West Bengal Academy of Science and Technology

REPORT

Regional Development through Science, Technology, and Innovation

PART I

Reports prepared by:

Sectional Committee-I: Mathematical Sciences

Sectional Committee-V: Earth and Planetary Sciences

Sectional Committee-XI: Social Sciences

December 2025

Preamble to the Collection of Reports prepared by the Sectional Committees

The pursuit of scientific excellence and technological innovation is a cornerstone of regional development, driving economic growth, improving quality of life, and fostering sustainable progress. In this context, the West Bengal Academy of Science and Technology (WAST) plays a vital role as a catalyst for change, bridging the gap between research and application, and nurturing the next generation of leaders and innovators.

The sectional committees of WAST have undertaken an in-depth examination of the transformative impact of science and technology on regional development in their respective fields. Through a series of comprehensive reports, this collection aims to highlight the potential of science and technology to:

- Foster innovation ecosystems and entrepreneurship, creating new opportunities for economic growth and job creation
- Develop human capital and build research capacity, ensuring a skilled workforce and a strong foundation for future innovation
- Inform policy and decision-making through evidence-based research, providing a solid basis for informed governance and strategic planning
- Address pressing regional challenges and opportunities, leveraging science and technology to drive sustainable development and improve the quality of life
- Facilitate collaboration and knowledge sharing among stakeholders, fostering a culture of cooperation and mutual benefit

Through case studies, expert insights, and empirical analysis, these reports examine the critical role of WAST in accelerating regional development and identify best practices for maximizing their impact. By exploring the intersections between science, technology, and regional development, this collection aims to provide a comprehensive understanding of the opportunities and challenges facing West Bengal and to inform strategies for sustainable growth and progress.

We are pleased to present the initial set of reports from three sectional committees that have completed their in-depth analyses, offering valuable insights and recommendations for regional development. Meanwhile, other sectional committees are actively engaged in preparing their reports, which will be released in subsequent phases, further enriching our understanding of the complex relationships between science, technology, and regional development in West Bengal.

Sivaji Chakravorti — Date: 15 Dec 2025
President, WAST

Regional Development through Science, Technology, and Innovation: Report prepared by the Sectional Committee – I : Mathematical Sciences

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The pursuit of scientific excellence and technological innovation is a cornerstone of regional development, driving economic growth, improving quality of life, and fostering sustainable progress. In this context, the West Bengal Academy of Science and Technology could play a vital role as catalysts for change, bridging the gap between research and application, and nurturing the next generation of leaders and innovators.

Mathematical sciences, statistics, and emerging technologies have tremendous potential to address critical challenges such as poverty eradication, enhancing agricultural productivity, and environmental sustainability. They provide robust analytical frameworks and predictive models to solve complex problems across various sectors. Statistical methods play a vital role in analyzing climate trends, optimizing supply chain processes, and advancing financial inclusion. The application of advanced analytical tools can offer valuable insights, enabling the reduction of socio-economic disparities and fostering sustainable regional growth.

Though there are groups working in different branches of Mathematics and Statistics throughout the state, there seems to be very little interaction among the researchers, in particular among those from different colleges, universities and the central institutes like ISI, IISER and IIT. For better coordination and interaction, research groups and active centres can be set up focusing on specific branches like topology, algebra, number theory, functional analysis (including operator theory), real and complex analysis, etc. The centres can have a head quarter in some prominent institute with two to three sub-centres in different locations of the state. Establish research institutions for number theory, algebra and geometry. Similar centres should be built up to enhance collaboration and interaction in applied mathematics branches and statistical science like centres and groups in operation research, mathematical physics, mathematical modelling and simulation, computational mathematics and data science, applications in physics, engineering, economics, and biology, statistical inference and modelling, probability theory and stochastic processes, data science, machine learning, and AI, to name a few. In respect of the latter mentioned branches, it is imperative to explore the scopes of collaborations with industries and government agencies which include consultations. WAST should come forward to take the initiatives through its fellows in different institutions involving experts and researchers from different institutes.

Given the present importance to computational aspects of mathematics and advent of computer science in different spheres of industry and society in general, key focus would be in cryptography, coding theory, and computer science, data science and analytics, artificial intelligence and machine learning and cyber security, mathematical finance and economics, computational biology and medicine. At the same time, centres can be set up in topics like computational number theory, computational algebra and geometry which are not that much focused in this state. If needed, experts from outside the state can be involved to give proper guidance and encouragement to set up research centres in these topics.

Policy Initiatives

At present there is no policy framework for development of both teaching and research in mathematical sciences in the state. There should be a common policy which encourages these. At the first step, there should be more focus on pedagogical training for existing young faculties and budding teachers as good teaching is the backbone of any subsequent development. There are already very successful national programs run by MTTS and NCM. There should be a state body like this with good amount of funding to carry out programs/ training schools for students, research scholars, teachers and researchers. Also the scope of industry-academia collaboration, in particular in applicable and interdisciplinary branches of mathematical sciences should be explored.

Infrastructure Development

Though research in mathematics, in particular pure mathematics is not dependent on too many external facilities, which is absolutely needed is access to international journals, good books, monograms in advanced topics. Most colleges and universities don’t have access to even a modest amount of this data base due to lack of funding. It is imperative to develop these in as many institutions as possible and at diverse locations. Further for applicable and interdisciplinary research one should develop research parks, advanced computational facilities and data centres, mathematical modelling and simulation labs, statistical consulting and research centres. There should be more emphasis to develop skilled workforce through different training programs.

Key Performance Indicators (KPIs)

Very few educational institutes in the state maintain database indicating research performances, which include list of research publications and citations, patent filings and research grants, details of industry-academia collaborations (if any) or details of science education and outreach metrics. More and more institutions, in particular colleges and universities should be requested to maintain that.

Challenges

There are several challenges, the most pertinent one being the lack of funding in the state run institutions. Most colleges and universities as a result have poor infrastructure which is not conducive for quality research. It is well known that large number of good students prefer to go outside the state in pursuit of their degrees with almost none staying back in the state. This is very evident from the decline in the quality of students all over state institutions in the last five to ten years in particular. WAST should take up these issues with the appropriate authorities.

Opportunities

In the last two decades, there has been more and more interest in the research in basic topics of mathematics and in particular in more applicable and interdisciplinary aspects of mathematics. With the advent of internet, it has become much easier to pursue common research with researchers from not only other parts of India but also from international research centres abroad. The researchers and faculties in our universities should be encouraged to do more collaborative research which have always been lacking except for institutes like ISI or IIT or IIM and very few from only some universities. Experts from these institutions should be involved in short workshops in universities and colleges to tell them about different scopes available. As almost the whole funding inside the country come from some central funding agencies like SERB, NBHM, DBT, DAE etc., these opportunities also need to be highlighted. There should be links of all these agencies in the website of WAST so that people can navigate to them from one window.

By addressing these challenges and opportunities, West Bengal can improve its mathematical sciences sector, driving scientific and economic development.

Regional Development through Science, Technology, and Innovation: Report prepared by the Sectional Committee – V: Earth and Planetary Sciences

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Intellectual infrastructure to facilitate scientific research and technological innovation lays the foundation of regional development and economic growth for a better tomorrow. In this context, the West Bengal Academy of Science and Technology, through its pro-active leadership, can play the pivotal role in bridging the gap between research and application, long-term planning in sustainable development, promoting collaboration within broader scientific community to achieve the common goals, and fostering the next generation of the scientific leadership.

Objectives

With a view to explore the transformative impact of science and technology on regional development, the sectional committee of Earth and Planetary Sciences primarily intends to:

1. promote public awareness on environmental issues and geo-heritage conservation;
2. facilitate collaboration and knowledge sharing among stakeholders from different institutions of the state of West Bengal;
3. play pivotal role in research capacity building; and
4. explore the best practices in research data management for maximizing their impact.

Policy initiatives

The Earth and Planetary Sciences have a special responsibility to address critical challenges related to the changing scenario of natural resource management to cope up with the cutting-age technology, and the environmental sustainability.

Public Awareness Programmes

WAST may conduct public awareness programmes, in collaboration with schools and colleges, on environmental issues and geo-heritage conservation through seminars, panel discussions and film show in the rural, semi-urban and urban areas of the state.

Collaboration and knowledge sharing

Any development plan can sustain only if it is extended down the line. Since the academic infrastructure of all the teaching institutions of the state offering courses in Earth Sciences is not adequate to cope up with the changing education policy of the country, proper coordination between the teaching institutions is to be initiated to ensure the quality teaching

in Earth Sciences through pedagogical collaboration, say, in the form of college clustering. WAST can take an initiative in this regard.
Short courses can be arranged for the young teachers, research fellows and senior students in collaboration with IIT Kharagpur, IISER Kolkata and other Central Institutions and Universities to expose them to the state-of-the-art laboratory techniques and new ideas.
School students are to be introduced with the prospect of Earth Sciences as a career option to encourage them to opt for it during their higher studies. This can be done by taking up outreach programmes for the school children of higher classes. This can be done through the Earth Sciences teaching institutions in different parts of the state. WAST may play the role of coordinator.
WAST can take up the matter of establishment of a state-level e-library with the state government for ensuring access for the students, research scholars and teachers of the state to all international journals, monographs, and other important publications. The state-run institutions, particularly the colleges, are badly suffering from lack of funding and consequently, the students and teachers of these institutions, are being deprived of the minimum academic infrastructure. This e-library can meet up a very basic need for the higher education.

Research capacity building

A special initiative may be taken for the establishment of a state-level Earth Science Council for coordination of national and international collaborations in research and knowledge sharing. Proper initiative is to be taken for establishment of a general platform for the industry-academia collaboration.
WAST, in its website, may provide with the links to different funding agencies and notifications for different special schemes. This will act as a single window for getting required information and will be of immense help to the young researchers, and the teachers of district colleges, in particular.
The Sectional Committee of Earth and Planetary Sciences may organise periodic brain-storming sessions to give the young researchers an exposure to the cutting edge of Earth and Planetary Sciences.

Promotion of the best practices in research data management

The Sectional Committee may take an initiative in developing best practices and workflows in research data management. Training opportunities for young scholars and students are to be created to raise their awareness of sustainable data curation at the early stage of their research career.
WAST, in collaboration with one or two pioneering institutions, may take an initiative to develop a repository for the ‘type’ specimens for different branches of Earth Sciences. This is long overdue, and is an essential research and teaching infrastructure as per the global standard.

Challenges and opportunities

The Sectional Committee would also like to address certain challenges and opportunities which would help in driving sustainable development, mitigating environmental risks, and improving the quality of life for its citizens of the state of West Bengal. These include:

1. Development of water harvesting systems.
2. Promotion of sustainable groundwater management practices.
3. Planning for sustainable soil conservation measures.
4. Development of early warning systems for natural disaster and emergency response plans.
5. Promoting utilization of satellite data for urban planning, infrastructure development, resource allocation, crop monitoring, disaster management, and environmental tracking.

Regional Development through Science, Technology, and Innovation: Report Prepared by the Sectional Committee XI – Social Sciences

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The pursuit of scientific excellence and technological innovation is a cornerstone of regional development, driving economic growth, improving quality of life, and fostering sustainable progress. In this context, the Social Sciences Section of the West Bengal Academy of Science and Technology may play a vital role as catalysts for change, bridging the gap between research and application, and nurturing the next generation of leaders and innovators.

The Social Sciences Sectional Committee suggests the following areas to be considered by the appropriate authorities. By addressing these challenges and opportunities, West Bengal can improve its social sciences sector, driving inclusive and sustainable development.

1. Education and Research:

1.1 Establish social science research institutes: To provide a hub for interdisciplinary research, capacity building, and knowledge dissemination and can bolster education and research in the field.
1.2 Enhance capacity building for social science researchers: This can be achieved through workshops, training programs, and fellowships that focus on research methodology, data analysis, and academic writing.
1.3 Promote interdisciplinary research: This can foster innovative solutions to complex challenges by integrating insights from sociology, anthropology, economics, and psychology, researchers can develop comprehensive understandings of social issues.
1.4 Develop policy-relevant research: This can bridge the gap between academia and governance. By conducting research that addresses pressing policy concerns, scholars can provide actionable insights for policymakers.
1.5 Foster international collaborations: This can enhance academic excellence and global relevance. Partnerships with foreign universities and research institutions can facilitate knowledge sharing, joint research projects, and faculty exchange programs. This can expose scholars to diverse perspectives, methodologies, and best practices.
These initiatives can address social challenges, inform evidence-based policy making and decision making, drive effective governance and promote inclusive development in the state.

2. Health and wellbeing:

2.1 Improve healthcare access and quality: It involves strengthening infrastructure, increasing healthcare workforce, and ensuring equitable access to services. Effective healthcare systems will reduce morbidity, mortality, and health disparities, ultimately contributing to improved quality of life, socio-economic development, and human wellbeing in the state, bridging urban-rural health gaps.

2.2 Address mental health concerns: It requires a multi-faceted approach by involving increasing awareness, reducing stigma, and expanding mental health services. Community-based initiatives, training healthcare professionals, and promoting psychosocial support can help mitigate mental health issues, enhancing quality of life, productivity, and socio-economic development in the state.

2.3 Enhance social determinants of health: It involves addressing education, poverty, housing, and employment to improve health outcomes. Investment in these areas can reduce health disparities and promote health equity

2.4 Promote health education and awareness: This can be achieved through community-based initiatives, school programs, and media campaigns, focusing on disease prevention, nutrition, and mental wellbeing**.**

2.5 Develop community-based health initiatives: This involves engaging local communities, leveraging traditional healthcare practices, and deploying community health workers.

3. Economic development:

3.1 Fostering entrepreneurship and innovation: It involves creating a supportive ecosystem, providing access to funding, and promoting incubation centers. This enables start-ups and MSMEs to thrive.

3.2 Enhancing skill development programs: It involves aligning training with industry needs, promoting vocational education, and encouraging public-private partnerships. This enables the workforce to acquire relevant skills, increasing employability, productivity, and competitiveness.

3.3 Promoting micro, small, and medium enterprises (MSMEs): It involves providing access to finance, technology, and markets to MSMEs. Initiatives like training, mentorship, and infrastructure support can enhance MSME competitiveness.

3.4 Developing economic infrastructure: It involves upgrading transportation networks, enhancing logistics, and expanding energy and communication services. This enables efficient movement of goods, services, and people.

3.5 Encouraging foreign investment: To attract global capital, technology and expertise a business-friendly environment has to be created by offering incentives and streamlining regulatory processes.

All these strategic initiatives will increase competitiveness, attract investment, drive economic growth, increase income opportunities and ultimately contributing to the state's socio-economic development and prosperity.

4. Social justice and equity:

4.1 Promoting gender equality and empowerment: It involves addressing disparities in education, healthcare, and economic opportunities. Initiatives like skill training, microfinance, and awareness campaigns can enhance women's autonomy, decision-making, and participation in public life.

4.2 Enhancing social protection programs: Strengthening existing pension schemes, health insurance, and livelihood support, expanding coverage, and ensuring effective delivery can mitigate poverty, vulnerability, and inequality, promoting social justice and equity, and improving the overall wellbeing of marginalized communities in the state.

4.3 Addressing child and adolescent development: It involves ensuring access to quality education, healthcare, and nutrition. Initiatives like child protection services, vocational training, and mentorship programs can promote holistic development, prevent exploitation, and empower vulnerable children and adolescents.

4.4 Fostering inclusive and accessible education: It involves promoting equity, diversity, and social justice. Initiatives like inclusive curricula, accessible infrastructure, and targeted scholarships can ensure quality education for marginalized groups, including girls, children with disabilities, and minority communities, bridging educational gaps and empowering future generations.

4.5 Protecting human rights: It involves promoting awareness, strengthening institutions, and ensuring accountability. Effective mechanisms for reporting and addressing rights violations, particularly for marginalized groups.

All these initiatives can foster a culture of justice, equality, and dignity, ultimately contributing to the state's social and economic development.

5. Cultural Development:

5.1 Preserving cultural heritage sites: Conservation and maintenance of iconic monuments, museums, and archaeological sites will preserve history and showcase the state's rich cultural diversity. This will also promote cultural tourism and foster a sense of pride and identity.

5.2 Promoting cultural festivals and events: It involves showcasing the state's rich cultural heritage through vibrant events like Durga Puja, Bengali New Year, and Kolkata International Film Festival. These events foster community engagement, cultural exchange, and tourism, contributing to the state's economic and cultural development.

5.3 Enhancing cultural education: It involves integrating arts, heritage, and cultural studies into school curricula and promoting cultural workshops, training programs. This fosters cultural awareness, appreciation, and talent, empowering future generations to preserve and promote West Bengal's rich cultural legacy and identity.

5.4 Supporting artisans and craftspeople: It involves promoting traditional crafts, providing training and resources, and facilitating market access. Initiatives like handicraft fairs, exhibitions, and e-commerce platforms can help artisans showcase and sell their products, preserving traditional skills, generating income, and contributing to the state's cultural and economic development.

5.5 Fostering cultural exchange programs: It involves collaborations with national and international institutions, universities, and cultural organizations. These programs facilitate mutual learning, artistic collaborations, and people-to-people diplomacy, promoting cross-cultural understanding, creativity, and innovation, and positioning West Bengal as a vibrant cultural hub on the national and global stage.

6. Policy initiatives:

6.1 West Bengal's social science policy: focuses on inclusive development, social justice, and cultural preservation. Initiatives prioritize education, healthcare, and livelihood empowerment for marginalized communities, while promoting cultural heritage and exchange programs. Evidence-based policymaking and community engagement drive the state's efforts to foster equitable growth and human development.

6.2 Health policy: prioritizes universal access to quality healthcare, focusing on rural and marginalized communities. Initiatives include strengthening public health infrastructure, expanding health insurance, and promoting preventive care. Emphasis is placed on reducing maternal and infant mortality, controlling infectious diseases, and addressing non-communicable diseases, ensuring holistic well-being.

6.3 Economic development policy: aims to foster inclusive growth, entrepreneurship, and job creation. Initiatives focus on MSME promotion, infrastructure development, skill training, and investment attraction. Emphasis is placed on key sectors like agriculture, manufacturing, and services, with a thrust on sustainable development, innovation, and digitalization to drive economic prosperity.

6.4 Social justice and equity policy: prioritize inclusive development, addressing disparities in education, healthcare, and economic opportunities. Initiatives focus on empowering marginalized communities, including SC/ST, women, and persons with disabilities, through targeted interventions, affirmative action, and social protection schemes, promoting equality, dignity, and human rights.

6.5 Cultural Development Policy: aims to preserve and promote the state's rich cultural heritage. Initiatives focus on conserving historical sites, promoting traditional arts and crafts, and showcasing cultural festivals and events. The policy also supports cultural education, research, and innovation, fostering a vibrant cultural landscape that showcases the state's unique identity.

7. Infrastructure Development:

7.1. Establish social science research centers: It aims to foster interdisciplinary research, innovation, and knowledge sharing. These centers will focus on policy-relevant research, capacity building, and community engagement, addressing pressing social issues and informing evidence-based policymaking, ultimately contributing to the state's sustainable development and inclusive growth.

7.2 Develop healthcare infrastructure: It involves upgrading hospitals, healthcare centers, and medical research institutions, expanding telemedicine services, and strengthening community health programs. Initiatives focus on enhancing accessibility, affordability, and quality of healthcare services, particularly in rural and underserved areas, to improve health outcomes, reduce disparities, and ensure universal access to comprehensive healthcare.

7.3 Enhance education infrastructure: It involves modernizing schools, colleges, and universities, with a focus on accessibility, inclusivity, and quality. Initiatives include upgrading classrooms, libraries, and digital infrastructure, as well as expanding vocational training and skill development programs, to improve educational outcomes and empower future generations.

7.4 Improve transportation infrastructure: It enhances connectivity, facilitates economic growth, and boosts social mobility. Upgradation of roads, railways, airports, and waterways increase access to markets, services, and opportunities, bridging rural-urban divides and fostering inclusive development, while also promoting tourism, trade, and cultural exchange.

7.5 Develop community centers: It fosters social cohesion, promotes cultural activities, and provides essential services. These centers serve as hubs for community engagement, offering education, healthcare, and skill development programs, while also hosting cultural events and festivals, ultimately strengthening community bonds and enhancing overall well-being.

8. Key Performance Indicators (KPIs):

8.1 Research publications and citations: Number of publications, citation index, h-index, and impact factor are important KPIs to assess research quality, productivity, and influence, enabling policymakers to evaluate the effectiveness of research initiatives and inform evidence-based decisions. This enhances the state's intellectual capital, informs policy decisions, and fosters collaborative research, driving development and innovation.
8.2 Healthcare access and quality metrics: These KPIs track metrics such as infant mortality rate, life expectancy, healthcare utilization, patient satisfaction, and disease prevalence. These KPIs assess healthcare system performance, identify gaps, and inform policy decisions to improve healthcare access, quality, and outcomes.
8.3 Economic growth rate: These KPIs track metrics such as GDP growth rate, per capita income, poverty reduction, unemployment rate, and investment attractiveness. These KPIs assess the state's economic performance, identify areas for improvement, and inform policy decisions to drive sustainable economic growth and development.
8.4 Social justice and equity metrics: These KPIs track metrics such as poverty reduction, education and healthcare access, gender equality, and social inclusion. These KPIs assess progress towards reducing disparities, promoting equality, and ensuring social justice, informing policy decisions to foster inclusive development.
8.5 Cultural development indicators: These KPIs track metrics such as cultural heritage preservation, arts and crafts promotion, festival and event participation, and linguistic diversity conservation. These KPIs assess the state's cultural vibrancy, inform policy decisions, and ensure the preservation and promotion of West Bengal's rich cultural heritage.

9. Challenges:

9.1 Funding constraints: Limited government allocations, scarce private investments, and inadequate international funding hinder the implementation of projects, research initiatives, and policy interventions, thereby slowing progress towards achieving sustainable development goals and improving the state's social indicators.
9.2 Inadequate Regulatory frameworks: Insufficient policies, outdated laws, and bureaucratic red tape obstruct the implementation of projects, delay research approvals, and limit collaboration with international organizations, thereby hindering the state's progress in addressing social challenges and achieving sustainable development goals.
9.3 Skill gap: Challenges include limited expertise, outdated curricula, and inadequate training programs, resulting in a shortage of skilled professionals. Addressing this gap requires modernizing education, promoting capacity-building initiatives, and fostering collaborations to equip researchers and practitioners with cutting-edge skills.
9.4 Infrastructure constraints: Challenges include inadequate research facilities, outdated technology, and limited access to digital resources, hindering data collection, analysis, and dissemination. Upgrading infrastructure, investing in digital tools, and promoting collaborative research spaces can help address these constraints.
9.5 Social and cultural barriers: Challenges include deeply ingrained social norms, cultural taboos, and linguistic diversity, limiting data collection and community engagement.

Addressing these barriers requires culturally sensitive approaches, community-led initiatives, and inclusive research methodologies to ensure meaningful participation and effective knowledge translation.

10. Opportunities:

10.1 Growing demand for social science research: Increasing recognition of social sciences' role in informing policy and addressing complex challenges has created a surge in demand for research expertise. This trend can foster collaborative research initiatives, drive evidence-based policymaking, and attract funding and investment.
10.2 Emerging technologies: like digital health, big data analytics, and artificial intelligence offer opportunities for social sciences research in West Bengal. These technologies can enhance data-driven decision-making, improve healthcare access, and optimize social services. Leveraging these technologies can foster innovative research collaborations, drive evidence-based policymaking, and promote sustainable development.
10.3 Innovation in social entrepreneurship: By leveraging innovative business models, social entrepreneurs can address pressing social challenges, create sustainable livelihoods, and drive inclusive growth. This can foster a vibrant ecosystem of social enterprises, promote collaborative problem-solving, and contribute to the state's economic and social development.
10.4 International collaborations: Partnerships with global institutions, researchers, and organizations can facilitate knowledge sharing, capacity building, and innovative research. This can lead to the exchange of best practices, access to funding and expertise, and the development of context-specific solutions to address the state's social challenges.
10.5 Cultural exchange programs: These programs facilitate people-to-people diplomacy, knowledge sharing, and cross-cultural understanding. By participating in international exchange programs, researchers, scholars, and practitioners from West Bengal can gain new perspectives, build global networks, and develop innovative solutions to address local social challenges.