Science, Technology and Innovation for Inclusive Transformation: Advancing India–Africa Cooperation

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Abstract

The relationship between science, technology and innovation (STI) and Africa's structural transformation has become an operational imperative. For a continent confronting simultaneous pressures—demographic acceleration, climate disruption, industrial stagnation, and health and food insecurity—STI is the architecture through which sustainable, sovereign, and inclusive futures must be constructed. Yet the material foundations remain critically underdeveloped: sub-Saharan Africa's R&D expenditure stands at just 0.4% of GDP (continental target is 1% of GDP), less than one-fifth of the global average of 2.0%,[1] while the continent captured a mere 0.6% of global venture capital in 2024.[2] This paper argues that India–Africa STI cooperation must transcend beyond the ceremonial and episodic engagements, reorienting toward sustained, evidence-driven, and institutionally embedded collaboration grounded in science diplomacy, policy alignment, and shared developmental purpose. It identifies high-impact domains for partnership and foregrounds the indispensable role of data systems, inclusive ecosystem design, and innovation financing in converting scientific knowledge into transformative development outcomes.

Introduction

Africa's development predicament is a structural paradox: a continent of extraordinary endowments—natural resources, arable land, critical minerals, and a young, expanding population—that remains at the margins of global value creation and knowledge production. What distinguishes the present moment is the recognition that these challenges demand systematic, science-based, and innovation-driven responses coordinated across institutions, sectors, and borders, and cannot be resolved through aid transfers or commodity revenues alone.

India emerges as a strategically apposite partner: its domestic experience deploying STI for large-scale, low-cost development challenges—from digital public infrastructure to generic pharmaceuticals and agricultural innovation—constitutes a model directly relevant to African contexts. India's Department of Science and Technology pursues international STI engagement through the India–Africa S&T Initiative,[3] commanding cooperation agreements across 83 countries, a network that, properly oriented, could powerfully accelerate Africa's knowledge economy.

Africa's STI Priorities

Africa's STI priorities[7] are structural necessities, not aspirational abstractions. As Table 1 illustrates, R&D expenditure has stagnated at 0.4% of GDP since 2005,[1] while the haemorrhage of approximately 70,000 skilled professionals annually[4] depletes the very human capital innovation ecosystems require. The

Table 1: Key STI and Innovation Ecosystem Indicators — Africa vs Global Benchmarks

Indicator	Africa / Sub-Saharan Africa	Global Average / Benchmark
R&D expenditure (% of GDP)	0.4% (stagnant since 2005)[1]	2.0%[1]
Share of global venture capital (2024)	0.6%[2]	Africa = 18% of the world population[2]
Skilled professionals emigrating annually	~70,000[4]	Among the highest rates globally[4]
Intra-regional trade share	~16% of total continental trade[5]	Asia >60%; Europe >70%[5,6]
Intra-African trade value (2024)	US$220 billion[5]	+13.9% growth driven by AfCFTA[5]

institutional logic is clear: ecosystems succeed when actors align around concrete, nationally relevant problems, and when knowledge-to-market translation mechanisms are deliberately constructed rather than assumed. This demands systemic integration of STI with industrial strategy, education, procurement, and regulatory frameworks—with universities, research councils, the private sector, and development partners functioning as co-architects, not episodic collaborators.

India's Cooperation Strengths

India's value proposition is distinguished not by financial volume but by developmental relevance. Its tradition of frugal engineering, scalable digital public infrastructure, globally competitive generic pharmaceutical industry, and expertise in space technology and renewable energy constitute a portfolio of capabilities directly applicable to African challenges. With agreements across 83 countries,[3] India has demonstrated the capacity for sustained scientific partnerships across diverse geopolitical contexts. The India–South Africa bilateral relationship—deepened through G20 and BRICS platforms and spanning biotechnology, astronomy, nanotechnology, and energy technologies since 1995—demonstrates that sustained, agenda-driven engagement accumulates compound institutional returns.

Priority Areas for Collaboration

The highest-return collaboration opportunities are those where knowledge application directly reduces structural poverty, expands productive capacity, and builds resilience. Table 2 maps five priority sectors against their joint programme focus areas and development objectives.

Digital innovation warrants particular strategic attention. India's capacity to architect scalable digital public infrastructure—from identity systems and payment rails to health data platforms—aligns powerfully with Africa's demand for efficient, interoperable, and sovereign digital governance. Enterprise development is equally critical: Africa's industrialisation depends not only on large capital projects, but also on a competitive, globally integrated private sector, for which India's experience with Small and Medium-sized Enterprises (SMEs) provides support, and industrial clusters offer replicable models.

Science Diplomacy and Policy Alignment

In an era of sharpening geopolitical rivalries and supply chain fragmentation, science diplomacy has re-emerged as one of the few genuinely constructive instruments of international relations. Unlike transactional foreign policy, it builds epistemic trust and institutional familiarity that enable durable

Table 2: India–Africa STI Priority Collaboration Sectors

Sector	Joint Programme Focus Areas	Development Objective
Agriculture	Climate-smart farming, seed systems, post-harvest loss reduction, rural mechanisation	Food security + income generation
Health	Diagnostics, vaccine R&D, digital health, local pharmaceutical manufacturing	Health resilience + industrial development
Energy	Off-grid electrification, battery storage, green hydrogen, clean cooking	Renewable transition + energy access
Digital Innovation	Fintech, e-governance, AI governance, cyber resilience, digital skills	Sovereign digital infrastructure
Enterprise Development	SME support, technology parks, industrial clusters, commercialisation pathways	Private sector competitiveness

cooperation. India and Africa share a foundational solidarity—rooted in non-alignment, a shared colonial history, and South–South philosophy—that provides the ideational substrate for a deeper knowledge-based partnership. The task is to operationalise that solidarity through structured research partnerships, mobility programmes, joint innovation platforms, and iterative policy dialogue.

AUDA-NEPAD and the African Union Commission bear the institutional responsibility of ensuring that bilateral and multilateral STI engagements align with continental strategic frameworks rather than fragment into disconnected project portfolios. Agenda 2063 demands robust monitoring, evaluation, and accountability architectures—STI cooperation must be designed around measurable outcomes, transparent reporting, and iterative learning mechanisms.

The Role of Data and Evidence

STI governance is only as robust as its evidence base. Governments require granular, timely data on R&D flows, firm-level innovation, technology adoption, patent activity, and startup survival to design genuinely transformative interventions. Without such data, STI policy defaults to input optimism—measuring expenditure rather than impact. Shared investment in harmonised STI metrics, joint evaluation frameworks, and digital evidence platforms would strengthen the empirical legitimacy of India–Africa cooperation and generate the institutional learning necessary for continuous improvement. Evidence, in this framing, is not a reporting requirement: it is the feedback mechanism through which cooperation evolves from good intentions to genuine transformation.

Innovation Ecosystems and Inclusion

The capacity to generate, absorb, and commercialise knowledge is a systemic property, not an individual one. Africa's ecosystem constraints are severe and measurable—as Table 1 shows, the continent captured just 0.6% of global venture capital[2] despite representing 18% of world population, and intra-African trade remains disproportionately low at approximately 16% of total continental trade[5]—reflecting not a deficit of entrepreneurial ambition but a systemic failure of enabling conditions: patient capital, regulatory certainty, market connectivity, and institutional support.

The India–Africa partnership must therefore function as an ecosystem intervention: co-investing in joint research centres, startup exchange programmes, technology transfer frameworks, and incubation infrastructure. Cooperation must be architecturally inclusive—integrating women, youth, and marginalised communities not as a normative addendum but as an economic imperative—and epistemically respectful,

treating African knowledge systems and locally generated solutions as assets for co-creation, not gaps to be filled by external expertise.

Strategic Directions

Five mutually reinforcing strategic directions emerge from this analysis, summarised in Table 3.

These directions are not sequentially achievable; they are mutually reinforcing and must be pursued in parallel. AUDA-NEPAD and India's Department of Science and Technology must provide the institutional convening and coordination that bilateral STI cooperation demands—sustained beyond electoral cycles, diplomatic summitry, and the short horizon of project funding.

Table 3: Five Strategic Directions for India–Africa STI Cooperation

S.No.	Direction	Operational Mechanism	Strategic Rationale
1	**Sectoral Depth**	Time-bound, jointly governed programmes in high-productivity sectors	Move beyond declarations to funded, measurable commitments
2	**Talent Pipeline**	Fellowships, researcher exchanges, joint doctoral programmes	Counter brain drain; build bilateral scientific networks
3	**Ecosystem Support**	Incubators, testing facilities, commercialisation pathways	Integrate innovation support as structural — not peripheral — priority
4	**Science Diplomacy**	Dedicated bilateral STI governance and policy dialogue mechanisms	Institutionalise cooperation beyond summitry and project cycles
5	**Data & Evidence**	Harmonised STI metrics, joint evaluation, digital evidence platforms	Embed accountability and learning from programme inception

Conclusion

India–Africa STI cooperation today needs to be strengthened. Structural conditions for a genuinely transformative partnership are more favourable than at any prior moment: shared developmental philosophies, complementary institutional capabilities, growing political engagement, and an African continental market increasingly integrated through the AfCFTA. Yet the gap between potential, readiness and performance remains wide. Africa's R&D expenditure must urgently converge toward the global average of 2.0% of GDP,[1] and intra-African trade—growing to US $ 220 billion in 2024[5]—must be deepened through regulatory harmonisation and digital trade infrastructure. The opportunity before both partners is not simply to cooperate more, but to do so with greater precision, ambition, and an unwavering commitment to ensuring that the knowledge generated translates into sovereign capability, shared prosperity and genuinely inclusive transformation.

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