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Viksit Bharat 2047: Measurement Issues

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1. Abstract

Viksit Bharat 2047 is the Government vision to develop India's economy to $30 trillion by 2047 based on self-reliance, innovation, and citizen empowerment with significant implications on socio-economic quality of life. However, specific indicators for goals of *Viksit Bharat* **(VB)** are not yet finalized. The paper provides a measurement framework for VB by proposing target-wise indicators. The indicators are aggregated by multiplicative aggregation of ratio of indicator scores at *t*-th year and base periods to get *j*-th target (T_{j_t}); Index of *m*-th Goal $I_{Goal_{mt}} = \prod T_{j_t}$ and index (I_{VB_t}) reflecting overall status of **VB** in *t*-th year= $\prod I_{Goal_{mt}} = \prod \prod T_{j_t}$. The index I_{VB_t} satisfying aggregation consistency helps in assessment of changes across time-period, identification of critical areas (targets or indicators), testing significance of progress in successive years, and finding distance from the multidimensional VB goals. However, selection of targets and indicators covering understanding and utilization of domestic and global trends, India's socio-economic landscape and equal opportunity for citizens, need to be deliberated and finalised along with data source of each indicator. Proposed indices accommodating any type of data offering significant benefits have theoretical advantages and is recommended.

2. Keywords:

Viksit Bharat; Socioeconomic status; Triple helix; Multiplicative aggregation, Progress path, Critical areas, JEL Codes: C34, E17, E66

3. Introduction

Viksit Bharat 2047 is the Government vision to build India a developed, modern, thriving nation based on self-reliance, innovation, and citizen empowerment with $30 trillion economy by 2047, the 100th anniversary of independence. Achievement of the monetary goal is likely to have significant implications for over 1.4 billion Indian population particularly on the job-led growth and reduced poverty. The vision is based on active participation and empowerment of *Youth (major* agents and recipients of change), *Poor (*requiring upliftment through inclusive development), *Women (*focusing on their empowerment and equitable participation in development) *and Farmers (*with modern tools and resources to enhance productivity).

Attempts have been made to project growth rate of GDP, per capita GDP of India under various scenarios along with projections for future inflation (both Consumer Price Index based and GDP deflator based inflations), exchange rate (based on complex inter-relationships among inflation, interest rates, trade balance, geopolitical events, etc.) and population size at various time points. Such projections by different methods with different sets of assumptions often gave rise to non-comparable findings. For example, to become a developed country by 2047, India needs to ensure:

- 7.6% annual growth rate of GDP till 2047 along with increasing per capita GDP from $2,696.66 (2024) to $22,000 (Behera et al. 2023).
- Growth of nominal GDP by 12%, modest population deceleration rate, depreciation of INR @ 2% per annum against USD (followed by 0.5% appreciation in each span of

five years) plus increasing per capita income to the level of at least $26,000 by 2047(Banerjee, 2024)

- Growth of Indian economy @ average rate of 6.02% from 2023-24 to 2047-48 giving rise to per capita income $\geq$ $15,237, keeping inflation rate at 4.5% and depreciation of the exchange rate at 2% (Shanmugam and Mathew, 2024).

However, monetary goal is meaning-less if school drop-out rates remain high and significant proportion of Indian children lack school education (Hindustan Times, 2024). Clearly, highly correlated GDP and per capita GDP (Sugumar et al. 2000) fail to reflect socio-economic well-being of citizens. A comprehensive framework is needed to deal with economic growth and dimensions like social advancements, empowerments, sustainability, effective governance, administrative reforms, strong Governmental networks, autonomous organizations, private sector, educational institutes besides the corporate organizations, etc. (Chavan, 2024) assessed current status of *Viksit Bharat (*VB) and quantified progress in terms of the chosen goals, targets and associated indicators.

Non-monetary objectives of VB 2047:

- Zero poverty
- Quality School Education.
- Access to high quality affordable comprehensive Healthcare.
- Higher percentage of skilled labour and women in economic activity.
- Welfare of farmers making our country world's food basket.

The vision to develop India to a developed economy by 2047 is associated with several challenges including significantly reduced socio-economic disparities across regions, environmental, governance issues, etc. In addition, consensus are required on measurable characteristics of developed country, specific targets to be achieved under each goal along with set of indicators to assess targets and sound method of aggregation of the chosen indicators facilitating measurement of current status of goals. Clearly, assessment approach has to be multidimensional. However, specific indicators for goals of VB are not yet finalized.

In line with Sustainable Development Goals (SDGs), the paper provides a measurement framework for VB by proposing target-wise indicators. For *t*-th year, indicators are aggregated by product of ratio of each indicator score and base period score to get *j*-th target (T_{j_t}); Index of *m*-th Goal $I_{Goal_{mt}} = \prod_{j \in m-th\ Goal} T_{j_t}$ and index (I_{VB_t}) reflecting overall status of **VB** = $\prod I_{Goal_{mt}} = \prod \prod T_{j_t}$. The index I_{VB_t} satisfying aggregation consistency helps in identification of critical areas (targets/indicators) for corrective policy measures, assessment of progress or decline across time, testing significance of progress in successive years, and finding how far we are from the goals of the VB @2047.

4. Literature review

Sahoo and Vadranam (2024) suggested necessary changes in education, healthcare, employability, decent pay and effective administration to bring holistic well-being of Indians to achieve the vision of VB. However, effectiveness of the suggestions depends on comprehensive characterisation and sound measurement of Inclusive Economic Advancement, Social Progress reflecting reduced social inequalities, environmental stewardship with priorities, efficient and accountable governance, etc. and appropriate aggregation of them.

PhD CCI (2024) identified major enablers for India's journey till 2047 like global scalability of the promising sectors with accelerated ease-of- doing business, push to digital transformation, renewable energy, etc. focussing on infrastructure facilities, continuous handholding with Start-up ecosystem, reforms for semiconductor, agriculture and food processing sector, increasing net exports, laboure-force size by filling the vacancies, etc. Each such factor is positively related to socio-economic growth of India. Gangwar and Ratan (2025) discussed influence of chosen indicators like GDP, Literacy Rate, Digital Penetration, Infrastructure Growth, Human Development Index, etc. on challenges of vision of the VB 2047.

5. Proposed Goals

Bases on objectives and literature survey, ten Goals of VB 2047 could be as follows:

Table 1: Ten Goals of Viksit Bharat 2047.

Sl. No.	Goals
1	Transform India's economy to $30 trillion ensuring inclusive economic participation for all.
2	Zero Poverty
3	Quality education and skill development for employment
4	Quality Healthcare
5	Women empowerment
6	Job creation and Inclusive Growth
7	Environmental sustainability
8	Good Governess
9	Welfare of farmers
10	Sustainable Development

Goal-1:

As of late 2025, India's estimated GDP is around $4.19 trillion, making it the world's fourth-largest economy, surpassing Japan recently. The growth is driven by strong domestic demand and policy reforms, positioning India as the world's fastest-growing major economy.

GDP growth is influenced by increased consumer spending (consumption), business investment, government spending on infrastructure and public services, net exports, and factors like human capital (investments in education, training, and skills development), technological advancements and innovation(leading to employment, efficient production and new products), physical capital (infrastructure), natural resources, entrepreneurship, globalisation and trade (including expansion of markets and opportunities), etc. These components directly add to nation's output, and facilitate economic growth. Instead of attempting to capture each factor of GDP which may overlap with targets of other Goals, the indicators under the Target 1.1 of Goal-1 are proposed to be (i) Annual GDP = $30 trillion; (ii) Per capita GDP of $18,414 adjusted with dollar exchange rate; (iii) Growth of nominal GDP@ 10.19% from 2023-24 (Rangarajan and Shanmugam, 2025) (iv) capital-output ratio (COR) = $\frac{Investment\ rate}{Growth\ rate}$ inversely related with GDP. COR helps to find necessary investment rate to achieve a specific GDP growth. Despite high $r_{GDP,Per-capita\ GDP}$ with

possibility of multicolinearity, both are considered since the latter is associated with living standard of people.

Inclusive participation for all can be addressed through a multi-pronged approach focussing on Socio-economic Participation Index (*SEPI*) in community life, politics, civil society with awareness on rights and responsibilities, mutual respect and non-violence in accordance with human rights and democracy (Hoskins, 2009). *SEPI* emphasise societal advancement. Yani & Hidayat (2018) assessed citizenship quality and extent of active participation (AP) with indicators at national level and individual level and found AP is higher in countries with high GDP along with favourable distribution of income and multi-religious climate. Proposed targets and indicators of AP are given in **Table 2**.

Table-2: Targets and indicators of Active Participation in Society.

Targets	**Indicators**
1.2.1Political	Membership of Political parties, Worked for political party during last one year, Donations to political organisation/action group during last one year.
	Voter turnout in Parliament
	Women Participation in national politics and influencing policy
1.2.2 Civil Society and Community life	Working in an organisation or association, Signing petitions, Participating in lawful demonstrations, Boycotting foreign made products. Contacted a politician
	Membership, Participation, Money donations, Voluntary work in organisation dealing with: - Human Rights - Environment - Business - Sports - Religious, Cultural, Social activities - Trade Unions Non-organised help in the community
1.2.3 Values	Supporting: -Same rights for Immigrants, - Law against work-place discrimination - Law against racial hatred Promoting inter-cultural activities
	Awareness regarding importance of: -casting votes -obeying laws -developing independent opinions - being active in voluntary organisations

While indicators like *Donation* coincides with Target 1.1, *Women Participation in parliament* is related to *Global Gender Gap Index* (GGGI) (WEF, 2025); indicators under 'Values' overlap with the components of *Social Cohesion Index* (SCI) (Langer et al. 2017). Thus, AP is positively related with Target 1.1, GGGI, and SCI.

E-participation and E-governance involve use of information and communication technologies (ICTs) by people for interactions among citizens, public administration, politicians, (Saebø, et al. 2008) including deliberation, decision-making and public service delivery (Medaglia, 2012). Comprehensive E-participation index (*CEPI*) reflects extent of use of online tools in promoting interactions between Government-to-government, Government-to-business, Government-to-citizens and among the people (Chakrabartty, 2024). E-participations are often assessed using questionnaires like *Citizen Engagement Self-Assessment Questionnaire* (*CESAQ*) (UNESCWA, 2021), *Local Online Services Index (LOSI*) (UNDESA, 2022), etc. with different formats and different scoring systems, generating data in ratio scale (like time spent on e-governance websites), counts (like number of internet users), ordinal scores (like public opinion on government policies using Likert scales), etc. However, E-Participation Index (EPI) of United Nations E-Government Survey has been criticised for overlooking socio-political context and emphasising more on technological aspects.

Indicators of EPI under the Target 1.3 could be (i) *E-information sharing***:** Quality of online information provided by the government to citizens (ii) *E-consultation:* Extent to which citizens can provide input and interact with the government through online, (iii) *E-decision-making:* Extent of citizen engagement in decision-making process. The indicators may be evaluated by combination of Surveys, User Feedback Analysis, Automated Metrics, and Benchmarking.

Socioeconomic status (SES) reflects social standing of individuals, families, communities, based on their income, education, power, occupation, and access to resources like healthcare, education, social opportunities, etc. (Smith et al. 2011). SES and social development are interlinked since improvement in one can improve the other. SES can influence both *SEPI* and *CEPI*. Reduction of SES-gaps can influence social progress. Subjective and objective measures of SES may include: *Zung Self-Rating Depression Scale* (ZSDS) (Zung, 1965); 10-rungs of the *MacArthur Scale of Subjective Social Status* to assess perceived rank relative to others (Adler et al. 1994); *Work and Meaning Inventory* (WMI) using 5-point scale (Steger et al. 2012); Kuppuswamy scale and B.G. Prasad scale – both based on education, occupation, and income; *Wealth index* (WI) (Rutstein & Johnson, 2004) combining household assets and construction materials of dwelling houses. Despite different degree of association of subjective and objective measures of SES, indicators of SES under the Target 1.4 are proposed as:

- Subjective Social Status by MacArthur Scale
- Work and Meaning Inventory
- Wealth index

Goal 2 - Zero Poverty:

Poverty deals with notions of inequality in income and wealth, deprivation, inadequacy, injustices, etc. However, income and wealth are different concepts. SDG-1 on poverty elimination (all forms) consider poverty line (PL) as daily income $\leq$ \$1.25 at 2017 Purchasing Power Parity (PPP) (UN DESA 2023) which was increased to \$1.90 per day (World Bank, 2021) and revised to \$2.15 per person per day (World Bank, 2022). Periodically updated inflation-adjusted separate PLs for urban and rural areas of India, works better. Multidimensional poverty index (MPI) considers number of poverty dimensions (say k) represented by a vector

$\boldsymbol{PL} = (D_{01}, D_{03}, , \ldots \ldots D_{0k})^T$ and a poor is one who fails in each D_{0i}(*Intersection method*) or in $\geq$ one D_{0i}(*Union method*), i = 1, 2, … k (Bossert et al. 2012). Clearly, proportion of multidimensional poor, denoted by H (head count ratio) exceeds in Union approach than the Intersection approach. MPI is calculated as H *A where A denotes average deprivation scores registered by poor, computed as weighted sum of deprivation scores where a household is scored as "1" if deprived and "0" if not. However, weights across the indicators are not uniform. Indicators of Global MPI (UNDP-OPHI 2021) varies across countries. National MPI of India considers indicators of Global MPI and additional indicators on maternal health and bank account holders. MPI has been criticised for **methodological limitations like** zero deprivation scores in Education for a household having no children; equal weights to the three dimensions (Pasha, 2017); assumption of independent items or dimensions (Nicole 2011); arbitrary cut-off mark of deprivation score $\geq 33\%$ (Mishra 2014); different elasticity of MPI with respect to H and A.

Proposed targets and indicators of Goal-2 are as follows:

Table 3: Dimensions and indicators of Overall Poverty Index (Goal-2).

Targets	Indicators
2.1 No. of Poor	Head count ratio as per Union approach of MPI
2.2 Health	Number of **undernourished** person <70-years
	Death of children <**18** years during previous five-years
2.3 Education	**Not completed at least six years of schooling**
	School-aged children **not attending** school
2.4 Access to basic infrastructure (number of households)	Lack of access to - drinking water - standard sanitation - electricity
	Use of **solid fuel** for cooking
	I**nadequate** housing materials in **floor/roof/walls**
	Possession of one or more **assets like** radio, telephone, computer, TV, refrigerator, bicycle, animal cart, motorbike.

Goal-3: Quality education:

Forward looking National Education Policy (NEP) 2020 of India aims at stronger foundation emphasising critical thinking, creativity and innovation, holistic development, learner-centric platform for comprehensive understanding of various subjects. Regarding Higher Education (HE), NEP (2000) envisages following:

- HE institutions to become autonomous multidisciplinary institutions imparting professional and vocational educations to drive excellence.
- Phasing out of 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' by ' Multidisciplinary Education and Research University (MERUs). MERUs to attract students from India and abroad with equitable access for all, with focus on socially and economically Disadvantaged Groups (SEDGs).
- Positive learning outcomes, increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, in-depth learning and mastery across fields, increased social and moral awareness, etc.
- Lifelong learning
- To emerge as a global study destination providing premium education (Vishwa Guru)

Targets and indicators under Goal-3 are as follows:

Table 4: Targets and indicators of Quality Education (Goal-3).

Targets	Indicators
School Education	
3.1 Outcomes	Learning Outcomes
	Enrolment rates
	School completion rates
	Gender parity
	Access Outcomes
	Infrastructure & Facilities for classrooms, sanitation, clean water, ladies toilets, etc.
3.2 Governance Processes Aiding Outcomes	Student and teacher attendance, teacher availability, administrative adequacy, training, accountability and transparency
	Educational expenditure as percentage of GDP
Higher Education (HE)	
3.3 Multidisciplinary institutions	Number of autonomous multidisciplinary institutions offering professional and vocational educations.
	Number of MERUs
	Number of centres like start-up incubation; technology development; frontier research areas; industry-academic linkages; interdisciplinary R & D including humanities and social sciences.
	Gross Enrolment Ratio (HE and vocational education, combined) to increase from 27.3% (2019-20) to 50% by 2035
3.4 Positive Outcomes	Subject knowledge
	Intellectual capabilities
	Character building
	Emotional and social maturity
	Business acumen
	Professionalism
	Scientific temper & Strategic thinking
	Values & Ethics
3.5 Lifelong learning	Number of persons motivated to lifelong learning with confidence in their own abilities and capacity to grow
3.6 Internationalization	Number of MERU students from: -Abroad, - India with SEDGs
	Number of MERU campuses in other countries

	Number of top foreign universities operating in India
3.7 Funding	Fund to support infrastructural facilities of MERUs. Financial support to students from marginalized communities
3.8 Digitalization	Technology driven teaching-learning process through initiatives like the National Educational Technology Forum (NETF)
3.9 Regulation	• Regulations by Higher Education Commission of India (HECI) (single regulator).

Goal-4 Quality Healthcare:

This is aligned with SDG-3 regarding good health and well-being for all and deals with universal access to quality, affordable healthcare driven by the National Health Policy focussing on increasing public health facility utilization, eliminating specific diseases, improved maternal and child health. Health indices proposed by European Union member states; World Health Organization (WHO), India Health Index (IHI) (Sehgal et al. 2024; **NITI Aayog 2021), etc. vary in number of indicators and methodology.** The proposed targets and indicators of Goal-4 are as follows:

Table 5: Targets and indicators of Quality Health Care (Goal-4).

Targets	Indicators
4.1 Outcome measures	-Maternal Mortality Rate (MMR) -Infant Mortality Rate (IMR), -Neonatal Mortality Rate (NMR), - Health Adjusted Life Expectancy (HALE) - Quality adjusted life year (QALY) - Percentage of fully immunized infants against the Seven EPI diseases. -Outcome measures of key initiatives like: • Ayushman Bharat Digital Mission (ABDM) to improve digital connectivity and access to care • E-Sanjeevani OPD integrated with ABDM to provide healthcare services in remote and isolated areas. • PM Jan-Aushadhi-Yojana operates through a network of dedicated outlets called '**Janaushadhi Kendras'** where generic medicines are given at much lower prices. • Integrated Rehabilitation Centres for drug addicts, Nasha-Mukt Bharat Abhiyaan, Child Health and Nutrition Mission, etc. leading to sustainable healthcare ecosystem - Disability rates: • Number of days of restricted activity • Bed disability days • Work-loss days within a specified period • Limitation of activity (ADL) • Disability Adjusted Life Year (DALY)
4.2 Nutritional status	- BMI-for-age z-scores - Percentage of: • Unnourished children • Unnourished women in reproductive age-category.
4.2 Health Governance	-Doctor- population ratio -Doctor -nurse ratio -Population -bed ratio - GDP percentage spent on health services -GDP percentage spent on health-related activities - Proportion of total health resources to primary health care.
4.3 Health system/Service delivery	-Attendance rate at OPDs, health centres, etc. -Admission, readmission and discharge rates -Spells of sickness **Length of Hospital Stay(ALOS)** - Utilization of public health facilities -Screenings for hypertension, diabetes, etc.

Goal-5 Women empowerment:

Women's empowerment covers among others female labour force participation rate (FLFPR), gender equality, societal progress and political empowerment. In India, disparities in women's empowerment persist. About 22% of adult Indian women are employed against 71% for adult men (https://www.ilo.org/data-and-statistics). Women's Empowerment Index (WEI) by National Family Health Survey (NFHS-5) (https://mohfw.gov.in) considers key indicators on population, health, women and child nutrition, domestic violence, etc. for each State and UT. WEI has been used to find the determinants of women's empowerment through correlation and multiple regression with socio-demographic-economic characteristics, and self-reported capabilities as independent variables (Nath and Das, 2024). Proposed targets and indicators of Goal-5 are as follows:

Table 6: Targets and indicators of Women empowerment (Goal-5).

Targets	Indicators
5.1 **Economic empowerment**	Percentage of adult women who: - were not employed during the last year. - own land or house, either alone or jointly. - have bank accounts - own businesses, including participation in the start-up ecosystem - have freedom to visit specified places alone - have taken loan from a microcredit program - use mobile phones for financial transactions - have control over their earnings and savings
5.2 **Decision-making**	Women participation in decisions on: - Spending family income - Making household purchases - Political and social participation - Visits to her family or relatives - Own health care

5.3 **Health and nutrition**	Percentage of women: -underweight or undernourished - having any anaemia (<12 g/dl) - covered by health-insurance or health schemes
	Percentage of women who know: - contraceptive methods - female sterilization - about pills - about condoms - about PPIUCD/IUD
5.4 **Gender roles**	Percentage of women who agree that: - Wives have right to control their own lives, both within and outside home. - Husband is justified in wife-beating - Husband has no right to physical, emotional, sexual violence, if wife refuses sex.

Illustrative initiative already taken are: 33% reservation of Lok Sabha and state assembly seats for women, guaranteeing 33% quotas for Scheduled Castes (SC), Scheduled Tribes (ST) women to promote women's leadership, increased rights and security for Muslim women by criminalisation of *triple talaq*, Financial inclusion of women in *Jan Dhan* bank account, *POSHAN Abhiyaan* to provide supplementary nutrition, healthcare, and education to women, children, and adolescent girls, Increased maternity benefits under PMMVY for promotion of inclusivity and empowerment of women, etc.

Goal-6 Job creation and Inclusive Growth:

Job creation focusses on jobs for each willing adult, across gender including self- employment indicating entrepreneurial activity and sectorial growth showing shift of employment patterns towards manufacturing and services. In India, job creation means better utilisation of over 60% share of Working-age population, higher **LFPR** and significant socio-economic benefits like increased incomes, higher consumptions, better living standards, reduced socio-economic disparities, enhancement of **growth,** etc. Initiatives like *Mah**atma Gandhi National Rural Employment Guarantee Act* **(MGNREGA),** ***Pradhan Mantri Viksit Bharat Rojgar Yojana*****, etc. ensure over** 100 days of guaranteed wage employment to rural households and supports to both employers and employees. ***Make in India*** **initiative** seeks to revitalize manufacturing generating large-scale employment especially for semi-skilled and unskilled workers. For enhancing women's participation in the workforce, several programmes implemented like *Namo Drone Didi* to empower women-led Self-Help Groups (SHGs) in agricultural services; *Mission Shakti* to foster inclusive and empowered society; ***Women in Science and Engineering*** **(WISE-KIRAN) and *SERB-POWER*,** to promote women in research and development.

Inclusive growth include among others skill development, women's empowerment, etc. Initiatives like *Deen Dayal Upadhyaya Grameen Kaushalya Yojana* (DDU-GKY), *Skill India Mission,* **etc.** provide high quality skill building to rural poor in age-group 15 -35, women up to 45 years, re-skill, and up-skill training, to enhance employability. Additionally, ***PM Internship Scheme*** and *public-private partnership* for skill development and vocational training including **promotion of digital literacy and eco-friendly workforce values have high potential.** Table-7 depicts targets and indicators of Goal-6.

Table 7: Targets and indicators of Job creation and Inclusive growth (Goal-6).

Targets	Indicators
Job creation	
6.1- Labour Force	Gender-wise LFPR for skilled, semi-skilled and unskilled workers
	Gender wise Worker Population Ratio(WPR)
	Percentage of subscribers to Employees' Provident Fund Organisation (EPFO)
	Monthly earnings of regular salaried workers- Percentage increase
	Self-employment – Percentage increase
	Casual labour – Percentage decrease
	Percentage of population in research and development – Gender-wise
	Number of rural households receiving 100 days of guaranteed wage employment
	Number of women-led SHGs
	Number of start-ups
	Percentage of population with **digital literacy**
	Percentage of **eco-friendly workforce**
	Unemployment Rate
Inclusive growth	
6.2. Skill Development	Percentage of population who received: -Industry-relevant training on skill-development aligned with national campaigns like Skill India, Make in India, Digital India, separately for SCs, STs, minorities, and women. -Placement assistance -Post-placement supports like mentorship, counselling, access to resources, etc. -Career progression support for advancing careers -Incentives for higher-paying jobs
	Percentage of enrolled candidates who: -Successfully completed their skill training. -Passed external assessment, aligned with the National Skills Qualifications Framework
	Trainee satisfaction with the training content, trainers, and facilities.

Goal-7 Environmental sustainability:

Aims at achieving net-zero carbon emissions by balancing economic growth with environmental conservation. Major components include promoting green and sustainable urbanization, augmenting renewable energy capacity, pursuing green hydrogen targets, and improving waste management India's journey towards net-zero carbon emissions is envisaged by transitioning to renewable energy (RE), with capacity target of 500 GW by 2030 (requiring investment of $223 billion)(Grant Thornton Bharat, 2024) and 1,000 GW by 2070. India has launched *National Green Hydrogen Mission* for increased capacity of Green Hydrogen (GH) production, to decarbonize sectors like transportation, shipping, steel, etc. EVs produce zero emissions, but their life-cycle-emissions depend on electricity for charging. Decentralized renewables, including micro-grids and off-grid

solar systems, may complement large-scale renewable projects by improving energy access and minimizing transmission losses and reducing grid pressure. Targets and indicators of Goal-7 are depicted in Table-8.

Table 8: Targets and indicators of Environmental sustainability (Goal-7).

Targets	Indicators
7.1 Reduction of fossil fuels and increased use of Renewable energy	**Reduction of fossil** fuels for electricity generation (70% in 2021)
	Percentage of: - electricity generated from RE-sources - grid utilization indicating efficient integration of RE-sources - industrial consumption of electricity from RE-sources.
	Expansion and up-gradation of grid infrastructure
	Dedicated corridors for RE-transmission facilitates
	Measure of efficient evacuation of power from RE-generation zones
7.2 Solar Energy	**Cumulative percentage of** installed capacity of non-fossil fuel-based energy resources. Total installed Solar capacity **Percentage of:** **- Houses with** rooftop solar energy **- Solar home lighting systems** **- Solar Parks** **- Solar-powered street lighting systems** **- Solar-powered irrigation systems**
7.3 Wind Energy	**Increasing wind energy capacity (48.16 GW in 2024)** **Number of wind energy sites** **Utilization of wind energy resources** **Total investment (private sector** and public-private partnerships)
7.4 **Hydrogen-based economy**	GH capacity (Target: **5MMT by 2030)** Annual production and utilization of GH Integrating GH production into the energy mix Volume of export of GH and its derivatives. Job creation (Target**: 6 lakh** jobs by 2030)
7.5 GHG emission	**Reduction of GHG**-emission by 45% in 2030 from 2005 level. Per-capita GHG emissions from sources like industry, transportation, and energy consumption Reduction in carbon footprint, covering emissions from all sectors - year wise
	Circular economy practices in the energy sector by: ○ - Recycling rates. ○ - Waste-to-energy conversion, through schemes like GOBARdhan. Periodic assessment of GHG emissions level using *GHG Platform India*, an acknowledged standard for measuring and managing GHG emissions/carbon footprint.
7.6 **Biodiversity and natural resources:**	Proportion of forests cover (24.62% in 2021) **Forest-health** based on density and quality of tree cover. Rate of deforestation, land-use changes Number of Ramsar sites Natural habitats converted to agricultural or urban areas Diversity of flora and fauna including species level of: • Dragonflies: indicating water quality • Earthworms: Sign of healthy, fertile soil. • Spiders: Can be indicators of climate change. • Dead wood and old trees: Indicating healthy, diverse environment that provides habitat for other species. Percentage of trees with **Lichens** **Keystone species count** Number of threatened or endangered species – year wise Percentage increase of Community-based ecotourism Red List Index: changing conservation status of species listed on the IUCN Red List. Habitat Indices: Status and integrity of different habitats. Ecosystem services index: Benefits of biodiversity to humans.
7.7 **Solid waste management**	100% door-to-door waste collection 100% source segregation of waste into wet, dry, and domestic hazardous streams. Percentage of: - Waste sent to landfills - Solid waste processed scientifically, - **Material recovery facility(MRF) capacity** - Capacity to convert waste into valuable resources, like waste-to-energy plants, bio-methanation facilities, and composting plants. - Compliance with landfill restrictions - Reduce, Reuse, Recycle model

	Recycling rate for various materials (like plastic, e-waste, glass)
7.8 Environmental governance and policy	Effectiveness of environmental policies Compliance with **National Green Tribunal (NGT) rules** Level of commitment to environmental action at community, government departments and agencies, collaboration with industry and civil society.

Goal 8- Good Governess:
Good Governance is the foundation for VB. Good Governing Index (GGI) 2020-21 by Govt. of India (https://drpg.gov.in) with core principle of 'minimum government and maximum governance' considers 58 indicators in 10 sectors to measure progress across regions and sectors. The Goal-8 of VB, may consider Sectors as Targets with indicators of GGI avoiding those overlapping with other VB targets.

Goal 9 - Welfare of farmers:
Welfare of farmers is addressed through various government schemes under targeted areas like:

- Financial support and income security
- Agricultural and infrastructure development
- Insurance and credit
- Modernization and planning

Targets and indicators of Goal-9 are depicted in Table-9.

Table 9: Targets and indicators of Environmental sustainability (Goal-9).

Targets	Indicators
9.1 Economic	**Av.** monthly income per agricultural household.
	Number of institutional credit availed
	Access to regulated markets (APMCs), e-NAM
	Awareness of minimum support price.
	Livestock ownership, household assets, and investment in land and machinery.
9.2 Social	Access to social security systems like health-facilities, education
	Health concerns, social isolation, and ability to fulfil family obligations.
	Degree of social capital and social networking
	Number of government schemes, households has benefited from.
9.3 Infrastructure and production	Availability of irrigation, electricity, and transportation facilities.
	Rural connectivity, including digital technology
	Foodgrain productivity, cropping intensity, and mechanization.
	Soil-health, use of fertilizers, and resource conservation
	Availability of post-harvest facilities (cold storage and warehousing).

Goal-10 Sustainable Development:
This aligns with SDGs and include socio-economic-environmental and governance pillars. Targets and indicators of each such pillar have already been described in previous VB Goals. Other relevant targets could be human-scale competitiveness based on cooperation among the Triple Helix (TH) i.e. university-industry-government in Knowledge Society aiming at lifelong learning, triple transition (climate, digital, demographic) for gender equality and employment generation. Helix-wise indicators used by Jovanović et al. (2020) are given in Table-10.

Table10: Indicators of Triple Helix (Goal-10).

Targets	Indicators
10.1 Industry helix:	Business Enterprise researchers as: - Percentage of national total; - Full-time equivalent employees(FTEs), specifically dedicated to R&D Percentage of : -Business expenditure on R&D -Gross expenditure on R&D (GERD)
10.2 Government helix:	Percentage of GERD: -performed by Government; - financed by Government - financed by Industry Government researches as percentage of: -National total -GDP - FTE specifically dedicated to R&D
10.3 University helix	Percentage of GERD performed by the HE- sector HE researchers as percentage of national total; HE expenditure (HERD)as percentage of GDP; Percentage of HERD financed by Industry; HE researchers (FTE).
10.4 University-Industry-Govt. combined helix	Technology balance of payments: -Receipts -Payments Total R&D person/thousand labour force No. of "triadic" patent families Per capita GERD

6. Problem areas

The indicators in percentages, ratios, numbers, ordinal scale, ratio scale, indices, etc. with different score-ranges and unknown distributions are not additive. For Literacy rate (LR), $LR_{Males} > LR_{Females}$ for 50% regions implies $LR_{Females} > LR_{Males}$ for the remaining regions of a country but$LR_{Country} \neq 0$. Thus, average of percentage LR of states and UTs ≠ Percentage LR of India. Meaningful addition of random variables X and Y requires similar probability distributions facilitating knowledge of distribution of $Z = X + Y$ enabling computation of $P(x + y \leq z) = \int_{-\infty}^{\infty}(\int_{-\infty}^{z} f_{X,Y}(x, t - x)dt.$ Combining ordinal scores (like MacArthur Scale) with count data (like number of digital transactions); ratio scale data (like life expectancy), etc. have inherent problems. Levels of items in questionnaires are not equidistant with respect to trait being measured. Thus, summated scale scores are not meaningful and mean, variance, correlation, etc. may be distorted (Rutter and Brown, 2017). Increase in number of levels changes score distribution and influence psychometric parameters of item/test more than the underlying variable (Lim, 2008).

Normalizing the indicators using Min-Max transformation (MMT) $Y = \frac{X-Min_X}{Max(X_i)-Min(X_i)}$ where $0 \leq Y \leq 1$ and taking weighted sum ($\sum W_i y_i$) is popular. Problems with MMT showing relative performance are:

- Change in Min_X can change marginal rates of substitution and rankings.
- Y remains unchanged if X is categorical taking values 0 or 1.
- Fixed zero-point of variables in ratio scale get altered.
- Sample specific $Max(X_i)$ & $Min(X_i)$ could be unreliable outliers.
- $\frac{Increase\ in\ Y}{Unit\ increase\ in\ X}$ is different for different score range of X and $r_{xy} \neq 1$
- Indicators with small score-ranges are overestimated
- $\sum y_i$ or $\sum W_i y_i$ suffers from substitutability effect where low value of indicators (say life expectancy) get compensated by high value of other indicators (say income) (Herrero et al. 2010).
- Can change shape of probability distributions of Y and distort the results (Mazziotta and Paretoa, 2021).
- Different ways of choosing weights give different results. No selection of weights is beyond criticism.

Weights have been assigned to indicators, targets, and regions. Weights to indicators performed better than weights to targets (Asadikia, et al. 2024). Selection of weights to assess SDG-progress are not uniform (UN-DESA, 2024). Example showing Country-A > Country-B by MMT, but reverse inequality for weighted sum was provided by Chakrabartty, (2024b).

Numerical value of targets/indicators are not always available. For indicator like MMR of 70 per 100000 live births (SDG target 3.1), India may go beyond the target to enjoy socio-economic and demographic benefits. For "**Reducing GHG-**emission by 45% in 2030 from 2005 level" is relative to baseline year. It could be desirable to aggregate ratios of an indicator at current year and corresponding value at base year, avoiding normalization and selection of weights.

7. Method

i) Ensure uniform direction of each indicator i.e. higher indicator score implies better performance
ii) For K-point scales, mark response-categories of items as 1, 2, 3, 4,…..K avoiding zero.

For the t-th year, let $x_{ij_t} > 0$ be value of i-th indicator of j-th target for i= 1,2, …., n and corresponding value in the base period be $x_{ij_0} > 0$. Value of the j-th target is proposed as

$$T_{j_t} = \sqrt[n]{\prod_{i=1}^{n} \frac{x_{ij_t}}{x_{ij_0}}} \quad (1)$$

which is equivalent to $T_{j_t} = \prod_{i=1}^{n} \frac{x_{ij_t}}{x_{ij_0}}$ (2)

Index of a goal is obtained by product of all targets belonging to the goal i.e.

$$I_{Goal_{mt}} = \prod_{j \in m-th\ Goal} T_{j_t} \quad (3)$$

Index (I_{VB_t}) reflecting overall status of **VB** as

$$I_{VB_t} = \prod I_{Goal_{mt}} = \prod \prod T_{j_t} = \prod_{j=1}^{k} \prod_{i=1}^{n} \frac{x_{ij_t}}{x_{ij_0}} \quad (4)$$

Equation (2) implies $ln\, T_{j_t} = \sum_{i=1}^{n} ln\, x_{ij_t} - \sum_{i=1}^{n} ln\, x_{ij_0}$

i.e., $logarithm$ of a target = Sum of $logarithm$ of n-indicators in current year- Sum of $logarithm$ of n-indicators in base year, which is an additive model following lognormal distribution for large sample size (Alf and Grossberg, 1979). Lognormal distributions are common when different factors of multidimensional index are multiplicative (https://www.mhnederlof.nl/lognormal.html) i.e. if X follows lognormal then log(X) follows normal and vice versa (Harvey et al. 2025).

The indices may be computed separately for states and UTs to see how they behaves over the regions and combined to get indices at the national level.

8. Properties

Each of the unit-free indices T_{j_t}, $I_{Goal_{mt}}$ and I_{VB_t} reflects status in the t-th year by monotonically increasing continuous variables irrespective of units of the indicators and satisfy:

- Aggregation Consistency since Index computed in stages = Index computed in a single stage (Chakravarty, 2003).
- -Time–reversal test since $\frac{I_{VB_t}}{I_{VB_0}} * \frac{I_{VB_0}}{I_{VB_t}} = 1$ and $\frac{T_{j_t}}{T_{j_0}} * \frac{T_{j_0}}{T_{j_t}} = 1$ enabling forward and backward movement across time
- Formulation of chin indices since $I_{VB_{20}} = I_{VB_{21}} * I_{VB_{10}}$
- Significantly reduced Trade-offs among the constituent indicators/targets/goals

Progress of I_{VB_t} in successive years can be assessed by $\frac{I_{VB_t} - I_{VB_{(t-1)}}}{I_{VB_{(t-1)}}} * 100$. Similarly, progress of a VB-Goal or VB-target can be measured where positive value indicates progress and effectiveness of the adopted policy measures.

Progress or decline of I_{VB_t} or individual Goal or target can be plotted in a graph showing progress/decline path at regional level and also at country level. Decline of T_{j_t} or I_{VB_t} at the relevant years can be probed for finding possible reasons and initiation of remedial action.

Relative importance of targets of VB can be found by $\frac{\Delta T_{j_t}}{\Delta I_{VB_t}} \times 100$. The targets can be ranked or prioritised based on values of $\frac{\Delta T_{j_t}}{\Delta I_{VB_t}} \times 100$. Intervention in the target with rank-1 will give most significant positive change in a shorter period. Similarly, relative importance of indicators in a target can be found for better monitoring. Relative importance vary for different regions. For regions and India as a whole, relative contributions may get changed across years.

The i-th indicator of j-th target may be critical if $T_{j_t} < T_{j_{(t-1)}}$ requiring necessary remedial action to arrest the poor performance. Similarly, critical goal of VB can be identified.

Enables testing of hypothesis like H_0: $I_{VB_t} = I_{VB_{(t-1)}}$, H_0:

$T_{j_t} = T_{j_{(t-1)}}$ or H_0: $T_{j_t} = T_{s_t}$ for $j \neq s$ by t-test using logarithm of the variables.

Achievement of all goals in 2047 implies $I_{VB_{2047}} \geq 1$. Thus, distance in t-th period from $I_{VB_{2047}}$ is given by $\frac{I_{VB_{2047}} - I_{VB_t}}{I_{VB_t}} * 100$ even in absence of numerical values of Goals or Targets.

New Multidimensional poverty index (I_{NMPI}) by multiplicative aggregation avoided unnecessary rejection of households/individuals (Chakrabartty,2024c)

9. Limitations

Assumed availability of positive numerical value for each indicator for any year. Treating missing data could be a future study. In case of introduction of new indicators, value of each new indicator needs to be estimated separately for the base period and subsequent periods.

10. Discussion

Multiplicative aggregation of the indicators under a target of VB at a given year ensuring $\prod_{i=1}^{n} \frac{x_{ij_t}}{x_{ij_0}} = T_{j_t}$ and $I_{VB_t} = \prod_{j=1}^{k} T_{j_t} = \prod_{j=1}^{k} \prod_{i=1}^{n} \frac{x_{ij_t}}{x_{ij_0}}$ reflecting current status of a target and overall current status of Viksit Bharat have theoretical advantages like:

- Reduced trade-offs.
- Meaningfully aggregation of data in different units or expressed in percentages, averages, rates, count data, and several sub-indices.
- Effects of outliers in data from developed or underdeveloped regions are practically nil.
- For a given time-period, the targets can be ranked with respect to $T_{j_t}'s$ or by their contribution given by $\frac{T_{j_t}}{I_{VB_t}} \times 100$.
- Identification of critical indicator(s) and critical goals at national level offers direction of improvement required for India and help in formulating action plans accordingly.
- Progress/decline paths of I_{VB_t} registered by different regions during the past p-years can be compared meaningfully by chain indices even if base year is changed and similarity of such paths can be found by a similarity measure, say cosine similarity between two q-dimensional vectors $\boldsymbol{P_1} = (Prog._{11}, Prog._{12}, \ldots, Prog._{1q})^T$ and $\boldsymbol{P_2} = (Prog._{21}, Prog._{22} \ldots Prog._{2q})^T$ (Chakrabartty and Sinha, 2022).

However, selection of targets and indicators based on understanding and utilization of domestic and global trends and equality of opportunity for citizens based on personal motivation & inherent capabilities, need to be deliberated and finalised in a comprehensive manner. Such exercise may also decide on data sources of each indicator either by secondary data or by primary data.

11. Conclusion

The proposed indices obtained through multiplicative aggregations of chosen indicators, avoiding problems of normalization and selection of weights, can be computed at national level in an integrated way. The indices can cover any type of data and offer significant benefits and is recommended. Future empirical investigations are suggested towards finding salient features of T_{j_t} and I_{VB_t} including distribution of I_{VB_t} and correlation matrix of $T_{j_t}'s$ and preparing comprehensive plan for achieving the goals of Viksit Bharat 2047.

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