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PAKISTAN

Changing landscape of science communication

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1. Background

Science and technology are linked with all aspects of society. Science has greatly advanced our understanding of the natural world and has brought countless creations of practical application and many meaningful advantages to the human species. The primary role of human society should be to promote and develop rational, logical ability and critical thinking amongst its citizens, so as to better understand the dynamics of nature, conserve it and benefit from technological developments on a sustainable basis. With regards to better understanding by society of scientific phenomena such as climate change, science communication plays an important role to raise awareness. Science journalism conveys scientific knowledge, concepts and processes to the public and policymakers, important for taking governing decisions. It bridges the gap between the scientific world and general public and exposes them to real world problems. However, the Islamic Republic of Pakistan lags far behind in science communication among the comity of forward-looking nations, even though the majority of its people are believers in Islam, a faith that encourages and strongly advocates education and learning 'from cradle to grave' for both men and women (Soomro and Tanveer, 2017).

Pakistan does not seem to have established the necessary framework to communicate science to its public effectively. The avenues for sharing of scientific thoughts and research outcomes among scientists, the general public and policymakers for decision-making are simply not enough. The fact is that

interest in science is fizzling out among kids and the gap between science and society continues to widen in the country. Science communication and science journalism in Pakistan are still in their initial phases; Pakistanis are just getting familiar with the idea of 'science for all', but due to the interesting, engaging and magnetic nature of science, people are always keen to know more—and this has the potential to brighten the future of science and technology in Pakistan.

Pakistan is a developing country with a population of over 207 million (Ministry of Finance, 2018).

The country is blessed with enormous resources, human as well as natural, but its economic growth and development are not commensurate with its available natural endowment. Since its independence in 1947, Pakistan has gone through many serious challenges including geopolitical turbulence, internal instability, natural disasters and a changing political and democratic landscape. As a result, Pakistan today faces various development challenges ranging from a sluggish economy, illiteracy, water and food scarcity, an energy crisis and environmental issues.

The country's science and technology (S&T) is an emerging sector and has played an important role in the development of the country. Pakistan has been known for its exceptional and talented pool of scientists, engineers, doctors and technicians whenever they have been provided with a conducive environment in Pakistan or abroad. Becoming a nuclear power is an example. However, it is unfortunate that despite its demonstrated quality of human capital, Pakistan is underperforming in many sectors of its economy. The lack of consistent policies and weak governance have been the main challenges. As a result, the institutional framework to support science, technology and innovation (STI) has remained weak, and the talented people of the country have not been given the opportunity to shine.

There appears to be little recognition of the communication of science for the general public at the top, mainly because the basic understanding of the role of STI in economic growth has been somewhat lacking among the leadership. This situation can be attributed to the inability of the country's scientific community to educate its politicians and policymakers. We do not see concerted efforts on the part of government, aimed at changing the behaviour of the people at large. With the exception of the nuclear program, science institutions do not get adequate funding. (Krishna and Naim, 2005; Osama, Hassan and Chattha, 2015). Thus the country faces serious challenges in attracting the right talent and securing adequate funding, which

has always been a challenge for researchers. Pakistan also lacks the conducive ecosystem and facilities needed for quality research in its universities and research institutes.

The Pakistani education system, like many developing countries, is influenced by sociocultural values, where questioning and inquiry are discouraged at schools as well as at home. There are arguments and counter-arguments on the relationship between science and religion: some people consider that science and religion are contradictory, while others believe in combining science with religion. At times, 'crackpots' denounce the globally accepted principles of biology, such as the theory of evolution. However, such perceptions exist in many developing and developed countries (Hoodhboy, 2016). In Pakistan, students are taught science by memorising some text rather than understanding the core scientific concepts, thus curtailing their cognitive abilities. Under such circumstances, it is difficult to develop and nurture scientific thinking and analytical skills (Soomro and Tanveer, 2017).

It is common for pseudoscientists and/or bureaucrats to become mainstream decision-makers or 'opinion builders' in Pakistani society; for example, premier institutions like Pakistan Science Foundation and Pakistan Council for Scientific and Industrial Research (PCSIR) have off and on been without a chief executive for long spells and looked after by bureaucrats with no science background. We also come across scams such as water-powered cars and doubtful treatment of human health ailments and dysfunctions. This is even though Pakistan is an Islamic state and functions in accordance with the Qur'an, a book of guidance with numerous indications and instructions to think critically and explore nature.

2. Historical perspectives

The 'Golden Age of Islam' in the 8th–13th centuries, emanating from the education and learning centres of the Middle East and well before the European renaissance, contributed significantly to modern science and technology and its communication (Faruqi, 2006). However, the need to communicate scientific knowledge to the public and to enlighten society about scientific discoveries in an organised way originated in the developed world. The developing world has the same communication needs, but they were only satisfied later, with the invasion of colonial powers in the developing regions. These include the Middle East, once cradle and bastion of education and knowledge. The debates around the potential benefit of science and technology in the public spheres emerged in post-colonial governments in the Indian subcontinent and Africa (Massimiano and Trench, 2008).

Science communication in present-day Pakistan originated well before Pakistan's creation and partition from India in 1947. Several scientific societies and publications began their work before independence. *Science* magazine was launched in the Urdu language in 1928 by Anjuman Tarraqi-e-Urdu in Delhi (Dawn News, 2011). It was the first popular science magazine in Urdu and, after independence, it continued publication from Karachi until 1956.

Pakistan recognised the importance of being able to communicate scientific concepts in local languages. In 1955 the Scientific Society of Pakistan was established to promote these discussions in the Urdu language. This society published Urdu journals *Science Bachoon Kay Liye* [Science for Children] and *Jadid Society* [Modern Society]; and their publications survived until 1972. The society used to organise annual science conferences where research papers were presented in Urdu and the entire proceedings were published in the Urdu language (Krishna and Naim, 2005).

The medium of instruction is of course a challenge when it comes to the teaching of science in Pakistan. It is commonly taught either in English or local languages, Urdu or Sindhi. Local languages are faced with the challenge of borrowing scientific terms from English. This can make it difficult to understand complex terms transcribed in Urdu and can lead young students to lose interest in science. One approach is to promote the national (Urdu) language in every walk of life including science. On the other hand, where science is taught in English, teachers at primary and secondary levels in public schools often do not have the capacity to employ English as a medium of instruction.

The Pakistan Association for the Advancement of Science (PAAS) was established in 1947 on the pattern of the British Association of Advancement of Science, for the promotion of science in Pakistan. Since its inception, PAAS has contributed towards communication and popularisation of science (International Science Council, 2007). PAAS provides a forum for scientific meetings, conferences and the publication of scientific papers for professionals, but not as much for public awareness. PAAS used to publish two journals, *Pakistan Journal of Science* and *Pakistan Journal of Scientific Research*, which were subsequently merged into the *Pakistan Journal of Science* (PJS) in 2008 (Pakistan Journal of Science, 2009). PAAS continues to organise an annual conference on science with a focus on key subjects ranging from health, agriculture, biological, physical to chemical sciences. It attracts over 300 participants each time and provides a space for interaction between the general public and scientists in the country. In 2018, PAAS held its 38th Annual Conference, sponsored by government agencies including the Higher Education Commission and Pakistan Science Foundation.

The PCSIR was established in 1953 to undertake and promote industrial and scientific research for the socioeconomic development of the country. Currently, it works under the Ministry of Science and Technology (MoST). PCSIR set up its publications branch in 1956 and launched a series of popular science publications, like *Science and Industry* and *Science Chronicles* in English, and in Urdu *Karwan-e–Science*, a popular science magazine (PCSIR, n.d.), all of which are not published anymore. PCSIR also launched a quarterly research journal, *Pakistan Journal of Scientific and Industrial Research*, in 1958, which continues to be published.

In 1974, a distinguished scientist of Pakistan, Professor Abdus Salam (who later won the Nobel Prize in Physics), proposed to establish an international forum so scientists from developing countries could interact with their peers from advanced countries. The Pakistan Atomic Energy Commission (PAEC) owned the idea and continues to hold the International Nathiagali Summer College (INSC), focusing on presentations of research by scientists (International Nathiagali Summer College, n.d.). In 2018, INSC held its 43rd event in the series. Since its inception, over 670 eminent scientists from abroad, including six Nobel Laureates, have participated in the summer college. The college has also facilitated the exchange of over 1,000 foreign scientists from 72 developing countries and benefited 7,000 Pakistani scientists.

The Sindh Science Society (SSS) was founded in 1971 to raise the public awareness of S&T through the local Sindhi language. SSS played a significant role in the promotion of science and provided numerous opportunities to the general public for interaction with the scientific community. SSS also published its monthly *Science Magazine* in Sindhi to disseminate the latest trends and developments in S&T. In the period 1976 to 1989, SSS faced some challenges and could not continue its monthly publication. It resumed publication in 1989 but ceased again in 1998.

Launched in 1981, the Urdu publication *Science Digest* continued until 2001 (Patairiya, 2006). Another popular science magazine, *Global Science*, was launched in 1998 and continued its paper-based edition until November 2016. The magazine could not sustain its print version but is now continuing with the web-based version. *Global Science* was Pakistan's most widely circulated Urdu-language magazine in S&T with an average monthly circulation of 4,500 copies.[1] Some of its special editions (including those that covered biotechnology reviews and the 2005 earthquake) peaked at 8,000 copies. It was a landmark achievement in terms of S&T journalism in Urdu.

1 See globalsciencemag.com.

During the course of history in Pakistan, a number of other popular science magazines and/or journals were launched for communication and dissemination of science to public. However, most of these magazines and journals have ceased to exist and only a couple of them have survived. This indicates that science journalism or communication has not taken off very well, despite the need, potential and available human capital in Pakistan.

3. The role of government and its policies

At the time of partition in 1947, Pakistan inherited a scanty infrastructure to begin its path towards socioeconomic development. Pakistan was an underdeveloped economy and many important sectors such as industry, transportation, trade and basic infrastructure were not sufficiently advanced, resulting in a very low standard of living. There were problems the new government had to address urgently, and the immediate challenge for Pakistan was the intense migration across the borders between India and Pakistan. The foremost priority for the newly established government was to provide food and shelter. Subsequently, the Government of Pakistan realised the significance of S&T for economic development and established a number of R&D institutions. Academic institutions and universities were also planned for provision of quality education in the country.

Liaquat Ali Khan, the first prime minister of Pakistan, undertook several initiatives to develop the S&T base of the country. He invited Professor Salimuzzaman Siddiqui, a renowned chemist of the Indian Subcontinent, to Pakistan by awarding him citizenship in 1951 (Dawn News, 2011). Professor Siddiqui was appointed as the first Science Advisor to the Government. He established PCSIR along with its 16 laboratories in different cities to support R&D and boost industrialisation. During the 1950s, Pakistan established numerous councils to carry out research and propose policy recommendations in emerging fields of S&T, such as medical, agriculture, nuclear, industry and forestry. This was the initial phase of institutionalisation of science and technology in the country, but formal development of policies for the S&T sector did not begin until the 1960s (Naim, 2001).

3.1. Science and technology policy development in Pakistan

In 1960, Professor Abdus Salam was entrusted by the then President Ayub Khan to formulate the National Science Commission (NSC) with a mandate to develop a plan of action for science in Pakistan. The NSC published its first report in 1960 with recommendations to establish R&D institutions

and universities across the country (Naim, 2001). The NSC report served as a de facto first S&T policy in the early development phase of Pakistan. The key focus of the recommendations was to strengthen R&D organisations and universities with provision of adequate funding for research and human resource development. It emphasised developing a career service structure for science professionals and allocation of at least 2.5 per cent of the national budget for science (Osama, Hassan, & Chattha, 2015). These recommendations broadly covered promotion of scientific research but did not specifically address the public awareness of science or science communication.

During the 1960s, several important institutions were launched, and various councils were established to advise the government on policy matters related to defence, irrigation, flood control and housing research (Krishna and Naim, 2005). Pakistan saw phenomenal growth in agricultural productivity in the 1960s as the government embarked upon a plan to encourage farmers to use dwarf varieties of wheat. Transmission of improved technology to the farmers through an extension services program played an important role in the agricultural growth in Pakistan (Ahmed, Shah and Zahid, 2004). This had a profound impact on the national economy and is considered as the 'Green Revolution' for Pakistan, where agricultural production almost doubled during the 1960s and 1970s (Broughton, 2017). Over the years, the government deployed a number of extension services to encourage farmers to use new varieties of grains. A high-yielding cotton variety 'NIAB-78' was developed in 1983 by Pakistani scientists using nuclear technology, and an active extension program led to a revolution in cotton production and the agricultural economy of the country.

In 1972, Pakistan established MoST to plan, coordinate and direct efforts to ensure effective S&T governance and research programs. In 1973, the Pakistan Science Foundation (PSF) was established through an Act of Parliament as an autonomous organisation under MoST. PSF today serves as the premier funding agency for supporting scientific and technological research as well as for the promotion and popularisation of science in the country.

However, it was in 1984 that Pakistan adopted its first national S&T policy, after an extensive process of consultations. This policy was quite comprehensive and aimed to address challenges to upgrade the country's S&T landscape (Ministry of Science and Technology, 1984). For the first time in the history of Pakistan, S&T policy highlighted and provided guidelines to promote public awareness of science and technology. Chapter 8 of this policy provides clear guidelines for the promotion of public communication of S&T:

> Creation of widespread public awareness of the vital importance of science and technology is absolutely necessary if these are to be utilised as instruments for improving the quality of life of the people in Pakistan.

This policy placed special interest on inculcating widespread awareness of science in society, developing a scientific culture and emphasised increasing public awareness through radio, television, newspapers, popular science publications and the establishment of science museums and centres. However, not much has been done over the decades to implement the policy.

In the 1990s, the focus shifted towards developing and commercialising indigenous technologies. In 1994, the National Technology Policy and Technology Development Action Plan were adopted with a goal to commercialise research and boost industrial sectors.

In the first decade of the new century, the S&T sector underwent a phenomenal revival and made revolutionary progress during the military rule of General Pervez Musharraf. The budget for S&T was increased 60-fold and many programs and initiatives were launched to strengthen research and human resource capabilities, such as a free national digital library for universities, high-speed internet access and the provision of fully funded PhD scholarships to study abroad (Nature, 2009).

The University Grants Commission (UGC), set up in 1947 to provide grants to the universities, was entirely overhauled and transformed into the Higher Education Commission (HEC) in 2002. For the first time in Pakistan's history, universities began to receive substantial funding for research and infrastructure development. Funding for the universities increased more than 10-fold, empowering universities to undertake quality research comparable to international standards. At times this proceeded a little too fast and to some extent, beyond the absorption capacity of the universities, resulting in spillage of some resources (Osama, Hassan and Chattha, 2015).

Even though the S&T Policy of 1984 was never implemented as required, Pakistan adopted a new policy in 2012. It emphasised using STI as central pillars for socioeconomic progression of the country, but the S&T sector (other than defence research) remained low priority and under-funded. Subsequently, with the change of government, MoST launched a revised STI strategy 2014–18 for 'effective' implementation of the policy, but still the sector remained a low priority. Nevertheless, a new government in February 2019 has set up a task force on science and technology led by Professor Atta ur Rahman FRS (Fellow of the Royal Society), with the aim of revamping the S&T sector. Only time will tell what actions are planned and what outcomes can be expected.

It can be concluded, therefore, that historically successive governments undertook a number of initiatives to augment the S&T sector with the creation of new R&D organisations, universities and the formulation of STI policies. But all these measures have been unable to deliver socioeconomic benefits. Time and again, these policies have failed to create any significant impact because the framework for implementation of such policies lacks a conducive environment and requires consistency in the funding and implementation of such policies. Moreover, S&T has remained a rather low priority for successive governments over the last decade.

4. Institutional framework for science, technology and innovation

Pakistan has a three-tiered S&T ecosystem and overall the sector can be classified into three main divisions: 1) university-based S&T; 2) public sector; and 3) defence research. However, the success and progression of the S&T sector (except for the defence research) has been mainly linked to high-stature personalities rather than strong institutions.

The bulk of scientific research is conducted in public and some private universities as well as at R&D organisations, but none of them pursues any systematic science communication program. While universities in Pakistan do offer degrees in journalism, none offers any courses related to science journalism, although there is an elective course on environmental journalism (Higher Education Commission, 2013). The scope for promotion of public communication of science at universities has been very limited, though the government has recently allowed universities to launch public radio channels. Thus, several universities have launched FM radio stations, particularly for dissemination of agricultural and health services among adjacent communities (Express Tribune, 2015). Agricultural and animal husbandry universities also provide farmer advisory services.

MoST is the lead entity responsible for planning, coordinating and directing efforts to launch and carry out public sector S&T programs and projects aimed at Pakistan's economic development. One of MoST's principal aims is to build Pakistan's S&T capacity in the 21st century by ensuring effective S&T governance and enhancing the capacity of indigenous innovation systems.

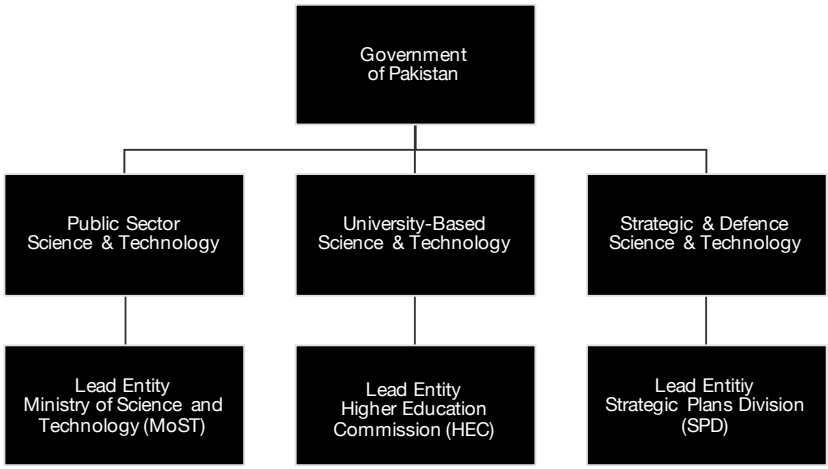

Figure 27.1: Pakistan's three-tiered S&T ecosystem

Source: After Osama, Hassan, and Chattha (2015).

4.1. Institutional support for popularisation of science in Pakistan

4.1.1. Pakistan Science Foundation

The Pakistan Science Foundation (PSF) was established in 1973 as an autonomous organisation under MoST. It is the apex body responsible for the funding and promotion of science education, research and communication in the country. The functions of PSF as laid down in its act through Article 4 (IV–VI) emphasise the promotion of public communication of science and technology, as follows:

i. The establishment of science centres, clubs, museums, herbaria and planetaria.
ii. The promotion of scientific societies, associations and academies engaged in spreading the cause of scientific knowledge in general or in the pursuit of a specific scientific discipline or technology in particular.
iii. The organisation of periodical science conferences, symposia and seminars.

PSF has established science societies, clubs, museums and S&T information centres for the communication of science to the scientific research community and the public. PSF organises and supports various conferences, science fairs and travelling expos, and training workshops and seminars throughout the country to engage the public and scientific community on emerging scientific and technological issues relevant to society.

In the wake of the 1984 S&T policy emphasising public awareness of science, PSF took several initiatives to popularise science and began its first science popularisation program in 1986 by hosting scientific film shows and a planetarium. Other PSF initiatives include the establishment of science caravans, science clubs in high schools, science film shows and popular science lectures.

4.1.2. Science caravans

To popularise science across the country especially in rural areas, PSF launched its Science Caravan program in 1988 (UNESCO, 2003). Up to 2019, nine science caravans have been established; they travel to far-flung areas of Pakistan and expose school children to some of the most fascinating scientific and technical concepts, processes and developments of modern science (Pakistan Science Foundation, 2017).

4.2. Financial support to scientific societies in Pakistan

Scientific societies work as non-government professional bodies for the promotion and development of scientific disciplines. Around 50 scientific societies are registered with PSF for financial support, but most of them provide forums for sharing scientific knowledge among their own communities through conferences, symposia, seminars and the publication of journals. Only occasionally do they hold open houses and science fairs or write popular articles for the general public. They do not normally interact with media but do send occasional press releases with research outcomes to raise awareness via wider dissemination to the public. As a consequence, Pakistanis are less aware of the potential of science and technology to address their local challenges.

4.2.1. National S&T fairs and travelling expos

In the 1990s, PSF organised a month-long mega National Science and Technology Fair every two years at the sports complex in Islamabad, where all R&D organisations, universities, defence R&D and production organisations and services as well as the manufacturing industry would join in. Around 1 million people, made up of the general public, students of all ages, families and the business community, visited those fairs each time. The last such fair was held in 1999; with the incident of 9/11 in 2001, the security situation changed quickly across the world and the mega fairs were stopped. However, in 2007, an indoor national S&T development fair was organised at the newly established Monument Museum Islamabad, which focused on S&T achievements of the past 60 years by Pakistan.[2]

2 Personal communication by senior author Soomro, who has been a member of the organising committee of science fairs in 1997, 1999 and 2007.

Figure 27.2: School kids during the Science & Technolgy Expo 2007: Shaping the Future.

Source: Manzoor Hussain Soomro, Pakistan Science Foundation (PSF).

Figure 27.3: Science and Technology Expo 2007: Shaping the Future.

Source: Manzoor Hussain Soomro, Pakistan Science Foundation (PSF).

Subsequently, PSF under the leadership of Professor Manzoor Hussain Soomro organised annual thematic travelling expositions on mathematics, water, environment, chemistry, biodiversity and energy, starting in 2008. They were held in 19 cities and towns across Pakistan and once in Afghanistan. These were visited by over 165,000 people (Pakistan Science Foundation, 2015). The expo series ended in 2013 as Soomro finished his services with PSF. The purpose of organising these travelling science expos was to stimulate public interest and illustrate the linkages between science, technology and economic/industrial development as well as the accomplishments of scientific discoveries.

4.2.2. Science centres

The PSF has a program for the establishment of science centres but its first and last science centre was set-up in 2000 through a public–private partnership at Faisalabad. This centre displays exhibits (only a few interactive) in the fields of natural history, biology, chemistry, physics and computer sciences, etc. with special emphasis on the application of science and technology in our daily lives. Subsequently, a proposal for setting up four more science centres was put to the government for funding but has not materialised yet.

4.2.3. Popular science lecture series

PSF as part of its science popularisation activities organises 'Popular Science Lectures'. These lectures address and highlight different scientific themes and issues of everyday life such as blood pressure and heart disease, floods, earthquakes, climate change, mosquito-borne diseases and viruses, etc. Eminent scholars, scientists, technologists and educationists are invited to lecture to diverse audiences.

4.2.4. Pakistan Museum of Natural History (PMNH)

Pakistan Museum of Natural History (PMNH) Islamabad, established in 1976 under the patronage of Pakistan Science Foundation, is mandated to provide current and historical specimens to researchers for their research and to raise awareness among students and the public, and to improve their understanding of the nation's natural history. PMNH plays an important role in public education to raise scientific awareness about fauna, flora and rocks and minerals, and shares the wonders of the natural treasures of Pakistan through dioramas, exhibits, lectures, workshops, seminars, posters and film shows (Rahim, 2016). PMNH currently holds nearly 1 million natural history specimens including

a rare specimen of a whale shark, the skeleton of a blue whale and a real-size replica of one of the largest (5.5 metres high and 8 metres long) land mammals, the Baluchitherium.[3]

4.2.5. Pakistan Scientific and Technological Information Center (PASTIC)

PASTIC, like PMNH, is a subsidiary of PSF that mainly serves as an information repository of research by national R&D and S&T institutions and provides information services through modern IT tools and applications. PASTIC has undertaken initiatives to strengthen and promote the role of scientists and journalists, and to enhance interaction of the general public with science. PASTIC has organised training workshops and seminars for capacity building of journalists for effective communication of science to the public. PASTIC produced numerous science documentaries during the early 2000s, addressing local challenges and issues on environment, health, disaster risks and biotechnology (Pakistan Science Foundation, 2006). The documentaries were broadcast through local TV channels, but it all remained in 'project mode'.

4.2.6. National Museum of Science and Technology

The National Museum of Science and Technology (NMST) was established in Lahore, Pakistan, in 1965 by the Government of Pakistan in order to raise public awareness about science and technology and to inculcate interest among the masses. However, after the 18th constitutional amendment and devolution of numerous federal ministries in 2010, the NMST became a provincial institution with limited scope.

4.2.7. Urdu Science Board

Urdu Science Board, under the Federal Ministry of Information, Broadcasting and National Heritage, plays a vital role in promoting science and scientific culture in the country. It was established in 1962 as the Central Board for the Development of Urdu through a resolution to fulfil the constitutional requirement to develop Urdu as Pakistan's national language. It was renamed Urdu Science Board in 1984 with the objective of familiarising the masses with the new developments in the field of S&T across the globe. The board has so far published more than 800 books on different science subjects and a science encyclopedia in Urdu.

3 Baluchitherium (Paraceratherium) is an extinct rhinoceros that lived during the tertiary period about 20–30 million years ago. Its fossils were discovered in the Dera Bugti area of Balochistan province in the late 1990s by French and PMNH scientists.

4.2.8. Pakistan Academy of Sciences

Established in 1953, the Pakistan Academy of Sciences is a non-government scientific body of distinguished scientists in the country. The Government of Pakistan has given the consultative and advisory status to the academy on all national and international matters relating to the development of science and technology. It aims to promote science and technology in Pakistan, disseminate scientific knowledge and honour eminent scientists primarily through their election as fellows. It has played an important role in science popularisation and promotion of scientific research with its exchange programs with international scientific societies, academies and learned bodies. The academy also arranges popular science lectures, seminars, symposia, conferences and workshops at national and international levels.

5. Emerging trends in the promotion and popularisation of science in Pakistan

Recent trends are encouraging as there is an increasing level of realisation that advancement in STI is the way forward for Pakistan. In this context, the non-government entities and private sector are playing a lead role and taking a keen interest in promoting a culture of critical thinking and science in the country. These initiatives and private sector engagement are critical to raise the public awareness of science. With emergence of modern information tools and platforms, Pakistan has witnessed well-orchestrated and planned science popularisation activities throughout the country. Some of these encouraging trends and success stories on science communication are highlighted below.

Pakistan recently saw a very successful campaign for school education, called 'Alif Ailaan'. Launched in 2013 and finished in 2018, it was funded by the Department for International Development (DFID) of the UK Government (Alif Ailaan, 2017a). Its prime objective was to ensure that parents and communities demand good-quality education with a special focus on science subjects. They ran strong political and media advocacy activities for education at schools. The campaign published a three-volume document *Powering Pakistan for the 21st Century* (Alif Ailaan, 2017b), and recognised the significance of mathematics and science for the country's progress as well as for individual cognitive development.

After the Alif Ailaan finished, an education NGO called the Pakistan Alliance for Maths and Science (PAMS) was launched as its legacy. It is a collective effort of more than 70 civil society organisations, businesses and government bodies and individuals, aiming to provide Pakistani children with more and

better opportunities to learn 21st century cognitive skills. PAMS and its member organisations during the past two years have had direct interactions with over 150,000 students across 30 districts of Pakistan (Pakistan Alliance for Maths and Science, 2018). These interactions have been through science fairs and festivals and other activities organised in government schools and Math-a-thon events organised in universities across Pakistan.

A number of scientific societies/associations (non-profit and for profit) have been established to further scientific culture in Pakistan's educational institutions and in the general public (Pakistan Alliance for Maths and Science, 2018).[4]

Khwarizmi Science Society (KSS) Lahore is one such example. It was established in 1997 to bring together scientists and scholars to work for the shared goal of making science accessible to the general public, especially children. Ever since, it has organised over 400 activities for the popularisation of science, including public lectures, symposiums, national workshops, the filming of scientific documentaries, science exhibitions and Melas (festivals). The Science Melas organised by the society are focused on simplifying rather complicated scientific phenomena to make them understandable to the general public. KSS inspired an enthusiastic young student to recreate Newton's telescope at the astronomical fair organised by the society (Farrell, 2011). The last Lahore Science Mela was organised at Lahore in October 2019.

Pakistan Science Club is also one of the emerging science clubs in Pakistan and is based in Karachi. It aims to promote a scientific research culture in society through interactive and innovative hands-on science activities, experiments and science fun events, as well as capacity-building workshops for children and their parents. In the wake of the Coronavirus pandemic (COVID-19), the club has begun 'Family Science Camps Online'.

Science Fuse Lahore is another interesting example, working as a social enterprise to promote science education among young learners. Science Fuse offers young students a unique opportunity to learn science by 'doing' at summer camps, extracurricular science workshops and after-school science clubs. Over the last few years, they have engaged almost 20,000 children through their informal science workshops and fun activities (Alveena, 2018).

4 Alif Ailaan, a nonprofit organisation working in the field of education in Pakistan since 2013, enlisted a number of emerging organisations dedicated to promoting scientific culture. Launched by a team of media and communications specialists, its program sought to highlight education on a priority basis in Pakistan and make the masses aware of the importance of education.

Similarly, a number of astronomical societies have been established to contribute towards the development of astronomy both as a science and as a fun activity for the public (Astronomy Without Borders, 2018).

With the emergence of the digital and online space, streaming services such as YouTube and online radios, are changing the course of broadcasting and telecasting. YouTube streaming has emerged as one of the critical disruptions for television. It is used as an effective tool for public lecturing and sharing popular science lectures. With the emergence of these technologies, Pakistanis are using digital applications to share news and popularise science.

The Eqbal Ahmad Centre for Public Education (EACPE) is an excellent online platform for the general public of Pakistan seeking to foster the use of science and reason to enable Pakistani citizens to participate fully in society as informed citizens (Razzaque, 2015). It runs an impressive series of online popular science articles and lectures by the prominent scientists and intellectuals of Pakistan covering various subjects of society, politics, culture, science and technology for the general public.[5]

Recently, many startups and initiatives have been spurred to seek out and leverage technology to promote scientific culture in Pakistan. One such example is an educational technology company called LearnOBots, launched in 2014 to promote science, technology, engineering and mathematics (STEM) education through robotics workshops and learning kits.

6. Science communication through media

Electronic, print and online media in Pakistan are vibrant sources of information. Television is considered to be the most popular medium for information and entertainment purposes, followed by radio and the print media. Almost all the media broadcasters have an online presence and web channels. Over the last two decades, the electronic media has made revolutionary progress with the emergence of cable and satellite TV networks (Baig and Cheema, 2015). Since then, the media industry has been considered one of the most influential forces in lawmaking and the political process in the country. However, science reporting or communication does not generally rank high among the priority areas for media outlets and newsroom hierarchies across the country. Pakistan has produced outstanding journalists in every field, including national politics, international affairs, entertainment and sports, but it would be very difficult to find a single 'true science journalist'

5 See eacpe.org.

in Pakistan. The obvious reason is that in the Pakistani media, whether print or electronic, journalists are usually obsessed with international and national politics and the demand for science journalism does not seem to be there. Those who are reporting science are not professional science journalists but rather general reporters.

Pakistan's media has a political bias where international and national political issues are given far more coverage than any other news. While countries of the developed world often have scientific issues like climate change high on the political agenda, it is often not part of political discourse in Pakistan and rarely discussed in the media. Pakistan is the seventh-most vulnerable country to climate change according to Global Climate Risk Index 2018 (Eckstein et al., 2020). Due to extreme weather events, thousands of people have been killed and millions have been displaced. Despite this grave situation, Pakistan's contribution to media coverage of climate change issues is rather negligible.

Sometimes English newspapers cover major science news or stories, such as 'Voyager 2 reaches interstellar space', but it is hard to discover such news in the Urdu media. There was hardly any coverage by Urdu channels on NASA's Voyager 2 when it entered interstellar space, despite this being one of the most remarkable events in the history of space travel.

There are over 83 TV channels in Pakistan, but none is dedicated to science and technology. Pakistan has produced only three popular science documentary series: *Ilm Kay Raastay* in 1980s, *Asrar-e-Jahan* in 1995 and *Bazm-e-Kainat* in 2003. The *Ilm Kay Raastay* program featured an interview of Professor Abdus Salam in late 1980s. All three documentary series were produced and developed by Professor Pervez Hoodbhoy, a Pakistani physicist who went on to receive the UNESCO Kalinga Prize for his efforts to increase public awareness of science and acquainting the public with the role of science in improving people's living conditions.

The lack of institutional support is considered to be a major contributing factor for underdeveloped science journalism (Ahmed, 2005). The business model of Pakistan's media outlets is such that they do not incentivise news reporting on science and technology. The universities in Pakistan do not offer any courses related to science journalism, which is one reason why science is never a topic of discussion among the public, or on electronic and social media. Scientists and researchers, both in public or private universities, are not given any incentives to share their scientific knowledge with the public for dialogue and policy making.

Radio plays a key role for public awareness of science in Pakistan, particularly in addressing agricultural and rural issues. Many rural farmers do not have an adequate access to communications technologies like TV or the web, but radio reaches a large rural population. Agricultural messages are broadcast at critical times of crop growth stages through radio channels year-round to educate the farming community about the latest and site-specific production technologies. Radio programs also include interviews with agricultural experts and progressive farmers.

The *Technology Times* is Pakistan's only newspaper devoted to the field of science and technology. On an average day, it receives about 80,000 hits. Their magazine is electronically distributed across Pakistan, particularly to universities and research institutes.

So far, only two Pakistanis have received the UNESCO Kalinga award for their exceptional work for increasing public awareness and popularisation of science: Misbah-Ud-Din Shami received his UNESCO Kalinga Prize in 1990 (UNESCO, 1990); and Pervez Amirali Hoodbhoy received his UNESCO Kalinga award in 2003 (UNESCO, 2003).

7. Conclusion

Science communication plays a significant role as it connects the general public with scientific arenas and helps them understand how science influences human lives. The country's science, technology and innovation fields are emerging sectors that have played an important role in the development of the country. However, the hard fact is that science and technology has never been a genuine priority for the Government of Pakistan, largely because of the many challenging issues the government has to deal with. Thus, science and technology have not really been successful in delivering social benefits to the country. At times, good policies for science and technology have been announced but the implementation of these policies has been weak and ineffectual.

Pakistan faces numerous development challenges ranging from a sluggish economy, poor literacy rate, water and food scarcity, to an energy crisis and environmental issues. The country must prioritise an adequate investment in STI to produce well-qualified and capable human capital to address these challenges. The country has to establish the necessary framework to communicate science to its public effectively to cultivate a science-literate society. With emerging digital technologies, the avenues for sharing scientific thoughts and research outcomes among scientists, the general public

and policymakers will continue to grow. In this context, the institutional development of science communication would be critical to bridge the growing gap between science and society.

The fact is that science journalism or communication has not taken off, despite its potential, the existence of a valid demand and the availability of human capital in Pakistan. During the course of history in Pakistan, a number of popular science magazines and/or journals were launched but the majority of them have ceased to exist and only a couple of magazines have sustained publication. The national S&T policy adopted in 1984 highlighted and provided guidelines to promote public awareness of science and technology. It placed special emphasis on widespread awareness of science in society, developing scientific culture and emphasised increasing public awareness through radio, television, newspapers, popular science publications and the establishment of science museums and centres. The policy exists, but it needs to be implemented in its true spirit.

Overall, the Pakistani media including electronic and print are vibrant sources of information but science reporting does not rank high among the priority areas of media outlets and newsroom hierarchies across the country. However, with the emergence of online and digital platforms, many startups and non-government entities have spurred to leverage technology to promote scientific culture in Pakistan.

Over the decades, Pakistan has witnessed innovative and encouraging trends in the promotion of public awareness of science and technology. Momentous campaigns like Alif Ailaan, together with persistent efforts of various science societies and clubs, determined popular science publishers, and excellent and untiring efforts of some individuals, have created meaningful impact. However, in order to make a significant contribution to the public awareness of science and technology in Pakistan, the government needs to prioritise STI and focus on the promotion of public awareness of science and technology. There is a need for collective efforts and initiatives to bring positive change and help transform Pakistan (Soomro and Tanveer, 2017).

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Timeline

Event	Name	Date	Comment
First interactive science centre established.	Faisalabad Science Centre	2000	The centre was established by Pakistan Science Foundation on a public–private partnership basis
First national (or large regional) science festival.	First was 1992 and the fourth was in 1999; all at Islamabad. Then the series ceased	17–30 Sept 1992	Organised by PSF and Ministry 'Science and Technology for Self-Reliance'. 2007: A smaller month-long National Science Fair, at the Monument Museum Islamabad
First National Conference in Science Communication.	'National Workshop on Science and Technology Reporting'	1991	Organised by the Ministry of Science and Technology, sponsored by Thomson Foundation and British Council
National government program to support science communication established.	Establishment of Science Media Cell in Pakistan Science Foundation (PSF)	2010	
First significant initiative or report on science communication.	Science Media Forum	2010	Organised by PSF

Event	Name	Date	Comment
National Science Week founded.	Proposal submitted to the government	None yet	10 November is World Science Day for Peace & Development, celebrated by students, teachers and scientists but not the general public
First significant radio programs on science.	*Tehqiq ki Duniya* [Research World]	Began late 1990s continued till 2004	2002–13: *Science ki Dunya* [Science World]
First significant TV programs on science.	*Bazm e Kainat* [Living in the Cosmos]	1994	Hosted by Pervez Amirali Hoodbhoy, of Quaid-e-Azam University, Islamabad 2000: *Asrar e Jahan* [Mysteries of the Universe]
First awards for scientists or journalists or others for science communication.	Dedicated awards for science journalists, by PSF	2017	Awards for scientists have been given ever since the establishment of Civil Awards in Pakistan
Other significant events.	A press briefing at the National Press Club in Islamabad	June 2017	Occasional press releases are issued by various organisations across Pakistan
	First museum established	1965	National Museum of Science and Technology, Lahore
	Kalinga Award to M. D. Shami	1990	2000: Kalinga Award to Pervez Hoodhboy

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