

# Establishing Innovation Systems in the Global South: Challenges and the Path Forward through South-South Cooperation



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**Received:** 01.10.2024

**Accepted:** 10.11.2024

How to cite: Leloğlu, U. M. (2024). Establishing Innovation Systems in the Global South: Challenges and the Path Forward through South-South Cooperation. *BRIQ Belt and Road Initiative Quarterly* 6 (1), 20-35.



## ABSTRACT

This paper examines the obstacles and prospects for establishing resilient innovation systems in the Global South. In addition to structural impediments like brain drain, fragile industrial bases, and insufficient legal and cultural frameworks, self-perpetuating polarization along the core-periphery axis and the monopolization of knowledge at the core further constrain these nations' capacity to establish robust science, technology, and innovation (STI) systems. The document underscores the constraints of North-South partnerships, which frequently intensify prevailing disparities, and accentuates the promise of South-South collaboration as a more equitable and sustainable option. Through the sharing of resources, expertise, and experiences, countries in the Global South may augment their innovation ecosystems, propel regional development, and fortify their standings in global value chains. Customized policies, regional collaboration, and fair international alliances are seen as crucial for the sustained success of innovation systems in the Global South. A proposed model delineates a shared research domain wherein players allocate adaptable budgets and comply with a notion of equitable returns within structured frameworks. This strategy could promote efficient and effective South-South scientific and technological collaboration at both regional and global levels. The BRICS STI Framework initiative can act as a significant reference for analogous regional organizations, enhancing their collaborative models via shared experiences and adaptable frameworks.

**Keywords:** brain drain, Global South, science, technology and innovation policy, South-South cooperation, sustainable development.

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## Introduction

DEVELOPMENT IS A PRIMARY OBJECTIVE for states worldwide; nevertheless, most of the global population lives in countries typically classified as “developing” or “emerging,” rather than “developed.” Covering extensive regions worldwide and including a significant portion of the global population, these nations have substantial obstacles in attaining the living standards characteristic of industrialized countries. Regardless of

the metric employed to assess development—be it economic indicators like gross domestic product (GDP), social metrics such as healthcare and education, or environmental sustainability indices—a significant number of countries do not qualify as “developed” or “high-income” nations.

For these countries, which include many in Africa, Latin America, Asia, and parts of Oceania, the challenge of development is not just an academic issue but an urgent reality that directly affects the everyday lives of billions of people.

Accelerating development, enhancing quality of life, and balancing environmental sustainability are among the foremost challenges of the 21st century. In response to this pressing need, a collective term, the Global South, has emerged, defined as “all emerging and developing countries, most often located in the Southern Hemisphere and home to approximately 80 percent of the world’s population” (Büyüktanir Karacan & Rufini, 2023). This term is not merely a geographic reference but also a political and economic one. It has come to represent the grouping of countries that share historical experiences of colonization, economic marginalization, and struggles with development, as well as aspirations for catching up with the more affluent Global North. One can also use the term “Global East” to refer to the same group of countries (Sun & Yang, 2024).

**Science, technology, and innovation (STI) systems play a critical role in the pursuit of development. There is widespread consensus among scholars, policymakers, and development experts that economic growth, social progress, and even environmental sustainability depend on the strength of a country’s STI capabilities.**

Science, technology, and innovation (STI) systems play a critical role in the pursuit of development. There is widespread consensus among

scholars, policymakers, and development experts that economic growth, social progress, and even environmental sustainability depend on the strength of a country’s STI capabilities. Advanced STI systems drive technological advancements, create new industries, increase productivity, and provide solutions to pressing societal challenges, from healthcare to climate change. In fact, many developed countries owe much of their prosperity to their robust and well-established innovation ecosystems, which have continuously fueled their growth.

For Global South countries, the importance of establishing strong STI systems has never been greater. The world is currently experiencing a period of rapid and profound transformation: supply chains are restructuring, geopolitical dynamics are rapidly shifting, and climate change is presenting unprecedented risks to human societies. These changes create both challenges and opportunities for Global South nations. On one hand, they must contend with new threats, such as disruptions in trade, economic volatility, and environmental disasters. On the other hand, the reconfiguration of the global economy provides opportunities for these nations to integrate themselves more deeply into global value chains and to leapfrog certain stages of development by adopting emerging technologies.

However, the gap between the Global South and the developed countries of the Global North in terms of STI systems is stark. Closing this gap requires not just incremental improvements but the establishment of powerful, highly efficient, and well-coordinated systems of innovation. Moreover, these systems must be resilient and adaptable, capable of responding to rapidly changing global conditions.

Despite these pressing needs, the Global South



The Global South Think Tanks Forum was held on October 16, 2024, in Beijing, China (Photo: CGTN, 2024).

faces significant obstacles in building such systems. Major challenges include inadequate funding for research and development (R&D), weak institutional capacities, a shortage of skilled professionals, the “brain drain” phenomenon, where talented individuals leave their home countries to seek better opportunities abroad, and most importantly, the monopolization of knowledge. Additionally, many Global South nations struggle with political instability, corruption, and weak governance, which hinder long-term investments in STI infrastructure. Furthermore, the effects of climate change and environmental degradation disproportionately affect these countries, adding

an additional layer of complexity to their development challenges.

Addressing these obstacles requires a multifaceted approach. National governments in the Global South must implement effective policies that foster innovation and scientific progress, but these efforts will not be sufficient on their own. The challenges are too large and too interconnected to be solved solely at the national level. Therefore, international cooperation is essential. Regional and global partnerships can help to pool resources, share knowledge, and coordinate efforts, creating synergies that benefit all parties involved.

This paper thoroughly explores these pressing issues. It begins by examining the hurdles for the establishment of effective STI systems in Global South countries at the national level. Then solutions at the national level are discussed, and it is shown that international collaboration is necessary to support the STI goals of Global South nations. The paper progresses to an analysis of challenges in the international context. Various international organizations that foster international collaboration of Global South countries are listed, and their collaboration models are discussed. Finally, an organization model is proposed for supporting joint projects to strengthen the STI systems and to build the innovation ecosystems they need to meet the challenges of the 21st century.

### National-Level Challenges in Building Innovation Systems

Building a strong, sustainable innovation system requires three essential pillars: an educated, skilled workforce; a competitive industrial base; and a robust legal and cultural framework supportive of innovation. Ideally, these elements work in harmony, generating new ideas, transforming them into market-ready products, and embedding them into the economy to create a self-sustaining cycle of growth and development. However, in the Global South, nations face substantial challenges in each of these areas, which severely hamper their ability to develop effective innovation systems.



The 1st Belt and Road Science and Technology Exchange Conference was held in Chongqing, China, on 6-7 November 2023 to strengthen scientific cooperation under the BRI (Photo: Xinhua, 2023).

## Workforce Challenges and the Impact of Brain Drain

A fundamental requirement for an effective innovation system is a highly skilled workforce—individuals educated and experienced in science, technology, engineering, and entrepreneurship. Yet, for many countries in the Global South, retaining this talent is an ongoing struggle due to the phenomenon of brain drain, where educated professionals leave their home countries in search of better opportunities abroad, often in the Global North. For decades, scholars and policymakers have debated the consequences of brain drain. Some argue that it can have indirect benefits for the source country, such as influencing policy changes or maintaining global connections that help those left behind (Ernst, 2015). Others propose the concept of brain gain, where the prospect of working abroad motivates young people in the Global South to pursue higher education and develop skills that may benefit the country if they return (Stark et. al., 1997).

However, these arguments offer little solace to countries that invest substantial resources in educating their populations, only to see a significant portion of their most talented individuals leave for better opportunities. The loss of potential scientists, entrepreneurs, and policymakers after years of training in education systems financed through great sacrifice delivers a deep and visible blow to these nations' development prospects. While the gains from brain drain may exist, they pale in comparison to the vast losses incurred, making it clear that this issue continues to be a significant barrier to the creation of an innovation-driven economy.

## Weak Industrial Base and Its Role in Innovation Systems

The second major challenge is the weakness

of the industrial base in many Global South countries. In a well-functioning innovation system, industries play a pivotal role not only by creating demand for new technologies and products but also by integrating the results of research and innovation into the broader economy. Industries commercialize innovations, which in turn fuel further research and development. Unfortunately, the industrial sectors in much of the Global South are underdeveloped and often rely heavily on technologies imported from developed countries.

In these regions, industries are frequently geared toward low-cost, labor-intensive production rather than high-tech, innovation-driven sectors. The local industries, which could otherwise be engines of technological advancement and economic growth, are typically too weak to support a national innovation system. They do not generate sufficient demand for advanced technologies, nor do they contribute meaningfully to the global value chains that drive innovation.

## Legal and Cultural Barriers to Innovation and Entrepreneurship

Beyond workforce and industrial challenges, the legal and cultural environment in many Global South countries also hinders innovation. A strong innovation system requires laws that protect intellectual property, regulate R&D funding, and promote entrepreneurship. Unfortunately, in many Global South countries, these legal frameworks are either weak or biased. Often, laws are crafted under the influence of multinational corporations, with the primary objective of safeguarding the rights of these firms rather than promoting local innovation.

Moreover, the cultural environment in many of these countries does not traditionally encourage entrepreneurship (Davids et al., 2021) (Adegbile et al., 2021). Many young people are discouraged from pursuing entrepreneurial ventures, either due to societal norms or the high risks associated with starting a business in environments where support systems are lacking. Forje (2009) suggests that colonial histories in many Global South countries suppressed entrepreneurial instincts, creating a legacy in which risk-taking and innovation are undervalued.

In addition to cultural barriers, widespread corruption and nepotism pose serious challenges to building innovation systems. Corruption (Senadjki et al., 2021) (Panagiotakopoulos, 2020) undermines the integrity of institutions, misallocates resources, and creates environments where merit is often overlooked in favor of personal connections. This discourages talented individuals from participating in the system, stifling both competition and innovation. Nepotism further entrenches these challenges, as it promotes favoritism and reduces opportunities for genuine innovators to emerge.

### **Developing National Innovation Systems: Challenges, Opportunities, and Strategic Approaches**

Establishing a robust and sustainable innovation system in the Global South is undeniably a daunting task, fraught with numerous obstacles. These nations face challenges related to brain drain, weak industrial bases, fragile legal frameworks, and underdeveloped research infrastructure. However, while the path forward is difficult, it is not insurmountable. The key lies in designing policies tailored to each country's unique socio-economic and political conditions. Simply transplanting the policies of developed nations into the Global South, as history has shown, is rarely effective (Jauhiainen &

Hooli, 2017) (Jauhiainen & Hooli 2019). Since the Global South countries are heterogeneous among themselves, appropriate policies may vary. However, this paper focuses on the main approaches.

### **Addressing Brain Drain and Retaining Talent**

One of the most pressing issues for innovation systems in the Global South is the persistent outflow of skilled labor to the Global North. Over the years, countries have attempted to combat this brain drain with coercive measures such as mandatory service requirements. Unfortunately, these efforts have often yielded minimal benefits. Yet, recent changes in global dynamics suggest a potential shift. Although countries like Germany (Cerna & Chou, 2023) have introduced policies to attract foreign skilled workers, rising xenophobia, anti-immigrant policies, and economic downturns in Northern nations are beginning to slow brain drain. This reduction in pull factors presents an opportunity for source countries to focus on reducing push factors and make it more appealing for skilled workers to stay.

Retaining talent is less about creating restrictive policies (Marsh & Oyelere, 2018) and more about fostering an environment that offers greater professional satisfaction, fair compensation, and a supportive working atmosphere. For instance, in the case of Greece, Panagiotakopoulos (2020) has shown that the primary factors driving brain drain were not financial but related to governance issues, corruption, and the erosion of social values. Adesoto and Osunkaya (2018) mentioned the absence of jobs where educated people can use their skills as one of the push factors. Korsi emphasized that, alongside standard push and pull factors, social networks and mari-

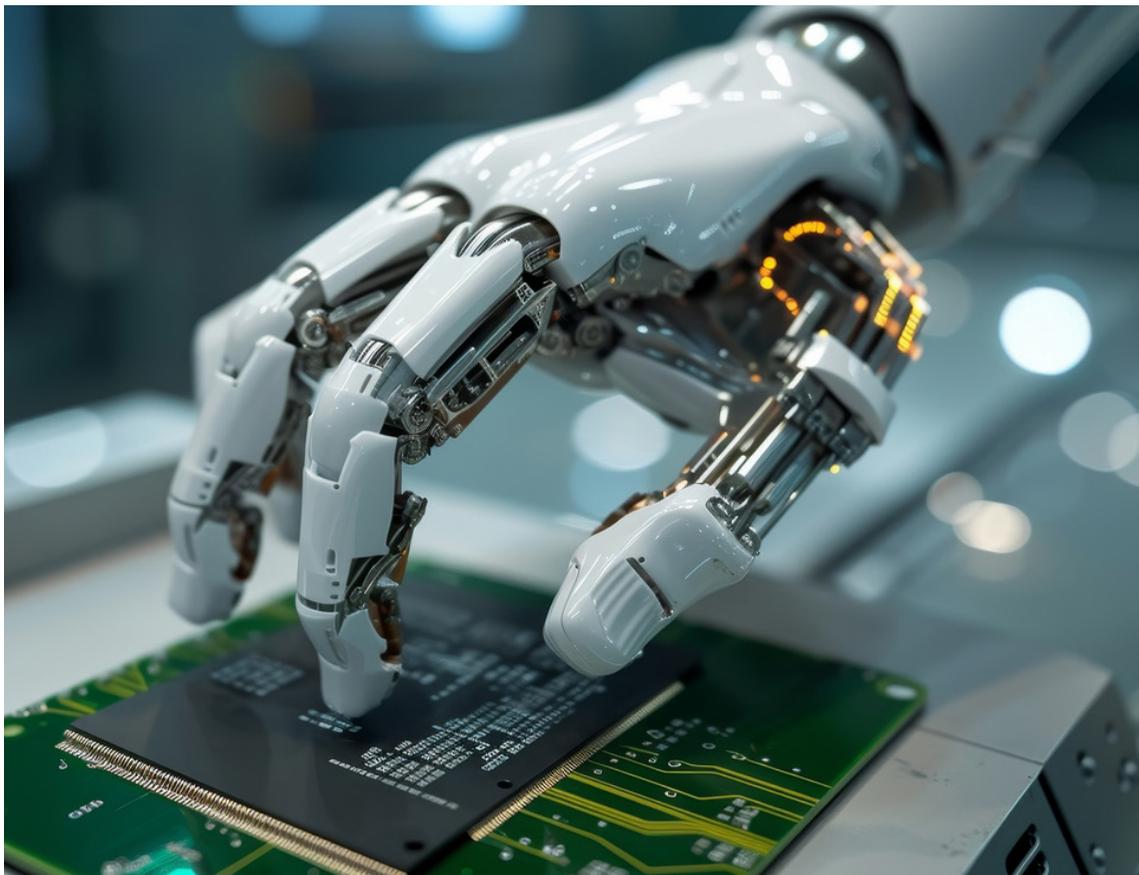
tal status are increasingly important, suggesting that good governance and the implementation of democratic principles can slow brain drain (Korsi, 2022).

However, these recommendations depend on the overall level of development, which further depends on the innovation system, creating a vicious cycle. While achieving widespread institutional reform to improve the overall innovation ecosystem may take time, creating “islands of excellence” within a country—such as universities, research centers, and technology parks—can provide an

immediate, micro-level solution. These innovation hubs, equipped with better infrastructure, governance, and living conditions, can help slow brain drain and nurture homegrown talent.

### Setting the Right Research Priorities

Another crucial factor for the Global South is setting research priorities that align with their specific strengths and developmental goals. Altenburg (2009) suggests that competing with developed nations in high-tech fields is often neither feasible nor advisable.



At the first Belt and Road International Cooperation Forum (BRF) in May 2017, China announced the launch of the Belt and Road Science, Technology, and Innovation Cooperation Action Plan, comprising the Joint Laboratory Initiative, the Science Park Cooperation Initiative, and the Technology Transfer Initiative (Photo: Global Times, 2024).

Instead, focusing on applied engineering and the diffusion of existing technologies might be a more pragmatic approach. In our view, while it is important to build a foundation in these areas, entirely abandoning high-tech development would be shortsighted. Confraria et al. (2017) suggested that a more strategic approach would be to concentrate limited resources on niche fields where the country has a comparative advantage to achieve the critical mass needed to compete globally. As will be explained later, regional cooperation among neighboring countries with similar challenges and goals can facilitate this process. By pooling resources and sharing knowledge, countries in the Global South can overcome limitations in expertise and funding.

### **Enhancing Collaboration Between Academia, Industry, and Government**

A well-functioning innovation system requires close collaboration between universities, industry, and government. The “triple helix” model (Etzkowitz & Leydesdorff, 2000) encapsulates this and emphasizes the critical interactions among these three pillars to drive innovation (Kadhila et al., 2024). Establishing technology parks and government laboratories focused on key sectors can accelerate this collaboration. However, the challenge lies in adapting these models to the unique social, economic, and political conditions of Global South countries. What works in one region might not work in another due to vast differences in governance, resources, and industrial capabilities (Owuondo, 2023).

Therefore, there is no universal blueprint for success. Policymakers must be informed by the successes and failures of similar countries and craft strategies that reflect local realities. International collaboration and knowledge-sharing platforms can play a crucial role here, allowing countries to

learn from each other while customizing approaches to fit their specific needs.

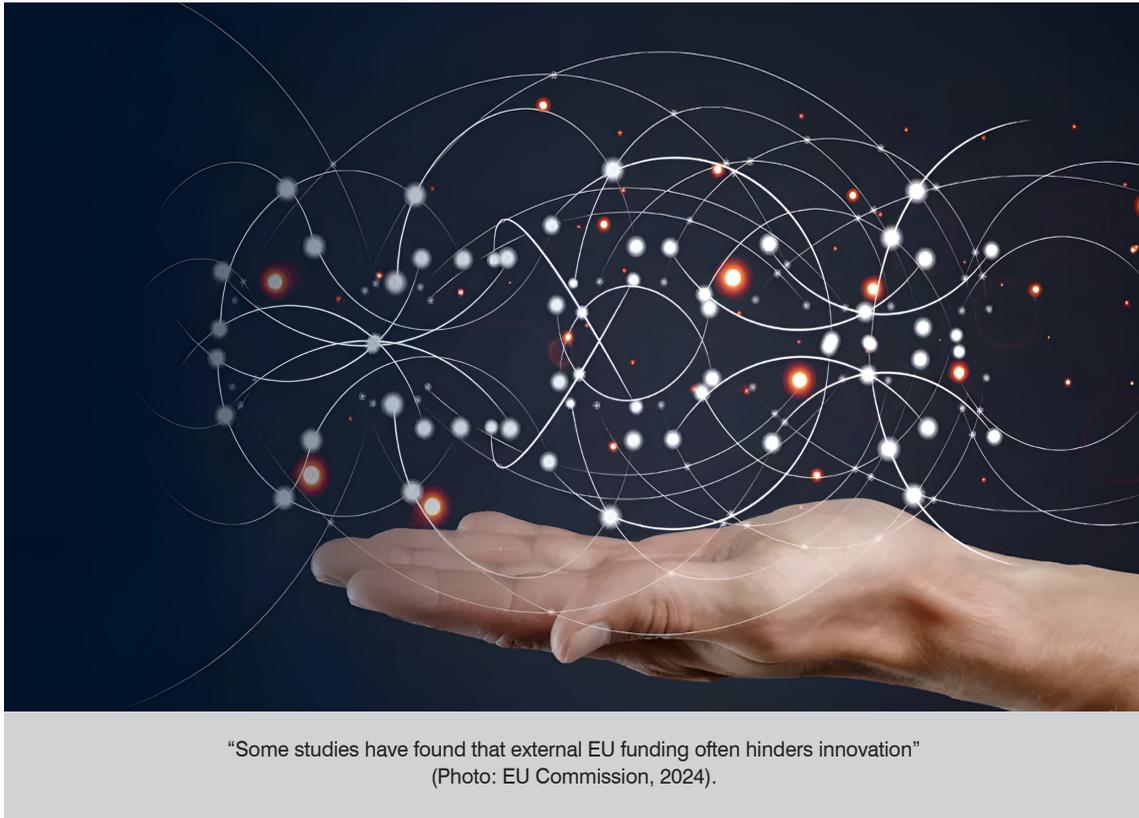
### **Leveraging Technology Transfer for Innovation**

One of the most promising avenues for accelerating innovation in the Global South is technology transfer from more developed nations. This process can occur through formal mechanisms like partnerships, foreign direct investment, and joint ventures, or informally through spillover effects. However, as research from Vietnam shows, technology spillover does not always happen automatically through employee mobility or spin-off firms. Instead, social interactions within knowledge-intensive clusters often play a more significant role (Ngo, 2020). Overall, spillover effects do not emerge as a significant mechanism.

On the other hand, there are successful examples of formal technology transfer. In fact, there are rare cases where entering a particular technology field at a later stage offers an advantage (latecomer advantage) once the technology has reached a certain point (Leloglu 2009). However, successful technology transfer depends on the recipient country’s capacity to absorb and adapt them (Leloglu & Kocaoglan, 2008) (Nasief & Basahal, 2023). Absorptive capacity—the ability of a country to assimilate, improve upon, and commercialize technology—requires skilled human capital, supportive institutions, and a strong industrial base. Without these foundational elements, even the most advanced technologies may fail to take root.

### **Financing the Innovation System**

One of the significant challenges faced by Global South countries in establishing a functional innovation system is the financing of STI support mechanisms. Many of these nations frequently experience



financial crises that strain their fragile R&D support systems. Sudden cuts to R&D budgets can halt progress, disrupt projects, and cause a loss of momentum in building local technological capacities. The financial strain is further exacerbated by policies imposed by international organizations, such as the Washington Consensus promoted by the International Monetary Fund (IMF), which often neglects the role of technological innovation, leading to further damage (Birdsall et al., 2010). Increasing R&D expenditure as a percentage of GDP to levels seen in developed countries (above 2%) is critical for fostering innovation. However, this is only possible through the effective integration of the innovation system into the value chain, which is intricately tied to solving the broader structural problems addressed in previous sub-sections.

### Conclusion: An Integrated, Persistent Approach

In summary, the components of a successful innovation system are deeply interconnected, and developing such a system requires a holistic, consistent approach. Countries in the Global South must implement long-term science, technology, and innovation policies that reflect their unique conditions. It is crucial to review the successes and failures of similar countries' policies, adjusting for local conditions, to enhance the efficiency and effectiveness of national systems without wasting time and resources. However, as explained below, it will be more effective to do this through international organizations.

**Issues in International Context:  
Imbalance in North-South Collaboration**

International cooperation, particularly between the Global North and South, has long been promoted as a key mechanism for helping developing countries leapfrog in science, technology, and innovation. However reality often diverges significantly from the idealistic vision. Despite the well-intentioned frameworks laid out in many cooperation agreements, the Global South often finds itself in a subordinate position, with its long-term development interests frequently not addressed.

One of the most significant issues in North-South cooperation is the unequal distribution of benefits. At first glance, such collaborations seem to offer

resources and knowledge transfer from more developed nations to the Global South. However, they frequently lead to a loss of critical talent from the South as skilled workers migrate to the North for better opportunities. The South also tends to be confined to basic scientific research that supports applied research in the North without gaining the skills or infrastructure needed to advance its own technological capabilities. This dynamic reinforces a cycle where the Global South becomes a consumer of Northern technologies rather than an independent creator or innovator (Gomes, 2023).

Moreover, many of these collaborations, especially in the form of research projects, often fail to empower local researchers. The phenomenon of “helicopter research” is particularly problematic,



“The monopolization presents a significant challenge for Global South countries attempting to build their innovation systems”  
(Cartoon: CGTN, 2019).

where Southern researchers are used primarily to conduct field studies without any significant transfer of skills or knowledge. This type of collaboration leaves little lasting impact on local scientific capacity and reinforces the dominance of Northern researchers and institutions (Büyüktanir Karacan & Ruffini, 2023). A study by Szczygielski et al. (2017) on EU funding showed that while domestic government research supports were effective in fostering innovation in less developed countries, external EU funds were often less effective and sometimes even hindered innovation. Given the greater power imbalance in North-South cooperation, it is reasonable to assume that the negative impact is even stronger in such cases.

Sometimes the nature of the collaboration is explicitly stated in policy documents of the North. For example, an expert group tasked with elaborating on the cooperation strategy of the EU in the field of STI has reported the objectives of priorities as supporting the competitiveness of the Union, dealing with societal challenges, and backing EU external policies (Serger and Remøe, 2012).

### Monopolization of Knowledge and Technology

Today's world is divided into two poles, the core and the periphery, as suggested by Wallerstein (2020). The core nations, monopolizing capital-intensive production, produce and sell high-tech products to the periphery, while the periphery supplies raw materials and inexpensive labor to the core. This self-reinforcing imbalance extends to knowledge itself, which remains concentrated within the core, amplifying the disparity between the two. Hence, a growing concern in the realm of international cooperation is the monopolization of knowledge (Rikap, 2023) (Nathan, 2024). As ad-

vanced technologies increasingly become concentrated in the Global North, particularly within multinational corporations, the disparity between the technological capabilities of the North and South continues to widen. The rise of artificial intelligence and multinational-owned data centers has accelerated this trend. These corporations now control vast amounts of data, resources, and infrastructure, making it even more difficult for countries in the Global South to compete or even participate meaningfully in global innovation systems.

This monopolization presents a significant challenge for Global South countries attempting to build their innovation systems. In the past, some countries were able to catch up through strategic investments in R&D and technology transfer. However, as cutting-edge technologies become more centralized and proprietary, it has become increasingly difficult for countries in the Global South to establish their own innovation systems, integrate into global value chains, and elevate their economies when compared to the past.

### South-South Cooperation

The growing complexity of global economic and technological systems has made it increasingly difficult for individual countries in the Global South to develop independent innovation systems and compete with powerful multinational corporations and the North in general. This has prompted many countries to turn toward South-South cooperation, a strategy based on mutual support and shared development goals among developing nations. Such cooperation offers a viable path for pooling resources, sharing knowledge, and building capacity, especially in fields like science, technology, and innovation.

**Table 1. International organizations aiming to build capacity in STI in mainly the Global South**

Type	Main Organization	Organization Type	Sub-Unit	Funding for Capacity Building
Global	The United Nations	International organization based on treaty	Economic and Social Council (ECOSOC) Commission on Science and Technology for Development (CSTD)	No funding. Advisory body
Global	The United Nations	International organization based on treaty	Office for South-South Cooperation (UNOOSC)	No funding. Provides advice and consulting
Regional	Asia-Pacific Economic Cooperation (APEC)	Informal international organization. Members are 'economies' rather than countries	Senior Officials' Meeting (SOM) Steering Committee on Economic and Technical Cooperation / Policy Partnership for Science, Technology and Innovation (PPSTI) Working Group	Capacity building or research projects are funded APEC Support Fund other sources
Inter-Regional	Forum for East Asia-Latin America Cooperation (FEALAC)	Informal international organization	Science, Technology, Innovation, Education Working Group	Regional projects are self-funded by contributing countries, FEALAC-wide Projects are funded by the FEALAC Multi-donor Trust Fund (Projects are not necessarily on STI)
Regional	The Association of Southeast Asian Nations (ASEAN)	Supranational union	Committee on Science, Technology and Innovation (COSTI)	Projects are funded by the ASEAN Science, Technology, and Innovation Fund and other funds. Multilateral projects are self-funded by contributing countries
Regional (continental)	African Union (AU)	International organization based on treaty	Specialised Technical Committee on Education, Science and Technology / Education, Science, Technology and Innovation (ESTI) Department	Establishment of African Science and Technology Innovation Fund (ASTIF) is recommended in Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024)
Regional	Southern African Development Community (SADC)	International organization based on treaty	The Protocol on Science, Technology, and Innovation	The protocol defines mechanisms but no information on the implementation was found
Regional	East African Community (EAC)	International organization based on treaty	East African Science and Technology Commission (EASTECCO)	East African Research and Technological Development Fund has recently started funding projects
Regional	Organization of the Bleak Sea Economic Cooperation (BSEC)	International organization based on treaty	Working Group on Cooperation in Science and Technology	Projects can be funded by BSEC Project Development Fund that depends on voluntary contributions
Regional	East Asia Summit (EAS)	Informal international organization	The East Asia Science and Innovation Area Joint Research Program (not directly affiliated to EAS)	Member Organizations of each country (three or more) participating in the call fund their own researchers in a co-funding process
Regional	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)	Informal international organization	Science, Technology & Innovation Sector of Cooperation	A technology transfer mechanism is being established to be funded by the members
Global (South)	BRICS	Informal international organization	BRICS STI Framework Programme (BRICS STI FP)	Large number of projects are funded. Multilateral projects are self-funded by contributing countries

Many international organizations focus on capacity building in STI, primarily within the Global South (Table: Leloğlu, 2024).

## Bilateral Cooperation

There are numerous examples where a relatively resource-rich country in the Global South has engaged in extensive bilateral cooperation with multiple countries. For example, Simelone (2023) highlights the outcomes of South Africa's bilateral collaborations with many countries. However, challenges such as the lack of infrastructure in African countries, the focus of university personnel on education due to insufficient funding, and brain drain have been identified. Models centered around a single country in star topology, by their nature, tend to offer suboptimal solutions.

India, in addition to its bilateral cooperation programs with African countries, also has a broader program aimed at the African continent (Sharma & Varshney, 2023). Although scholarships and educational programs aimed at building capacity in Africa are beneficial for those countries, multilateral programs could be even more helpful in capacity building. On the other hand, India is also involved in scientific and technological cooperation within the framework of regional organizations such as the Association of Southeast Asian Nations (ASEAN) and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC).

Similarly, Liu et al. summarize the science and technology cooperation under China's Belt and Road Initiative (Liu et al., 2023). From 2016 to 2021, China's Ministry of Science and Technology implemented over a thousand projects, focusing on human exchange, joint laboratories, science and technology parks, and technology transfer. The Ministry of Education has developed educational cooperation, and the National Natural Science Foundation of China supported nearly 1,000 projects between 2016 and 2022. Additionally, the Chinese Academy

of Sciences (CAS) established the Belt and Road Alliance of International Scientific Organizations (ANSO). Although this large-scale initiative has led to significant capacity development within the framework of South-South cooperation, it still faces some of the same challenges as the examples mentioned earlier.

## Regional Organizations as a Pathway for Growth

A second category of cooperation occurs within the framework of regional organizations. Many international organizations focus on capacity building in STI, primarily within the Global South.

Table 1 provides a non-exhaustive list of these organizations.

Unfortunately, few reports assess the effectiveness or efficiency of these organizations, making it challenging to compare various organizational models. For instance, Ridley and Offiong (2022) evaluated the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024), which was adopted by the African Union (2014). In their assessment of the first five years of STISA-2024, Ridley and Offiong (2022) noted that many African countries had developed STI policies, that financial resources had diversified, and there was a significant increase in publications and patents. Additionally, they observed a rise in large companies and start-ups. However, they also pointed out that only a few countries made significant progress, while some countries had fallen further behind, innovation and entrepreneurship were concentrated in just a few centers, and most funding came from outside Africa. They emphasized the need to learn from similar initiatives on other continents.

Some organizations start as coordination or advisory bodies, helping members develop their STI policies; they then start mechanisms for funding joint projects.

Some less formal models coordinate the project with partners financed by their respective scientific funding organizations, whereas the more robust models establish a common fund to support projects competitively. Strong models, similar to the European Union Framework Programmes, will probably have the maximum effectiveness. However, such models may not be affordable for countries with very limited resources, and they might not have a share of the projects proportional to their funding. Hence, a structured but flexible model is necessary for the funding of joint projects.

In the literature, a model has been proposed for regional organizations (Leloglu, 2021). This model suggests defining a common research area where participants contribute with flexible funding and follow a fair return principle, all within formal mechanisms. This could create efficient and effective scientific and technological cooperation at regional or global levels. Among the organizations listed in Table 1, the BRICS STI Framework Programme (BRICS STI FP) is the closest model. With a growing number of members, BRICS is well-positioned to play a leadership role in this regard, offering a platform for the Global South to come together and address shared challenges in a coordinated manner. BRICS could also assume the role to facilitate collaboration between regional organizations, share best practices, and promote the exchange of knowledge and resources.

Additionally, the creation of thematic organizations like the Asia-Pacific Space Cooperation Organization (APSCO) (Yan 2021) should be encouraged. The key point here is to have rules of engagement for funding from the start. Such structures, with balanced participation, can prevent the emergence of the same inequalities seen in North-South relations within South-South relations, as Jouili warns about (Jouili, 2021).

## Conclusion

The challenges facing innovation systems in the Global South are multifaceted, including insufficient funding, inadequate infrastructure, unequal power dynamics in international cooperation, and monopolization of knowledge and technology by developed countries. North-South collaborations, while intended to spur growth in developing regions, have often perpetuated existing imbalances, limiting the autonomy of the Global South in establishing self-sustaining innovation systems. However, South-South cooperation offers an alternative, more equitable pathway for shared growth and mutual capacity building.

By pooling resources, fostering regional and multilateral partnerships, and building collective capacity in science and technology, countries in the Global South can strengthen their innovation ecosystems. Numerous international organizations—spanning regional and global scopes—aim to strengthen STI capacity in these countries, though it remains difficult to compare the effectiveness of their organizational models and policies. A discernible pattern has emerged where these organizations frequently evolve from being coordination bodies or advisory entities to supporting R&D projects with direct funding, thereby driving greater impact. The BRICS STI FP is among the most advanced models of South-South STI collaboration, having achieved substantial progress in fostering joint research initiatives and technology transfer across BRICS countries. The success and lessons learned from BRICS STI FP serve as a valuable reference point for similar regional organizations, which could improve their collaboration models through shared experiences and adaptable frameworks.

To create a sustainable and competitive innova-

tion environment, countries in the Global South must continue to develop resilient, integrated innovation systems. This involves adopting a structured but flexible model of funding and collaboration, as well as building infrastructure that can withstand global market pressures. Ultimately, achieving a more balanced global innovation landscape will empower the Global South to compete on a global scale and promote sustainable, inclusive development across the region. 🌸

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