CHINA-PAKISTAN JOINT THINK TANK

AUTHORS:

Professor Dr. Atta-ur-Rahman (NI, HI, SI, TI)
Fellow of the Royal Society, UK
UNESCO Science Laureate
Distinguished Senior Fellow, NUST GTTN
President Pakistan Academy of Sciences
Former Federal Minister of Science and Technology, and Information Technology
Former Federal Minister/ Chairman Higher Education Commission of Pakistan

Atia Ali Kazmi
Senior Research and Policy Analyst, NUST GTTN

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Assisted By:
Jahandad Khan
Research Intern, NUST GTTN
Respected Friends

I am pleased to share with you the current paper of the China-Pakistan Joint Think Tank on higher education collaboration between China and Pakistan. The paper puts forward a holistic approach for enhancing bilateral collaboration in the spheres of S&T-based higher education that could foster innovation in Pakistan and help accelerate national socioeconomic development. As a result of the trust-based relationship of the two countries, the opportunity for China-Pakistan cooperation in the sector is a concrete one.

A world-class higher education system serves as the foundation of a developing country’s takeoff to sustainable socioeconomic development. China exhibited foresight and took this path decades ago; its unprecedented and continued economic growth is due in no small part to radical reforms it has instituted in its higher education sector as part of the continuing larger process of modernization with Chinese characteristics through reform and opening up that was initiated in the late 1970s. Chinese reforms in higher education have played a key part in unleashing the forces of research and development, innovation and entrepreneurship, as well as in the realisation of triple helix linkages of academia, industry, and government. This is one of the key strengths of China’s peaceful development.

The working paper is distinguished by the fact that none other than Professor Dr. Atta-ur-Rahman is its co-author. Dr. Atta-ur-Rahman is one of the main visionaries and advocates of the veritable higher education revolution, which began in Pakistan with the founding of the Higher Education Commission (HEC) in 2002. The fact that knowledge economy is now a well-known concept in universities and institutes of higher learning across Pakistan is in large part due to his efforts as the first Chairman of HEC. In recognition of his world-class contributions to scientific and research cooperation, the Chinese Academy of Sciences has conferred on him the prestigious International Scientific Cooperation Award for the year 2013. This paper has benefitted from Dr. Rahman’s vast experience of excellence in international knowledge-based collaboration and higher education governance.

I am confident that this paper will be a positive contribution to the question of harnessing the potential of cooperation between China and Pakistan in higher education to effect the transition in Pakistan from a traditional resource-based to a knowledge-based economy and society to the mutual advantage of the two friendly countries.

Amer Hashmi
President
China-Pakistan Joint Think Tank
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Science, Technology, and Innovation-Based Higher Education: China’s Sustained Development and Areas of Collaboration with Pakistan

“Science education, in the broad sense…is a fundamental prerequisite for democracy and for ensuring sustainable development.”

Declaration on Science and the Use of Scientific Knowledge, World Conference on Science, Budapest, 2 July 1999

1. Introduction

1. A developed, industrialized, just, and peaceful Pakistan is significant for regional and global peace and prosperity. However, this objective can be best realized once Pakistan achieves a niche in knowledge-based endeavors embedded into science, technology, and innovation-based higher education, which is the engine to a nation’s growth and transformation. Pakistan has the potential for sustained development if its higher education system is adopted and adapted according to international standards and best practices, especially the successful model adopted in the People’s Republic of China.

2. The complete chain of a national higher education system comprises, among other things, multidimensional exposure, multidisciplinary learning, broad-based skill acquisition and expertise, work ethics, and iron-cast commitment to learning. These are all yoked together and realized in the ability of a country’s citizens and institutions to formulate techno-economic and techno-social solutions for multiple challenges emanating from changes occurring in the state, economy, and society in their mutual interaction in the contemporary globalized world.

3. The focus of this paper is Pakistan’s cooperation with China to foster the former’s science, technology, and innovation-based higher education system for a comprehensive tertiary education overhaul with strong positive externalities for holistic technological, economic, social, cultural, and moral development of the country.

4. Pakistan and China’s all-weather friendship is meeting rapidly changing and challenging global and regional scenarios. Pakistan can energize innovation and progress through mutually cooperating with China and learning from the latter’s strategies for sustained development in this domain. Amongst myriad of reasons behind its phenomenal rise, China owes its exemplary economic growth to its creative focus on science, technology, and innovation (STI)-based higher education. In order to become an innovative nation by 2020 and a scientific power by 2050, Beijing has made substantial investment in its research and development (R&D) pursuits.

5. China, which drew this orientation in the 1950s from former Soviet Union’s policy to invest in colleges and departments of universities, has now achieved modernization and transformative breakthrough in knowledge and technology policies and systems.

6. China weathered the global crisis of sustainability because it had developed a robust technological setup. Beijing had made a commitment in funding for modernization and technological development, which can be mirrored in Pakistan to meet the challenge of re-
viving a moribund economy.

7. The Chinese science and technology (S&T) bureaucracy has made heavy financial investments in arranging corporate ventures’ R&D, in promoting university-based research and technology transfers and expertise, in creating linkages between commercial firms and research institutions, in establishing technology development zones and commercial centers, and in developing an international market for China’s services and goods.

8. In the given context, this paper analyzes China’s sustainable STI and higher education policies and associated institutions and organizations—a setup that has driven China’s strong development trajectory. This analysis is followed by Pakistan’s current STI and higher education systems. The paper concludes with recommendations for China-Pakistan’s mutual collaboration in this area.

2. China’s landmark achievements in Science, Technology, and Innovation (STI)-based Higher Education Sector

2.1 Backdrop

9. China is appreciated as a fast rising power having become the world’s second largest economy since 2010. China spends some $179 billion on R&D and seeks to enhance spending from 1.8 percent of GDP to 2.5 percent by 2020. The scientific literature in terms of annual output has witnessed an 80 percent rise within last five years.

10. China’s higher education has swiftly developed over the past decade. The higher education sector also provides innovation impetus for the country’s development. The twenty higher education institutions (HEIs) back in 1949 have risen to 3000, amongst which majority are specialized colleges. China’s C9 League universities account for 10 percent of national research expenditure and 3 percent of the country’s researchers. Two of these—Tsinghua and Peking Universities—are in the first fifty global universities’ reputation ranking (Times Higher Education World Reputation Rankings).

11. In 2010, 70 percent of the Chinese National Technology Innovation Awards, National Natural Science Awards, and National S&T Progress Awards were secured by universities. A meager number of 33 overseas students in Chinese universities in 1950 rose to a striking figure of 110,000 by 2009. These universities provide the crucial foundations for resilient industrial clusters.

12. Today, China appears to be a confident global leader in clean energy and transportation, telecommunications, and information technology. It is also a competitor in global technologies in low emission coal energy plants, third and fourth generation nuclear reactors, high-voltage transmission lines, alternative-energy vehicles, solar and wind energy devices, and high-speed trains. It has promoted hi-tech research in nanotechnology, new materials, aerospace, biotechnology, engineering, nuclear science, defense technology, and many other cutting-edge scientific fields. Its corps of engineers, research scientists, and a thriving share of research publications in global science and engineering journals and patenting activity are swiftly increasing.

2.2 Institutional Setup in China to support STI and Higher Education

13. Since 1999, China’s investment in science has flourished tremendously. In 2012, China invested 1.9 percent of its GDP in research and development edging past EU’s R&D investment of 1.96 percent of the collective GDP of EU states.

14. The top level State Council Steering Group of Science, Technology, and Education provides the coordinating mechanism for strategic issues. Likewise, the Ministry of Science and Technology (MOST) supervises the governance of the S&T system. Some ministerial level organizations include the National Development and Reform Commission (NDRC), the Chinese Academy of Sciences (CAS), the Chinese Academy of Engineering (CAE), the Ministry of Information Industry (MII), the Ministry of Agriculture (MOA), and the National Natural Science Foundation of China (NSFC).

15. MOST is China’s main policymaking and coordination institution. It funds the major projects and programs for STI and R&D. The Chinese Academy of Sciences oversees 117 institutions, two universities, around 100 key laboratories, 200 engineering research centers, and 1000 field stations all over China. The Chinese Academy of Engineering is an advisory board which provides a converging platform for the country’s industrial and academic engineers and stimulates worldwide collaboration on engineering ventures.
16. The Chinese Ministry of Education (MOE) plays a dynamic role in the country’s STI pursuits by envisaging policies for research and human resource development. Similarly, the Ministry of Finance supports technological firms such as through the Innovation Fund for Small Technology-Based Firms.

2.3 China’s National Policies and Programs for STI and Higher Education

17. According to the Chinese Law of Higher Education, 1998, “The task of higher education is to train people to become senior specialists imbued with the spirit of creativeness and the ability of practice, to develop science, technology, and culture, and to promote the socialist modernization drive.” (The Law of Higher Education, China – Chapter 1, Article 5).

18. The National Innovation Policy and national policies for STI and higher education in China are well synchronized with its Law of Science and Technology Progress, which seeks to “promote S&T… [and] making the primary productive force for improving the service of S&T in economic growth.”

19. These policies comprise special programs and sustainable five-year plans to maintain a viable system of STI in the R&D and higher education sectors. The Twelfth Five Year Plan (2011 - 2015) exhibits the Chinese Government’s aims of increasing collaborative innovation projects which combine production and research.

20. The main programs that focus on STI and higher education are given below:

21. The 211 Project – the “Trans-centenary Key Construction in higher education” - was launched in 1995 that envisioned a globally competitive China through strengthening some 100 universities and 600 key academic topics in major disciplines “as a national priority for the 21st century” through quality education, research, management, development of higher education and the socioeconomic sector, and high level professional training. Until 2011, the 112 universities falling under this project had trained 80 percent of the country’s doctoral students, two thirds of its graduates, half the international students, and a third of undergraduates.

22. The 985 Program was established in 1998 at the centennial ceremony of Peking University and envisages establishing world class S&T-based universities. The program’s target is to convert some 40 selected universities into state-of-the-art schools that meet international standards.

23. Chinese Scholarship Council, the local government, and the relevant ministries in charge support students and academics exchange programs. These universities account for less than 2 percent of China’s 2000 full-time higher education institutions but support more than 50 percent Ph.D candidates, and national key laboratories.

24. The Key Technologies R&D Program – the first state steered plan – was initiated in 1982. Its main focus is on industrial technology and projects designed to aid industrial development and restructing in vital economic sectors such as energy, agriculture, electronics, and materials.

25. The Basic Research Program (973 Program) – established in 1983 – promotes capable technologists/scientists besides supporting multi-disciplinary research in cutting-edge technology and international cooperative research.

26. The National High Technology Research and Development Program (863 Program) – introduced in 1986 – is spearheading Chinese technological innovation in key technological fields as biotechnology, space, information technology, laser technology, automation, energy, new materials, telecommunications, and marine technology. The program funds applied and basic research on marketable technologies and covers assignments ranging from selecting researchers for specific topics and encouraging firms’ participation in projects. The Program capitalizes on China’s progress in high-technology, ultimately allowing a reduced reliance on foreign technology and the exorbitant costs entailed.

27. The SPARK Program – launched in 1986 – envisioned advancement and usage of technology in almost 90 percent of China’s rural areas mainly through sci-tech demonstration projects (some 150,000 accomplished so far), sound investment environment, and the technology developers-users connecting periodic China High Technology Fairs (CHTF). The STI-oriented farmers contribute heavily to the quickly developing and productive rural economy. The Program seeks for broader and more intensive cooperation and exchange with foreign countries and international organizations, jointly contributing to the prosperity and progress of the world.
28. The Torch Program – established in 1988 – has a goal to develop and commercialize products in frontline innovative fields. It assists local governments in launching technology zones for corporate and technology start-ups, the number now exceeding fifty-four, and supports personnel training and worldwide collaboration of the Chinese firms. The government’s policy incentives have attracted massive foreign direct investment.

29. The recent higher education reforms in China are envisaged in a comprehensive state owned plan formally called “State Guidelines for Medium-to-Long-Term Education Reform and Development Plan between 2010 and 2020”, otherwise known as the Development Plan. The plan focuses on decentralization and autonomy of HEIs and modified admission process and educational infrastructure.

2.4. The “Triple Helix” Model in China

30. The growing trends of globalization of science and technology have paved way for academic communities to become a significant part of the global innovation system. The Chinese 1979 regulation prescribes universities as centers for teaching and scientific research, thus marking formal inclusion of universities into China’s national science research structure.

31. The reform initiatives at national level helped China implement the “Triple Helix” model that made the government, universities, and industry equivalent partners in the knowledge ecosystem, thus providing a boost for research and development undertakings.

32. The basic structure of this interaction revolves around “the flow of university graduates to the market as well as the flow of new knowledge generated by university-based research through public channels” (UNESCO 2011). In this way, the Chinese universities are directly participating in pursuits of socioeconomic activities and enterprises are setting up private universities, thus expanding business in higher education systems. Universities are working in collaboration with the industrial sector in a diversified manner through joint research, human resource training programs, and exchange programs while also being the hubs of production and application of knowledge.

33. The various forms of universities’ linkages with the market include “informal consulting by university researchers to industry, technology contracts, technology transfer and licensing, joint research centers, university-run enterprises, and university-based science parks” (UNESCO 2011). Technology contracts mostly comprise technology development and transfer (patent licensing and non-patent technology transfer), and technical services and consultancy.

34. The science and technology parks (STPs) are “incubators” for small and medium-sized hi-tech companies and technology-industry clusters, mostly set up by universities. In China, these parks are provided special tax breaks and incentives, and research and development subsidies. At the early phase, many companies at the premier Chinese STP, Zhongguancun, were closely connected to the academic circles. Initially a small market for electronic components and devises for technicians and researchers, this STP claims to be China’s biggest technology hub today (China Daily 2011).

35. In 1999, the Chinese Ministry of Education launched a “Project to stimulate the development of high-tech industry in universities”, which was a vital constituent of the formal national program named, “Invigorating Education Towards the 21st Century.” The project aimed at encouraging universities to set up engineering research centers and productivity promotion centers in collaboration with enterprises (MOE, 1998).

2.5. The Role of Political Will in China’s STI and Higher Education Leap

36. China’s economic and STI-based higher education progress and global competitiveness is pinned to its ideological and political will to achieve its goals. The institutional rationale and the political will to implement it have significantly contributed to the growth of China’s present academia-industry-government linkage. The narrowing knowledge gap between these three main actors in STI and higher education landscape complements a continued reform structure in China.

37. The sustainable policies which are implemented free of political changes in the country have enabled China to possess a strong development and welfare-oriented political system and an equity-oriented long-term economic growth strategy. China’s membership of WTO in 2001 gave a fillip to development of high technology, manufactured export, and growth in GDP ratios.

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1. The Triple Helix model comprises multi-tiered “university-industry-government” collaboration and was introduced by Etzkowitz and Leydesdorff. The model “anticipates a synergistic process of scientific achievement and accelerated innovation across the different actors through collaboration” (UNESCO 2011) to maximize investment gains in research and development that possess the real potential for transformation into socioeconomic value.
3. Science, Technology, and Innovation-based Higher Education in Pakistan

3.1. Backdrop

38. As amazing as the successes are in China, many challenges and opportunities remain to be realized in Pakistan. Pakistan's STI education and training infrastructure, especially in fields such as engineering, has been under-resourced and under-valued. The overall neglect of technical training and higher education institutions since the country's inception has had negative impact on the capacity of required skill base, particularly in STI. Eventually, Pakistan continues to import expensive technical assistance which does not enable the country to build STI capacities, and thus is a short-term remedy. A multifaceted system of institutions, players, policies, connections, and networks are required to harness advantages of STI-based higher education.

39. The establishment of the Higher Education Commission (HEC) in 2002 fairly raised the standards and budget for the then Ministry of Science and Technology (MoST) and the Ministry of Education. The number of scholars and higher education programs increased to a reasonable extent along with educational facilities, infrastructure, and research support. However, the need of the hour is to align the HEC’s mandate of STI-based higher education with viable policies and extensive market-oriented research, and link the salient fragments of knowledge economy in order to bridge the gap between the government, industry, and academia, so that skilled labor is introduced into market.

40. The establishment of HEC played a key role in the dramatic increase of tertiary enrolment from 401,056 tertiary students in 2003 to more than 1.8 million in 2012. This increase is put in a better perspective when it is seen that in 1990 the tertiary enrolment stood at 304,928. In thirteen years from 1990 till 2003, there was only about 32 percentage change compared to an almost extraordinary 353 percentage increase in the 9 years from 2003 till 2012 after the formation of HEC (UNESCO 2014). Still, in Pakistan, the literacy rate is a mere 55 percent and only 8 percent of the tertiary-age population is enrolled (UNESCO 2014).

41. STI plays little role in Pakistan's major exports and almost all major technology is imported. Pakistan's major exports include textile products, rice, cotton, fish, carpets, leather, sports and surgical goods etc. Conversely, the major imports include machinery, transport, equipment etc. There are 124 higher education institutions and about 85 R&D organizations in public and private sectors of Pakistan in fields of agricultural sciences, engineering and technology, medical sciences, business, IT, arts and design, and social sciences. The 2008-09 Pakistan Council for Science and Technology (PCST) Survey indicated that the total spending on S&T on all types of organizations was a paltry 1.05 percent of the GDP. The research expenditure on S&T and 83 R&D-based organizations was 0.59 percent of GDP (PCST 2009, p.45).

42. Although these statistics may appear dismal, it is worth appreciating that despite economic challenges the higher education institutions grew from less than 5 in 1947-48 to some 59 in 2000 and 137 in 2011.

3.2. Pakistan’s National Policies and Institutions for STI and Higher Education

43. Education, STI, and IT sectors are cross-cutting and interdependent. Hence their policies must have a well-structured and institutionalized overlap. This realization has dawned very late in Pakistan, with the advent of the 21st century, and has also been recognized in the National Science, Technology, and Innovation Policy of Pakistan (2012). However, the higher education policy requires similar recognition and intent.

44. In Pakistan, the training and research undertakings of higher education institutions need to be well-oriented towards the development of expertise, experience, and entrepreneurial capability to innovate, fuel, and retain the country’s prosperity, progress, and sustainability. With a stronger focus on academia-industry collaboration and public-private partnership, Pakistan must take cognizance of the fact that actors are more diverse and expert.

45. The National Science, Technology, and Innovation (STI) Policy of Pakistan (2012) states that S&T sector did not undergo “systematic development during the last couple of decades” and that Pakistan has been able to formulate a new S&T Policy in 2012 after the first policy document in 1984.

46. The 1984 policy was issued after a lengthy process of deliberations that spanned nine years. The objectives set in the 1984 policy remained largely unfulfilled. A year before completing its term, the then government released the National STI Policy-2012 and now it awaits the present government’s will, either for endorsement or change. Nevertheless, the policy envi-
visions achieving security, prosperity, and social cohesion of Pakistan through equitable and sustainable socioeconomic progress using science, technology, and innovation as central pillars of development in all sectors of economic activity. The current policy identifies the need to bridge the gap between well-articulated intentions and tangible actions, and of instituting an effective mechanism of policy oversight.

47. The National STI Policy identifies National Commission for Science and Technology, Ministry of Science and Technology (MoST), Pakistan Council for Science and Technology (PCST), and S&T Departments of all provinces as the principal stake holders besides others in the national STI endeavor. The policy provides guidelines on human resource development, indigenous technology development, technology transfer and creation of absorptive capacity, and international cooperation. Sixteen areas of thrust for R&D activities have been laid out in the policy that include cutting-edge technologies like nanoscience, nanotechnology, space technology, etc.

48. Strengthening higher education institutions through generous funding, availability, and maintenance of experimental facilities and resources for international mobility is one of the objectives of the National STI Policy – 2012. In order to achieve that, the R&D expenditure shall be enhanced to 1.0 percent of GDP by 2015 and 2.0 percent by 2020.

49. The policy endorses the vision adopted in the National Education Policy – 2009. However, the area of STI based higher education remains generic in the policy. The vision states: “Our education system must provide quality education … to enable them to … contribute to development of tolerance … based on the ideology of Pakistan.” Likewise, the National STI Policy’s focus is on intervention at primary and higher-secondary education levels.

50. The National Education Policy – 2009 has envisioned investment on higher education to the tune of 20 percent of the education budget along with an enhancement of the total education budget to 7 percent of GDP. The document recognizes that the laboratory equipment etc. at the S&T-based educational institutions is outdated and that there is a need for making more Ph.D qualified persons available to impart quality education (National STI Policy – 2012, p.16).

51. With regard to the university education, the policy recognizes the role R&D based organizations can play under HEC aegis in S&T-based higher education. A mega-project “Strengthening of HRD in MoST and its organizations – development of 400 Ph.Ds” at the cost of Rs. 2898.98 million in eight years is a significant step towards quantitative and qualitative increase in manpower.

52. Five policy actions have been identified in the realm of higher education related to STI. These include enhancement of the existing facilities, establishment of new institutions, development of mechanism for linkage, and mobility of professionals among the academia, industry, and research institutions, and also the promotion of applied research through technology incubations and business development centers at educational and research institutions (National STI Policy – 2012, p.18).

53. In Pakistan, there is a need of synergizing policies, priorities, and the political will. The Higher Education Commission is the premier institution to implement programs for enhancing quality, access, and relevance of higher education. However, leaps in STI-based higher education are high if focus rests on deployment of knowledge and technology as well. The broad-based and value-added industry-academia linkages will provide required knowledge inputs and skilled workers besides pulling together research sources, thus reorienting educational and research organizations towards the economic progress, and completing the virtuous cycle of sustainable development.

4. Scope for NUST’s STI-based Higher Education Collaboration with China:

54. NUST, a leading science, technology, and innovation-based higher education institution in Pakistan, can capitalize on this collaboration in a diverse manner by being a hub in promoting capacity building and human resource (HR) development, and cultural, economic, and R&D-based partnerships. Exchange programs on specific project requirements or teaching at partner Chinese universities shall be a useful utilization of potential of NUST’s competent faculty which has qualified from elite Pakistani and international universities.

55. NUST has envisioned the establishment of the National Science and Technology Park (NSTP) in order to build value-producing networks based on technology, management know-how, and technical and social innovation, which shall form a comprehensive knowledge ecosystem of entrepreneurs, venture capitalists, academics, students, and community for mentoring and learning to act as entrepreneurial organizations.
Amongst others, the key constituents of this innovative umbrella are the Corporate Advisory Council (CAC), the Global Think Tank Network (GTTN), and the various functions unified under the NUST Office of Research, Innovation, and Commercialization (ORIC). The NSTP seeks to promote interaction between institutional elements – such as universities, research parks, large companies, etc. – and non-institutional entities i.e. various bodies of knowledge. This initiative shall link local assets to the domestic and global markets, besides ensuring employment opportunities. Chinese collaboration, based on its efficient science and technology parks experience, shall render great help for NUST to expedite its NSTP program.

56. Moreover, the Chinese partner universities can support inclusion of Chinese language in various NUST disciplines. A progressive program of joint internships in NUST engineering disciplines and Chinese universities, research centers, and enterprises shall boost research skills of students.

57. A series of memorandums of understanding (MoUs) between NUST and Chinese counterparts have sought to map areas for cooperation for mutual benefit of the two partners. The sectors identified for collaboration are: education, coal power technology, infrastructure such as roads and dams, ports and shipping, pharmaceuticals, logistics and transport, renewable energy (solar cell technology), and applied R&D and joint HR cooperation for solar technology applications. A speedy follow up of these memorandums shall ensure win-win arrangements of both countries’ organizations to succeed in the global competitive environment.

5. Recommendations for Collaboration at the National Level

58. China’s sustained development in STI-based higher education offers Pakistan’s emerging higher education system and national technology and innovation policies ample avenues for acquiring and devising mechanisms to realize the latter’s socioeconomic aspirations.

Similarly, Pakistan can offer three quid pro quos to China:

I. Its geographical location which provides an access to the Arabian Sea and a land bridge of trade route of Central Asia and China;

II. Its economic potential, especially in terms of its burgeoning youth – skilled youth can provide a huge and inexpensive labor force; and,

III. Pakistan’s potential intellectual capital and human resource – this brain power with its financial strength shall be encouraged to study in top Chinese universities.

59. This collaboration, comprising a well-implemented comprehensive strategic framework, along with policies and organizations to facilitate technology foresight exercise with Chinese assistance in establishing a road map for development, shall ensure consolidation of time-honored and diversified relationship of the two countries.

60. The restructuring of STI-based higher education institutions in Pakistan must be steered by the vision based on China’s policies and experience in higher education governance, with a special emphasis on improving accountability and quality of cooperation between the institutions.

61. This section proffers some recommendations for mutual cooperation between China and Pakistan in STI-based higher education.

i. Bilateral and Trilateral Institutional Linkages with China and Other States

62. China’s Twelfth Five Year Plan (2011-15) emphasizes the strategic significance of its seven priority industries that include biotechnology, new materials, information technology, and high-end manufacturing.

63. In the light of Chinese academic collaboration with western countries in these fields, an opportunity for future China-Pakistan collaboration could be assessed in the broader context of bilateral or trilateral partnerships involving China, Pakistan, another advanced economy. Support to institutional linkages in STI areas together with development of faculty and new courses shall boost Pakistan’s higher education. Both governments can ensure an over-arching participation primarily through entities such as China-Pakistan Joint Think Tank, a collaborative initiative of National University of Sciences and Technology (NUST), Pakistan, and Tsinghua University, Beijing, and South West University of Political Science and Law, Chongqing, China.

64. Moreover, direct collaboration of Pakistan’s premier STI-based universities with top Chinese counterparts such as Tsinghua University, Peking University, and Fudan University shall be useful. Such linkages can further focus on training of some 5000 Pakistani
scientists and engineers in top Chinese universities within a span of ten years. Also, jointly run programs with international accreditation shall ensure quality of output.

65. Another approach can be a two-pronged strategy based on Chinese technology transfer to and technical capacity building of researchers in Pakistani higher education institutions. NUST schools have active human resource development component which features the continuous technological learning and acquisition of technical skills.

ii. Scientific Collaboration

66. The Chinese Academy of Sciences and Pakistan Academy of Sciences signed an executive protocol in 2012 for exchange of scientists and students. Such best practices must be materialized for graduation and post-graduation programs at universities in Pakistan and China in diversified fields, followed by strong implementation. For instance, research in key areas like stem cells, bio films, autoimmune disorders, enzymes for bio fuel, energy, nano-engineering, and chemical engineering are being carried out in NUST. They can achieve full potential if synchronized properly with Chinese counterparts in these areas.

iii. Skill Development

67. To generate and cultivate the intersection between STI and higher education for requisite skill development, China and Pakistan can collaborate in areas such as R&D, policy direction, ICT skills and infrastructure, expansion of broad-brand services, teacher training and curricular design, virtual and distance learning, and intensive knowledge of products and techniques.

68. Chinese best practices can help Pakistan perform economic and sector analyses and gather credible data to validate the value, need, and strategic vision for calculated prioritization for sectors’ growth. Trade liberalization and low-cost communication and transport shall significantly facilitate mutual flow of educated labor force.

69. Campuses or schools of Chinese best S&T-based universities in Pakistani higher education institutions shall expand networks especially with sister institutions in other regions.

iv. Case Study Universities

70. The Social Sciences and Humanities Research Council of Canada (SSHRC) project focuses on case study of twelve Chinese institutions for the transition from elite to mass higher education system in China (Hayhoe, 2006). Researches of this kind produce strong output for policy interventions and equip academia with trained human capital. A case study methodology can be employed in Pakistan for research at national and system level with collaboration of institutions such as the Chinese Academy of Sciences and Pakistan Academy of Sciences, as well as the skilled human resource at higher education institutions such as NUST.

v. Centers of Excellence

71. The Chinese Academy of Sciences conjointly with the World Academy of Sciences (TWAS) supports five centers of research excellence in CAS institutes on: Green Technology, Biotechnology, Climate and Environment Sciences, Space Science for Disaster Mitigation, and Water and Environment. The purpose of these centers of excellence is to extend collaboration with scientists and engineers in the developing world with the purpose of promoting research, exchanging knowledge, and enriching global networks. The centers will complement China’s South-South collaborations and its increasing contribution to the developing world’s science capacity.

72. The program encompasses workshops, researchers exchange and training, and Ph.D programs. Pakistani scientists’ and engineers’ comprehensive exposure to these centers will facilitate best practices in Pakistan and shall work as value-addition to knowledge and injection of skilled labor in the Pakistani market.

73. Moreover, the cooperation strategy must assist in strengthening national and regional centers of excellence in the selected areas such as engineering, health sciences and support services, business enterprise, teacher training, energy, and linking higher education and STI to the productive sector.

74. NUST, being an active follower of the Triple Helix Model, can be taken on board in this regard through:

I) short duration training for post-doctorate faculty; II) split Ph.D programs; III) exchange fellowships; IV) appointment of visiting/contractual Chinese professors who can teach at various schools and vice versa, thus propagating best experiences and practices; and
V) joint research publications.

vi. Confucius Institutes and Pakistan Studies Centers

75. People-to-people associations usually pave way for perception building and sustained relationships. The British Council, American Studies Centers, Goethe Institutes, and Alliance Francaise promote their respective cultures worldwide.

76. Likewise, China-Pakistan STI-based cooperation in higher education can become a motivating force once it is reinforced by active cultural contact. China’s Confucius Institutes, in this regard, are playing a key role in promoting the country’s overseas culture, language, higher education apparatus, student exchange, global image, and on-campus benefit to students. There are reportedly 327 Confucius Institutes functioning in 93 countries around the world; the US tops the list with 71 Confucius Institutes followed by Russia (17), South Korea (17), France (14), UK (13), Japan (12), Germany (11), and Italy (1) (University of Nebraska-Lincoln, US, 2014). Pakistan has only one Confucius Institute. However, it is encouraging to note that of the 300 Confucius centers in 50 countries, the one at National Institute of Modern Languages (NUML) in Islamabad was ranked first in 2011. An increased number of these Institutes in Pakistan’s main cities shall boost cooperation in higher education sector between the two countries.

78. NUST can also house on its premises an active Confucius Institute or a China Studies Center in collaboration with a top Chinese university. The project ed China Center at NUST shall be a milestone in this respect. Similarly, a good number of Pakistan Studies Centers in different regions in China shall supplement the similar vision and strengthen the cultural and educational ties.

vii. Secondary and Technical Education

79. Secondary education is a vital block for STI-based higher education. It must be made a national priority in Pakistan through collaboration of all development partners that are essentially involved in supporting the lower education sector. Such collaboration should focus on teaching of mathematics, science, and technical subjects. Similarly, Pakistan’s vast non- and semi-skilled labor force’s capabilities can be capitalized through the help of Chinese experts and a mechanized exposure to the Chinese markets.

viii. Mutual Recognition Agreement (MRA)

80. The mutual recognition of higher education qualifications between countries recognizes the pluses of creating mechanisms for mutual acknowledgment of academic degrees and qualifications. Such an agreement has the potential to increase the level of higher education cooperation and improve student and professional mobility between China and Pakistan. China currently has partnerships with 39 countries, including Sri Lanka and India, thus Pakistan must not be an exception. The initiative, while endorsing the friendship, shall also let China achieve milestones of its “science diplomacy” and aim of increasing its share of foreign students studying in Chinese universities to half a million by 2020.

ix. Funding the Higher Education

81. The budget spent in Pakistan for the education sector continues to be low, with a few significant improvements observed during past two decades.

82. Pakistan can identify new sources of funding for higher education through Chinese assistance in developing sustainable model for funding of collaborative projects between public-private sectors to achieve common goals.

83. These goals comprise academia-industry linkages and revitalization of science and technology for economic growth and S&T Education Development (STED) program previously implemented by MoST, Pakistan. Moreover, China can render expert assistance to develop a revolving ‘innovation fund’ of some five billion rupees to support indigenous technology development in public and private sectors.

84. China launched the Government Subsidized Student Loans Credit Insurance (GSSLCI) program to tackle growing inequality in terms of access to higher education institutions. It relies on a successful model of public-private partnerships based on innovative alliances between banks, universities, insurance companies, and government agencies resulting in employment, gender equality, and lesser higher education costs. Pakistan can implement the model for equitable higher education.

85. Also, the policies envisaged in the OECD Review of Financing and Quality Assurance Reforms in Higher Education in the People’s Republic of China are impressive to be followed. Examples of income-
contingent schemes include:

I. a graduate tax, which only graduates who have received financial assistance from the government with their higher education costs would be liable to pay, as a supplement to their regular income tax;

II. a deferred contribution scheme; and a loan scheme under which individuals can choose to pay their costs as tuition fees as they arise, or can take out loans to pay these fees, repayable after graduation (Organization for Economic Cooperation and Development).

6. Conclusion

86. In this knowledge-driven world, socioeconomic success is indistinguishably entwined with science, technology, innovation, and higher education reform. Although this realization is on upswing in Pakistan, most of the country’s policies and institutions require incessant overhaul in order to ensure a fully-implemented framework for sustainable socioeconomic development. Policy documents such as the Vision 2030 and National Innovation Policy focus on a strategic program for the long-term comprehensive and integrated development of Pakistan so that it plays its due part in collaboration with all stakeholders for regional and global prosperity.

87. China’s leapfrogging in science, technology, and innovation-based higher education sector has furthered its economic development. The key construction projects in China were designed to improve the country’s higher education system and international competitive capacity, and to streamline its contribution to technological and economic development along with better accomplishment of national interests.

88. Truly, the “China phenomenon” is altering the “knowledge balance of the world.” China’s sustained economic and technology based higher education and robust research and development sector hold innumerable avenues for a channelized collaboration with Pakistan in these fields. This strategy must be aligned with the specific needs of the higher education sector and the market in order to facilitate deployment of skilled labor in specific sectors of the economy. This synergy with China in science, technology, and innovation-based higher education has the potential to put Pakistan on the path of economic growth like Beijing envisioned four decades ago.

89. The paper has provided the analytical foundations for an explicitly strategized approach in order to identify areas of mutual collaboration in science, technology, and innovation-based higher education between China and Pakistan. The Chinese model of sustainable policies and the political will to implement institutional breakthroughs extend sound guidelines to the Pakistan’s leadership and experts to accelerate the country’s pace on the road to socioeconomic development, thus making it a strong, just, and progressive Pakistan.
Bibliography


