	42.52
Haixi Mongolian and Tibetan Autonomous Prefecture	0.793	0.837	0.692	0.861	46.82
<b>Ningxia Hui Autonomous Region</b>	<b>0.763</b>	<b>0.870</b>	<b>0.700</b>	<b>0.728</b>	<b>720.27</b>
Yinchuan	0.796	0.889	0.743	0.763	285.91
Shizuishan	0.778	0.869	0.704	0.769	75.14
Wuzhong	0.740	0.869	0.669	0.698	138.27
Guyuan	0.714	0.874	0.652	0.640	114.21
Zhongwei	0.733	0.860	0.668	0.684	106.73

**Table 1 (continued): Provincial and Prefecture-Level Human Development Index and Sub-Indices in China (2020)**

Administrative region	HDI	Life expectancy index	Education index	GNI index	Permanent residents (10,000 persons)
<b>Xinjiang Uygur Autonomous Region</b>	<b>0.763</b>	<b>0.856</b>	<b>0.716</b>	<b>0.724</b>	<b>2585.23</b>
Ürümqi	0.805	0.868	0.763	0.789	405.44
Karamay	0.871	0.950	0.766	0.908	49.03
Turfan	0.753	0.836	0.704	0.725	69.40
Hami	0.798	0.862	0.734	0.803	67.34
Changji Hui Autonomous Prefecture	0.795	0.882	0.716	0.796	161.36
Bortala Mongol Autonomous Prefecture	0.801	0.911	0.724	0.779	48.82
Bayingolin Mongol Autonomous Prefecture	0.792	0.904	0.721	0.761	161.40
Aksu Prefecture	0.746	0.846	0.693	0.709	271.44
Kizilsu Kyrgyz Autonomous Prefecture	0.718	0.842	0.706	0.622	62.22
Kashgar Prefecture	0.703	0.825	0.690	0.610	449.64
Hotan Prefecture	0.676	0.836	0.681	0.544	250.47
Ili Kazakh Autonomous Prefecture	0.744	0.831	0.707	0.700	277.89
Tacheng Prefecture	0.762	0.831	0.707	0.753	113.86
Altay Prefecture	0.755	0.831	0.720	0.718	66.86

## 02 TECHNICAL APPENDIX 1 METHODOLOGY FOR CALCULATING PROVINCIAL AND PREFECTURE-LEVEL HUMAN DEVELOPMENT INDEX (HDI)

The Human Development Index (HDI) is a composite measure calculated as the geometric mean of three-dimension indices: the Life Expectancy Index, Education Index (calculated as expected years of schooling and mean years of schooling), and Gross National Income (GNI) index. Calculation thresholds adopted in this report are consistent with those used by UNDP (2024). Due to data availability constraints, existing studies often lack precision in estimating indicators such as life expectancy, mean years of schooling, and expected years of schooling, particularly when looking beyond national aggregates. This report employs multiple sources of statistical data to estimate the HDI at the prefecture level in China.<sup>92</sup>

The primary data sources are shown in Table S1.

### 1. Estimation of life expectancy

At the provincial level, life expectancy data for 2010 and 2020 were directly obtained from the website of the National Bureau of Statistics. The data for 2015 was retrieved from the Five-Year Plan, specialized health sector plans, and other official publications. Data for the remaining years was completed through interpolation.

At the prefectural level, starting from the "13th Five-Year Plan" period, most local governments began to include life expectancy as a primary target in their five-year plans, often listing the actual value achieved at the

**Table 2 Primary Data Sources**

Dimension	Indicator	Minimum	Maximum	Data Source
Health	Life expectancy at birth (years)	20	85	Population census data, local development plans, other official publications
Education	Mean years of schooling for population aged 25 years and older	0	15	Population census data
	Expected years of schooling (years)	0	18	Development plans, other official publications
Income	Gross national income (GNI) per capita (2017 PPP \$)	100	75000	National Bureau of Statistics of China, CEIC database, World Bank database

<sup>92</sup>A more detailed calculation method can be found in: Yang, Y., & Gong, P. (2025). *Assessing China's Human Development: Pathways to a Sustainable Future*. Science Press, Beijing.

end of the previous plan period. Consequently, life expectancy data for 2015 and 2020 at the prefectural level could be retrieved from the Five-Year Plans and specialized health sector plans. Data for other years (especially post-2015) was partially retrieved from official publications such as statistical yearbooks and government work reports. However, during the "12th Five-Year Plan" period, most local governments had not yet established life expectancy as a primary target. Therefore, the 2010 prefectural-level life expectancy was primarily estimated using census data and the abridged life table method. For this estimation, the infant and child mortality probabilities and the death underreporting rates for other age groups from the Sixth National Population Census were adjusted based on findings from existing academic literature<sup>93,94</sup>. Any remaining missing prefectural life expectancy data was filled through interpolation and extrapolation. For extrapolation, the growth rate of the province to which the prefecture belongs was used as a reference.

It is important to clarify that while the 2020 prefectural-level life expectancy could also be broadly estimated using census data and the abridged life table method, this approach may introduce errors. This is due to the current difficulty in obtaining data on infant and child mortality probabilities and death underreporting rates for various age groups from the Seventh National Population Census. By comparison, local development plans are released after being reviewed and approved by the People's Congress, and the data they contain is of relatively high authority and reliability. Therefore, the 2020 prefectural-level life expectancy data in this report is primarily sourced from local development plans and other official documents.

The primary objective of this report is to enable cross-

regional comparisons of life expectancy disparities and historical trends on a unified scale. The adopted methodology integrates multiple official data sources and yields estimates with minimal average deviation from official statistical standards, thereby ensuring high reliability. The consistent application of standardized technical procedures in data processing further enhances the comparability of estimates across regions.

### 2. Estimation of mean years of schooling

The mean years of schooling for the population aged 25 and above is calculated as:

$$MYS_n = \sum_k P_{nk} \cdot k$$

$MYS_n$  denotes the mean years of schooling for the population aged  $n$  and above,  $P_{nk}$  represents the proportion of the population aged  $n$  and above with  $k$  years of education. This report adopts the conversion standards set by National Bureau of Statistics of China, where primary school is equivalent to 6 years of schooling, junior secondary school to 9 years, senior secondary school to 12 years, and college education and above to 16 years.<sup>95</sup>

For 2020, the mean years of schooling for the population aged 25+ at the provincial and prefecture-level can be directly computed using detailed provincial census data. For the year 2010, the mean years of schooling for the population aged 15 and over at both provincial and prefectural levels were directly obtained from the Tabulation on the 2010 Population Census of the People's Republic of China by County. Concurrently, since the 2010 census only released provincial-level data on educational attainment by age group, we

Table 3. Data Sources for Life Expectancy at Different Administrative Levels

Administrative Level	Data Source	2010		2015		2020	
		Count	%	Count	%	Count	%
Provincial (31)	National Bureau of Statistics of China	31	100.0			31	100.0
	Five-Year Plans			4	12.9		
	Special Plans			26	83.9		
	Other Official Publications			1	3.2		
	Life Table						
	Interpolation/Extrapolation			26	83.9		
	<b>Total</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>
Prefectural (331)	National Bureau of Statistics of China						
	Five-Year Plans			59	17.8	269	81.3
	Special Plans	1	0.3	216	65.3	42	12.7
	Other Official Publications	71	21.5	18	5.4	3	0.9
	Life Table	255	77				
	Interpolation/Extrapolation	5	1.5	38	11.5	17	5.1
	<b>Total</b>	<b>331</b>	<b>100</b>	<b>331</b>	<b>100</b>	<b>331</b>	<b>100</b>

93. Huang, Rongqing, and Zeng, Xinxin. 2013. "An Estimation of Error in Infant Mortality Rate from the 2010 Census Report and the Actual Level." *Population Research* 37(2): 3–16.

94. Cui, Hongyan, Xu, Lan, and Li, Rui. 2013. "An Estimation of the Accuracy of the 2010 National Population Census Data." *Population Research* 37(1): 10–21.

95. [https://www.stats.gov.cn/english/PressRelease/202105/t20210510\\_1817191.html](https://www.stats.gov.cn/english/PressRelease/202105/t20210510_1817191.html)

were able to calculate the mean years of schooling for the population aged 25 and over at the provincial level. The corresponding figure for the prefectural level was then derived by applying the proportional relationship between the mean years of schooling for the 15+ and 25+ age groups observed at the provincial level. Furthermore, for the year 2015, the mean years of schooling for the population aged 25 and over could be directly calculated for 20 provinces based on data from the 1% National Population Sample Survey. Data for all other years were completed through interpolation and extrapolation. Specifically, when extrapolating the mean years of schooling for the 25+ age group at the prefectural level, the growth rate of the respective province was used as a reference.

### 3. Estimation of expected years of schooling

Expected years of schooling are calculated using the formula:

$$EYS = \sum_i \lambda_i \cdot a_i$$

$\lambda_i$  represents the enrollment rate for each educational stage and  $a_i$  denotes the duration in years of each stage. The calculation incorporates China's four education stages: primary education ( $a_1 = 6$ ), junior secondary education ( $a_2 = 3$ ), senior secondary education ( $a_3 = 3$ ), and higher education ( $a_4 = 4$ ). Given China's full implementation of universal 9-year compulsory education, gross enrollment rates for primary and junior secondary education nationwide exceed 100 percent, leading to reduced publication of these rates at provincial and prefectural levels. This report consequently applies a 100 percent enrollment rate assumption for primary and junior secondary education across all sub-national levels. For prefectural-level higher education enrollment rates, provincial averages serve as proxies due to China's provincial-based college admission system. The estimation prioritizes

gross enrollment rates from the Five-Year Plans and specialized education sector plans as primary sources, with supplementary data drawn from other official publications where gaps exist. For provinces where available, senior secondary and higher education enrollment rates are approximated using reported enrollment figures and age-eligible population data. All remaining missing data were completed through interpolation and extrapolation. For the extrapolation of prefectural-level gross enrollment ratios, the growth rate of the respective province was used as a reference.

### 4. Estimation of GNI per capita

This report converts provincial and prefecture-level GDP per capita into GNI per capita (in constant 2017 PPP terms) using a conversion factor. The conversion factor is derived from the ratio between China's GDP per capita, as published by the National Bureau of Statistics of China (2010–2020), and China's GNI per capita (in constant 2017 PPP terms), as reported by the World Bank. Provincial per capita GDP data was sourced from the National Bureau of Statistics. Prefectural per capita GDP data was primarily obtained from the CEIC database. Due to missing per capita GDP data for some prefectural-level cities in 2020, we calculated this figure by dividing their 2020 GDP by the resident population count from the Seventh National Population Census. A small number of remaining missing observations were filled by interpolating data from adjacent years.

**Table 4. Data Sources for Provincial Gross Enrolment Rates**

Administrative Level	Data Source	2010		2015		2020	
		Count	%	Count	%	Count	%
Gross Enrolment Rate in Higher Education	National Bureau of Statistics of China						
	Five-Year Plans	1	3.2				
	Special Plans	19	61.3	30	96.8	23	74.2
	Other Official Publications	5	16.1			1	3.2
	Life Table	5	16.1				
	Interpolation/Extrapolation	1	3.2	1	3.2	7	22.6
	<b>Total</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>
Gross Enrolment Rate in Senior Secondary Education	National Bureau of Statistics of China						
	Five-Year Plans	1	3.2				
	Special Plans	24	77.4	31	100	28	90.3
	Other Official Publications	4	12.9			2	6.5
	Life Table	2	6.5				
	Interpolation/Extrapolation					1	3.2
	<b>Total</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>	<b>31</b>	<b>100</b>

Note: a. The gross enrolment rate in senior secondary education for Xinjiang, as reported in its special education plan, is based on the 2019 value and was extrapolated to estimate the 2020 value.

Table 5 Data Sources for Prefecture-Level Gross Enrolment Rates

Administrative Level	Data Source	2010		2015		2020	
		Count	%	Count	%	Count	%
<b>Gross Enrolment Rate in Higher Education</b>	Same as corresponding provincial value						
	National Bureau of Statistics of China						
<b>Gross Enrolment Rate in Senior Secondary Education</b>	Five-Year Plans	27	8.2	33	10	31	9.4
	Special Plans	39	11.8	149	45	195	58.9
	Other Official Publications	1	0.3	1	0.3		
	Life Table						
	Interpolation/Extrapolation	264	79.8	148	44.7	105	31.7
	<b>Total</b>	<b>331</b>	<b>100</b>	<b>331</b>	<b>100</b>	<b>331</b>	<b>100</b>

### 03 TECHNICAL APPENDIX 2 METHODOLOGY FOR CALCULATING PLANETARY PRESSURES-ADJUSTED HUMAN DEVELOPMENT INDEX (PHDI)

In 2020, the Human Development Index was further expanded. In its *2020 Human Development Report*—a special edition marking the 30th anniversary—titled “*The Next Frontier: Human Development and the Anthropocene*”,<sup>96</sup> the UNDP for the first time incorporated direct carbon emissions per capita and material footprint into the evaluation of human development. These two indicators were used to adjust the original HDI, resulting in the creation of the Planetary Pressures–Adjusted Human Development Index (PHDI). The PHDI aims to guide countries toward advancing human development, while simultaneously reducing their pressure on the planet.

Specifically, direct carbon emissions refer to the total carbon emissions directly generated by all economic activities within a region or country, including industrial production, energy generation and consumption, transport, buildings, and agricultural activities. This metric reflects local emissions, calculated from the perspective of where emissions physically occur, and excludes emissions embedded in imported goods and services. This approach is known as production-based accounting or territory-based accounting.

The China Provincial Material Footprint model employed in this study was constructed in several steps. First, a provincial-level database of domestic material extraction was established, covering major resources such as fossil fuels, biomass, metals, and non-metallic minerals. This database was designed to be consistent in its classification and scope with the standards of the UN International Resource Panel and

the global MRIO database, EXIOBASE. Subsequently, by integrating standardized customs data, China's inter-provincial MRIO table was linked with the global MRIO database. This process embedded material extraction information from both China's provinces and other international regions into the framework, enabling a systematic tracking of trade and resource flows for provincial sectors on a global scale. It is important to note, however, that the compilation of the inter-provincial MRIO table is a complex and data-intensive process. Due to the incomplete availability of some foundational data, we have not yet been able to comprehensively update the model to more recent years.

Unlike direct carbon emissions, material footprint defines “footprint” more comprehensively by accounting for resource use both within and beyond a country's borders. For instance, a car manufactured in China, but sold and consumed in the United States, contributes to the material footprint of the United States, not China. This metric reflects the interconnectedness of global trade and the distribution of environmental responsibilities, offering a more equitable representation of resource consumption in a globalised context.<sup>97</sup>

In terms of methodology, the PHDI is derived by adjusting the HDI with an adjustment factor A, calculated as the arithmetic mean of normalised direct carbon emissions and material footprint. The design principle is that countries with higher per capita emissions and material footprint bear greater environmental costs for their development, and thus, their HDI should be

96. <https://hdr.undp.org/content/human-development-report-2020>

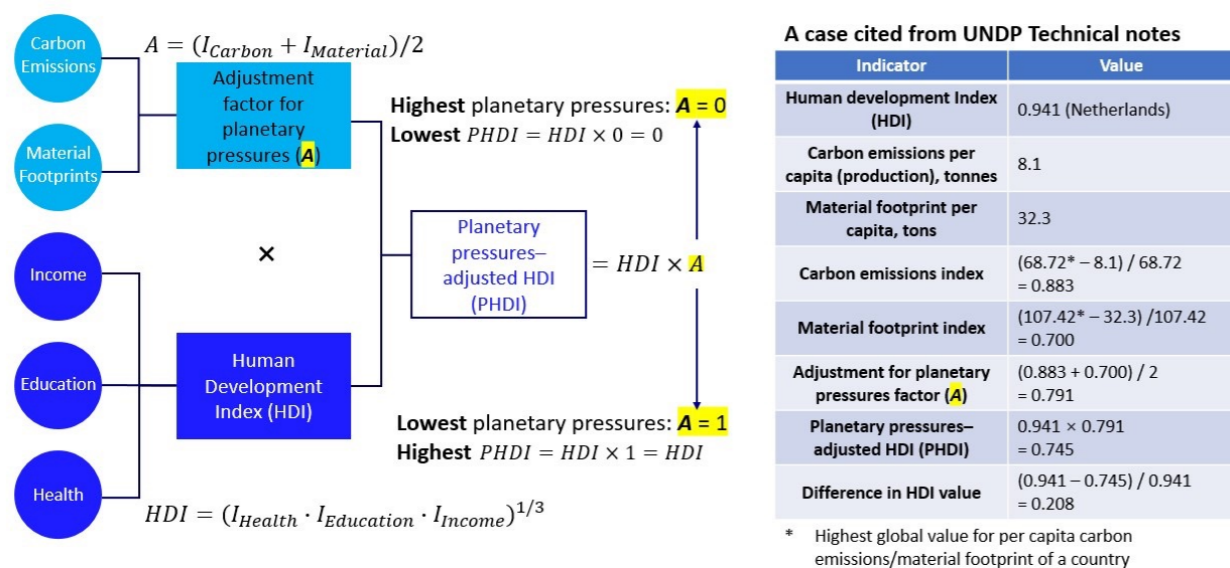
97. <https://www.pnas.org/doi/10.1073/pnas.1220362110>

discounted accordingly. The value of A ranges between 0 and 1; as carbon emissions and material footprint increase, A decreases, resulting in a PHDI that is lower than the HDI (see Figure A1 for an overview).

For example, in 2021, the United States had an HDI of 0.921 (as shown in Figure A1) and an adjustment factor A of 0.758, resulting in a PHDI of  $0.921 \times 0.758 =$

0.698. In the same year, China's HDI was 0.768 and its adjustment factor A was 0.844. China's higher A value indicates that, on a per capita basis, its development exerted less planetary pressure than that of the United States. Accordingly, China's PHDI was calculated as  $0.768 \times 0.844 = 0.648$ .

**Figure 1. An overview of the planetary pressures-adjusted Human Development Index**



Note: This is revised from UNDP HDR 2022, Fig. 7.4. See UNDP HDR 2021/22 Technical Notes for details. The case study is cited from the technical notes of the Human Development Report 2022. It is important to point out that the upper reference values (i.e., the maximum historical values observed globally since 1990) used to calculate the CO<sub>2</sub> emissions index and the material footprint index are not static. As the United Nations Development Programme (UNDP) revises its data series in different annual editions of the Human Development Report to reflect the latest statistics or methodological updates, these upper bounds are subject to change. The maximum values used in this study appear to be based on the Human Development Report 2021-2022. However, in the most recent Human Development Report 2025, the maximum per capita CO<sub>2</sub> emissions have been updated to 76.61 tones, and the maximum per capita material footprint has been updated to 90.27 tones.

### 04 TECHNICAL APPENDIX 3: PRODUCTION-BASED AND CONSUMPTION-BASED ACCOUNTING—ASSIGNING RESPONSIBILITY FOR CARBON EMISSIONS AND RESOURCE CONSUMPTION

There are two ways of calculating carbon emissions and resource consumption: production-based (PBA) and consumption-based accounting (CBA). Each allocates environmental responsibility differently.

PBA assigns responsibility for all carbon emissions from a country's production to that same country—even if the products made are ultimately exported for use elsewhere. Big manufacturing countries such as China and India therefore have higher carbon emissions under PBA, while consumption-oriented economies, such as the United States and the United Kingdom, see lower carbon emissions. This approach is intuitive and relatively easy to regulate, but fails to reflect carbon imports and exports embedded in international trade.

CBA takes international supply chains into account and allocates all carbon emissions or resource use arising across a product's lifespan to the ultimate consumer. If Germany imports a Chinese car, carbon emissions arising during manufacture are added to Germany's CBA, not China's PBA. As such, CBA better reflects a country's actual resource use and environmental responsibilities. Under the CBA approach, a material footprint calculation covers all direct use of materials,

then adds those used in imported products and subtracts those used in exported products. As a result, in many developed countries—such as the United States and Switzerland—the material footprint measured by CBA is typically over 50 percent higher than that calculated using PBA. While CBA is considered a fairer approach, it is also more complex, requiring advanced models and large volumes of high-quality data.

For global PHDI calculations, both are used:

- Carbon emissions (PBA): Provincial emissions (direct flows) are calculated. The main factors are the energy mix and industrial structure.
- Material footprints (CBA): Calculations cover all resource use across product lifetimes (both direct and indirect flows). This includes resource use embedded in imported products and reflects the full environmental costs of economic activity.

These two complement each other and provide a basis for fairer allocation of environmental responsibility, but scholars have not yet reached consensus on choosing between them.

### 05 TECHNICAL APPENDIX 4: METHODOLOGY FOR CALCULATING THE INEQUALITY-ADJUSTED HUMAN DEVELOPMENT INDEX (IHDI) BY REGION

The Inequality-adjusted Human Development Index (IHDI) is an indicator first introduced in the Human Development Report 2010. It accounts for the distribution

of achievements in each dimension of the HDI across the population. When calculating the national-level IHDI, the UNDP measures inequality in life expectancy using

the distribution of life expectancy across different age cohorts from abridged life tables. It then estimates the distribution of individual achievements in education and income using national household survey data. Subsequently, three inequality-adjusted sub-indices are calculated and aggregated to form the final IHDI.

Specifically, the degree of inequality in each dimension is measured by calculating the Atkinson inequality aversion coefficient ( $A_x$ ). Due to the lack of representative micro-level survey data on education and income at the provincial level, this report adopts a different strategy from the UNDP's to calculate this coefficient. Unlike the original methodology, which examines disparities in HDI achievements among different population groups (e.g., age cohorts or income groups), our approach focuses on assessing the negative impact of inter-regional imbalances below the provincial level on the overall human development of the entire province. This enriches the measurement of the HDI from a spatial equilibrium perspective.

In summary, the fundamental idea of our algorithm is to calculate the provincial-level, region-inequality-adjusted HDI by measuring the inequality across prefectural-level administrative units within a province in the three dimensions of health, education, and income. The specific algorithm is as follows.

First, the inequality aversion coefficient ( $A_x$ ) is calculated:

$$A_x = 1 - \frac{\sqrt[n]{X_1 \cdots X_n}}{\bar{X}}$$

Next, the inequality-adjusted sub-indices ( $I_x$ ) are calculated:

$$I_x = (1 - A_x) \cdot I_x$$

$I_x$  is the original sub-index score for each dimension of the HDI. The IHDI is then the geometric mean of the three adjusted sub-indices:

$$IHDI = (I_{Health} \cdot I_{Education} \cdot I_{Income})^{\frac{1}{3}} = [(1 - A_{Health}) \cdot (1 - A_{Education}) \cdot (1 - A_{Income})]^{\frac{1}{3}} \cdot HDI$$

Meanwhile, we can also calculate the loss in human development for each province due to the inequality among its constituent prefectural-level administrative units:

$$Loss = 1 - [(1 - A_{Health}) \cdot (1 - A_{Education}) \cdot (1 - A_{Income})]^{\frac{1}{3}}$$

Where  $x_i$  represents the life expectancy, mean years of schooling, and per capita GNI for each prefectural-level administrative unit  $i$ ;  $I_x$  is the original sub-index score for each dimension of the HDI;  $i$  denotes the prefectural-level administrative units within a given province.



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