COMSATS Newsletter

Commission on Science and Technology for Sustainable Development in the South (COMSATS)

September-October 2015 | 5 | 2015 | Vol.7 | www.comsats.org

Ghanaian State Minister at Presidency, Minister and Deputy Minister for Environment, ST&I, and E.D COMSATS along with the participants of the 3rd General Meeting of COMSATS (Page 10)

Inside this Issue

Patron:
Dr. Imtinan Elahi Qureshi
Executive Director COMSATS

Editors:
Mr. Irfan Hayee
Ms. Farhana Saleem

Editorial Support:
Mr. Abdul Majid Qureshi

Designing & Development:
Mr. Imran Chaudhry

Contributions from readers are welcome on any matter relevant to the mission of COMSATS, namely the promotion of South-South cooperation in science and technology for sustainable progress of the developing countries. The responsibility for the accuracy of any information rests with the original source. Views expressed in this publication do not necessarily reflect those of its editors, publisher or COMSATS.

COMSATS Secretariat:
Shahrah-e-Jamhuriat, G-5/2
Islamabad - Pakistan
Tel: (+92-51) 9214515 to 17
Fax: (+92-51) 9216539
E-mail: comsats@comsats.org
URL: www.comsats.org

From the Executive Director's Desk

The words of Chairperson COMSATS, H.E. Dr. John Dramani Mahama, President of the Republic of Ghana, delivered by his State Minister, Hon. Elvis Afriyie-Ankrah, echoed in the auditorium of La-Palm Royal Beach Hotel in Accra, on 27th October 2015 at the opening of COMSATS' third General Meeting as a clarion call for the developing world. He reminded that; "The history of nations shows a direct relationship between technological advancements and political, military and economic dominance. It is, therefore, essential that the leaders of developing countries realize this and put in place requisite measures for making it a prime concern". While paying tributes to COMSATS as a platform for S&T cooperation created by the developing countries in 1994, at the behest of Pakistani Nobel Laureate, Prof. Abdus Salam, President Mahama appealed; "As the Chairperson of COMSATS, I call upon all Member States to improve their cooperation with one another and redouble their efforts aimed at the development of Science and Technology. This would require greater spending on the matter at home and increased level of financial support towards South-South cooperation". Needless to say that investment made on infrastructure for research and development in areas of scientific research directly related to socio-economic development, always pays back with huge interest in the form of enhanced value-addition to exports of commodities and services. Similarly, contributions made to organizations providing multilateral opportunities of sharing know-how and resources is actually a mechanism of reducing national burden of solo ventures. In this regard, the agreement made in the General Meeting to operationalize an endowment fund for COMSATS is a welcome move aimed at financial sustainability of the organization. COMSATS' performance over the last 21 years shows an excellent record of South-South cooperation activities. Just one week before the General Meeting, a team of experts from Pakistan visited Ghana to conduct a workshop on 'Repair and Maintenance of Scientific Equipment', which essentially involved the transfer of know-how from one developing country to another, at a minimal cost of economy-class air travel, and basic boarding and lodging, resulting in restoring functionality of advanced instruments worth hundreds of thousands of dollars. Through scores of

continued on page 03

NEWS/ACTIVITIES/HIGHLIGHTS FROM COMSATS SECRETARIAT

Ambassador of Palestine Signs COMSATS' Accession Agreement at a Dinner Hosted in Honour of Ambassadors of Member States

Two significant events took place on COMSATS 21st Anniversary, October 5, 2015. Firstly, the State of Palestine joined COMSATS as its 23rd Member State. Secondly, the Ambassadors of COMSATS' Member States in Islamabad or their representatives were apprised about COMSATS' then upcoming 3rd General Meeting and 3rd Consultative Committee Meeting in Accra, Ghana, during a dinner meeting hosted by H.E. Mr. Rana Tanveer Hussain, Minister for Science and Technology, Government of Pakistan.

The signing ceremony of Palestine's accession agreement was held after the Dinner in the presence of representatives of 13 diplomatic missions in Pakistan, belonging to Bangladesh, China, Egypt, Ghana, Iran, Jordan, Kazakhstan, Korea (DPR), Morocco, Nigeria, Sri Lanka, Syria, and Tunisia. The Federal Secretary, Ministry of Science and Technology (MoST), Mr. Fazal Abbas Maken also represented COMSATS' Focal Ministry in Pakistan, at the meeting. Also present on the occasion were other senior officials of MoST, the Ministry of Foreign Affairs, COMSATS Secretariat and COMSATS Institute of Information Technology (CIIT), as well as members of local print and electronic media.

Executive Director COMSATS and Palestinian Ambassador to Pakistan after the Signing of COMSATS' Accession Agreement

The Ambassador of the State of Palestine to Pakistan, H.E. Mr. Walid Abu Ali, and the Executive Director COMSATS, Dr. I. E. Qureshi, signed the Accession Agreement on behalf of the Government of Palestine, and COMSATS, respectively. With the signing authorized by the Palestinian Government, the Accession Agreement was effective immediately. The agreement entails appointment of a relevant Ministry of the State of Palestine as COMSATS' Focal Point, and, nomination of a suitable Palestinian R&D institution by the Focal Ministry to join COMSATS' Network of International S&T Centres of Excellence. In this regard, correspondence with the Palestinian Ministry of Higher Education has already been initiated. Apart from its representation in the statutory bodies of COMSATS, Palestine can now benefit from COMSATS' International Thematic Research Groups; Distinguished Professorship Scheme; Panel of Experts on Science, Technology and Innovation Policy; and capacity-building and knowledge-sharing activities, as well as the scholarship offers by some of COMSATS' Centres of Excellence, in particular CIIT, Pakistan.

Speaking on the occasion, the Minister appreciated the induction of Palestine as a Member State of COMSATS. The Minister urged the representatives of the foreign missions of COMSATS' Member States to sensitize their governments about the importance of the Ghana Meetings to ensure highest level participation. The Minister noted that the Government of Pakistan is funding the running expenses of the Secretariat as the country's contribution towards COMSATS' mission of South-South cooperation.

The Palestinian Ambassador to Pakistan conveyed his government's determination to actively participate in the programmes and activities of the organization. On a subsequent visit to COMSATS Headquarters on 13th October 2015, His Excellency, inter alia, discussed matters related to availing CIIT's offers of scholarship for Palestinian students. The Ambassador was presented official documents prepared in connection with COMSATS' 3rd General Meeting.

COMSATS holds Seminar to Commemorate the UN Day for South-South Cooperation

Out of the international observances celebrated to highlight various issues and events, UN's South-South Cooperation Day is the most relevant to COMSATS' mandate. To commemorate the Day, COMSATS in collaboration with the Centre for Policy Studies (CPS) of COMSATS Institute of Information Technology (CIIT) held a National Seminar on 'South-South Cooperation: Towards a Sustainable Future', in Islamabad, on 14th September 2015.

The Director-General Institute of Strategic Studies Islamabad (ISSI), Pakistan, Ambassador (R) Masood Khan, presided over the inaugural session as the Chief Guest. The Executive Director COMSATS, Dr. I.E. Qureshi; and Assistant Country Director and Chief Development Policy Unit of the United Nations Development Programme (UNDP), Mr. Shakeel Ahmad, also addressed the gathering at the inauguration. More than 65 participants, including, diplomats, academicians, scientists, economists, CIIT

faculty members and students, as well as representatives of media and civil society attended the ceremony. The inauguration was followed by a technical session comprising of highly informative talks by four eminent speakers.

Ambassador Khan in his inaugural address considered South-South and triangular cooperation mechanisms important for the success of Sustainable Development Goals (SDGs). He cautioned against the dangers of the developing countries' over dependence on Official Development Assistance (ODA), and opined that the South should make sincere efforts to fully exploit its indigenous resources for its development. He noted how South-South cooperation can facilitate trade and commerce, industry and academia, and S&T, with special reference to Pakistan. He concluded on the hope that COMSATS would continue to play a transformative role with other UN agencies in achieving the global sustainable development agenda.

Earlier in his welcome address, the Executive Director COMSATS noted that the obligations stipulated in the SDGs have more or less been a part and parcel of COMSATS' programmes owing to the mandate given to the organization in its international agreement signed by its founding Member States in 1994, as well as the Charter of COMSATS' Network of International S&T Centres of Excellence. He opined that COMSATS is a living example of a long-haul commitment to triangular and South-South cooperation.

In his talk, entitled 'South-South learning in the context of Sustainable Development', Mr. Shakeel Ahmad noted that the Global South is gradually becoming a source of ODA to other countries (least developed countries). Referring to UNDP Human Development Report (2013), he said that by 2020, the combined economic output of three leading developing countries, namely Brazil, China, and India, is expected to surpass the aggregate production of Canada, France, Germany, Italy, the United Kingdom and the United States. He noted that South-South Cooperation is becoming more of a necessity than just one of the options for achieving growth and human development in the South. He said that the statistics of developing countries suggest an

Distinguished guests, organizers and speakers of the Seminar on South-South Cooperation Day

contd. from page 1 ... 'From the Executive Director's Desk'

other similar programmes, COMSATS has been providing South-South cooperation opportunities at the grass-root level, making a difference in the lives of working scientists.

The representatives of seventeen Heads of State/ Government present in Accra for the General Meeting were upbeat about their endeavors aimed at development of S&T sector at national levels. They also recognized the enabling role of COMSATS in this respect and renewed their commitment to work with COMSATS for achieving objectives of scientific capacity building. Recognizing the large gap of S&T strengths within the group of twenty-three Member States of COMSATS, it was natural that some countries extended offers of training and education to others having limited resources. Turkey, Iran, Pakistan, China and Egypt expressed their willingness to extend cooperation in areas of their expertise, such as technology parks, renewable energy and biotechnology. In this context it was considered desirable to expand the participation of Member States in 'International Thematic Research Groups', which are currently operational under the aegis of COMSATS. While the areas of active groups cover extremely important research fields, such as, low-cost Wi-fi, medicinal plants, mathematical modeling for pollution studies, new strains of food crops, and effects of global warming, it is obvious that more research activity within this scheme has to be initiated to undertake economically beneficial projects in material science, light-based technologies, genetic engineering and Internet security. It is not surprising that the General Meeting agreed to endorse COMSATS' strategy for the next five years, which is based on the concept of promoting rather than simply facilitating research in areas of critical importance for socio-economic progress. It was also not a surprise that the incumbent Chairperson was re-elected for the second term of three years. COMSATS' community is glad to extend heartiest congratulations to His Excellency and the Government of Ghana, with an eager expectation that strong guidance and support will be provided to COMSATS by the office of the honourable Chairperson.

COMSATS will highly appreciate any comments on the contents of this Newsletter by worthy readers.

unequivocal potential and opportunities that the countries of the South, and South Asia in particular, could explore for achieving SDGs.

The technical session of the seminar comprised of insightful presentations and talks on different aspects of South-South cooperation by Ambassador (R) Sohail Amin, President Islamabad Policy Research Institute (IPRI), Islamabad; Prof. Dr. Qamar-uz-Zaman Choudhary, Special Advisor to the Secretary-General of World Meteorological Organization (WMO); Dr. Vaqar Ahmed, Deputy Executive Director Sustainable Development Policy Institute (SDPI), Islamabad; and Dr. Talat Anwar, Advisor, CPS, CIIT-Islamabad.

Mr. Amin opined that some major developments through South-South cooperation have accelerated the developing countries' drive for collective self-reliance. These included the founding of the Non-Aligned Movement (NAM) in 1961 and the Group of 77 (G-77) in 1964. He stressed on the potential of South-South cooperation for strengthening collaboration among their economic, environmental, cultural and social sectors. Prof. Choudhary informed that Pakistan has been included in eight countries most vulnerable to the consequences of climate change. He noted considerable increase in the frequency and intensity of extreme weather events, erratic monsoon rains causing frequent and intense floods and drought. These threats may lead Pakistan to major concerns in terms of its water security, food security, energy security and national security.

Dr. Ahmed highlighted the role being played by SDPI in the global efforts for sustainable development as an independent think tank. He enumerated rise of media, independent judiciary, and self-funded/self-organized efforts by communities, as well as empowered youth as the factors that helped social sector develop in Pakistan. He pointed out that the major threats to Pakistan's development are its shrinking exports in global markets and its declining trade with the neighboring countries.

Dr. Anwar informed that a number of countries have liberalized trade through foreign direct investment (FDI) and that middle and low-income countries have received considerable inflow of FDI that has played a great role in their development. He was of the view that emerging economies like China need to direct their savings to other developing countries for a mutual gain, and dividends in the long run. Some challenges to economic cooperation between the developing countries highlighted by Dr. Anwar included the substantial non-tariff barriers; challenges to alter anti-dumping; as well as perception of sharply unequal benefits to individual countries.

COMSATS' Capacity-Building Events

During the reporting period, COMSATS organized four capacity-building events, three serial and one to observe UNESCO's International Year of Light. Brief reports of these events, held in Turkey, Tunisia, Ghana and Pakistan, are as follows.

5th International Workshop on 'Internet Security: Enhancing Information Exchange Safeguards'

The 5th International Workshop on 'Internet Security: Enhancing Information Exchange Safeguards' was jointly organized by COMSATS, the Islamic Educational, Scientific and Cultural Organization (ISESCO), the Inter Islamic Network on Information Technology (INIT), COMSATS Institute of Information Technology (CIIT), Pakistan, and the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), Turkey. Held on September 14-18, 2015, the event was fifth of the series of workshops on the theme conducted to train I.T professionals of developing countries, enabling them to collectively address issues and challenges related to information and Internet security.

The event was inaugurated by Prof. A. Arif Ergin, President of the Scientific and Technological Research Council of Turkey (TUBITAK), Government of Turkey, on 14th September 2015. In his inaugural address, Prof. Ergin noted that the world is moving from traditional computing to cloud computing, and that the information and data is distributed over thousands of network nodes all over the world, due to which cyber security has become extremely difficult to ensure. Noting the lack of indigenous capacities in the developing world to address relevant challenges, he pointed out the need to build their capacities to improve hardware and network protocols for improved cyber security practices. He informed that TUBITAK governs 19 research facilities in Turkey, nine of which are working in different fields of ICTs and electronics.

A Technical Session of the workshop on Internet Security in progress

Earlier, in his welcome address, Ambassador Musa Kulaklikaya, Director General SESRIC, stated that cyber security is especially important for the developing countries, as they are in the nascent stages of transition towards becoming knowledge societies, and can suffer irreversible damages at the hands of cyber criminals. He informed that SESRIC is actively engaged in building scientific capacity of OIC member countries since 2009, which includes organizing a number of capacity-building events each year, as well as conducting scientific studies.

Dr. I.E. Qureshi, Executive Director COMSATS, in his message on the occasion, noted the ever-increasing fraudulent activities in cyberspace that range from system hacking to identity theft and cyber stalking. He informed that COMSATS is committed to developing and strengthening linkages among the countries of the South for exchange of resources, technology, and knowledge. He acknowledged the consistent support of ISESCO and INIT towards COMSATS' programmes and activities in the common Member States, and thanked SESRIC for hosting the workshop. He also desired and looked forward to having further collaboration with SESRIC on long-term basis.

Dr. S.M. Junaid Zaidi, President INIT and Rector CIIT, in his message called for special protocols to be put in place in order to ensure cyber security in governmental and business activities. Dr. Zaidi informed that INIT has devised certain programmes and initiated a number of activities in different fields of information technology.

Dr. Aicha Bammoun, Acting Director (Sciences), Science Directorate, ISESCO, conveyed the greetings of the Director General ISESCO, who stressed the significance of securing the computing devices against malicious cyber-attacks that often result in critical confidential information and system-control breaches. She informed that ISESCO is implementing various activities that aim to strengthen and promote knowledge and skills that are necessary to induce progress in the scientific and technological research sectors to keep pace with the requirements of the new age.

About 35 young researchers, practitioners, academicians, system administrators and programmers working in the field of Internet/ information security, from Brunei Darussalam, Jordan, Nigeria, Maldives, Morocco, Tanzania, Pakistan, Palestine and Turkey, benefited from the proceedings of the workshop.

The training modules pertained to various important subjects relating to organizational security; cryptography and network security; ethical hacking; cyber security and information security design principles; and security information and event management systems. Six resource persons imparted training during the event: Dr. Haider Abbas, Research Fellow/Assistant Professor, Center of Excellence in Information Assurance, King Saud University, Saudi Arabia; Dr. Malik Najmus Saqib, Assistant Professor, COMSATS Institute of Information Technology (CIIT), Pakistan; Mr. Zafar Mir, Regional Manager, Information Security Risk, MENA – HSBC, UAE; Mr. Asad Raza, School of Electrical Engineering and Computer Science (SEECS), National University of Sciences and Technology (NUST), Pakistan; Mr. Uður Altun, Cyber Security Institute, Turkey; and Mr. Yakup Korkmaz, Cyber Security Institute, Turkey.

Dr. Haider Abbas delivered lectures on various topics related to 'organizational security'. He stated that cyber vulnerability is directly linked to exponential growth in connectivity. While highlighting the significance of ensuring security of critical infrastructure, he informed that cyber crimes cost the global economy over US$ 400 billion annually. Corporations and governments are facing increasingly sophisticated cyber threats that far exceed traditional defenses. In this regard, he informed that 97% of Fortune 500 companies have been hacked. He recounted some of the recent cyber attacks. Dr. Abbas also explained the concepts of Cyber Warfare and Electronic Warfare through various case studies. Highlighting the international standards and best practices for information security, he discussed security policies and their objectives and procedures. He also touched upon the concepts of Risk Assessment, and conducted practical exercises on information security policy/procedures writing, information assets identifications & valuation, and risk assessment & treatment.

Dr. Malik Najmus Saqib covered the topics related to 'Cryptography and Ethical Hacking'. He stated that

Group Photo of the participants of the Internet Security Workshop

cryptography is the art and science of secrecy. Covering the topics related to cryptography, he explained Brute-Force attack, encryption and decryption, computational security, cryptanalysis, classical ciphers, caesar cipher, monoalphabetic cipher, polyalphabetic ciphers, transposition ciphers, etc. He conducted practical exercises on ethical hacking, including penetration testing, external and internal security, in-house and outsourced security assessments, etc. He also imparted training regarding the use of Metasploit framework and Meterpreter for the purpose of ethical hacking.

Mr. Uður Altun explained the basics of penetration testing and highlighted its importance. He also elaborated the steps involved in pentest from the perspectives of pentester and customer through real life experiences. Mr. Asad Raza imparted hands-on training to the participants regarding enumerating windows users, enumerating open ports, enumerating running services, hacking windows operating systems, using encoders to bypass antivirus and firewalls, cracking WEP, WPA and WPA2, capturing insecure passwords, capturing secure passwords, cracking windows system passwords, installation and configuration procedure, OSSIM dashboard, integration with Snare and Nessus, and prevention methods.

Mr. Yakup Korkmaz explained the key characteristics of Advanced Persistent Threats using real-world examples. He also explained the techniques and tools for detection and analysis of such threats. Mr. Zafar Mir covered topics related to information security design principles, emerging cyber threats and their significance, dissecting a cyber attack, various phases in planning a cyber attack, recent distributed denial of service attacks, possible mitigation solutions to service attacks, etc.

Speaking at the Concluding Ceremony held on 18th September 2015, Mr. Tajammul Hussain, Advisor (Programmes) COMSATS, offered the human and technological resources available with COMSATS to address issues related to Internet/information security, and thanked ISESCO, INIT, CIIT and SESRIC for joining hands with COMSATS to organize this important workshop. Prof. Huseyin Hakan Eryetli, Director (Publication & IT), SESRIC, thanked the local and foreign participants, as well as the partner institutions for jointly organizing this event.

Third Regional Consultative Workshop on 'National Innovation System and Intellectual Property (Arab Region)'

The third Regional Consultative Workshop on 'National Innovation System and Intellectual Property' for the Arab Region, was held successfully on October 5-7, 2015, in Tunis, Tunisia. This workshop was hosted by the Tunisian National Commission on Education, Science and Culture (TNCESC). The event was third of the series of workshops organized by COMSATS in collaboration with the Islamic Educational, Scientific and Cultural Organization (ISESCO) and the Inter Islamic Network on Information Technology (INIT). The first two of the series focused on Asian and African regions.

In line with the theme of the series of workshops, this intellectual exchange activity was also meant to benefit middle to high level policy makers, IP practitioners and academicians. The key objectives of the workshop were to deliberate on the contours of National Innovation System (NIS) and IP Regimes in the Arab World; develop capacities of relevant stakeholders from the Member States of COMSATS, ISESCO and INIT; as well as to sensitize them on the need of having strong NIS/IP policies for effectively meeting the challenges of competitiveness in the midst of globalization and rapid technological transformation.

The three-day workshop was inaugurated on October 5, 2015, by the Assistant Secretary General, TNCESC, Mr. Mohamed Kamel Essid. Over 25 subject specialists, IP practitioners, experts and government functionaries and members of the media were present at the inaugural ceremony. These included 17 expert speakers hailing from 12 countries, including China, Egypt, Jordan, Lebanon, Malaysia, Mauritania, Morocco, Oman, Pakistan, Palestine, Sudan and Tunisia.

On the occasion, Mr. Essid conveyed the greetings of the Tunisian Minister of Education and the President of TNCESC. He stressed the importance of an efficient and a well thought-out National Innovation System and IP regime for any developing country to prosper. In his message read-out by Mrs. Wafaa El Alami, Head of Planning, Information and Documentation Centre (CPID) of ISESCO, H.E. Dr. Abdulaziz Othman Altwaijri, Director General, ISESCO, expressed his confidence in fruitful cooperation with COMSATS and INIT.

Mr. Riad Ben Boubaker, Director, National Center for

A presentation being made during the NIS/IP Workshop

Educational Innovation and Research in Education (CNIPRE), representing the Tunisian Minister for Education, hoped the workshop would generate policy guidelines to the governments of the Arab region for keeping pace with rapid developments taking place around the world. The Executive Director INIT, Mr. Tahir Naeem, underscored the need for efficient NIS/IP regime in the wake of decreasing marginal returns on investments in physical resources. He noted that knowledge and technology have assumed a centre stage for increasing productivity and competitiveness of firms, industries and, in turn, the (national) economies.

In his message, the Executive Director COMSATS called for creating enabling environment for innovation by harnessing the creativity of individuals and enterprises, developing good management practices, particularly in small and medium sized firms, as well as facilitating linkages among different stakeholders.

The technical proceedings of the event spread over seven working sessions comprised of talks and presentations that highlighted the importance of a robust and efficient National Innovation System and its impact on innovation and economy, particularly in the Arab region. Country/ organizational case studies highlighting successfully implemented NIS/IP frameworks/models in the region were presented to underscore the importance of IP towards valorization of innovation and protection of ideas and advances in knowledge. These case studies covered national and/or institutional approaches to national innovation systems and intellectual property regimes of China, Egyptian, Lebanon, Malaysia, Morocco, Oman, Palestine, Sudan, and Tunisia. The participants discussed challenges faced by developing countries in implementing effective IP regimes, including problems in drafting and examining patents. Several cases of Arab innovation system and frameworks of intellectual property being promulgated in these countries, and their role in making an economy knowledge-driven were discussed.

A round-table discussion, highlighting various aspects of the themes, concluded the technical deliberations of the event with key recommendations for improving the state of awareness on the subject in the developing world. The recommendations to the organizers called for adopting a "utility model" law to take advantage of scientific research and innovation results; creating a Network of Intellectual Property in the Arab and Islamic countries to share knowledge, experiences and expertise; supporting Arab and Islamic countries on the development of regulations relating to intellectual property in the legislative, technical and human and institutional fields; as well as organizing workshops in the future in cooperation with the intellectual property offices on writing and documenting the patents.

A resolution was adopted unanimously by the participants/organizers of the workshop, urging the need to continue dialogue on a sustained basis and affirming the resolve to promoting the subject areas of the workshop.

The event was formally closed on October 7, 2015, by the Assistant Secretary-General, TNCESC, who lauded the organizers for sensitizing the stakeholders on key issues of NIS/IP with regard to their socio-economic development.

International Symposium on 'Light and Life'

A three-day International Symposium on 'Light and Life' was organized by COMSATS, in collaboration with COMSATS Institute of Information Technology (CIIT), at the latter's campus in Islamabad, from October 14-16, 2015. The event was organized to celebrate the UN International Year of Light and Light-based Technologies, and highlighted the latest research and developments in the field taking place across the globe. The sponsors of the event included Abdus Salam-International Centre for Theoretical Physics (AS-ICTP), Italy; the Ministry of Science and Technology, Government of Pakistan; the Higher Education Commission (HEC) of Pakistan; Pakistan Academy of Sciences (PAS); and National Testing Service (NTS) of Pakistan.

The Minister for Science and Technology and Defence Production, H.E. Mr. Rana Tanveer Hussain, inaugurated the symposium during a ceremony attended by a gathering of over 150 researchers, scientists, students, and officials from relevant organizations in Pakistan and other COMSATS' Member States. Apart from the inaugural

Participants and Beneficiaries of the IYL Symposium at its inauguration

address by the Minister, the ceremony featured speeches and remarks by the Rector CIIT, Dr. S.M. Junaid Zaidi; Prof. Dr. Aslam Khan, Advisor (Physics) at CIIT and the Chairman of the event's Organizing Committee; Prof. Dr. Aslam Baig, Distinguished National Professor at the National Centre for Physics (NCP), Islamabad, and Dr. I.E. Qureshi, Executive Director COMSATS.

In his inaugural address, the Minister noted the importance of the theme of the event and recounted the number of relevant fields in which advancements have benefitted the society. The Minister apprised the audience that his government is conscious of the need to invest in the development of infrastructure and human resources in this field. He considered it necessary to develop well-coordinated programmes in collaboration with national, regional, and international groups and centres of excellence.

The technical proceedings of the Symposium comprised of 16 technical sessions, 9 plenary talks, 14 invited talks, 26 contributed talks, and 17 poster presentations. The topics covered during the event fell in the following broad categories: Light Detection & Harvesting; Light Emitting Devices; Light-Matter Interactions; Light-based Technologies; Photochemistry & Photobiology; Optoelectronics & Photonics; Imaging Science; and Quantum Informatics. The programme of the Symposium also included a Pre-symposium Workshop on 'Technology of Light Emitting Diodes' held at CIIT on October 13, 2015, attended by about hundred students and faculty members. A total of 49 talks were presented on relevant topics by speakers from Bangladesh, China, Germany, Iran, Ireland, Italy, Japan, Pakistan, Sudan, Turkey, UK, and USA. Over 175 registered participants of the event benefitted from the expertise and experiences of these and other speakers of the event.

Pre-Symposium Workshop on LEDs

The technical deliberations of the Symposium highlighted great potential of light and light-based technologies for benefitting the societies at large. Special emphasis was on Solar Energy Harvesting, LEDs, OLEDs, Lasers, Imaging Science even below the diffraction limit with applications in Bio-Sciences and Biotechnology, Environmental Monitoring, Nano Science particularly Nanoscopy, Photonic Devices, Accelerator-based Light Sources, including Synchrotron and Free Electron Lasers, and Extreme Ultraviolet & X-Ray Lasers, as well as Quantum Information Processing. The scientists showed how changing the material properties on the atomic scale can help in having more control over the materials response for desirable use, such as efficient conversion of light and maneuverability over the conventional laws of light dispersion, refraction, scattering, etc. Such controls could help minimize losses in the light-based technologies. Considerable emphasis was laid on the solid state lighting (SSL) and its focus on improving the device's optical power density, efficacy, light quality and operating life. The scientists highlighted the potential of SSL to become competitive with conventional light sources in the future that could greatly increase their share in the general illumination manufacturing industry and relevant markets.

The techniques of production and propagation of light through various light-generations, confining and guiding structures in order to enhance emission and absorption, and also to manipulate photons for desired applications were discussed. It was pointed out that efficiency enhancement of deep-UV LEDs has become very important because of their increasing demand. The role of concentrated Photovoltaic (CPV) technology and its cost effectiveness in solar energy systems makes it viable for developing countries and the advantages of using MOCVD for cell research and development were also elaborated.

A number of applications related to Photonics were also discussed, mainly the use of light sources, such as Synchrotron and Free Electron Lasers for the diversification of energy portfolio and minimization of environmental impacts; use of nanoscopic techniques for detecting and measuring the optical properties of materials and also to investigate nano-structures and nano-devices. While talking about some of the applications of photo-chemistry and photo-biology, experts highlighted the emerging use of optical imaging and spectroscopy of tissues for both diagnostic and therapeutic purposes; use of bio-photonics for the study of different physiological or pathological process at cellular or tissue level. The role of optical detection techniques like absorption, fluorescence, Raman spectroscopy and confocal microscopy was also discussed as powerful tools for the detection of parasitic diseases.

Dr. Shaukat Hameed Khan, Coordinator General COMSTECH, formally closed the event on 16th October 2015. During the concluding ceremony, Dr. Aslam Khan presented the Symposium Report. Dr. Arshad Saleem Bhatti, Dean Faculty of Science, CIIT, suggested that an

A glimpse of the poster presentation session of the IYL event

Optical Society of Pakistan, like the one in the USA, may be created for furthering the spirit of the International Year of Light and Light-based Technologies. Dr. Raheel Qamar, In-charge Islamabad Campus and Dean of Research, Innovation and Commercialization, CIIT; Dr. Khizar Bhutta, Lead Scientist at Whirlpool Corporations (USA); and Dr. Sabieh Anwar of LUMS School of Science & Engineering, Lahore, Pakistan, also spoke on the occasion.

Workshop on Repair and Maintenance of Scientific Engineering Equipment

COMSATS organized a training workshop on 'Repair and Maintenance of Scientific Engineering Equipment' in Accra, Ghana, on October 12-16, 2015, under the auspices of the Ministry of Environment, Science, Technology and Innovation (MESTI), Government of Ghana. The theme is a regular feature of COMSATS' individual and joint activities. The workshop was hosted by Ghana Atomic Energy Commission (GAEC), an affiliated institution of MESTI, Ghana, and was the second workshop on the theme organized by COMSATS in the country during the last two years.

During the technical sessions of the workshop, hands-on training was imparted to technicians of GAEC on repair and regular maintenance of important scientific instruments. Mr. Arif Karim and Mr. Faisal Ghazanfar from Pakistan Council of Scientific and Industrial Research (PCSIR), Pakistan, rendered their services as resource persons for the workshop. The training comprised of hand-on demonstrations complemented by lectures on various repair and maintenance dynamics and techniques. Based on the learning made during the sessions, participants also worked on the faulty equipment under the supervision of the experts. Fifteen engineers and lab technicians were trained for indigenous repair of a number of equipment and instruments at the various GAEC facilities, including Organic lab; Ghana Research Reactor (GHARR-1); Non-Destructive Testing Unit; Biotechnology and Nuclear Agriculture Research Institute (BNARI); Environmental Protection and Waste Management Centre (EPWMC); Radiological and Medical Sciences Research Institute (RAMSRI); as well as Applied Radiation Biology Centre (ARBC) of the Radiological and Medical Sciences Research Institute (RAMSRI).

Twenty-six instruments/equipment repaired during the course of the workshop included: Fourier Transformer Infrared – Spectrophotometer; X-ray Machine; Spectronic 21D UV/Vis; Blood Auto Analyzer; Content Analyzer; Gas Chromatograph and Gas Chromatograph Auto Injector; FTHS 900 Microwave Lab-station; as well as PCR machine.

During a meeting prior to the workshop, the Director General GAEC, Prof. Benjamin Jabez Botwe Nyarko, expressed his gratitude to COMSATS for accepting GAEC's request of organizing the workshop at his institution. Mr. Nisar Ahmad, Deputy Director (Systems) briefed Prof. Nyarko and his colleagues about the workshop methodology and also highlighted the success of the series of workshops held under the theme that has trained more than 340 scientists, engineers and technicians in COMSATS' Member Countries since 2004.

Hands-on training being imparted during the R&M workshop

D.G. GAEC with Members of Pakistan Delegation

SPECIAL SECTION: COMSATS' INTERNATIONAL MEETINGS IN GHANA

COMSATS' statutory bodies play a pivotal role in giving impetus and direction to the programmes and projects of the organization for realizing its mission of science-led socio-economic development of Member States. During the reporting period, meetings of two of the statutory bodies, the Commission and the Consultative Committee, were held in Ghana, from 26th to 28th October 2015 to deliberate on relevant agendas.

The Commission is COMSATS' apex statutory body, with Heads of 23 States/Governments comprising its Membership. Attended by the Ministerial-level nominees of these Heads of States, the General Meetings of the Commission deliberate on key policy matters for providing patronage to other statutory bodies of the organization, its Network of International S&T Centres of Excellence, South-South and South-North cooperative schemes and overall programmes and activities.

The Consultative Committee comprises the national scientific 'Focal Points' of the member States of the Commission, and has the mandate to formulate general policies of the COMSATS' Network and facilitate the provision of services of these Centres in line with the Member countries' developmental needs.

The meetings were hosted by COMSATS' Focal Ministry in Ghana, the Ministry of Environment, Science, Technology and Innovation (MESTI). The meetings were attended by delegates from 17 countries: China, Egypt, Ghana, Iran, Kazakhstan, Morocco, Nigeria, Palestine, Philippines, Pakistan, Senegal, Sri Lanka, Sudan, Tunisia, Turkey, Uganda and Zimbabwe.

The Third General Meeting of COMSATS

The third General Meeting of the Commission on Science and Technology for Sustainable Development in the South (COMSATS), which was convened by the Chairperson of COMSATS, H.E. John Dramani Mahama, President of the Republic of Ghana, was held on 27-28 October 2015, in Accra, Ghana. The Meeting was held at the level of senior officials nominated by the Heads of Member States.

The meeting was inaugurated on 27th October 2015, by Hon. Elvis Afriyie-Ankrah, Minister of State at the Office of the President of Ghana. Apart from the delegates, the inaugural ceremony was attended by about 80 senior officials from the Ghanaian Flagstaff House, relevant ministries and departments; representatives of foreign missions in Ghana; senior officials of Ghanaian R&D/S&T organizations and higher education institutions; and local media personnel; as well as officials from COMSATS Secretariat. Also present at the ceremony was Hon. Dr. Alfred Sugri Tia, Ghanaian Deputy Minister for Environment, Science, Technology and Innovation.

During the First Plenary Session, the Executive Director COMSATS presented his report entitled, 'Overview of COMSATS' Activities and Future Plans'. It covered the activities of COMSATS since the 2nd General Meeting of the Commission in April 2012 and highlighted numerous initiatives taken by COMSATS, during the intervening period, in the light of COMSATS' five-year strategy (2012-16). He also shared in detail the efforts made by COMSATS Secretariat for the establishment of COMSATS Endowment Fund for the financial sustainability of the organization.

In his presentation, some of the unique features of COMSATS were elaborated and the progress made towards achieving the objectives of the organization was described, which was later discussed under different agenda-items of the Meeting. The salient points of the presentation were:

a. Annual meetings of the Coordinating Council: The Council comprises of Heads of 20 R&D organizations

Chief Guest, Distinguished Speakers and Participants of the Inaugural Session of the Third General Meeting of COMSATS

EXCERPTS OF SPEECHES AT INAUGURATION

"...Ghana highly values COMSATS as an organization of the countries of the South that promotes interdependence and self-reliance... The Government of Ghana is focused on its 'Agenda for Transformation', which inter alia calls for adopting new and innovative ways of doing things, drawing on the power of science and technology to diagnose and solve problems…The country welcomes S&T led South-South cooperation and pledges to play its due role for the benefit of other Member States."

(Welcome Address by the Minister for Environment, ST&I, Hon. Mahama Ayariga)

"...COMSATS is not just an organization; it is also a movement – a movement that derives its inspiration from the trail blazing leaders of the third world independence struggles such as; Toussaint L'Ouverture of Haiti, Kwame Nkrumah of Ghana, Dr. Mohammad Mossadeq of Iran... developing countries should have the capacity to plan and execute the cooperation instruments, the way they believe is best suited to them. This is the philosophy that led to the creation of COMSATS."

(Introductory Remarks by Executive Director COMSATS, Dr. I.E. Qureshi)

"…. I consider the establishment of COMSATS as one of the bright spots of the vision of political leadership in Pakistan. It reflects the commitment of the Government of Pakistan to give S&T its due share in national development strategy, and also to let Pakistan play a role for the development of other fellow countries belonging to the global South…. COMSATS secretariat was helpful when we needed to prepare a new S&T policy document in 2011. A broader perspective of what is happening in other countries enabled us to absorb some of the novel elements of policies in other developing counties in our policy document."

(Remarks by Chairperson of COMSATS' Consultative Committee, Mr. Fazal Abbas Maken)

"…. COMSATS and other similar organizations are no doubt working hard to project what should have been obvious to all; namely, the quintessential requirement of developing science and technology to bring about economic progress… As the chairperson of COMSATS, I call on all member states to improve their cooperation with one another and redouble their efforts at the development of science and technology. This would require greater spending on the matter at home and an increased level of financial support towards south-south cooperation."

(Inaugural Address of the Chairperson COMSATS, H.E. Dr. John Dramani Mahama, read out by Mr. Elvis Afriyie-Ankrah, Minister of State, Office of the President of Ghana)

that make up COMSATS Network of International S&T Centres of Excellence in four continents. South-South cooperation avenues are discussed every year and implemented through interaction among the Council members, who are renowned scientists of their respective countries. Four new Centres of Excellence were added to the Network during the last three years.

b. COMSATS Institute of Information Technology (CIIT): The Institute offers 97 degree programmes in its 7 campuses, having more than 30,000 students and 3,500 faculty members. The Institute welcomes students from COMSATS' Members States and 100 scholarships are on offer for students from member States to undertake graduate studies. Moreover five post-doctoral fellowships have been offered by CIIT.

c. International Thematic Research Groups Programme: COMSATS is managing multi-national research groups under this programme. Currently, there are five active groups working on the projects:

   i) Mathematical Modeling and Simulation of Air and Water Pollution;
   ii) Drug Discovery from Nature for Neglected Diseases;
   iii) Characteristics and Mechanism of the Extreme Climate Events under the Climate Change Background;
   iv) Biotechnological Approaches to improve some Wheat Lines Productivity under Biotic and Abiotic Stresses; and
   v) e-Solutions for Community using Low-cost Wi-Fi.

d. Science Advocacy: COMSATS' programmes of Science Advocacy include, seminars on Science Journalism; Science Diplomacy through designated Science Ambassadors; lectures by COMSATS' Distinguished Professors; consultancy by the COMSATS' Panel of Experts on Science, Technology and Innovation policy; international events to celebrate UN-Days and Years, such as International Day of South-South Cooperation, International Day of Science for Peace and

Inaugural Session of the Third General Meeting of COMSATS

Technical Session of the Third General Meeting of COMSATS being attended by Delegates from 17 countries

Development, International Year of Crystallography and International Year of Light and Light-based Technologies.

e. COMSATS' Technical Activities and Outreach: During the reporting period COMSATS held over 65 capacity-building events, published 22 issues of its Newsletters, 4 editions of COMSATS' journal 'Science Vision', brought out one publication of the series "Excellence in Science" (with TWAS) and a book entitled 'AS-ICTP: 50 Years of Science for the Future - Views from Islamabad' covering the proceedings of the AS-ICTP 50th Anniversary ceremony held in Islamabad Pakistan in 2014.

The presentation by the Executive Director was followed by Country Statements by the Heads of 15 country delegations, who highlighted the various initiatives taken by their respective governments in the field of science and technology and shared their future aspirations in the light of their countries' priority areas. The statements made provided guidance to COMSATS Secretariat in determining priorities of the Member States and developing new programmes in order to address their scientific needs. Common points of these statements related to:

- The acknowledgment of Science and Technology (S&T) as the vehicle to secure fast-track, socio-economic development;
- Overviewing scientific and technological activities in the S&T institutions and research organizations of these countries; and
- Expression of commitment and support to COMSATS' international and regional programmes and projects.

Chinese representative expressed her country's willingness to enhance cooperation with COMSATS' Member States, as well as other developing countries, especially under China's "Six 100s" programme. China pledged the continuity of contribution to COMSATS on the basis of existing cooperation.

Egyptian representative proposed availing Egypt's Science and Technology Development Fund (STDF) for initiating collaboration programmes with other COMSATS' Member States. It was noted that the Egyptian Ministry of Higher Education and Scientific Research is focused at its short-term research plan on four main axes; namely water, renewable energy, health and agriculture.

Appreciating COMSATS' activities that benefitted Ghana recently, Ghanaian representative showed keen interest in availing the scholarship opportunities offered by COMSATS, as well as pledged to play its due role for the benefit of other Member States. She noted that the country is focused on its 'Agenda of Transformation', and requires the support of other developing countries in its strides for growth and development.

Representative of Kazakhstan highlighted the State Programme of Industrial and Innovative Development of Kazakhstan for 2015-2019 that has been developed by COMSATS' Centre of Excellence in Kazakhstan the Al-Farabi Kazakh National University (KazNU) in accordance with the long-term priorities of the 'Kazakhstan-2050' Strategy. It was noted that Kazakhstan is ready to collaborate with other Member States in areas of Oil and Gas, ICTs, Space Technology, Green Industry, Food Industry, Green Energy and pharmaceuticals.

Moroccan representative shared his country's intent to play an active role as a COMSATS Member State, while benefiting from its international programmes and projects.

Nigerian representative pledged to sensitize his government regarding the benefits of making Annual Membership Contribution to COMSATS.

The representative from Palestine informed that his country's focus is on higher education and scientific research, aimed at industrial growth, and has established various Centres of Excellence with the support of private sector and donor organizations/countries.

Pakistani representative noted that the Government of Pakistan is committed to extend full support to the programmes and activities of COMSATS. Recognizing the importance of COMSATS' International Thematic Research Groups, enhanced participation of Member States was called for. The representative also reiterated CIIT's offers of scholarships, short-term trainings (on reciprocal basis) and exchange of scientists to the Member States.

Senegalese representative informed that his country is re-orienting its education system towards technology, science, engineering and mathematics, as well as establishing new professional higher education institutions. It was noted that the country is a member of various regional and international organizations, and looks forward to actively participating in COMSATS' programmes.

Sri Lankan delegate urged COMSATS to play a catalytic role in sensitizing the political leaders of the Member States regarding the importance of Science and Technology and Innovation in attaining Sustainable Development Goals.

Sudanese representative expressed his country's keenness to collaborate with other developing countries for technologies related to agriculture, food security and natural resources.

Tunisian official urged the country delegates to highlight the activities and programmes of COMSATS in their respective countries and regions in order to enhance the scope and impact of its programmes.

Turkish official informed that his country offers a number of scholarship opportunities for higher education and post-doctoral research, as well as supports international bilateral research and development programmes pertaining to academia and industry, which are also available for COMSATS Member States. Turkey extended support to COMSATS programmes and activities through the various research institutions of TUBITAK.

Ugandan representative pledged to take up the matter of designation of a Centre of Excellence with the concerned authorities of his country.

Zimbabwean delegate noted that his country has concrete plans in place for the establishment of five new science and technology universities, centres of excellence, technology centres for young scientist pioneers and research institutes focusing on enhancing food security, mitigating climate change adversity, developing renewable energy technologies and alternative technologies through reverse engineering. He offered Zimbabwe to be COMSATS' regional node in Southern Africa for coordinating collaborative research and serving as the facilitator of the institution's programmes in the region.

After the country statements, an Open Forum titled 'Discussion on South-South cooperation issues and COMSATS' Future Programmes' was held, during which the delegates deliberated upon issues of mutual interest. The need for preserving genome and biodiversity resources and safeguarding intellectual property rights of the developing countries was highlighted. In this regard, Turkey offered its help to other Member States of COMSATS in setting-up frameworks for the protection of their intellectual property rights.

While discussing the existing programmes of COMSATS, the Member States pledged to join, and actively participate in the International Thematic Research Groups of COMSATS, which constitute the lynch pin of COMSATS'

Plenary Session-II being Chaired by Ambassador of Sudan to Ghana

Strategy. The Member States also pledged to nominate appropriate experts and scientists to join COMSATS' Panel of Experts on Science, Technology and Innovation Policy; COMSATS Distinguished Professorship Scheme; and Panel of COMSATS' Science Ambassadors. Pakistan invited other Member States to benefit from the experience of COMSATS Institute of Information Technology (CIIT), Pakistan, in setting up the COMSATS Technology Park as well as Incubation Centre.

Under the agenda item concerning mobilization of financial resources for COMSATS, the delegates pledged to sensitize their respective governments regarding the benefits of regularly making annual membership contributions to COMSATS, as well as to mobilize financial resources for COMSATS' Endowment Fund. In this regard, the draft Rules and Regulations of COMSATS Endowment Fund, prepared by COMSATS Secretariat, were approved by the Commission. The participants appreciated the Government of Pakistan for its generous and continued financial support to COMSATS for the past 21 years, as well as its commitment for extending its financial support for COMSATS' future activities. The Member States also agreed to raise the matter of placement of representatives of Member States at COMSATS Headquarters with the concerned authorities in their respective countries, in order to enhance the effectiveness of the organization's programmes and activities.

Other important decisions made during the Meeting included approval of the Statutes of COMSATS, as well as re-election of H.E. John Dramani Mahama, President of Ghana, as COMSATS' Chairperson for the next three years. It was agreed that the next meeting of the Commission will be held in 2018.

Recommendations

The following recommendations were made during the proceedings of the Meeting:

i. COMSATS may strengthen linkages with the reputed higher education and research institutions in the developing countries, in order to provide greater opportunities of graduate scholarships, doctoral fellowships, and short-term trainings to Member States.
ii. COMSATS may continue to collaborate with the international organizations having similar mandates and visions for jointly addressing the socio-economic needs of the developing countries. Initiatives such as capacity building activities, science popularization activities, and joint fellowship programmes, are proposed.
iii. The Centres of Excellence of COMSATS may increase their interaction and cooperation with other members of the Network, including expert exchange, technology transfer, joint research, etc., in order to realize the objective of promoting South-South cooperation, being pursued by the organization.
iv. Cyber Security being an important global consideration in wake of ever increasing use of ICTs in the organizations, businesses and day-to-day activities of the general public, the meeting proposed establishing a 'National Centre of Excellence in Cyber Security' in Pakistan, having the objective of facilitating the Member States in building capacities and formulating relevant laws, legislation and policies. The proposal was acknowledged as a welcome step towards reducing and eventually eliminating cyber crimes.
v. Noting with satisfaction the progress made in connection with the establishment of COMSATS Technology Park at CIIT, Pakistan, the Member States were encouraged to increase the number of technology parks, in order to promote the culture of innovation, as well as to find solutions to the challenges faced by industries and businesses. All Member States may benefit from the experience of China in establishing Technology Parks.

The Meeting concluded with the pledge by Member States to strengthen their communication channels with COMSATS Secretariat, in order to advise the organization regarding their scientific priorities and needs, with a view to enhance the effectiveness of COMSATS' programmes and activities.

The Third Consultative Committee Meeting

The third Consultative Committee Meeting was held a day before the third General Meeting of COMSATS. It was inaugurated in Accra by H.E. Mr. Mahama Ayariga, Minister for Environment, Science, Technology and Innovation, Government of Ghana, on 26th October 2015.

The inaugural session of the Consultative Committee Meeting included Welcome Speech by Ms. Salimata Abdul-

Salam, Chief Director MESTI; Introductory Remarks by Dr. I.E. Qureshi, Executive Director COMSATS; Address by Mr. Fazal Abbas Maken, Chairperson COMSATS Consultative Committee and Federal Secretary for Science and Technology, Government of Pakistan; and Inaugural Address by the Ghanaian Minister, H.E. Mr. Mahama Ayariga.

Speakers of the Inaugural Session of the 3rd Consultative Committee Meeting

During his inaugural address, the honourable Minister expressed pleasure on having the opportunity of hosting the two extremely important statutory body meetings of COMSATS in Ghana, which have direct relevance to the socio-economic development of his country and other Member States. He stated that Ghana places science, technology and innovation (ST&I) development high on its priority list, which is expected to contribute to the country's social and economic growth, as well as improve the quality of life of its people. He further noted that a part of this commitment is the national ST&I Policy of Ghana, which was launched in March 2010 by his Ministry.

The Chairperson of COMSATS Consultative Committee expressed pleasure on the strong role being played by COMSATS for South-South Cooperation in various sectors of Science and Technology. Recalling the functions of the Consultative Committee, Mr. Maken noted that this forum acts as a bridge between those who formulate S&T policies in the Member States and those who actually undertake actions under these policies. He urged the members of the Consultative Committee to ensure that COMSATS' Centers of Excellence in their respective countries get sufficient governmental support to perform due role as per their national development agendas, as well as extend support in areas of their expertise to the Member States.

Earlier, the Executive Director COMSATS highlighted the functions of COMSATS' statutory bodies, as well as the significance of the two statutory meetings of COMSATS, while the Chief Director MESTI extended warm welcome to the foreign participants and country delegates.

The representatives from China, Egypt, Ghana, Iran, Kazakhstan, Morocco, Nigeria, Pakistan, Palestine, Philippines, Senegal, Sri Lanka, Sudan, Tunisia, Turkey, Uganda and Zimbabwe, in addition to the senior officials of the COMSATS Secretariat attended the meeting.

The Consultative Committee meeting deliberated upon an eleven-point agenda during its two technical sessions. The participating delegates presented Country Statements, which covered their respective government's stance on S&T-led sustainable development and recommendations for enhancing the effectiveness of COMSATS' programmes and activities in its Member States. The salient points made in these statements were:

- Egypt will explore the possibility of establishing an Egypt-COMSATS research fund.
- Pakistan encouraged the Member States to benefit from the offers of scholarships and short-term trainings made by the COMSATS Institute of Information Technology (CIIT).
- Philippines, Uganda, Zimbabwe, Morocco and Palestine pledged to convey to the relevant authorities in their respective countries the need to designate one Centre each to join COMSATS' Network of Centres of Excellence.
- Turkey encouraged the Member States to benefit from the huge scholarship programme of TUBITAK.

Dr. Salimata Abdul-Salam making Welcome Address Speech

- Tunisia offered its water research expertise to COMSATS' Member States.

Moreover, COMSATS' officials briefed the Committee regarding COMSATS' activities that took place during the period from May 2013 to October 2015, in the light of COMSATS Strategy (2012 - 2016), as well as actions taken by COMSATS Secretariat to follow-up the decisions and recommendations of COMSATS' 2nd General Meeting of the Commission (April 16-17, 2012, Pakistan) and the 2nd Consultative Committee Meeting (1st May 2013, Ghana).

The Committee approved the Minutes of the 2nd Meeting of COMSATS Consultative Committee, and showed satisfaction over the implementation status of its decisions. The participants also took stock of the follow-up of 2nd General Meeting of COMSATS and welcomed the organization of the 3rd General Meeting at the level of representatives of Heads of State/Government that was to follow the 3rd meeting of the Consultative Committee. The Meeting also appreciated COMSATS' activities undertaken after its last meeting (May 2013) in the light of COMSATS Strategy (2012 - 2016), including the capacity-building programmes, bilateral and multilateral cooperative research, and the consultancy/advocacy for the promotion of Science and Technology. The launching of the two new International Thematic Research Groups (ITRGs) on: 'Mathematical Modeling' (2nd December 2014, Abuja, Nigeria); and 'Agriculture, Food Security and Biotechnology' (10th June 2015, Cairo, Egypt), was highly appreciated. The activities of the organization under its new initiatives, including COMSATS Distinguished Professorship Scheme; COMSATS' Panel of Experts on Science, Technology and Innovation Policy; COMSATS Science Diplomacy Programme; COMSATS Technology Park, were lauded.

Moreover, the document of the draft Harmonized Statutes of COMSATS, then to be presented to the 3rd General Meeting of COMSATS, was endorsed with the hope that the organization's operations would be further streamlined after its approval by the Commission. The Committee also noted with satisfaction the efforts made for the establishment of COMSATS' Endowment Fund and considered it imperative to stabilize the financial position of the organization. The Rules and Regulations of Endowment Fund framed by COMSATS Secretariat were endorsed during the meeting. In this regard, it was hoped that the Member States would start contributing towards this Fund. The participants of the Meeting also expressed resolve to make efforts towards commencing/continuing regular payments of Annual Membership Contribution by their respective governments to fulfill their financial obligations and to show their commitment to COMSATS.

The Committee appreciated the efforts of COMSATS Secretariat to enhance the membership of its Commission and the Network of Centres of Excellence that resulted in induction of two more Member States (Morocco and Palestine) and three Centres of Excellence since its last meeting in May 2013 (ITI, Sri Lanka; CERTE, Tunisia; and KazNU, Kazakhstan).

The Committee also recognized the key role of the Focal Points of COMSATS towards securing the political support of their countries' top leadership for the international programmes of COMSATS, as well as for mobilizing necessary financial support for COMSATS Centres of Excellence in their respective countries.

Group Photo of the Delegates attending the 3rd Consultative Committee Meeting with the Chief Guest, Mr. Mahama Ayariga

Resolution Adopted in the Third General Meeting of the Commission on Science and Technology for Sustainable Development in the South (COMSATS) held in Accra, Ghana, on 27- 28 October 2015

We, the participants of the third General Meeting of COMSATS, representing Members of the Commission,

APPRECIATING the efforts of the Government of Ghana for hosting the Commission's Meeting in Accra;

REALIZING the importance of the application of Science and Technology for achievement of the sustainable development goals by the countries of the South;

RECOGNIZING the need to strengthen Scientific and Technological activities of the Commission in the light of new opportunities and challenges and to enhance its financial strength to achieve its objectives;

RENEWING the member countries' resolve and commitment to support the objectives of the Commission as contained in its harmonized Statutes approved by the Commission at its 3rd meeting;

APPRECIATING the role of Commission's Network of Centres of Excellence and the Secretariat in the progress made so far for building S&T capacities of Member Countries through the mechanism of South-South cooperation;

COMMENDING the support provided by the Government of Pakistan to the Secretariat for successfully carrying out its international operations;

WELCOMING the re-election of the incumbent Chairperson of the Commission for the next three years;

hereby resolve as under:

1. CONTINUE extending their full support to the Commission in its efforts to promote the integration of progress in the realm of Science and Technology into Member Countries' national and regional development plans for achieving rapid socio-economic development in the South;
2. INCREASE the allocation of funds for strengthening the Scientific and Technological capacities of their respective countries and making full use of the collaborative forum of COMSATS in these efforts;
3. STRENGTHEN the role of Focal Points in ensuring the allocation of sufficient funds for the COMSATS' Centres of Excellence based in their own countries, to enable their effective participation in COMSATS' programmes and activities and their transformation into International level Centres of Excellence;
4. PROMOTE the objectives and programmes of the Commission at national as well as international levels through diplomatic and other channels and devise effective frameworks for disbursement of adequate financial contribution to COMSATS on voluntary basis;
5. CONTRIBUTE towards the COMSATS Endowment Fund of US$ 20 Million launched during the 2nd Commission Meeting (Islamabad) and initiated by COMSATS Secretariat with a token deposit of US$ 5,000 and PKR. 500,000 towards the Fund.
6. FACILITATE the exchange of scientists, engineers, technicians, educationists, scholars and experts amongst the relevant organizations of the Member Countries to strengthen the activities related to capacity-building and transfer of technology;
7. FACILITATE the continuity of the Commission's Meetings once every three years as stipulated in the Statutes and to convene the next meeting of the Commission in 2018;
8. EXPRESS solidarity with Member States who are subjected to external restrictions hampering the development of their S&T sectors.

And urge the Executive Director COMSATS to:

9. CONTINUE making all efforts to achieve the objectives of the Commission with the support of the Governments of the Member Countries through respective focal points with the help of its Centres of Excellence;
10. CONTINUE the current strategy of COMSATS during the next five years, 2016-2020, with emphasis on technical cooperation projects employing, inter alia, the concept of International Thematic Research Groups in order to provide maximum socio-economic benefits to the member countries;
11. INCREASE efforts for elevating the S&T capacity and the international status of its affiliated Centres of Excellence;
12. ENHANCE the campaign for the expansion of the membership of the Commission and Centres of Excellence to achieve wider South-South cooperation; and
13. PREPARE a comprehensive follow-up report on the relevant provisions of this resolution for presenting to the Commission at its next meeting.

S&T INDICATORS OF MEMBER STATE

In Spectrum: Republic of Zimbabwe

The Republic of Zimbabwe is a landlocked country located in southern Africa, between the Zambezi and Limpopo Rivers. It borders South Africa to the south, Botswana to the west, Zambia to the northwest, and Mozambique to the east. The capital and largest city is Harare.

An ethnically diverse country of roughly 13 million people, Zimbabwe has 16 official languages, with English, Shona, and Ndebele the most commonly used. English is the main language used in the education and judiciary systems. President Robert Mugabe serves as head of state and government, and as commander-in-chief of the armed forces.

The country is mostly savannah, although the moist and mountainous east supports tropical evergreen and hardwood forests. Trees include teak and mahogany, knobthorn, msasa and baobab. Among the numerous flowers and shrubs are hibiscus, spider lily, leonotus, cassia, tree wisteria and dombeya. There are around 350 species of mammals that can be found in Zimbabwe. There are also many snakes and lizards, over 500 bird species, and 131 fish species.

Zimbabwe's Human Development Index (HDI) value for 2013 is 0.492— which is in the low human development category—positioning the country at 156 out of 187 countries and territories. Between 1980 and 2013, Zimbabwe's HDI value increased from 0.437 to 0.492, an increase of 12.6 percent or an average annual increase of about 0.36 percent.

Table-A shows Zimbabwe's progress in each of the HDI indicators. Between 1980 and 2013, Zimbabwe's life expectancy at birth increased by 0.5 years, mean years of schooling increased by 4.0 years and expected years of schooling increased by 2.8 years. However, 44.0 percent Zimbabwe's GNI per capita decreased by about between 1980 and 2013.

Despite the turbulence of its recent years, Zimbabwe's education sector remained stable. In 2012, 91% of youth aged 15-24 years were literate, 53% of the population aged 25 years or more had completed secondary education and 3% of adults held a tertiary qualification.

Large parts of Zimbabwe were once covered by forests with abundant wildlife. Deforestation and poaching has reduced the amount of wildlife. Woodland degradation and deforestation, due to population growth, urban expansion and lack of fuel, are major concerns and have led to erosion and land degradation which diminish the amount of fertile soil. Local farming practices are criticized to be unsustainable and forests have been massively cut and

wood burnt for heating and raising crops.

According to the World Fact-book Zimbabwe's economy depends heavily on its mining and agriculture sectors. Following a decade of contraction from 1998 to 2008, the economy recorded real growth of more than 10% per year from 2010-2013, before slowing to roughly 3% in 2014 due to poor harvests, low diamond revenues, and decreased investment. Infrastructure and regulatory deficiencies, a poor investment climate, a large public and external debt burden, and extremely high government wage expenses impede the country's economic performance.

According to the CIA World Fact-Book, up-to 2014, the Zimbabwean economy was to a large part comprising of the Services sector (54.2% of GDP), employing 24% of the labor force, followed by the industrial sector (25.7% of GDP), employing only 10% of the labor force. The agricultural sector which employs 66% of the labor force is only able to

Table A: Zimbabwe's HDI trends based on consistent Time-series Data and New Goal-posts

Years	Life expectancy at birth (years)	Expected years of schooling (years)	Mean years of schooling (years)	GNI per capita (2011 PPP$)	HDI value
1980	59.4	6.5	3.2	2,334	0.437
1990	59.2	9.8	4.5	2,042	0.488
2000	44	9.9	5.9	1,984	0.428
2010	53.7	9.3	7.2	1,183	0.459
2013	59.9	9.3	7.2	1,307	0.492

Source: *Human Development Report 2014*

generate 20.1% of the GDP. This calls for urgent measures to improve productivity, employing current techniques for value addition and improving market access to farmers in addition to employing best practices of farming.

With the assistance of UNESCO, the Second Science and Technology Policy was launched in June 2012, replacing the earlier policy dating from 2002, and has six main objectives:

- Strengthen capacity development in Science, Technology and Innovation (ST&I);
- Learn and utilize emerging technologies to accelerate development;
- Accelerate commercialization of research results;
- Search for scientific solutions to global environmental challenges;
- Mobilize resources and popularize science and technology; and
- Foster international collaboration in ST&I.

Table-B: Zimbabwe's Performance on Development Indicators

Indicator	1990	2000	2014
GDP growth (annual %)	7	-3.1	3.2
Agriculture, value added (% of GDP)	16.5	18.3	13.6
Industry, value added (% of GDP)	33.1	..	29.6
Exports of goods and services (% of GDP)	22.9	38.2	26.5
Imports of goods and services (% of GDP)	22.8	35.9	55.5
High-technology exports (% of manufactured exports)	1.5	1.7	-
Military expenditure (% of GDP)	4.7	5.2	2.7
Mobile cellular subscriptions (per 100 people)	-	2	81
Internet users (per 100 people)	-	-	20
Fixed broadband subscriptions (per 100 people)	-	-	1
Population, total (millions)	10.48	12.49	15.3
Birth rate, crude (per 1,000 people)	37	32	-
Prevalence of HIV, total (% of population ages 15-49)	11.7	28.4	16.7
Antiretroviral therapy coverage (% of people living with HIV)	-	-	51

Source: *World Bank Development Indicators, Zimbabwe (2014)*

This new policy cited sub-sectoral strategies with a focus on biotechnology, ICTs, space sciences, nanotechnology, indigenous knowledge systems, emerging technologies and scientific solutions to emergent environmental challenges.

A National Biotechnology Policy was adopted in 2005. Despite its poor infrastructure and a lack of both human and financial resources, biotechnology research is better established in Zimbabwe than in most of the sub-Saharan countries (*World Science Report 2015, UNESCO*).

There are policy provisions for establishing a National Nanotechnology Programme. However the most important implication of the Second Science and Technology Policy was that it asserted the government commitment to allocate at least 1% of GDP to GERD (*World Science Report 2015, UNESCO*).

In 2013, the Ministry of Science and Technology Development (dating from 2005) was disbanded and its portfolio relegated to the newly established Department of Science and Technology within the Ministry of Higher and Tertiary Education, Science and Technology Development, which also serve as the COMSATS national focal point.

Zimbabwe has a long research tradition. However, the economic crisis has precipitated a brain drain on university students and trained research professionals leading to 22% of Zimbabwean tertiary students are completing their degrees abroad. The government has created the Zimbabwe Human Capital Website to provide information for the diaspora on job and investment opportunities in the country. However, the government policies have no particular strategy to attract human resource to back in the country.

Zimbabwe is also among the few COMSATS' Member States that have yet to nominate a national institution to become an active part of the COMSATS' Network of International S&T Centres of Excellence. This has also led to Zimbabwe under-utlise the potential and fully benefit from COMSATS' programmes and activities for Human Resource development.

The government of Zimbabwe, according to the World Science Report 2015 (UNESCO), is planning to establish two new universities with a focus on agricultural science and technology: Marondera and Monicaland State Universities. The long-standing University of Zimbabwe, is particularly active in research producing more than 44% of Zimbabwe's scientific publications in 2013.

The penetration of broadband and telephony is also very encouraging; Zimbabwe's foray into the international ICT market holds immense potential. Application development and mobile telephony are key to improving governance and efficiency of state services and institutions in the coming years. However Zimbabwe needs higher investments in research and development in order to stand up to its myriad challenges of development, particularly in areas of agriculture, sustainability, biotechnology and material sciences.

ACTIVITIES/NEWS OF COMSATS' CENTRES OF EXCELLENCE

CIIT-Pakistan establishes Linkages with Belarusian Institutions

Dr. S.M. Junaid Zaidi, Rector COMSATS Institute of Information Technology (CIIT) and Dr. Arshad Salim Malik, Head International Office CIIT, visited Minsk, Belarus, during early August 2015. The delegation explored avenues for collaboration in cutting-edge research and academic cooperation between CIIT and various Belarusian educational and research institutions. As an outcome of the visit, Memoranda of Understanding were signed with the leading Belarusian S&T institutions and universities, including the National Academy of Sciences of Belarus (NASB), Belarusian State University (BSU) and Belarusian State University of Informatics and Radioelectronics (BSUIR). The signing of these MoUs was also witnessed by the President of Belarus and the Prime Minister of Pakistan.

RSS-Jordan Organizes Three Training Workshops under FOSTEr in MED Project in Aqaba

The Royal Scientific Society (RSS), Jordan, organized three training workshops in connection with the project, entitled 'Fostering Solar Technology in the Mediterranean Area' (FOSTEr in MED) during September and October 2015. Financed by the European Union under the ENPI CBC Mediterranean Sea Basin Programme, the project aims to promote the adoption of innovative solar photovoltaic technologies with a strategic approach in six countries of the Mediterranean area: Italy, Spain, Egypt, Lebanon, Jordan, and Tunisia. Designers (engineer and architects), installers (mostly SMEs) and university students benefitted from the trainings held in Aqaba, which mainly focused on the building integrated photovoltaic technology (BIPV).

Main topics covered in the trainings included: renewable energy sources and energy efficiency in buildings; main characteristics and architectural integration of photovoltaic modules; national legislation and incentives for BIPV plants; cost-benefit analysis and economic evaluation, as well as installation and maintenance procedures for photovoltaic systems. As a practical demonstration of BIPV, pilot projects will soon be set up in five Mediterranean cities.

Group photo of the Participants of the RSS Training Workshop in Aqaba

TUBITAK-MAM Research to Help Improve Municipal Wastewater Digesters

A part of doctoral research of Dr. Sedat Yalcinkaya, Senior Researcher at the Environment and Cleaner Production Institute of TUBITAK Marmara Research Center (MAM), Turkey, was published in October issue of the journal 'International Biodeterioration & Biodegradation' (http://dx.doi.org/ 10.1016/j.ibiod.2015.08.007). The article reports the performance of anaerobic co-digestion of municipal wastewater sludge and un-dewatered grease trap waste for assessing direct feed of grease trap waste in municipal digesters. Substrate degradation, methane potential and process inhibition were monitored in two laboratory scales, semi-continuous feed reactors under mesophilic conditions (35°C). The results demonstrated that using un-dewatered grease trap waste as the co-substrate instead of dewatered grease trap waste can improve digester performance, providing more stable digestion.

IROST-Iran to House International Center for Medical Technologies

On October 18, 2015, Dr. Mohammad Farhadi, Iranian Minister of Science, Research and Technology, Prof. Madjid Samii, President of the International Neuroscience Institute of Hannover (Germany), and Dr. Fathollah Moztarzadeh, Deputy Minister and President of IROST, Iran, signed a Memorandum of Agreement (MoA) to establish Madjid Samii International Center of Scientific Research and Medical Technology (MSIC) in Iran. As per the agreement, IROST is to host the Centre in order to develop state-of-the-art medical technologies through joint cooperation of experts from Iran and Germany. The construction of a building of about 5,000 square feet has already been started, and preparations for constructing biomedical laboratories have been made.

Al-Farabi KazNU, Kazakhstan, Organizes a Round Table to Discuss National Priorities

On October 28, 2015, a round table meeting focusing on 'Key Priorities of Socio-economic and Environmental Development of the Country in the Context of Global Challenges' was organized by Al-Farabi Kazakh National University (KazNU), Kazakhstan, at its Higher School of Economics and Business. Preliminary results of research conducted under the projects financed by the Kazakh Ministry of Education and Science came under discussion.

The main issues discussed during the round table meeting included: innovative technologies for local public administration and self-government in the country; public administration in agriculture; theoretical and methodological foundations for studying problems of competitiveness of national economy in conditions of industrial-innovative development; and benchmarking and energy efficiency indicators in transition of kazakhstan to a green economy.

Embrapa Agrobiologia-Brazil research shows reduced GHG emissions in the country

In his lecture given on 28 October 2015 as part of the activity of Johanna Döbereiner Scientific Week at Embrapa Agrobiology, Brazil, Dr. Renato Rodrigues, soil researcher at Embrapa Agrobilologia and one of the representatives of Brazil on the Intergovernmental Panel on Climate Change (IPCC), noted that Brazil has considerably reduced GHG emissions between 2005 and 2010, which is in keeping with the environmental and food security concerns of the relevant UN agencies. The expert emphasized that soil plays an important role in agriculture related GHG emissions. "When well-managed, soils have a high capacity to absorb carbon and may even consume methane and nitrous oxide from the atmosphere, helping to reduce the greenhouse effect". He opined that Low Carbon Agriculture Plan (ABC) and measures like zero illegal deforestation will further help reduce GHG emissions.

Dr. R. Rodrigues giving a lecture during Johanna Döbereiner Scientific Week at Embrapa Agrobiologia, Brazil (Photo by: Ana Lucia Ferreira)

Activities at IRCC-Sudan

The Industrial Research and Consultancy Centre (IRCC), Sudan, organized the Regional Workshop on 'The Modern Technologies and its Role in Development of Small and Medium Enterprises', on October 13-15, 2015, in collaboration with the Federation of Arabic Scientific Research Councils. The workshop had the participation of a number of researchers from Arab countries who presented their scientific papers. A group of local researchers, scientists, and representatives from SMEs, industrial sector, financial banking sector and other relevant organizations of Sudan also benefitted from the workshop. Moreover, representatives of IRCC also presented papers during the Third Regional Consultative Workshop on National Innovative System and Intellectual Property Right (Tunisia, 5-7 October); International Symposium on Light and Life (Pakistan, 14-16 October); and Workshop on Prevention and Safety Promotion in the Chemical Process Industries (Germany, 12-17 October).

ICCBS-Pakistan Continues its capacity building programme

During the reporting period, the International Center for Chemical and Biological Sciences (ICCBS), Pakistan, organized a number of online lectures, seminars, and workshops. These included two lectures by Director ICCBS, Prof. Dr. M. Iqbal Choudhary, on the topics: 'Single Crystal X-ray Diffraction Technique - Basic Principles'; and 'NMR Methodology Developments in the Investigation of Complex Mixtures in Natural Products and Food Chemistry: From Chemical to Analysis Metabolomics' (18-22 September 2015). Themes of some of the other capacity building events were: Entrepreneurship for Scientists; Advanced Immunology; Plant Remedies used Against Skin Diseases in Sindh and Drug Discovery and Molecular Medicine .

Honor for CIIT-Pakistan and BCSIR-Bangladesh

Dr. Naeem Rashid, Assistant Professor, Department of Chemical Engineering, CIIT Lahore campus, has won the Green Talent Award (2015) in a ceremony held in Berlin. The Award was conferred by the German Federal Ministry of Education and Research in acknowledgement of Dr. Rashid's research on bio-energy production from waste materials and micro-algae.

Another faculty member of CIIT, Dr. Muhammad Shakil Ahmad from the Department of Management Sciences, CIIT Attock campus, won the 'Young Scholar Award' at the 4th Annual International Young Scholars Workshop in Public Policy and Administration Research, hosted and sponsored by Centro de Investigación y Docencia Económicas (CIDE), from August 9-14, 2015, in Mexico City, Mexico.

Dr. Md. Sarwar Jahan, Principal Scientific Officer, Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Dhaka, Bangladesh, received the 3rd Prize in the 'ISTIC-TWAS Competition for Successful Innovation in Science and Technology in Developing Countries', on 11th October 2015. The award was in recognition of Dr. Jahan and his colleagues' research work on creating an environment-friendly method for using agricultural waste.

OPINION: INNOVATION IS ESSENTIAL FOR COMPETITIVENESS AND INDUSTRIAL GROWTH

S. Tanveer Kausar Naim*

The simplest definition of innovation is the ability to add value to an activity by finding new ways or inventing something new for social and economic well-being. When a new idea is conceived it is called invention, when the idea is brought to fruition or converted into a product, process or service and has market value, it is called innovation. Innovation is also about adaptation, absorption and improvement of existing technologies and knowledge. It is essential not only for competitiveness and survival of national economies but for meeting challenges of poverty, hunger, disease and natural disasters. Innovation related challenges may differ for developed and developing countries but innovation is as important for developing countries as it is for developed countries *(Altenburg, T, 2009)*.

Whereas invention or a new idea may be born to an individual within a university or a research establishment, innovations that are results of development and commercialization of an entirely new idea (radical innovations), such as the early aircraft, designed and produced by Wright Brothers or early motor-cars or the first computer, are the results of collective efforts of several individuals having different skill sets and capabilities. Most radical inventions have undergone considerable improvements in design and size with time, these are commonly known as 'incremental innovations'. Unlike radical innovations, which are mostly dependent on extensive R&D efforts, incremental innovations require technical, engineering, design and management expertise and organizational skills *(Bell and Pavitt, 1992)*. Radical innovations mostly take place in developed countries due to their abilities to invest in extensive R&D and knowledge repositories that have been available to them in universities. Currently, most developing countries are involved in incremental innovations.

Innovation is a systemic process *(Freeman, 1989)*. It is highly contextual in nature and is dependent on institutional competence, skills and capabilities. Also relevant are organizations ruled by institutions that provide incentives and regulatory frameworks for innovation. These organizations include universities, research establishments, technical schools, firms and government ministries. These are regarded as components of the innovation system. There are several other cultural, social, economic, legal and political factors, which contribute to facilitating or hindering the formation of an effective innovation system. These are context specific and may vary from one country to another.

Innovation capabilities, therefore, depend not just on a wide set of historical practices and cultural beliefs, but also on building strong institutions and networks they support for meeting demand with supply. Major players in the innovation systems are firms as they not only demand innovation but are also responsible for creation and commercialization of innovation. Firm-level innovation capability is dependent on technical skills and prior relevant accumulated knowledge that firms may possess. Developing country firms wishing to adopt innovation produced outside their national borders, require excellent management, engineering design and entrepreneurial skills, which in turn depend on sound judgement about market potential, investment, technology and marketing capabilities *(Bell and Pavitt, 1992)*.

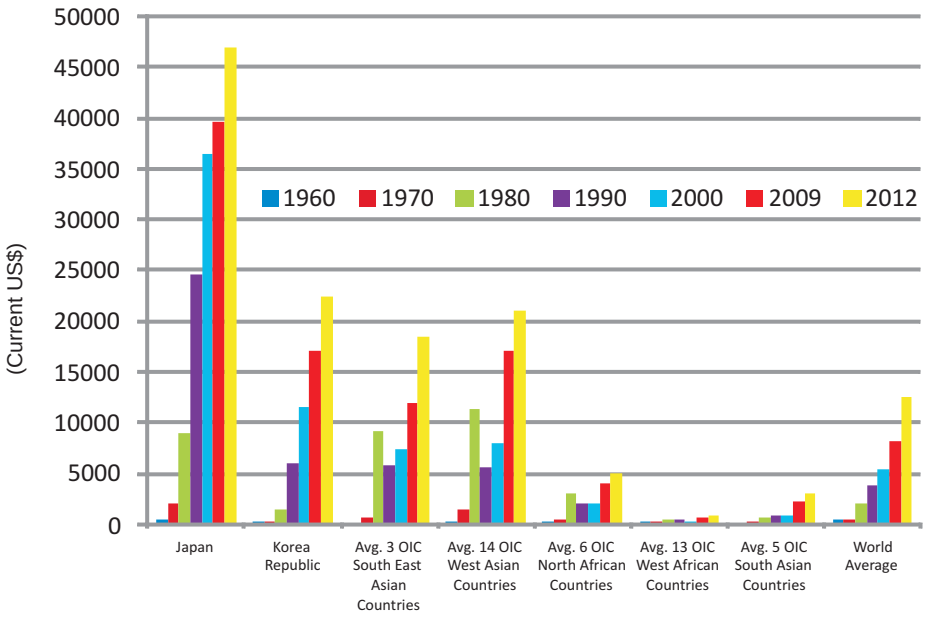
Innovation capabilities comprise two types of learning systems; Science, Technology and Innovation (STI) learning, which depends on generation of new knowledge in universities and R&D organizations, the R&D expenditures, protection of intellectual property, etc. and the doing, using and interacting (DUI) mode of learning, which is about firm-level on-the-job learning. It is also about inter-firm collaboration and network learning that is facilitated by competition laws, Intellectual Property Protection and Corporate laws and reform of financial and market institutions *(Edquist, 2001)*. Networks both at the local, national, regional and international levels play an important role in the flow of tacit knowledge which is most important for innovation. Thick networks or knowledge clusters are mostly located in a certain geographic location and are known as 'regional innovation systems' *(Joseph K.J, 2009)*.

Regions do not develop in isolation but sustain their competitive advantage on core competence that they achieve being part of regional, national or international networks. Several authors have discussed the importance of international linkages and cross border collaboration of national firms with international ones *(Lundvall, 1992, Ernst D., 2002)*. They propose that national innovation system perspective, although relevant in terms of capabilities and linkages between key actors of the system within national borders, should not be considered in isolation from

*** About the Author:** Dr. S.T.K. Naim is presently Consultant in the Secretariat of the OIC Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH). In this position she has been instrumental in establishing the COMSTECH Centre for Technology and Innovation Policy Research. Earlier she served as Chairperson of the Pakistan Council for Science and Technology (PCST), and Secretary to National Commission on Science & Technology.
E-mail: **consultant@comstech.org**

international systems of production and knowledge flows. In most emerging developing countries, local firms catch-up strategies are aimed at entering global value chains.

The concepts of innovation and of building innovation systems, are mostly discussed in connection with promotion of competitiveness, industrial diversification and economic growth. More recently, concerns have been expressed by some economists that for countries to achieve equitable growth, the focus of innovation has to shift from selective economic benefits to collective distribution of benefits for social welfare. In the context of developing countries, innovation strategies would have to be different from those of developed countries, as most developing countries have not been able to address the basic problems of providing food, water, sanitation, health and energy security to a large majority of their population.



Average for West Asian OIC: year 1960: 4, 1970: 11, 1980: 11, 1990: 13 countries
Average for North African OIC: Year 1960: 5 Countries
Average for Western OIC : year 1960: 9 countries
Average for S. Asian OIC: Year 1960: 3 countries
Source: *World Bank*

Figure-1: Per Capita GDP, Region wise Average of OIC Counties , Japan and South Korea (1960 - 2012)

Most developing countries face multiple developmental challenges. A large chunk of government revenue goes towards debt servicing and the remaining financial resources are thinly distributed to address several competing priorities. Lack of political will and focused efforts combined with institutional incompetence results in underdeveloped human capital, weak institutions responsible for generating, absorbing and commercializing knowledge, and a national production system which is based on natural resource extraction or agriculture produce, and is almost completely dependent on imported technology.

At best the innovation strategies of firms in these countries are focused on replacing old production equipment with new imported machines. Local firms are not encouraged to invest in firm level learning through public incentives to absorb imported knowledge. Public policy is generally focused on providing incentives to a few firms producing consumer goods. This often leads to the formation of cartels and oligopolies.

The history of development of countries demonstrates that innovation is not a domain of a few nations. Knowledge of innovation and technology is a human heritage and has moved from one civilization to another. We have witnessed, within our lifetime, many developing countries with large populations and the majority living under poverty attain the status of developed countries. Examples are East Asian countries like Japan, South Korea, Taiwan and Singapore. More recently the BRIC countries (Brazil, Russia, India and China) are emerging as innovation leaders in some specific areas, Brazil in Air Craft industry; Russia in Defense and Aero-space technologies; India in Information Technology and Pharmaceuticals; and China in mass production of consumables.

Figure-1 shows the relationship of economic growth with innovation. During the 1960s, the per-capita GDP of most OIC member states located in different geographic locations looked similar to that of Japan and South Korea. During late 60s and early 70s, the international oil and gas companies discovered large reserves of energy resources in majority of OIC member states located in West Asia, East Asia, and more recently in some states of North and West Africa. The export of oil and gas has helped achieve both social and economic growth in Gulf States having small populations; their per-capita income has increased to average US$ 37,903. The per-capita incomes remained low in West African OIC Member states (average US$ 976), and South Asian member states (average US$ 2892) with large populations. Many of these states, such as Nigeria and Sierra Leone that are endowed with energy and mineral resource, did not achieve similar growth in their per-capita incomes.

In contrast, most East Asian countries, including Japan, South Korea, Singapore, Taiwan that are not endowed with energy or mineral resources, achieved higher per-capita GDP growth. The higher growth rates in these states accompanied better distribution of wealth. The economic transformation of Korea and Japan is attributed to early demolition of the feudal system, investment in infrastructure, human capital and building of technology capabilities.

South Korea's economic transformation, from one of the poorest states in early 1960s to a developed state and a member of the group of rich OECD countries, is attributed to visionary political leadership and a transparent and capable bureaucracy committed to reforms *(OECD, 2013)*. First, land reforms were carried out to abolish the feudal system. The government decided to invest in education and infrastructure projects with equal access for all. This laid the foundations for equity-based development. Realizing that private sector plays the most important role for innovation, the government provided tax and other incentives to select private firms in order to build absorptive capacity for technology transfer. The demand for technological innovations was created through several instruments, which included public purchasing, tax incentives, R&D expenditure and establishment of knowledge generation and technology infrastructure not just for scientific research but also for standards and quality control. Local firms were encouraged with incentives to export but infant industry was protected till such time that they could compete with foreign manufactured products in international markets. Export orientation policy exposed domestic industry to international competition, thus stimulating demand for innovation and highly skilled manpower.

A parallel investment pattern for education, promotion of scientific research and industrial innovation such as that in Japan, South Korea and Singapore, is not seen in OIC states (Figure-2). The UNDP Technology Achievement Index has ranked countries in four categories; as 'leaders', 'potential leaders', 'dynamic adopters' and 'marginalized'. None of the OIC states are ranked in the group of 18 countries known as 'technology leaders'. At present, 9 states out of 57 possess some scientific capability, just two states; Malaysia and Turkey, are included in the group of 'potential leaders'. Iran, Egypt, Indonesia and Algeria are grouped with 'dynamic adopters'. Rest of the OIC states appear in the lowest category as either 'marginalized' or those for which complete data is not available.

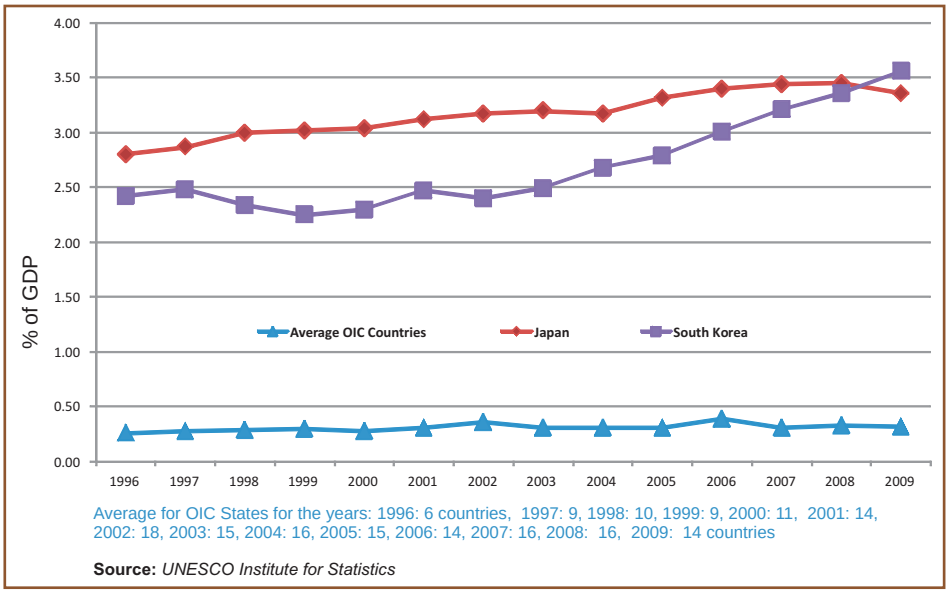


Figure-2: R&D Expenditure, Avg. of OIC Counties, Japan and S. Korea (1996-2009)

References

- Altenburg, T., 2009. "Building Inclusive Innovation Systems in Developing Countries: Challenges for IS Research", in: Bengt-Åke Lundvall et. al.: Handbook of Innovation Systems and developing countries, Cheltenham, UK: Elgar, pp.33-56.
- Bell, M., and Pavitt, K., 1992. "Accumulating Technological Capability in Developing Countries". Proceedings of the World Bank Annual Conference on Development Economics, Washington, DC.
- Edquist, C., 2001. "Innovation Policy - A Systemic Approach". In The Globalizing Learning Economy, D. Archibugi and B.A. Lundvall, eds. Oxford: Oxford University Press.
- Ernst, D., 2002. "Global Production Networks and the Changing Geography of Innovation Systems. Implications for developing countries" in Economics of Innovation and New Technology, pp. 497–523.
- Freeman, C., 1989. "Introduction: Measuring the Japanese Challenge", Scientific Europe: Research and Technology in 20 Countries, Scientific Publishers Ltd.
- Joseph, K.J., 2009. "Sectoral Innovation Systems in Developing Countries: The Case of ICT in India," in: Lundvall, B.A., Joseph, K.J, Chaminade, C. and Vang, J. (ed.): Handbook of Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Setting, Edward Elgar, Chapter 7.
- Lundvall, B.A., (ed.), 1992. "National Innovation Systems: Towards a Theory of Innovation and Interactive Learning", Printer, London.
- OECD, 2013. Structural Policy Challenges for South East Asian Countries, South East Asian Economic Outlook 2013 with Perspectives on China and India.

FEATURE: A SYNOPSIS OF 2015 NOBEL PRIZES & LAUREATES IN SCIENCE

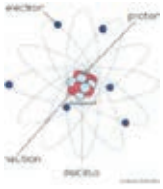
This section features the 2015 Nobel Laureates in the fields of Physiology or Medicine, Physics, and Chemistry. A synopsis of their prize-winning research and brief profiles are as follows.

Physiology or Medicine

One half of the 2015 Nobel Prize in Physiology or Medicine was jointly awarded to William C. Campbell and Satoshi Ômura for their discoveries related to a novel therapy against infections caused by roundworm parasites and the other half was awarded to Youyou Tu for her discoveries concerning a novel therapy against malaria.

William C. Campbell and Satoshi Ômura discovered a new drug, Avermectin, the derivatives of which have radically lowered the incidence of River Blindness and Lymphatic Filariasis, as well as showing efficacy against an expanding number of other parasitic diseases. Youyou Tu discovered Artemisinin, a drug that has significantly reduced the mortality rates for patients suffering from Malaria. These two discoveries have provided humankind with powerful new means to combat these debilitating diseases that affect hundreds of millions of people annually.

Physics



The Nobel Prize in Physics for the year 2015 was awarded to Takaaki Kajita of Super-Kamiokande Collaboration, University of Tokyo, Japan and Arthur B. McDonald, Sudbury Neutrino Observatory Collaboration, Queen's University, Canada, "for the discovery of neutrino oscillations, which show that neutrinos have masses."

The prize is in recognition of scientists' key contributions to the experiments which demonstrated that neutrinos change identities during their propogation. This metamorphosis means that neutrinos are not massless. The discovery has changed our fundamental understanding of the working of matter at the innermost level and can prove crucial to our view of the universe.

Chemistry

The Nobel Prize in Chemistry for 2015 was awarded to Tomas Lindahl of Francis Crick Institute and Clare Hall Laboratory, Hertfordshire, UK; Paul Modrich, Howard Hughes Medical Institute and Duke University School of Medicine, Durham, NC, USA; and Aziz Sancar, University of North Carolina, Chapel Hill, NC, USA; "for mechanistic studies of DNA repair." Their findings have provided fundamental insights into how cells function at molecular level and how they are able to repair damaged DNA. Such an information can be used, for instance, in the development of new cancer treatments.

Brief Profiles of the 2015 Nobel Laureates

William C. Campbell was born in 1930 in Ramelton, Ireland. He received his Ph.D. from University of Wisconsin, Madison, WI, USA in 1957 and joined the Merck Institute for Therapeutic Research. He later got associated with Assay Research and Development in capacities of Senior Scientist and Director. He is currently a Research Fellow Emeritus at Drew University, Madison, USA.

Satoshi Ōmura was born in 1935 in the Yamanashi Prefecture, Japan. He received a Ph.D. in 1968, from the University of Tokyo, Japan, and another Ph.D. in 1970, from the Tokyo University of Science. He is currently Distinguished Emeritus Professor at Kitasato University (Japan), and Max Tishler Professor of Chemistry at Wesleyan University (USA).

Youyou Tu was born in 1930 in China. She graduated from the Pharmacy Department at Beijing Medical University in 1955. In the past, she has served as an Assistant Professor, and as a full Professor at the China Academy of Traditional Chinese Medicine. From 2000, Tu has been Chief Professor at the China Academy of Traditional Chinese Medicine.

Takaaki Kajita, born in 1959 in Higashimatsuyama, Japan, studied at the Saitama University and graduated in 1981. He received his doctorate in 1986 at the University of Tokyo. Since 1988 he has been at the Institute for Cosmic Radiation Research, University of Tokyo, where he became an Assistant Professor in 1992 and Professor in 1999.

Arthur B. McDonald was born 1943 in Sydney, Canada. He obtained Ph.D. in 1969 from Californa Institute of Technology, Pasadena, USA. Previously, he has served as Professor Emeritus at Queen's University, Kingston, Canada.

Tomas Lindahl was born 1938 in Stockholm, Sweden. He did his Ph.D. in 1967 from Karolinska Institutet, Stockholm, Sweden. In the past, he has been Professor of Medical and Physiological Chemistry at University of Gothenburg; and Emeritus director of Cancer Research UK at Clare Hall Laboratory, Hertfordshire, UK.

Paul Modrich was born in 1946. He did his Ph.D. in 1973 from Stanford University, Stanford, CA, USA. Previously, he has been the Investigator at Howard Hughes Medical Institute and James B. Duke Professor of Biochemistry at Duke University School of Medicine, Durham, NC, USA.

Aziz Sancar was born in 1946 in Savur, Turkey. He received his Ph.D. in 1977 from University of Texas, Dallas, USA, and has served as Sarah Graham Kenan Professor of Biochemistry and Biophysics, University of North Carolina School of Medicine, Chapel Hill, USA.

Sources: *Nobel Foundation (www.nobelprize.org) and Science Daily (www.sciencedaily.com)*

SCIENCE, TECHNOLOGY AND DEVELOPMENT

Improving Solar Cells by Using Genetic Engineering

Researchers used engineered viruses to provide quantum-based enhancement of energy transport, as reported by *Science Daily* in its edition of October 15, 2015. This work points the way toward inexpensive and efficient solar cells. The work is inspired by the evolutionary perfection of energy harvesting through the natural process of photosynthesis, which supports all forms of life on Earth.

According to the research, one way in which plants achieve near 100 percent efficiency for harnessing solar energy for photosynthesis is by making use of the exotic effects of quantum mechanics, also referred as "quantum weirdness". According to the report, engineers at MIT have used these effects to achieve a significant efficiency boost in a light-harvesting system using genetically engineered viruses to construct chromophores with specific intervals yielding optimal harvest of solar energy.

Advances in Genetics Help Make Wheat Varieties Heat-tolerant and Productive

A fourth wheat gene governing vernalization – the biological process requiring cold temperatures to trigger flower formation – has been identified. As vernalization governs flowering time, it is crucial to a plant's reproductive success and maximizing grain production in wheat, barley and other cereal crops. In cold climates, the vernalization process ensures that the cold-sensitive flowering parts of the wheat plant develop only after harshest period of winter passes. In contrast, the "spring wheat" varieties do not have a vernalization requirement and can be planted in spring and harvested in fall.

This finding of the newly characterized gene (VRN-D4) and its three counterpart genes would enable plant breeders in developing improved varieties of wheat that are better adaptive to adverse effects of climate change. Although the world produces more than 700 million tons of wheat annually but this is immensely stressed due to the rapidly growing global human population, and the long-term global climate change scenario posing key challenges. Identification of VRN-D4 gene would help ensure one-fifth of the calories and proteins consumed globally. The study appearing in the 4th September edition of *Science Daily*, also shows how the spring growth habit in some wheat varieties traces back to ancient wheat, that grew in what is now Pakistan and India.

According to another study published in *The Plant Journal* (Sept. 27, 2015) and reported in the *Science Daily* (October 6, 2015), wheat scientists at the Kansas State University have completed the first study of a chromosome in a tertiary gene pool and termed it a breakthrough in future crop improvement. In the study, researchers used a flow sorter to dissect a single chromosome from the larger genome in a wild wheat variety. The new knowledge would help wheat breeders develop new varieties that are resistant to disease and more tolerant to heat and drought.

New Genome Editing Circumvents GMO Laws

General public and scientists in the West are divided over the safety of genetically modified (GM) food. However, scientists have now created a way to genetically modify plants using the CRISPR-Cas9 (a gene-editing technique) system without the addition of DNA. Currently, the European Union regulations on Genetically Modified Organisms (GMO) don't allow for food with added DNA. Because no DNA is used in this process, the resulting genome-edited plants could be given a warmer reception by the public. This novel genetic modification technique was reported by *Science Daily* on October 19, 2015.

This technique could also be revolutionary for the future of the seed industry, and is ready for use to bolster plant output and create healthier crops in foods like tomatoes and lettuce. The application of the Cas9 RNP gene editing technique could be the next step in ending food shortages.

Scientists Create Plastic Skin with Sense for Prosthetic Limbs

According to a report by Tom Abate appearing in the Stanford News (October 15, 2015), Stanford chemical engineering Professor, Zhenan Bao, and her team, have created a skin-like material that can tell the difference between a soft touch and a firm handshake. This is material analogous to a “plastic skin”, having the ability to flex and heal, and if pressed creates an electric signal much like sensory receptors transmitting sensations to the brain. The research was published in Science and will ultimately lead to creation of a flexible electronic fabric embedded with sensors that could cover a prosthetic limb and replicate some of skin's sensory functions in order to bring prosthetic limbs feeling closer to real.

At the heart of the device is a two-ply plastic construct: the top layer creates a sensing mechanism and the bottom layer, comprising of carbon nanotubes, acts as the circuit to transport electrical signals and translate them into biochemical stimuli compatible with nerve cells.

Bao's team has already worked with Bianxiao Cui, an associate professor of chemistry at Stanford, to show that direct stimulation of neurons with electrical pulses is possible. There are six types of biological sensing mechanisms in the human hand, and the experiment described in Science reports success in just one of them. However this multiple-ply approach means the team can add sensations as it develops new mechanisms to successive layers by inkjet printing fabrication process.

PROFILE OF HEAD OF COMSATS' S&T CENTRE OF EXCELLENCE

PROF. IBRAHIMA THIOUB, RECTOR/PRESIDENT UCAD, SENEGAL

Prof. Ibrahima Thioub is the incumbent Rector /President of the Assembly of University Cheikh Anta Diop of Dakar (UCAD), Senegal, which has been a Centre of Excellence of COMSATS since May 2012.

Prof. Ibrahima Thioub did his Baccalaureate in Literature in 1978, and was awarded a Certificate of Specialization in History of Africa in 1981. He continued pursuing higher education and received a Masters degree in 1982 and a doctorate degree in 1989 from the University of Paris.

Professor of History at UCAD since 1990 and an Associate Member of the Nantes Institute for Advanced Study Foundation since 2009, Prof. Thioub specializes in slavery studies. He is regarded a specialist in the social and cultural history of Africa and was awarded honorary Doctorate degree by the University of Nantes, France, in March 2012.

Prof. Thioub has command over three languages, Wolof (native), French (working) and English (spoken), and teaches courses on the history and historiography of Senegal; history of Islam in Senegal (Xth-XXth centuries); and Slavery in Africa. He was a visiting professor at the EHESS and several universities in the United States and Europe. He was the Director of an international research program on alcohol and drug abuse in Asian countries (Nepal, India, Sri Lanka) and in many African countries (Gambia, Sierra Leone, South Africa). In 2008-2009 he was a resident researcher at Wissenschaftskolleg in Berlin.

Prof. Thioub's current research interests include studying slavery in daily life of Saint-Louis, Senegal (18th-19th centuries); and intellectual history of Francophone Africa and African identities. He has a critical eye on literature on African slavery and the Atlantic slave trade. Besides the employment of slaves in economic activities, he studied their role in social relations and their legal representation in private and public spaces. His study is a part of a historical perspective that takes into account the changes recorded over time in Saint-Louis.

He founded the African Centre for Research on Treaties and Slavery (CARTE) and serves as its Director. He has also been rendering services as:

- Executive Director of Centre for Research on Social Policies (CREPOS) (October 2009 - present); and
- Director Publication of the journal History & Heritage in Africa: Research and Experiments (January 2008 - Present).

He has been contributing to different councils, boards and associations in the following capacities:

- Member of the Scientific Council of the University Cheikh Anta Diop (since 2007);
- Coordinator of the Cluster of Excellence Regional "Slavery and Treaties: Communities, Borders and Identities" (since July 2007);
- President of the West African Research Association (WARA) (since June 2004);
- Chairman of History Department, Cheikh Anta Diop University (2004-2008);
- Member of the Board of the Association of African Historians (AAH) (since 2001); and
- Editor of *Afrika Zamani*.

As an academic, he has many publications to his credit, mostly in French language. Translated titles and details of some of Prof. Thioub's publications are as follows:

- The Question of Chromatic Identity and Anti-colonial Movement in Africa, 1st International Congress of Black Writers and Artists, IEA Nantes, Scientific Events, Nantes 2012-2013 pp. 135-140.
- Stigmas and Memory of Slavery in West Africa: Skin Color and Blood as Social Fracture Lines, New Global Studies, Volume 6, Issue 3, 2012.
- Slavery in Saint-Louis in Senegal in the eighteenth-nineteenth century, Jahrbuch 2008/2009, Wissenschaftskolleg zu Berlin, 2010, pp. 334-356.
- The African Sarkozy. A Denial of History, Paris, Karthala, 2008, pp. 155-180.
- Heritage and historical sources in Africa (ed.), International Academic Union, UCAD, 2007, 179 p.
- Controlling Knowledge in Colonial Context: An Aspect of the French Cultural Policy in West Africa, Listening (Again) to the African Past. Smith College, Northampton (USA), October 18-26, 2003.
- Economic Liberalization in Senegal: Shifting Politics of Indigenous Business Interests, African Studies Review, 1998, 63-89 [co-author].

Contact details:

Prof. Ibrahima Thioub
Rector/President
Assembly of the University Cheikh Anta Diop
of Dakar (UCAD)
P.O. Box 5005, Dakar-Fann, Dakar
Republic of Senegal.
Tel: (+221-77) 569 28 09;
URL: www.ucad.sn
E-mail: ibrahima.thioub@ucad.edu.sn;
rectorat@ucad.edu.sn

COMSATS' BRIEF AND ANNOUNCEMENTS

Selected Forthcoming Scientific Events in COMSATS' Countries

10-13 December 2015	3rd International Renewable and Sustainable Energy Conference (IRSEC'15), Marrakech, Morocco *(www.med-space.org/irsec15/)*
14-16 December 2015	13th International Conference on Frontiers of Information Technology (FIT'15), Islamabad, Pakistan *(fit.edu.pk/)*
19-21 January 2016	2nd International Conference on Biological Engineering and Natural Sciences, Cebu, Philippines *(icbens.org/)*
24 - 26 February 2016	2nd International Conferences on Green Computing, Intelligent and Renewable Energies (GCIRE2016), Manila, Philippines *(sdiwc.net/conferences/gcire2016/)*
7- 18 March 2016	Workshop on New Frontiers in Internet of Things, Trieste, Italy *(www.ictp.it/scientific-calendar.aspx?start_date=01/01/2016&end_date=31/12/2016)*
17-19 March 2016	The Second Menactrims Congress — MENACTRIMS (Middle East North Africa Committee for Treatment and Research in Multiple Sclerosis), Amman, Jordan *(www.2016.menactrims.com)*
24-27 March 2016	2nd International Conference on Science and Engineering of Polymeric Materials (SEPM 2016), Monastir, Tunisia *(www.sctunisie.org/sepm2016)*

Scholarships offered by the COMSATS' Centres of Excellence for Member States

COMSATS Institute of Information Technology (CIIT), Pakistan, offers100 graduate studies scholarships for students/researchers for post-graduate studies in all disciplines offered by the university at its 7 campuses, as well as five post-doctoral fellowships.

The Iranian Research Organization for Science and Technology (IROST), Iran, offers 7 Ph.D scholarships [4 fully paid and 3 partially paid (50%)] and five-post-doctoral fellowships in disciplines offered by the Organization.

The International Center for Chemical and Biological Science (ICCBS), Pakistan, offers scholarships for MS and Ph.D studies in disciplines offered by the Center.

For more details, please write to Mr. Tajammul Hussain, Advisor-Programmes, COMSATS Headquarters at **hussient@comsats.net.pk**.

Science Vision - Call for Papers

COMSATS invites scholarly contribution for Volume 21(1) of its bi-annual journal Science Vision, which aims at highlighting the important scientific and technological developments that have a bearing on socio-economic conditions of the people.

For more information, visit the journal's website: **www.sciencevision.org.pk**

A BRIEF ON COMSATS

The Commission on Science and Technology for Sustainable Development in the South (COMSATS) is an intergovernmental organization, with its Secretariat located in Islamabad, Pakistan.

COMSATS, currently, has 23 developing countries as its members, spread across three continents, i.e., Latin America, Africa and Asia. A network, of 20 International S&T Centres of Excellence, is also affiliated with COMSATS to contribute to scientific development of its Member States. The mission of COMSATS is to help create a world where all nations are at peace with one another and capable of providing good quality of life to their populations in a sustainable way using modern S&T resources. For detailed information, please visit COMSATS' website: www.comsats.org.

COMSATS NETWORK

BCSIR-Bangladesh
www.bcsir.gov.bd

ICENS-Jamaica
www.icens.org

UCAD-Senegal
www.ucad.sn

Embrapa Agro-biologia-Brazil
cnpab.embrapa.br

RSS-Jordan
www.rss.jo

ITI-Sri Lanka
www.iti.lk

ICCES-China
english.icces.ac.cn

KazNU-Kazakhstan
www.kaznu.kz/en/

IRCC-Sudan
www.ircc.gov.sd

CIF-Colombia
www.cif.org.co

NMC-Nigeria
www.nmcabuja.org

HIAST-Syria
www.hiast.edu.sy

NRC-Egypt
www.nrc.sci.eg

ICCBS-Pakistan
www.iccs.edu

TIRDO-Tanzania
www.tirdo.org

CSIR-Ghana
www.csir.org.gh

CIIT-Pakistan
www.ciit.edu.pk

CERTE-Tunisia
www.certe.rnrt.tn

IROST-Iran
www.irost.org

TÜBITAK MAM-Turkey
www.mam.gov.tr