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YOJANA MAGAZINE ANALYSIS

(December 2024)

(Part 1/3)

TOPICS TO BE COVERED

PART 1/3

- VISION AND ROADMAP FOR SCIENCE AND TECHNOLOGY
- REAPING INDIA'S DEMOGRAPHIC DIVIDEND: STRATEGIC PATHWAYS FOR GROWTH

PART 2/3

- THE YEAR OF INDIA'S STRATEGIC EMERGENCE
- GOVERNMENT INITIATIVES IN CLIMATE CHANGE: A SUSTAINABLE PATH FOR VIKSIT BHARAT@2047

PART 3/3

- ROADMAP FOR INDIA'S GEOPOLITICAL STRATEGY
- INDIA'S MISSION TO FIGHT SICKLE CELL DISEASE

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VISION & ROADMAP FOR SCIENCE & TECHNOLOGY

India, with its rich heritage of scientific and technological contributions, is poised to play a pivotal role on the global stage by blending its **ancient wisdom** with **modern advancements**. From the traditional knowledge of **Ayurveda** to innovations in **material science** and **chemistry**, India's history provides a strong foundation for cutting-edge scientific progress. By harnessing modern tools like **Artificial Intelligence (AI)**, **quantum computing**, and **biotechnology**, India can:

- **Drive global scientific progress** through innovative solutions.
- Integrate **ancient knowledge** with **modern science** to address global challenges.
- Propel national growth and establish a competitive advantage globally.

KEY MILESTONES

India has made notable advancements in **science**, **technology**, and **innovation** in recent years. Key achievements include:

- **Global Research Standing:**
 - India has moved up from **7th** place (2010) to **3rd** in the world in terms of scientific research.

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- Surpassing countries like **the UK, Germany, and Japan** in **scientific publications** over the last five years.
- Ranked **3rd globally** in the number of **PhDs** awarded in **Science and Engineering**, following the **US and China**.
- India has climbed from **81st** (2014) to **39th** (2024) in the **Global Innovation Index (GII)**.
- **Patent Filings:**
 - India has witnessed a **doubling** of **patent filings** from **2018 to 2023**.
 - India now ranks **6th globally** with **82,811 patent filings**.
- **Startup Ecosystem:**
 - India is now the **3rd largest startup hub** globally, with over **140,000 startups** in 2024 (a huge leap from 450 in 2016).
 - India is home to **115+ unicorns**.

CHALLENGES HINDERING PROGRESS

While India has made significant strides, there remain key challenges that need to be addressed to fully realize its scientific potential:

- **Insufficient R&D Investment:**
 - India allocates just **0.64% of its GDP** towards **R&D**, far below the global average of **1.79%**.

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- Countries like **China** (2.43%), the **USA** (3.46%), and **South Korea** (4.93%) invest significantly more in R&D.

- **Private Sector Contribution to R&D:**

- In India, only **37%** of total R&D spending comes from the private sector, whereas countries like **China** (77%), the **USA** (78%), and **South Korea** (79%) see much higher contributions.

- **R&D Workforce Gap:**

- India has **262 full-time R&D professionals** per million people, compared to leading global economies.

STRATEGIC ROADMAP FOR INDIA'S FUTURE

To ensure sustainable growth and global leadership in science and technology, India needs to adopt a future-oriented strategic roadmap. This roadmap will focus on the following key areas:

- **Sustainability and Resilience:**

- **Climate Change Mitigation:** India must embrace transformative technologies like **e-mobility**, **green hydrogen**, **nuclear energy**, and **solar cells** to decarbonize energy systems.

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- **Strategic Autonomy in Emerging Sectors:** Developing **AI, cybersecurity,** and **quantum cryptography** technologies will enhance national security and provide strategic autonomy.
- **Resource Optimization:**
 - **Addressing Resource Constraints:** India must advance **precision agriculture, advanced materials** technologies, and develop **alternative solutions** for critical minerals such as **lithium, nickel,** and **rare earth elements.**
 - **Supply Chain Resilience:** Leveraging **AI, advanced manufacturing, quantum sensors,** and **space exploration** will optimize India's supply chains and ensure future resilience.
- **Longevity and Viability of Life:**
 - **Modernizing Healthcare:** India must invest in **assistive technologies** and **preventive healthcare** to cater to an aging population.
 - **Smart Cities:** Sustainable cities with smart **transportation, housing, pollution control,** and **digital connectivity** are essential for future urban development.

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INDIA'S LEADERSHIP IN CRITICAL TECHNOLOGIES

India is emerging as a leader in numerous **critical technologies** across a wide range of sectors. These include:

- **Smart Materials & Biofuels:** India is making substantial strides in **smart materials**, **biofuels**, and **natural language processing (NLP)** technologies.
- **AI Algorithms & Photovoltaics:** India has developed **AI algorithms** and advanced **solar energy** technologies like **photovoltaics**, positioning itself as a leader in renewable energy innovation.
- **Cybersecurity & Quantum Technologies:** India is advancing in **cybersecurity**, **quantum sensing**, and **quantum cryptography**, which will play a crucial role in global security and technological warfare.
- **Drones & Robotics:** India is fostering innovation in **drones**, **robotics**, and **photonic technologies**, which are vital for industrial, agricultural, and defense applications.

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MISSION DRIVEN PROGRAMS FOR ACCELERATING TECHNOLOGICAL PROGRESS

India's government has launched several mission-driven programs to push the boundaries of **scientific innovation**:

- **National Quantum Mission**
- **National Mission on Interdisciplinary Cyber-Physical Systems (NMICPS)**
- **India AI Mission**
- **India Semiconductor Mission**
- **National Green Hydrogen Mission**
- **Mission Mausam** (focused on improving climate predictions and weather systems)

These programs aim to drive India's leadership in **frontier technologies** while focusing on **sustainable development** and **strategic security**.

BIOTECHNOLOGY & BIOECONOMY: A VISION FOR 2030

India has ambitious plans for biotechnology and bioeconomy development, aiming to create a **US\$ 300 million bio-economy by 2030**. Key initiatives include:

- The **BioE3 Policy** (Biotechnology for Economy, Environment, and Employment), which promotes **bio-based chemicals**, **precision biotherapeutics**, and **lab-grown foods**.

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- These efforts are critical to building a **resilient** and **sustainable bio-economy** that can meet the challenges of both **economic growth** and **climate change**.

INDIA'S SPACE EXPLORATION AMBITIONS

India's space exploration goals are bold and forward-thinking:

- **Chandrayaan-4:** Advancing lunar exploration and seeking to unlock the Moon's mineral resources.
- **Bhartiya Antriksha Station:** India's first space station module, slated to be operational by **2035**.
- **Gaganyaan Mission:** Aiming to send a **three-member crew** to space.
- **Astronaut Moon Landing:** Expected by **2040**.

India aims to capture a **15% share** of the global space economy, with private sector participation.

INSTITUTIONAL SUPPORT

To further bolster scientific and technological progress, the **Anundsundan National Research Foundation (ANRF)** was established in **2023**. Its objectives are to:

- **Position India Globally:** Align R&D with **national imperatives**.

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- **Foster Inclusive Growth:** Build R&D capacities in **state and central universities**, ensuring equitable access to scientific resources.
- **Encourage Excellence:** Cultivate **high-impact research ecosystems** and drive **frontier technologies**.
- **Bridge Academia-Industry Gap:** Accelerate **commercialization** and foster **entrepreneurship** in the private sector.

FUTURE FUNDING & INNOVATION

India has committed to a **Rs 1 lakh crore R&D fund**, which will:

- Stimulate **private sector innovation**.
- Promote **industrial applications** of research.
- Create **globally competitive industries** and drive **self-reliance** in technology (Atma Nirbharta).

CONCLUSION

India stands at the cusp of becoming a **global leader** in **science, technology, and innovation**. By addressing challenges in **R&D investment**, building **capacity**, and accelerating the adoption of **disruptive technologies**, India can carve out a leadership role in the 21st century. Through mission-driven programs, public-private collaboration, and a clear focus on **sustainability** and **strategic growth**, India can integrate its **ancient wisdom** with modern science and technology, shaping a better, more **sustainable** future for all.

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REAPING INDIA'S DEMOGRAPHIC DIVIDEND

India is at a critical juncture in its **demographic transition**, with its growing **working-age population** (15-64 years) offering immense potential for economic growth. The share of the working-age population has increased from **59% in 2011** to **63% in 2021**, and it is expected to remain stable for the next 15 years. To become a **\$30 trillion economy by 2047** and achieve an annual per capita income of **\$18,000**, India faces the challenge of **multiplying real per capita income sixfold** over the next 23 years. The **labor force** will be central to this growth, with a focus on improving **skills** and fostering **competitive firms** that integrate with **global markets**.

DEFINING EMPLOYMENT IN INDIA

Understanding **employment** is crucial to addressing India's labor force dynamics. According to the **International Labour Organization (ILO)**:

1. **Current Weekly Status (CWS)**: "Did you work at least one hour in the preceding week?"
2. **Usual Status (US)**: "What was your primary and secondary job for more than six months in the preceding year?"

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In India, where a significant portion of the workforce is engaged in **seasonal agricultural work**, the **usual status** is a more accurate reflection of employment patterns, given the seasonality of agricultural tasks.

KEY EMPLOYMENT DATA

India's labor market shows promising growth in terms of both job creation and **labor force participation**:

- **Employment Opportunities:**
 - Over **8 crore jobs** were created between **2017-18** and **2021-22**, with an **average annual job creation** exceeding **2 crore**.
- **Labor Force Participation Rate (LFPR):**
 - Increased from **57.9%** (2022-23) to **60.1%** (2023-24) for individuals aged 15 and above, indicating broader economic inclusion.
- **Worker Population Ratio (WPR):**
 - Improved from **56%** to **60.1%** during the same period, reflecting growth in labor force engagement.

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- **Reduction in Unemployment:**

- Data from periodic labor force surveys (PLFS) suggests that **employment growth has consistently outpaced labor force growth**, leading to a reduction in **unemployment rates**.

STRUCTURAL DIMENSIONS OF EMPLOYMENT: CHALLENGES & OPPORTUNITIES

- **Slow Industrialization:**

- Industrial growth has lagged behind the demographic transition. However, recent decades have seen improvements in the **employment-to-population ratio**.

- **Link Between Productivity and Real Wages:**

- **Real wages** are intrinsically linked to **labor productivity**, which depends on better **human capital** (education, health, skills) and technological adoption.
- **Rising earnings** and **job creation** are essential to leverage India's demographic advantage.

- **Labor Productivity:**

- India's productivity growth has supported its **6% annual growth** over three decades. According to the **Economic Survey 2023-24**, India needs to generate **8 million non-farm jobs annually** to accommodate its growing workforce.

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WOMEN & YOUTH IN WORKFORCE

Female Workforce Participation:

- Increased from **24.5%** (2019) to **37%** (2023), mostly in **agriculture** and **unpaid family work**.
- Expanding **women's participation** in the workforce is vital for **inclusive growth** and addressing gender disparities in economic outcomes.

Youth Employment:

- **Youth unemployment** has reduced from **17.8%** (2017-18) to **10%** (2022-23), but **unemployment among first-time entrants** remains a persistent challenge.
- Targeted **youth employment programs** are critical to providing **meaningful opportunities** for the next generation.

BUDGETARY SUPPORT

The **Union Budget** plays a critical role in shaping employment outcomes, including:

1. **Employment Incentives and Skilling Programs:** These initiatives are designed to enhance the skills of the workforce, particularly in emerging sectors such as **IT, manufacturing, and services**.

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2. Women-Led Development:

- Programs such as **working women's hostels, crèches, and skilling initiatives** support women's participation in the workforce.

CHALLENGES IN EMPLOYMENT GENERATION

• Small Size of Firms:

- **Indian firms** tend to be smaller, less productive, and slower-growing compared to global peers. Promoting the growth of **MSMEs** (Micro, Small, and Medium Enterprises) is critical for **resilient economic recovery** and enhanced **job creation**.

• Informality in Employment:

- More than **90% of India's workforce** remains in the **informal sector**, where jobs lack **social security** and **benefits**. Policies to promote **formalization** and improve **wages** are necessary for greater **worker protection** and **economic security**.

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- **Skewed Employment Towards Agriculture:**

- **46.6%** of the workforce is employed in **agriculture**, a sector with low productivity and income growth potential. Accelerating **non-farm job creation** is essential for diversifying the economy and enhancing **job quality**.

THE ROLE OF STATES IN EMPLOYMENT GENERATION

India's demographic challenges vary across regions, requiring state-specific strategies:

- **States with Growing Young Populations** (e.g., **Bihar, Uttar Pradesh**):

- These states must focus on creating job opportunities for the **youth**, leveraging their demographic advantage to build a skilled, productive workforce.

- **States with Aging Populations** (e.g., **Kerala, Tamil Nadu**):

- These states need policies focused on **skills upgrading, healthcare, and support for elderly populations**, ensuring that demographic changes are addressed through innovation.

- **Integrated Labor Markets:**

- Developing **support systems for internal migration**, such as **skill centers and employment exchanges**, is critical for ensuring **balanced economic development** across the country.

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STRATEGIC FOCUS FOR LEVERAGING DEMOGRAPHIC DIVIDEND

- **Skill Development and Education:**

- Expanding access to **quality education** and **vocational training** for youth, women, and marginalized communities is essential for developing a **highly skilled workforce**.

- **Incentives for MSMEs:**

- Promoting **small and medium enterprises** by providing access to finance, technology, and markets is critical for fostering **job creation** and **economic resilience**.

- **Enhancing Productivity:**

- Improving **labor productivity** by promoting **technology adoption, automation,** and better **working conditions** will help elevate wages and job quality.

- **Formalizing the Workforce:**

- Creating pathways for the **formalization of employment** will increase social security coverage, enhance **worker rights**, and improve economic outcomes.

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CONCLUSION: UNLOCKING INDIA'S DEMOGRAPHIC POTENTIAL

India stands at a unique moment in history to reap the rewards of its **demographic dividend**.

With a **large working-age population**, the country has the potential to become a global economic powerhouse. However, harnessing this potential requires focused strategies:

- **Investing in skills and education.**
- **Promoting MSMEs and formalizing the workforce.**
- **Fostering youth and women's participation** in the economy.
- **Developing state-specific policies** for balanced growth.

By implementing these measures, India can transform its demographic potential into a **\$30 trillion economy** by **2047**, securing a prosperous and equitable future for all its citizens.

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