



# Scientific Social Responsibility: Revisiting Policy Options for Global South

## Connecting Innovation Systems with Development

Technology is the most powerful tool for accelerating socio-economic development and systemic transformations to deal with grand challenges. While Europeans have come up with new understanding on Responsible Research and Innovation (RRI) (Owen *et al*, 2012; Owen *et al*, 2013; von Schomberg, 2013), countries like India have developed their own understanding on Scientific Social Responsibility (SSR) (DST, 2019, 2022) and Access, Equity and Inclusion (AEI) (Chaturvedi *et al*, 2015; Chaturvedi and Srinivas, 2015) when it comes to driving science, technology and innovation (STI) policies towards social accountability and ethical practices. There is limited understanding so far on how to match supply and demand when it comes to scientific research and technological solutions that can address specific development goals and targets across countries having different contextual

realities and resource endowments. Such possibilities are further curtailed due to extreme inequalities in STI capacities and localization (Saha and Ali, 2024).

In this article we relate to socio-economic development primarily in the SDGs parlance and leverage the existing practice of indicator-based measurement of development outcomes in order to deliver Agenda 2030 globally and at the same time the rising awareness on localizing developmental efforts. We argue that there is a need to go beyond the contemporary conceptual and analytical framework to comprehend the development of an STI ecosystem suitable for the purpose of achieving the SDGs.

This involves pursuing an integrated approach, where all the relevant stakeholders such as government, private sector, academia, research, international agencies and civil society, are taken on board. Several international agencies have prepared their respective frameworks on Science, Technology and

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<sup>1</sup> Emerging technologies include a variety of technologies such as educational technology, information technology, nanotechnology, biotechnology, robotics, and artificial intelligence.

<sup>2</sup> Enabling Technology is the use of various forms of devices and tech to support a person with disabilities to live as independently as possible. These types of technologies include sensors, mobile applications, remote support systems, and other smart devices.

Innovation (STI) for SDGs (STI4SDGs) based on improvised methodologies but rarely tested or applied (RIS, 2023). While countries differ in their capacities to generate and process data, connecting it with genuine technological needs away from price signals remains a difficult challenge.

## Persistent Inequalities Adding to Setback of the SDGs

Environmentally sound technologies, for example, can enable more sustainable development trajectories through research, development, implementation, and general diffusion. Food security and enhanced nutrition will be aided by the widespread adoption of available agricultural technologies. Access to healthcare and education services can be improved with the use of information and communication technologies. Funding for research will aid in the resolution of public health concerns as well as the easing of environmental and energy challenges.

In the literature, efficacy of innovation systems against quantifiable development gaps, and strategies to address those have not been dealt with in any significant manner. It has to be borne in mind that,

national innovation systems must be organically and spontaneously connected with other forms of innovation system such as regional and sectoral. Little effort has been made to assess how innovation systems contribute to short-, medium- and long-term development needs and what kind of technological solutions need to be deployed. By and large implementing agencies across developing countries lack such knowledge. During the pandemic, the integration of the national innovation system with the biomedical sector in India, could lead to the development and delivery of healthcare products and services in a short span of time (Chaturvedi et. al., 2023). Such a new approach needs to be pursued in multiple sectors towards achieving the SDGs. The UN Guidebook on STI for SDGs Roadmaps has elaborated the rationale for STI for SDGs Roadmaps and the need for strengthened international partnerships on STI4SDGs (European Union and United Nations Inter-Agency Task Team, 2021).

On the question of STI for SDGs, it can safely be said that key technologies are needed in the short to medium term as part of any template for development interventions in any region, irrespective of local capacities or resources. In fact, all development

### Scientific Social Responsibility (SSR)

“On the lines of Corporate Social Responsibility, the concept of Scientific Social Responsibility needs to be inculcated to connect our leading institutions to all stakeholders, including schools and colleges. We must create an environment for sharing of ideas and resources.”

- Prime Minister of India Shri Narendra Modi in his address to the 104th Indian Science Congress at Tirupati, January 3-7 2017

policy designs are increasingly being shaped by their technology content. From the perspective of the process involved, scientific discoveries and technological advancements need intermediaries to complete the feedback loop on assessing the nature of demand. Government

agencies, national and sub-national, may play that role. There are some attempts to identify technologies in terms of their nature and use. Iizuka and Hane (2020, 2021) present a useful illustration in this regard presented in Table 1 below.

**Table 1: Types of Technology and Relevance to SDGs**

	<b>Emerging Technology<sup>1</sup></b>	<b>Enabling Technology<sup>2</sup></b>	<b>General Purpose Technology<sup>3</sup></b>
<b>Novelty</b>	Radical technology	Drive radical change in use	Affect broad socio-economic areas
<b>Impacts</b>	Uncertain and ambiguous	Enhance user capability	Change extant economic and social structure
<b>Impact of technology</b>	Coherence/Convergence	Applicability to diverse field	Creates many spillover effects
<b>Observed change</b>	Relatively fast growth in use	Rapid development of subsequent technology	Societal transformation
<b>Complementarity</b>	Explore methods of use	Complement for broader impacts	Complementary for transformative change and acceleration

Source: Iizuka and Hane, 2020

<sup>3</sup> General-purpose technologies are technologies that can affect an entire economy. GPTs have the potential to drastically alter societies through their impact on pre-existing economic and social structures. These include the steam engine, railroad, interchangeable parts, electricity, electronics, material handling, mechanization, control theory (automation), the automobile, the computer, the Internet, medicine, and artificial intelligence

<sup>4</sup> <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1990696>

### Focus on Access, Equity and Inclusion (AEI)

As patterns of social exclusion and inequality vary across countries and regions and across groups there can be no universal solution. But the need to measure the outcomes of policies through Access, Equity and Inclusion (AEI) criteria is feasible only if suitable indicators and methodologies to measure AEI are developed. RIS undertook preliminary steps in measuring AEI based on data on social and economic development in different states in India.

Access and Equity are linked with inclusion. Access to benefits of advances in S&T and deriving the benefits of technological advances is important. Hence, access is an important value. Equity is a contested term but iniquitous distribution of benefits of advances of S&T and/or bearing the disadvantages from developments in S&T without deriving any benefits indicates that S&T policies can exacerbate persisting inequalities in the society and thereby contribute to widening disparities or worsening of the condition.

See Chaturvedi *et al* (2015) and Chaturvedi and Srinivas (2015)

## How Enabling Technology Ecosystems can be Integral to Delivery of Development – Emerging Indian Experience

India is creating a significant ‘big push’ by integrating technology deployment in flagship welfare schemes for last-mile delivery. India’s large scale welfare schemes spread across key ministries that deal with rural development, agriculture, health, water and sanitation, renewable energy and urbanization have been the key vehicles to catapult digital public infrastructure (DPI) as well as several other emerging technologies for mass application. This has created a virtuous cycle of technology development and adoption and has to some extent facilitated start-up ecosystems and private sector participation for deepening of technological capabilities.

India’s experience, in recent years, suggests that a wider STI ecosystem, composed of many relevant stakeholders is emerging. Such an ecosystem would facilitate close coordination among the relevant stakeholders and primarily help the line ministries in formulating their respective plans to integrate the application of STI for achieving the related SDG goals and targets. All important scientific ministries and departments are vital participants in the process and play a significant role in directing STI activities towards achievement of the SDGs. As development partners in this effort, organisations from the public and private sectors, businesses, and start-ups, are effectively contributing to the process. All key scientific ministries and

line departments through the Flagship schemes have to play a major role in providing direction to STI efforts and are therefore preeminent stakeholders in the process. Sub-national governments particularly, the state governments also form vital pillars for supporting formulation of national STI for SDGs Roadmaps.

Line ministries are pivotal in the identification, procurement and deployment of technologies in the flagship welfare schemes for citizens. Significant learning and experience are being generated on ways and means to leverage technology under flagship schemes. Therefore, line ministries need to further augment internal capacities to come up with coherent strategies for appropriate technology choices towards speedy and optimal outcomes in the delivery of development schemes.

The push towards monitoring and evaluation of flagship schemes at micro level and household level through use of GIS, IoT, ICT, Geo-Tagging and other modern technologies has been strengthened and extended to monitoring the quality over and above the quantity of outcomes through flagship schemes. However, regional asymmetries in adoption and deployment of technologies in Flagship schemes need to be examined to avoid exclusions among the target population. State governments as the implementing authority must be supported to overcome the S&T capacity gaps in respective states.

While a broad array of technologies is being delivered on the ground, the wider connection is coming from leveraging ICT technologies at a very large scale. This is also derived from India's push

<sup>5</sup> <https://pib.gov.in/FactsheetDetails.x?Id=149061#:~:text=The%20initiative%20was%20launched%20by,system%20and%20online%20payment%20facility.>

<sup>6</sup> <https://pib.gov.in/PressReleasePage.aspx?PRID=1998748>

<sup>7</sup> <https://pib.gov.in/FactsheetDetails.aspx?Id=149066>

<sup>8</sup> <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2040860#:~:text=2024%2C%20more%20than%2034.7%20crore,%2C%20West%20Bengal%2C%20and%20Odisha.>

for Digital Public Infrastructure (DPI) that creates a mega universe of data-driven applications for government users, beneficiaries, citizens and public policy practitioners. The constant internal advocacy and capacity building within the system to appreciate and leverage the power of digital technologies has created a natural self-sustaining momentum. Policy templates for large-scale social welfare programmes as well as social and physical infrastructure-driven efforts, are witnessing near universalisation through digital and emerging technologies like GIS tagging of assets, HGM maps, IoT-based sensors, and ICT applications, among others. From the Indian perspective we looked at four inter-related SDGs; food security and agriculture (SDG 2); health and wellbeing (SDG 3); access to water and sanitation (SDG 6); and access to clean and renewable energy (SDG 7). The push-through technologies has enabled large-scale progress in addressing the challenges in these sectors.

Under the Public Distribution System, the One Nation One Ration Card scheme is now in operation and aims to ensure food security for migrant workers who were earlier excluded from the PDS umbrella. This scheme operates through two portals - Integrated Management of Public Distribution System (IM-PDS) and Annavitran. Similarly, under the POSHAN Abhiyaan, the Poshan Tracker app is another important tool that provides daily data from 1.23 million Anganwadi centers. It has around 100 million beneficiaries, including pregnant women, lactating mothers, newborns, and adolescent girls. This app is a major source of real-time information for

mapping nutritional status, vaccinations, and other maternal and child-related policy interventions. The e-NAM is a virtual agricultural market that connects around more than 1000 APMCs in India. This market runs through a virtual e-NAM portal platform that provides real-time transactions and bidding data throughout APMCs. ICT technologies are a major source of real-time information, monitoring and evaluation for these flagship schemes.

ICT tools and IoT sensors are being used under Mission Indradhanush to complement the Universal Immunization Programme (UIP), targeting vaccination for approximately 27 million newborns and 29 million pregnant women annually. Under the mission Electronic - Vaccine Intelligence Network (e-VIN), a technological ecosystem is developed that is used across 23,507 sites in 585 districts to get real-time information on vaccine stock inventory and storage temperature from every vaccine storage and cold chain point situated in peripheral government health facilities using cell phones, web-based applications, temperature loggers, and a cloud-based server.

Similarly, Under the Jal Jeevan Mission (JJM), which aims to provide Functional Household Tap Connection (FHTC) to every rural household, the line ministry, in collaboration with other institutions, has developed an array of technological tools for the delivery, monitoring and evaluation of the target. A few innovative instruments deployed under the JJM are:

- Hydro-Geo-Morphological (HGM) Maps developed in collaboration with the National Remote Sensing Centre

<sup>9</sup> <https://pib.gov.in/PressReleasePage.aspx?PRID=1966931> 11 IMF. Rethinking My Economics, Angus Deaton. (2024)

<sup>10</sup> <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2002712>

<sup>11</sup> <https://pib.gov.in/PressReleasePage.aspx?PRID=1959918>

<sup>12</sup> <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1989815>



(NRSC), Hyderabad, for locating groundwater sources;

- GIS technology for finding locations of existing water sources; village digital 3D contour maps prepared by Ministry of Electronics and Information Technology (MEITY) for the location of drinking water infrastructure;
- Digital inventory of existing assets and overlaying them on GIS maps;
- Supervisory Control and Data Access (SCADA) system in Multi Village Scheme (MVS) for monitoring treatment plants and distribution system;
- GIS technology and IoT based sensors to monitor the status of the functionality of assets and Solar Energy based stand-alone water supply systems for scattered/ isolated/ tribal/ hilly villages.

Since the launch of the mission, 65 million rural households have been provided with FHTC, bringing the total rural household with FHTC to 100 million out of the 190 million total rural households.

Further detail on Flagship Schemes and Technology Component is presented in Table 2.

## Policy Roadmap

- **Mapping unmet technology needs:** A mapping methodology for technology needs is important. Focus may be on those SDG indicators that are directly aligned with known significant scientific challenges that are in turn connected to existing complex

development gaps often beyond accessible technological solutions in developing countries. In such cases, access, equity, affordability alongside sustainability would be important considerations for any scientific enterprise. One way to encourage national planners and policymakers to pay attention to STIs for SDGs is by demonstrating that the use/ availability of existing or potential STI solutions would help accelerate the achievements under respective indicators. From the perspective of developing countries, diffusion of available technologies in all regions is equally important. With respect to grand challenges, developing countries are at a continued disadvantage and may not be in a position to develop, acquire or access STI solutions unless appropriate policy interventions are made.

- **Evaluating existing, emerging and new technologies:** The mapping of technologies with their respective SDG targets and indicators opens up various new areas of innovation, as laid out in the UN Guidebook for preparation of STI for SDGs Roadmap. Given that there exists an array of technological options that could cater to these challenges, it is imperative to first assess these alternatives. One way of doing this is by classifying all relevant technologies into existing, emerging or new. Since newer technologies will take some time to fully penetrate their desired markets or users, the prioritization

of alternative technologies will have to be such that priority is given to existing technologies, then emerging and later to new technologies. This also allows us to identify gaps in the existing technology landscape. The information could be very useful in channeling research investments into new technologies that address these gaps.

- **Strengthening Data Availability on STI for SDGs:** Targets defined under each SDG are development objectives that need to be achieved universally, in totality and in spirit to fulfill the aspirations of a sustainable and equitable world. Targets are also instruments to connect more than one SDG so that achievement of a particular target would support fulfilling objectives under other

SDGs as well. While countries are free to define their indicator framework, a reference indicator framework has been identified by the UN after rigorous negotiation process among statistical agencies of various countries. While the range of indicators that have been identified captures the spirit of the related target, the aspiration of the target as well as that of the concerned SDG goal can only be achieved by addressing the slated issues going beyond the scope of specific indicators in some cases. This is partly due to the fact that indicators are developed keeping in mind data availability as well as the status of the methodology that goes into computation of indicators. However, abilities of statistical

**Table 2: Flagship Schemes and Technology Component**

Flagship Schemes	Line Ministry	Outreach and scale	Key Technology Platform and Associated Technologies
One Nation One Ration Card (ONOS) (SDG 2)	Ministry of Consumer Affairs, Food & Public Distribution	<p>An amount of INR 205250.00 crore has been allocated under Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY).</p> <p>The ONORC plan has been enabled in all 36 States/UTs (across the country) covering around 80 Crore NFSA beneficiaries.</p> <p>Since inception of ONORC plan - more than 125 Crore portability transactions have been recorded, delivering more than 241 LMT foodgrains<sup>4</sup></p>	<ul style="list-style-type: none"> <li>• Two portals - IMPDS and Annavitran</li> <li>• ePOS terminal with biometric scanner</li> </ul>

<p>Electronic - National Agriculture Market -e-NAM (SDG 2)</p>	<p>Ministry of Agriculture &amp; Farmers Welfare</p>	<p>1389 Agriculture Mandis (Agriculture markets) of 23 States and 04 UTs have been integrated to e-NAM platform.</p> <p>More than 1.77 crore farmers &amp; 2.53 lakh traders have registered on e-NAM platform</p> <p>Total volume of 8.96 Crore MT &amp; 30.99 Crore numbers collectively worth approximately INR 3.19 lakh crore of trade has been recorded on e-NAM platform.<sup>5</sup></p>	<ul style="list-style-type: none"> <li>• Pan India electronic trading portal -Virtual market</li> <li>• e-NAM software hosted on Meghraj Cloud</li> </ul>
<p>Pradhan Mantri Poshan Shakti Nirman (POSHAN) Abhiyaan 2.0 (SDG 2)</p>	<p>Ministry of Women and Child Development</p>	<p>10.01 crore beneficiaries registered on Poshan Tracker.</p> <p>9.55 crore, or 95.39 percent beneficiaries have been Aadhaar verified to ensure last mile tracking and delivery of services.<sup>6</sup></p> <p>An amount of INR 12467.39 crore has been allocated for Pradhan Mantri Poshan Shakti Nirman (PM POSHAN) for year 2024-25</p>	<ul style="list-style-type: none"> <li>• POSHAN Tracker Mobile application</li> <li>• 11.03 Lakh Smartphones for data collection on real time basis</li> </ul>
<p>National Digital Health Mission (SDG 3)</p>	<p>Ministry of Health and Family Welfare</p>	<p>Till February 2024, more than 56.67 crore Ayushman Bharat Health Accounts (ABHA) have been created and over 34.89 crore health records have been linked.</p> <p>Around 2.35 lakh health facilities have been verified on the Health Facility Registry.<sup>7</sup></p> <p>An amount of INR 200.00 crores has been allocated for National Digital Health Mission – NHM in the budget 2024-25</p>	<ul style="list-style-type: none"> <li>• Open-API based Ecosystem</li> <li>• India Enterprise Architecture Framework</li> <li>• Open Telemedicine and e-Pharmacy Network</li> <li>• Health lockers, Health Workforce Registry, Healthcare Facility Registry</li> </ul>



<p>Pradhan Mantri Jan Arogya Yojana – PMJAY (SDG 3)</p>	<p>Ministry of Health and Family Welfare</p>	<p>More than 34 crore Ayushman cards created under Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY)</p> <p>More than 7 crore hospital admissions worth INR One lakh crore authorized under the scheme<sup>8</sup></p> <p>An amount of INR 7300.00 crores has been allocated for the Ayushman Bharat - Pradhan Mantri Jan Arogya Yojana (PMJAY) in 2024-25</p>	<ul style="list-style-type: none"> <li>• PMJAY- Beneficiary Identification system</li> <li>• PMJAY Dashboard, Hospital Empanelment System, Transaction Management System based on API</li> </ul>
<p>Mission Indradhanush (SDG 3)</p>	<p>Ministry of Health and Family Welfare</p>	<p>Since 2014, 11 phases of Mission Indradhanush have been completed across the country.</p> <p>A total of 5.06 crore children and 1.25 crore pregnant women have been cumulatively vaccinated till date under the campaign.<sup>9</sup></p>	<ul style="list-style-type: none"> <li>• Electronic Vaccine Intelligence Network (e-VIN)</li> <li>• Immunization Supply Chain and Logistics (ISCL) system National Cold Chain Management Information System</li> </ul>
<p>Jal Jeevan Mission - JJM (SDG 6)</p>	<p>Ministry of Jal Shakti</p>	<p>As on January 2024, out of 19.27 Crore rural households in the country, more than 14.21 Crore (73.76 percent) households are reported to have tap water supply in their homes.</p> <p>More than 10.98 Crore additional rural households have been provided with tap water connections under JJM since 2019<sup>10</sup></p> <p>An allocation of INR 70162.90 crores has been provided for Jal Jeevan Mission (JJM) / National Rural Drinking Water Mission in 2024-25</p>	<ul style="list-style-type: none"> <li>• JJM IMIS portal</li> <li>• GIS, IoT based sensors and iCloud</li> <li>• Hydro-Geo-Morphological Maps</li> <li>• Supervisory Control and Data Access (SCADA)</li> </ul>

<p>Swachh Bharat Mission (SDG 6)</p>	<p>Ministry of Jal Shakti</p>	<p>Over 4.4 Lakh villages declare themselves Open Defecation Free (ODF) plus.</p> <p>An ODF Plus village is one which has sustained its Open Defecation Free (ODF) status along with implementing either solid or liquid waste management systems</p> <p>All Villages in 14 States/UTs achieve ODF Plus Status and in 4 States/UTs achieve ODF Plus Model Status<sup>11</sup></p> <p>An allocation of INR 7192.00 crore has been made towards Swachh Bharat Mission (Gramin) in the Budget Estimate of 2024-25</p>	<ul style="list-style-type: none"> <li>• Online Monitoring System from Baseline survey</li> <li>• Module for monitoring ODF Twin pit toilets, Phytoid Technology</li> </ul>
<p>Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan PM KUSUM (SDG 7)</p>	<p>Ministry of New and Renewable Energy</p>	<p>PM-KUSUM progress report as of November 30, 2023<sup>12</sup></p> <p>Component A (MW): 4,766 MW sanctioned, 141.33 MW installed.</p> <p>Component B (Nos): 971,471 sanctioned, 278,114 installed.</p> <p>Component C (Nos): 134,286 sanctioned (IPS), 2,912,466 sanctioned (FLS), 4,594 installed.</p> <p>An allocation of INR 1996.00 crores has been made towards Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM) in year 2024-25</p>	<ul style="list-style-type: none"> <li>• Renewable Power projects of capacity 500kW to 2MW</li> <li>• Standalone solar Agriculture Pumps/ Transition from grid connection agricultural pumps to solarise</li> </ul>

Source for budgetary allocation - Expenditure Profile 2024-2025

agencies to report relevant data are widely disparate.

- **Overcoming regional asymmetries in technology deployment/ absorption:** Finally, challenges still exist in the deployment of technologies owing to the limited social and physical infrastructure. The experiences with India's flagship schemes have depicted possible trajectories for countries in the Global South, where the technological interventions have to be complemented by an adequate push in social and physical infrastructure at the local level to create dynamism at the bottom of the pyramid and ensure inclusivity and equity. Regional and social asymmetries in terms of natural, institutional and economic endowments have to be incorporated into the policy-making to design such technological tools in accordance with the adaptive nature of the regions and societies.

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