

# Mapping Pakistan's Resource Centers

Reverse Linkage





# **Mapping Pakistan's Resource Centers**

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The Islamic Development Bank (IsDB) has developed a Geo-mapping System to share the complete profiles of Resource Centers (RCs) with the public as well as with development partners in continuation of its long history of promoting cooperation among its Member Countries (Mcs). The Geo-mapping system can be accessed through the following URL. <https://maps.isdb.org>

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## ACRONYMS

<b>ACIAR</b>	Australian Centre for International Agricultural Research
<b>APAARI</b>	Asia Pacific Association of Agricultural Research Institutions
<b>APQN</b>	Asia Pacific Quality Network
<b>APRC</b>	Asia Pacific Regional committee
<b>AVRDC</b>	Asian Vegetable Research and Development Center
<b>CGMP</b>	Current Good Manufacturing Practice
<b>CIMMYT</b>	International Maize and Wheat Improvement Center (CIMMYT)
<b>CPEC</b>	China Pakistan Economic Corridor
<b>CRDF</b>	Civilian Research and Development Foundation
<b>CUST</b>	Capital University of Science & Technology
<b>DRAP</b>	Drug Regularity Authority of Pakistan
<b>DRAP</b>	Drug Regulatory Authority of Pakistan
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization
<b>GDP</b>	Gross Domestic Product
<b>GMP</b>	Good Manufacturing Practices
<b>GSP</b>	Generalized System of Preferences
<b>HEC</b>	Higher Education Commission of Pakistan
<b>IBRO</b>	International Brain Research Organization
<b>ICARDA</b>	International Center for Agricultural Research In the Dry Areas
<b>ICIMOD</b>	International Centre for Integrated Mountain Development
<b>ICRISAT</b>	International Crops Research Institute for the Semi
<b>IsDB</b>	Islamic Development Bank
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>IFPRI</b>	International Food Policy Research Institute
<b>ILO</b>	International Labour Organisation
<b>ILRI</b>	International Livestock Research Institute
<b>IRRI</b>	International Rice Research Institute
<b>ISO</b>	International Organization for Standardization
<b>ITAP</b>	Investment Promotion Technical Assistance Program
<b>IWMI</b>	International Water Management Institute
<b>JICA</b>	Japan International Cooperation Agency
<b>MC</b>	Member Country
<b>MCPS</b>	Member Country Partnership Strategy
<b>MHRA</b>	Medicines and Healthcare products Regulatory Agency UK
<b>MNFSR</b>	Ministry of National Food Security & Research

## ACRONYMS

<b>NCRPs</b>	National Coordinated Research Programs
<b>NDA</b>	National Drug Authority
<b>NEPRA</b>	National Electric Power Regulatory Authority
<b>NIAB</b>	Nuclear Institute of Agriculture & Biology
<b>NTDC</b>	National Transmission And Despatch Company Limited
<b>OIC</b>	Organization of Islamic Cooperation
<b>ORIC</b>	Office of Research Innovation & Commercialization
<b>PCM</b>	Project Cycle Management
<b>PCRWR</b>	Pakistan Council of Research in Water Resources
<b>PERN</b>	Pakistan Education & Research Network
<b>PIDE</b>	Pakistan Institute of Development Economics
<b>PMDC</b>	Pakistan Medical & Dental Council
<b>PPE</b>	Personal Protective Equipment
<b>PPMA</b>	Pakistan Pharmaceutical Manufacturer's Associations
<b>PSEB</b>	Pakistan Software Export Board
<b>QEC</b>	Quality Enhancement Cells
<b>R&amp;D</b>	Research & Development
<b>RCs</b>	Resource Centers
<b>S&amp;T</b>	Science & Technology
<b>SaaS</b>	Software as a Service
<b>SDG</b>	Sustainable Development Goals
<b>SME</b>	Small and Medium Size Enterprises
<b>SSC</b>	South-South Cooperation
<b>TCP</b>	Trade Cooperation & Promotion Program
<b>UNCSD</b>	UN Conference on Sustainable Development
<b>UNDP</b>	UN Development Program
<b>UNFPA</b>	United Nations Fund for Population
<b>UNIDO</b>	UN Industrial Development Organization
<b>UNOSSC</b>	United Nations Office for South-South Cooperation
<b>USAID</b>	United States Agency for International Development
<b>USDA</b>	United States Department of Agriculture
<b>VQA</b>	Vocational Qualifications Authority
<b>WAIPA</b>	World Association of Investment Promotion Agencies
<b>WAPDA</b>	Water and Power Development Authority
<b>WTO</b>	World Trade Organization

### ACKNOWLEDGEMENT

This report is the result of a collaboration between the Islamic Development Bank (IsDB) and The Higher Education Commission of Pakistan (HEC). The main objective of this study is to identify Resource Centers in Pakistan, and document their best practices, successful models and approaches, which have the potential to be emulated by other institutions in IsDB Member Countries. In addition to documenting best practices, the list of institutions listed in this report are deemed to be suitable candidates for including in technical cooperation projects between countries. In this sense, the report is meant to serve as a resource for project officers, development practitioners and decision makers in the formulation of international cooperation projects within the framework of South-South Cooperation (SSC).

The partner institutions extend their thanks and appreciation to the Resource Center's focal points (see Appendix 4 for the detailed list) for their excellent cooperation in sharing information about their institutions through interviews, questionnaires and profiles. We particularly extend our special thanks to Prof. Dr. Zia Ul-Qayyum (Vice Chancellor, University of Gujrat), Air Vice Marshal Faaiz Amir, Retd. (Vice Chancellor, Air University), Prof. Dr. Fazal Ahmad Khalid (Vice Chancellor, UET), Prof. Dr. M. Iqbal Choudhary (Director, Dr. Panjwani Center for Molecular Medicine and Drug Research), Dr. Yusuf Zafar (Chairman, PARC), Shamim Ahmad Khan (Chairman, Amson) and Mr. Sikandar Mustafa Khan (Chairman, Millat Group) for their remarkable support to the preparation of this report.

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“The Islamic Development Bank highly values the excellent achievements of Pakistani institutions, which have been realized in the midst of numerous challenges. The current status of such institutions is a natural result of the investment in knowledge that the Government of Pakistan has been persistently pursuing over the past years. The Islamic Development Bank considers that the time is ripe for these achievements to be shared with all Member Countries. In its role as a catalyst of development, the Bank will do its best to effectively match the capacity development demands of Member Countries with Pakistan's accumulated expertise and technologies.”

Dr. Bandar M. H. Hajjar  
President, Islamic Development Bank

“The Islamic Development Bank has always been a major partner of the Government of Pakistan in its developmental efforts. We see the IsDB's initiative of Reverse Linkage as a continuation of such a role. It is a powerful mechanism to foster South-South cooperation, while bringing gains to all the parties concerned. We always encourage Pakistani institutions to share their experiences with other IsDB member countries. I am confident that this report will enable Pakistani institutions to enhance their cooperation with other member countries. I thank the Higher Education Commission, Pakistan, and the IsDB for this comprehensive report.”

Mr. Muhammad Hammad Azhar  
Minister for Economic Affairs  
IsDB Governor of the Islamic Republic of Pakistan

“In today's information age, networks are of immense importance in the provisioning of information, knowledge sharing, exchange of expertise and technical resources for mutual development. HEC continues to indulge in local regional and global partnerships for fostering societal benefits through the effective utilization of available knowledge and skills. In this backdrop, it gives me immense pleasure to present this report of mapping Pakistan's best Resource Centers in four important sectors viz; Agriculture, Agro-based Industries, the Pharmaceuticals Industry, and Information Communication Technologies for sharing Pakistan's expertise and knowledge with other IsDB member countries. I am grateful to IsDB for initiating this project with Pakistan to fill the gap in different expert domains and hope that the booklet would catalyze better use of technical expertise especially amongst the OIC member countries.”

Prof. Dr. Mukhtar Ahmed  
Chairman, Higher Education Commission (Former)



### EXECUTIVE SUMMARY

In the post-global financial crisis era, many emerging countries are seeking opportunities to achieve development cooperation with other IsDB Member Countries. In this context, South-South cooperation is viewed as one of the effective drivers for development that offers a framework for Identifying, matching and exchanging of solutions to common problems and best practices for fostering development cooperation.

On the other hand, Pakistan is now on the road to stable democracy. It has geared towards developing human and social capital of the country by enabling universal access to education and health facilities, empowering women and eradicating poverty; thereby increasing the overall productivity. Strategies have been devised to encourage public-private partnerships in the development process. Moreover, energy reforms have been proposed and special emphasis has been laid on improving the performance of the large-scale manufacturing sector. Agriculture, Agro-based Industries, the Pharmaceutical Industry and Information Communication Technology (ICT) were identified as important areas with high growth potential.

Against this backdrop and in the light of the fact that South-South cooperation gives the opportunity of transferring the knowledge and resources among IsDB Member Countries, the present study entitled "Mapping Pakistan's Resource Centers" aims to provide an analysis on Pakistan's potential role in South-South cooperation, showcase the country's achievements in some selected sectors and present profiles of Pakistan's selected Resource Centers from the public and private sectors.

## METHODOLOGY FOR MAPPING RESOURCE CENTERS

The Islamic Development Bank has undertaken the task of developing standard guidelines and supporting documentation that can be used during the mapping exercises for IsDB member countries. The purpose of these guidelines is to provide a consistent and structured framework to assess the capabilities of the Resource Centers (RCs) and identify those that qualify for partnering with the IsDB in providing innovative interventions to meet the capacity development demands of Member Countries. Based on this guideline, comprising 12 steps, this report summarizes the profiles of 16 Resource Centers (Rcs), which are identified out of approximately 45 through an objective evaluation process.

## PRIORITY AREAS

In this study, four sectors were selected to focus on: (1) Agriculture; (2) Agro-based industries; (3) the Pharmaceuticals industry; and (4) Information Communication Technology. These sectors were selected from among a wide range of areas where Pakistan can offer expertise, knowledge and technologies to other IsDB member countries. The selection criterion is mainly based on the close relationship between IsDB's priority areas with those of Pakistan's Five-Year Development Plan (2013-2018) as well as where Pakistan has significant experience and expertise.

## PROFILES OF THE SELECTED RESOURCE CENTERS

This section provides profiles of Pakistan's selected Resource Centers (RCs) by priority areas. In each priority area, specific Resource Centers (RCs) have been selected in order to provide a picture of the institutional capacities that Pakistan possesses and is ready to share with other IsDB Member Countries. These profiles have been prepared through questionnaires, activity reports, strategic plans, interviews and expert meetings. It is worth mentioning that these Resource Centers represent just a selection among a wide range of institutions. The 16 best practices were selected through an objective evaluation process. On the other hand, the main criteria of Reverse Linkage interventions is the ability of RCs to co-finance Reverse Linkage projects. Different sources of funding such as government, membership, donation, foreign resources, international private institutions, development agencies' contributions and self-funding exist with Pakistan's selected Resource Centers.

# PAKISTAN

## A Country of 200 Million People

and an area making it 36th largest country of the world.

The untiring struggle and immeasurable sacrifices of Muslims destined them to have a federal parliamentary republic with a population exceeding 200 million people and a geographical area that makes it the 36th largest country of the world.

The geographical location of Pakistan makes it very crucial. Pakistan has a varied topography that consists of flat, Indus plain in the east, Balochistan plateau in the west and Karakoram Range in the north. The world's second highest mountain, K-2, is also within Pakistan's borders, as is the famous 38 mile long Baltoro Glacier. This glacier is considered as one of the longest glaciers outside of the earth's polar regions.

The country has 1,046 kilometers of coastline along the Arabian Sea and the Gulf of Oman in the south. It is bordered by Afghanistan, Iran, India and China and is also very close to Tajikistan, a country separated from Pakistan by the Wakhan Corridor in Afghanistan. It was this varied geographical nature that attracted China, a gigantic economic power, to launch a multibillion China-Pakistan Economic Corridor project.

The country has archaeological remains dating back more than 4,000 years. Aside from the historical distinctions that the land of Pakistan enjoys, being a home to numerous civilizations of the world, almost seven decades of Pakistan's age leave a history encompassing political and economic ups and downs, social progress and integration and, of course, defense excellence, cultural enrichment, and an enviable status in the Islamic world.

The real potential Pakistan enjoys is in the form of youth, an undeniable asset. Approximately 110 million of the population is below the age of 30. During the last few years, the Government of Pakistan has taken a number of initiatives for human resource development, particularly among youth.

Despite facing political instability, Pakistan has always stood firm in the comity of nations with its high status earned through its relentless resilience and adaptability to all odds and ordeals. National unity and patriotism have made Pakistan the seventh nuclear power in the world.





The visible growth in various sectors will soon bring the day very close when Pakistan will be considered at the top of the list of developed countries. Though Pakistan is confronted with different challenges on the internal and external fronts, the country's economic condition is improving steadily.

Pakistan believes in peaceful coexistence and desires peace and tranquility in the whole world and this is what the country has been focusing on in its diplomatic endeavors, while countering conspiracies being hatched by enemies to isolate Pakistan. The political and military leadership, economic troubleshooters, clerics and scholars and the nation at large are committed to make Pakistan a prosperous and developed country.

**As we pass through an era of unprecedented change and complexity, it is imperative that we refresh our framework for national development to create a robust platform and to place Pakistan in the league of Upper Middle Income countries by 2025. However, our ultimate destination is to see Pakistan among the top ten economies of the world by 2047 – the centennial year of our independence.**



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## HIGHER EDUCATION COMMISSION

### STRENGTHENING PAKISTANI UNIVERSITIES & RESEARCH

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the Higher Education Commission (HEC) of Pakistan formulates higher education policy and regulates the university sector in terms of access to higher education, quality, standards and guidelines.

Established in 2002, the Higher Education Commission (HEC) of Pakistan formulates higher education policy and regulates the university sector in terms of access to higher education, quality, standards and guidelines. It provides funding for recurring and development expenditure to the higher learning institutions in the public sector in addition to its support to private universities in different ways. The main objective HEC pursues is to facilitate the higher learning institutions to serve as an engine for the socio-economic development of the country.

Different initiatives taken by HEC have played a significant role in the development of new higher education institutions and, at the same time, lifting the standards of the existing ones. The Commission has paid special attention to ensure quality at different levels as well as inculcate a culture of research, innovation and entrepreneurship among faculty members and students.

Various divisions of the HEC including Academics, Learning Innovation, Human Resource Development, Research & Development, Quality Assurance, Planning & Development, Accreditation & Attestation, and Information Technology have respective functions in pursuing the goals of a knowledge-based economy.

Among the various programs that HEC has undertaken over the years include overseas and indigenous scholarships for MSc, PhD and post-doctoral studies, merit and needs based scholarships, research and travel grants, the establishment of Quality Enhancement Cells (QECs), Offices of Research, Innovation and Commercialization (ORICs) and Business Incubation Centers, capacity building programs for faculty and university management, the Pakistan Education & Research Network (PERN) and video conferencing.

The HEC program also includes digital Library, campus management solution, improvement of physical infrastructure of universities, the implementation of a plagiarism policy, execution of a PM Laptop Scheme and a PM Fee Reimbursement Scheme, and verification/ equivalence of educational documents of students from within and outside the country.



During the last 13 years, thousands of research projects in higher education institutions and R&D organizations have been funded across the country by the HEC. The HEC has established ORIC in Higher Education Institutions with an aim not only to facilitate researchers and inventors but also to fight for the commercial use of their research work. It is due to the promotion of research activities, and their effectiveness in accordance with national needs, that a Thomson Reuters report, released in September 2016, has shown that Pakistan is even overtaking Brazil, Russia, India, and China in the citation of its research papers. Likewise, the Business Incubation Centers set up by the HEC have a remarkable role in nurturing new businesses and helping start-ups achieve their commercial targets.

A large number of scholars have travelled abroad for MSc, PhD and post-doctoral studies under different Overseas Scholarship Programs. Moreover, the number of indigenous PhD scholarships awarded to Pakistani students within the country since the inception of the HEC is also very high. Under the Aghaz-e-Haqooq-e-Balochistan Programme, since its start, the HEC has given scholarships to Baloch students while supporting them to overcome financial obstacles to achieving their education. Students from less developed areas of the country are benefiting from the Prime Minister's Fee Reimbursement Scheme, as the HEC is executing the scheme in the letter and the spirit. The scheme is certainly a boon for the students who pay their fees but deserve to be reimbursed.

Alongside other development projects, students across the country have been given laptops under the Prime Minister's Laptop Scheme being executed by the HEC. Now, the second phase of scheme has also been launched and students of different universities have been awarded laptops along with internet connectivity devices to boost the effectiveness of the government's paramount initiative. The second phase is continuing.



The HEC has signed agreements with a number of advanced countries including France, Germany, Australia, New Zealand, China, South Korea, Cuba, the USA, the UK and Hungary on collaboration in higher education, scholarship and research issues. The key point of many of the Memoranda of Understanding is the exchange of faculty and students, as HEC strongly believes that the faculty members and students gaining foreign experience will bring back valuable learning and utilize their experience effectively in Pakistani institutions.

With regard to increasing access to higher education in the country, one of the achievements of HEC is that it has begun to build university campuses in far-flung districts, where students have so far been lacking higher education opportunities. The future plans of HEC envisage a further strengthening of the higher education sector and the aligning of the academic and research priorities of higher education institutions with the national socio-economic goals, particularly the achievement of targets set for 2025 under the Vision 2025.





# Methodology For Mapping Resource Centers



Within the system of OIC, the Islamic Development Bank (IsDB) is the only multilateral development financing institution whose membership is drawn entirely from the developing South. The articles of agreement of the IsDB clearly affirm “harmonious and balanced development through mutual financial and economic cooperation amongst its members.”

Indeed, the IsDB has been promoting cooperation among its member countries through a variety of programs including, but not limited to, the Technical Cooperation Program (TCP), the Trade Cooperation and Promotion Program (TCPP), the Investment Promotion Technical Assistance Program (ITAP), Capacity Building Program for IsDB member countries, the Alliance to Fight Avoidable Blindness Program, the Bilingual Education Program, as well as the Science & Technology Programs. The implementation of these programs has enabled the IsDB to mainstream and scale-up successful stories and best practices through the concept of Reverse Linkages.

Reverse Linkages are specific cooperation activities whereby the IsDB member countries are the principal, forefront and direct agents in the provision of expertise, knowledge, know-how, investments, success stories, best practices as well as other specialist services to address development constraints or exploit unique opportunities in other member countries. This is achieved through a mutually beneficial arrangement, whereby the IsDB plays the facilitator role.

One of the requirements in Reverse Linkage interventions is to have a well-researched and validated roster of institutions that would qualify as Resource Centers. These RCs would provide the capacity development solutions to sister organizations in IsDB member countries. Therefore, there is a need to map the RCs that exist in IsDB member countries, understand their capabilities and assess their ability to cooperate internationally.

Figure 3.1 Process for Mapping Resource Center



The Reverse Linkage division has undertaken the task of developing standard guidelines and supporting documentation that can be used during the mapping exercises for IsDB member countries. The purpose of these guidelines is to provide a consistent and structured framework to assess the capabilities of the RCs and identify those that qualify to partner with the IsDB in providing innovative interventions to meet the capacity development demands of member countries.

As shown in the figure above, the mapping exercise comprises 12 steps (see Appendix 1 for details). During the mapping study of Resource Centers in Pakistan, these steps have been realized one by one in a chronological order. Questionnaires have been circulated to all RCs in order to collect key information that will feed into the RC's profile. Approximately two to three months were needed in order to receive the questionnaires filled by each RC. However, the information provided in some of these questionnaires did not incorporate statistical facts required for this exercise.

Documents such as activity reports, strategic plans and brochures were collected in order to fill the gaps in the data provided in the questionnaires. This step took time, around two months, as the information provided by some of the RCs was not sufficient in to profile these RCs as well as to score them. Once the information was collected according to the requirements of mapping guidelines. RCs were scored and shortlisted based on a predefined set of objective criteria and a scoring scheme. The short list of RCs was sent to the IsDB Governor's Office in order to seek their views and endorsement. The first 16 RCs were selected and a draft report with short-listed RCs profiles was prepared. Then, each profile was sent to the respective RC for validation. This step was essential in order to update information and data regarding RCs. After validating the profiles with RCs, the final report was prepared.

The report starts with an overview of four sectors selected in the areas of agriculture, agro-based industries, the pharmaceuticals industry, and information communication technology. Then, the report summarizes the profiles of 16 Resource Centers that had been identified out of approximately 45 through an objective evaluation process





# Priority Areas



In the present study, four sectors were selected to focus on: (1) Agriculture, (2) Agro-based industries; (3) the Pharmaceuticals Industry; and (4) Information Communication Technology. These sectors were selected from among a wide range of areas where Pakistan can offer expertise, knowledge and technologies to other IsDB member countries. The selection criteria are mainly based on the matching between IsDB's priority areas with those of Pakistan's Five-Year Development Plan (2013-2018) where Pakistan has significant experience and expertise.

According to the Vision 1440H of IsDB and the most urgent contemporary challenges confronting its member countries, the Mission of IsDB is to promote comprehensive human development, with a focus on the priority areas of alleviating poverty, improving health, promoting education, enhancing governance and improving the prosperity of the people. Pakistan's Five-Year Development Plan (2013-2018), on the other hand, comprises four dimensions of development which are: (1) Qualified individuals, strong society, (2) Innovative production, sustainable high growth, (3) Livable places, sustainable environment, (4) International cooperation for development.

This section offers an overview of these four sectors in Pakistan by giving the reasons for their selection. This includes a review of the main developments, strategies and policies for these selected areas in light of Pakistan's Five-Year Development Plan (2013-2018). Such a review aids a better understanding of the capacities in these key areas and Pakistan's potential for transferring best practices and programs to other IsDB member countries.

### Agriculture

The agriculture sector plays a vital role in the economy of Pakistan through a variety of channels. It accounts for about 21% of Gross Domestic Product (GDP), employs almost 43.7% of the labor force and 60% of the rural population depends on agriculture for its livelihood. In addition, the sector provides raw materials for various finished goods for export. The overall growth of agriculture sector during the last few years was 3%, due to positive growth in major crops and livestock sub-sectors. This is mainly due to the strong efforts of research and development organizations working in the country and agriculture-friendly policies of the Government, to promote the sector in Pakistan. In 1949-50, Pakistan produced only 2.4 million tons of wheat and could not feed its population of 30 million people. Now, wheat production had increased more than ten-fold, rising to 25 million tons, not only feeding 195 million of its people but also exporting the surplus.



Pakistan has now emerged as the third largest exporter of rice, and its share in international trade has risen from 6.9% in 1985 to 14% by 2013-14. The country is also the fifth largest producer of cotton, with cotton production of 14 million bales from a modest beginning of 1.7 million bales in the early 1950s; is self-sufficient in sugarcane; and is the fifth largest producer of milk in the world. A substantial increase in corn production has helped the poultry industry to grow utilizing almost 65% of the production of poultry feed. The country produces top-quality raw materials (raw skin and leather) from cattle, buffalo, goats and sheep.

A major jump in crop production took place in late 1960s and early 1970s due to the Green Revolution. Pakistan has the honor to be a hub of research activities for green revolution and as a result, the first wheat variety was approved as

MAXIPAK. Shallow tube wells also contributed to a 50% increase in the cropping intensity, which was augmented by farm mechanization. In addition, Government price support policies, particularly for wheat, have paid dividends in form of higher production, increased use of modern inputs and higher yields.

Beginning in the 1980s, livestock emerged as the prime mover of agricultural growth, due to special incentives like loans for dairy development, with the crop sector taking a secondary position. This sector now contributes 55% to agriculture value addition and about 11.5% of GDP. Its share is rising gradually. Empirical studies have found that public development expenditures lead to enhancement in private investment in agriculture. The implementation of well-targeted public investment in infrastructure projects complements and stimulates private investment in agriculture.



In addition, many steps are taken by the Government to boost the agricultural sector in the country such as Institutional reforms, research and innovation, collaboration between public and private sector, timely dissemination and availability of agriculture related information and development of new technologies. Innovative extension methodologies are being adopted such as Community Service Centers (CSC), the Farmer Field Schools (FFS) and Plant Clinics (PC) etc.

In order to complement provincial agriculture and food security efforts, the Ministry of National Food Security & Research Ministry of National Food Security & Research (MNFSR) at federal level is on driving front and launching a series of national flagship projects. Pakistan has one of the largest agricultural research systems among developing countries, employing more than 4,000 full-time and highly-qualified researchers with a viable infrastructure at federal and provincial level. The Pakistan Agricultural Research Council (PARC), the country's principal R&D organization, is an autonomous body of MNFSR and has a broad mandate to coordinate research among federal, provincial, and higher education agencies and to undertake areas of research not covered by other institutions. PARC has planned its structure accordingly with an enabling environment for the national research system. For the purpose, it has developed National Coordinated Research Programs (NCRPs) on different commodity crops, and livestock as a mechanism of undertaking joint efforts, for conducting joint research, providing platform for proper planning, execution, monitoring and evaluation of research agenda on issues of national importance.

Moreover, four other federal agencies under MNFSR are also involved in agricultural research: the Agricultural Price Commission and the Soil Survey of Pakistan conduct applied research related to agricultural prices and soil resources, respectively; the Federal Seed Certification and Registration Departments focused on the sampling, testing and characterization of seeds for approval of newly-developed varieties, and the National Veterinary Laboratory conducts research related to animal disease control and vaccine development. Furthermore, a large number of federal government institutions conduct agriculture-related R&D. They include the Pakistan Council for Research in Water Resources (PCRWR), the International Waterlogging and Salinity Research Institute, the Pakistan Forest Institute (PFI), the National Fertilizer Development Centre (NFDC), the Sustainable Development Policy Institute (SDPI), the Pakistan Institute of Development Economics (PIDE), the Livestock Development Board and the Marine Fisheries Department. The Pakistan Atomic Energy Commission oversees four relatively large research institutions related to agriculture: the National Institute for Biotechnology and Genetic Engineering (NIBGI) in Faisalabad, the Nuclear Institute for Agriculture

and Biology (NIAB) in Faisalabad, the Nuclear Institute for Agriculture (NIA) in Tandojam, Sindh, and the Nuclear Institute for Food and Agriculture (NIFA) in Peshawar.

At the provincial government level, agriculture is divided into five sub-sectors: crops, livestock and fisheries, food, natural resources (soil water, forestry, and wildlife), extension and education. Research conducted by the federal government organizations is largely long-term priority research, while that of the provincial research system is mostly applied and adaptive in nature. Each of the four provinces has an agricultural research facility set up under the administrative oversight of the respective Department of Agricultures. The Ayub Agricultural Research Institute (AARI) Faisalabad is the premier research institute in the Punjab and has 25 institutes across the province in all the agro-ecological zones. The Livestock and Dairy Development Department is responsible for livestock and veterinary research in the province. Other departments like the Forestry, Wildlife, and Fisheries departments focus on research and development in their respective domains. Similarly, agricultural research under the Department of Agriculture in Baluchistan and KPK is organized in a similar manner. The Agricultural Research Institute Sariat in Balochistan and the Agricultural Research System in Khyber Pakhtunkhwa are the main institutions with their branches at the required places for the same purposes. For agricultural research in Sindh, the Agricultural Research Institute Tandojam (ARIT) focuses on crops research. Livestock research is separate and falls under the provincial Department of Livestock and Fisheries. In addition, 17 higher education Institutions are involved in agricultural research like Agricultural universities in Faisalabad, Rawalpindi, Peshawar, Multan, DI Khan and Tandojam while Lahore has a veterinary university, meeting the requirements of livestock sector.

Besides cooperating at the national level, wide interaction at regional and international levels is also given due importance. PARC maintains close linkages with the Consultative Group on International Agricultural Research (CGIAR) centers and has been drawing upon their facilities for training, expert service, research methodologies, germplasm, and scientific information. These centers include the International Center for Agricultural Research In the Dry Areas (ICARDA), the International Livestock Research Institute (ILRI), the International Water Management Institute (IWMI), the International Rice Research Institute (IRRI), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Maize and Wheat Improvement Center, known by its Spanish acronym (CIMMYT) Centro Internacional de Mejoramiento de Maíz y Trigo.

Other links are in place between the Pakistan Agriculture Research Council (PARC) and the Asian Vegetable Research and Development Center (AVRDC), the Australian Centre for International Agricultural Research (ACIAR), the International Centre for Integrated Mountain Development (ICIMOD), the International Food Policy Research Institute (IFPRI) and the Asia Pacific Association of Agricultural Research Institutions (APAARI). PARC has technical cooperation programs on various commodities with the United States Department of Agriculture (USDA), the United States Agency for International Development (USAID), Japan International Cooperation Agency (JICA) and the Food and Agriculture Organization (FAO). Moreover, PARC cooperates with institutes in some 50 countries in Asia, the Middle East, Latin America, Africa, Europe, Australia and North America. Benefit of this cooperation is also extended to the national research system of the country.

Non-profit and for-profit private companies have a minimal, but growing, involvement in agricultural R&D in Pakistan. A number of private companies have now developed their own infrastructure to undertake research activities in the country for development of high-yielding varieties, production and protection technologies, certified seeds and machinery.

### Agro Based Industries

Agro-based Industries produce the inputs to Agriculture (e.g. fertilizers, equipment, instruments) and convert the output of Agriculture to more valuable commercial products (e.g. textile, sugar). Pakistan is located on a large land mass, between latitude 23° and 37° and longitude 61°, and is boundaried in the northwest by Afghanistan, in the north by China, in the east by India, and in the south by the Arabian Sea.

Pakistan has a geographical area of 796,095 square kilometers. Of this, about 58.5 million hectares is under cultivation. Pakistan with an estimated population of 194.8 million and a GDP of US\$ 269.97 billion in year 2015-16, is an important economic player in South Asia and the 43th largest economy in the world. According to the well-known British economist, Jim O'Neil, Pakistan could become the 18th largest economy of the world by 2050, if it achieves its real growth potential in the years to come. Despite the ongoing recession in most of the economies of the world, Pakistan succeeded in attaining 4.7% growth in fiscal year 2015-16 against the growth of 4.04% in the preceding year. The growth has remained broad-based with the contribution of all important economic sectors.

The recent global food crises, while creating difficulties for net food importing countries, is equally providing opportunities for developing countries like Pakistan to focus and benefit from the current situation by giving more serious attention to



agriculture-based industries. In this scenario, Pakistan is changing its policy-orientation towards yield enhancement and addressing structural issues such as improving poor crop management skills of farmers; provision of affordable inputs like quality seeds; improvement in agriculture infrastructure; reducing post-harvest losses; developing value chains; narrowing gap between research and its practical applications; and provision of adequate funding for research and development activities.

Pakistan is one of the leading producers and consumers of cotton in the world market. Owing to its strong agricultural base, globally important businesses and designers consider Pakistan as a major buying source for raw cotton, cotton yarn, cotton fabric, textile and textile articles. Textile industry is the mainstay of Pakistan's exports. The country has a vast range of international standard textile products. Several leading international brands have established their production houses in Pakistan. The abundance of raw material in the shape of better cotton yields, coupled with cheap and skilled labor, provides an additional incentive for any investor. Similarly, the country is the fourth biggest producer of cotton, the sixth biggest producer of mangoes, and the eighth largest producer of wheat in the world.

Sugarcane is also among the most valuable crops of Pakistan. It is a source of raw material for the entire sugar industry. At present, the sugar industry is the second largest agro-based industry in Pakistan. Sugarcane is an important industrial and cash crop in Pakistan and is ranked fifth in terms of area under sugarcane cultivation, and 15th in sugar production, in the world. Sugarcane is grown on over a million hectares and provides the raw material for Pakistan's 84 sugar mills, which comprise the country's second largest agro-industry after textiles.



A substantial increase in corn production has helped the poultry industry to grow, utilizing almost 65% of the production in poultry feed. The first feed mill was set up in 1962, and now 141 feed mills are operational producing 2,540,000 tons of compound feed per annum. The country produces the best-quality raw materials (raw skin and leather) from cattle, buffalo, goats and sheep. Pakistan is a net food exporter, except in occasional years when drought adversely affects the harvest.

The newly-emerging seed industry is also developing very fast. More than 750 seed companies have been registered. The Seed Act was approved to provide a regulatory mechanism for variety release and controlling the quality of seeds of various crops through establishing requisite infrastructure. With the enactment of the Seed Act, 1976, the National Seed Council at federal level and Provincial Seed Councils at provincial level are now operational.

Huge investment opportunities also exist in quality seed production, food processing and cold chain management, for example, Pakistan is the second biggest producer of buffalo milk in the world. The European Union (EU) from 1 January, 2014 under the Generalized System of Preferences (GSP Plus) regime of the World Trade Organization (WTO) has allowed duty-free imports from Pakistan to the EU of almost 6,700 trading lines/articles mostly in cotton, textile and leather sectors. It will ensure greater integration of Pakistan's economy in the world trading system, make local industries more competitive and help achieve the objectives of inclusive development.

Pakistan, like other developing countries, is a consumption-oriented society, having a high marginal propensity to consume. Total consumption reached 92.49% of GDP in 2013-14. With such a large consumer base and a persistent increase in demand, the country is a lucrative market for various products and services. Agriculture remains a high priority area and the government policies place special emphasis on the rapid promotion and development of Agro-based Industries to move forward for self-reliance. As a result, Pakistan has been ranked better than its neighboring countries in terms of business indicators. According to a recent survey by the Overseas Investors Chamber, Pakistan's economic outlook is improving; the business confidence in the country has improved to a positive 36%, up 14 points compared with 22% in 2015. The country is an important supplier of its products in the world market at competitive prices. International companies could explore this sector for joint ventures. The unique blend of the advantages explained above and a friendly investment policy offers ideal opportunities for investment in Pakistan where a number of multinational corporations are already earning record profits. Further, Pakistan's youthful population ensures an abundant educated and skilled workforce.

### Pharmaceuticals Industry

In applied medicine, pharmaceuticals and vaccine manufacturing is one of the fastest-growing sectors in Pakistan. This sector is considered as a backbone of public health services in the country. Almost 800 formulation units have been contributing to fulfill 90% of country's finished product needs, including those operated by 25 multinationals. The pharmaceutical industry in Pakistan has a growth rate of 15% with a net worth of US\$ 2.3-2.5 billion. Although, the ratio of import to export of pharmaceuticals is relatively higher for the country, the sector is actively contributing in the strengthening of economy by exports of around US\$ 124 million.

The manufacturing units are equipped with the latest technology and follow current Good Manufacturing Protocols (cGMP), ensured by the Drug Regulatory Authority of Pakistan (DRAP) under the Ministry of National Health Services, Regulations and Coordination. DRAP has 13 divisions among which Pharmaceutical Evaluation and Registration, Licensing, Quality Assurance, Health and Over-the-Counter products, Biological products and the Narcotics and Control Drug Division are the major ones. The regulatory body has been striving to ensure quality in the manufacturing of human and veterinary Pharmaceuticals and Biological products yet providing easy access for everyone to life-saving drugs.

The Government takes a keen interest in securing the quality of medicine and understands the importance of the pharmaceutical industry for the overall impact on the economy by taking initiatives to assist companies in their efforts to export medicines. Also, the irrefutable professionalism of industry personnel makes sure that finished products meet the international quality standards for pharmaceuticals. Furthermore, there is healthy competition among national pharmaceuticals to capture markets, thus bringing domestic investment of around US\$ 500 million and foreign investments of US\$ 100 million.

The raw materials for the formulation are imported mainly from China and European countries. The domestic industry only fulfills 4% of country's raw material needs. The raw materials, as well as finished products, are subjected to strict testing for the maintenance of quality. The quality control mechanism is well established and latest methods for checking purity and efficacy of medicines are used. Pharmaceutical R&D has also been contributing to provide better solutions for the problems encountered in the manufacturing and processing of pharmaceuticals.

Universities in alliance with industry are exploring the possibilities of developing new dosage forms on an industrial scale. The overall impact of R&D on the pharmaceutical sector can be seen by the establishment of biotechnologically-advanced manufacturing units in Pakistan. In addition, the academia and university linkages have proven to be effective with regard to solving technological and finished product formulation problems in the local industries. Such collaborations have also been encouraged by the Ministry of Science and Technology and the Higher Education Commission of Pakistan.

The success of the pharmaceutical sector in Pakistan can be attributed to the fact that all companies maintain high standards of quality in production processes according to cGMP, resulting in export of medicine to various countries. The prices are economical and the complaint facilitation mechanisms are robust. Essential drugs outlined in the WHO list are manufactured by the national companies. Almost all dosage forms are produced by national pharmaceutical companies e.g. tablets, syrups, capsules, suspension, drops, creams, gels, ointments, optic/ophthalmic drops, infusions, insulin, vaccines, Injectable (liquid & powder), inhalers, enemas, vitamin sachets and modified release dosages.

The production facilities include state-of-the-art equipment imported from European, Chinese and US manufactures. Highly reliable quality products of national companies have involved multinational partners to become strategic partners.

Leading companies have acquired International Organization for Standardization (ISO) certifications. Also, many international countries and quality certification authorities have acknowledged and accepted the quality of national pharmaceutical products including in the European Union (German GMP), Canada (MoH), UAE (MoH), Uganda (NDA), Sri Lanka (MoH), Sudan (MoH), Tanzania (MoH) and others. Various quality management certifications such as ISO 9001, 2000 and ISO 14001 have also been awarded to leading national companies.

Exports are given priority by all departments of the Government of Pakistan. Due to strict checks and the control system of Pakistan Pharmaceutical Manufacturer's Association (PPMA) for the export of medicine, Pakistani registered medicine products are exported to many developing countries including Russia, Canada and Singapore. Also, other production inputs such as labor, technology, power, and packaging materials are easily available.

Human resources engaged in pharmaceutical and vaccine sector are highly educated, well trained, competent and committed. The sector employs over half a million people and is considered as the largest employer of university graduates. Pharmaceutical professionals are highly skilled in process development and process optimization using latest scientific methodologies. Industry-related issues are covered through the Pakistan Pharmaceutical Manufacturer's Association (PPMA) and Pharma Bureau, which are long-established associations recognized by Government of Pakistan.



### Information Communication Technologies

In Pakistan, there are about 30 million internet users out of a total population of 180 million. Whereas 114 million have subscribed to the mobile phone services. ICT is a US\$2.6 billion industry in Pakistan, with US\$1.2 billion of domestic business and US\$1.4 billion earnings in exports. The contribution of ICT to GDP is about 1.4%. From a total of 1,800 IT companies spread across Pakistan, 10% provide technological solutions. The growth of IT sector from 2003-2016 averages a healthy rate of 30% annually. The top priority of Pakistan in ICT has been education, governance and health.

Telecommunication sector in Pakistan has seen a phenomenal growth during the last decade and has reached teledensity (number of telephone connections for every hundred individuals) of 75.1% from 15% in 2010-2011 as of March 2015 by the Pakistan Telecommunication Authority (PTA). The auctioning of 3G/4G/LTE licenses has enabled the telecom sector to enter into the next phase of its growth. The rapid increase of subscribers of mobile broadband has increased the overall broadband subscriber base to 15.6 million by March 2015 from 4.7 million in June 2014. This increase is mainly attributed to mobile broadband after the newly introduced 3G/4G/LTE services by the telecom operators. Almost 85% of Pakistan's communication network is on optical fiber, therefore providing excellent opportunities for foreign investment.

Introduction of public sector services are being made accessible online to support the citizens, enhance efficiency and transparency in governance. The efforts have been initiated to move public e-services to the lowest tier of government for a real change towards good governance. Also, for successful implementation of e-government initiative, the availability of IT professionals within the public sector further needs to be ensured.

The e-government initiative which had lost steam in the past was re-taken with a new strategic approach during the year 2016. This new approach will enable the Government to introduce e-government solutions in its various departments on an accelerated pace. The Federal Government, during the year, established National Information Technology Board (NITB). This new organization will enable better utilization of resources and effective coordination amongst the various organs of the Government for the implementation of e-government initiative.

Pakistan's IT industry is now on the verge of experiencing an exponential growth. However, to create a synergistic effect that translates into visible and significant economic growth, certain tangible measures have to be put in place.

Availability of high-speed national broadband backbone, creation of new technology centers in the country, policies that give impetus to localization of content and establishment of third-party payment gateways in the country are key steps taken by the Pakistan government to compete with developed countries in the IT industry. Furthermore, the State Bank of Pakistan and the Ministry of Information Technology issued rules and regulations for setting up e-commerce payment gateways. These are important steps in accelerating the growth of economy, increasing investments and helping improve domestic e-commerce activities by facilitating online payments.

The Pakistan Software Export Board (PSEB) is an apex Government body mandated to promote Pakistan's IT industry in local and international markets, which works with telecom regulators and operators to reduce bandwidth tariffs and improve the services. The human capital engaged in IT are professional. Ten thousand IT graduates enter the market each with a native English accent and a professional education from the best IT institutions of the country.

One of the major achievements of the PSEB and the Ministry of Information Technology is the establishment of Information Technology Parks, which ensure the provision of reliable and redundant data communication services along with software and ICT based solutions for other sectors such as pharmaceuticals, health, financial institutions, the textile industry, large scale manufacturing, academia and the power sector.

The China-Pakistan Economic Corridor (CPEC) is the harbinger of change. Where other infrastructure initiatives will be undertaken under this umbrella, alternative international internet connectivity through China will provide further impetus to the IT industry in carrying out its offshore business more effectively. This link is strategically very important and would also serve as alternative route to the existing submarine cables, which already landing in Karachi.





### Science & Technology

The stunning advances in various fields of science and technology have had a profound impact on people's lives in almost every sphere of our activity, such as health, agriculture, communication, transportation, and defense. These advances have been driven by an ever-growing volume of exciting discoveries, largely emanating from science laboratories in the west, and by their transformation into new products or processes that have flooded world markets. These floods in turn shower vast economic rewards on those nations that have the will and vision to make science and technology the cornerstone of their development programs. It needs to be understood that development is a multifaceted process, and a number of factors must dovetail together before economic growth and progress can occur. With this consideration, five key components must come together. First, the development process must be built on a foundation of high degrees of literacy and quality education at all levels.

The Pakistan government places science and technology among its highest priorities. A comprehensive program has been worked out and launched for building a knowledge-based economy by integrating science and technology with economic development programs. In the science and technology domain, our programs aim mainly at human resource development, technology development and industrialization, strengthening of R&D activities, and use of science and technology for economic development. In bringing this into reality Pakistan requires evidence-based policy formulation. Reliable and timely statistics and indicators are essential tools for informed and accurate decision-making. They are needed to measure progress, evaluate the impact of on-going programs, analyze trends, and forecast future development needs. During the past decade, an effort has been made on a regular basis to provide support to policy makers by offering an overview of indicators on science, technology and innovation. Following indicators would assist while measuring performance in science and technology sectors across Pakistan.

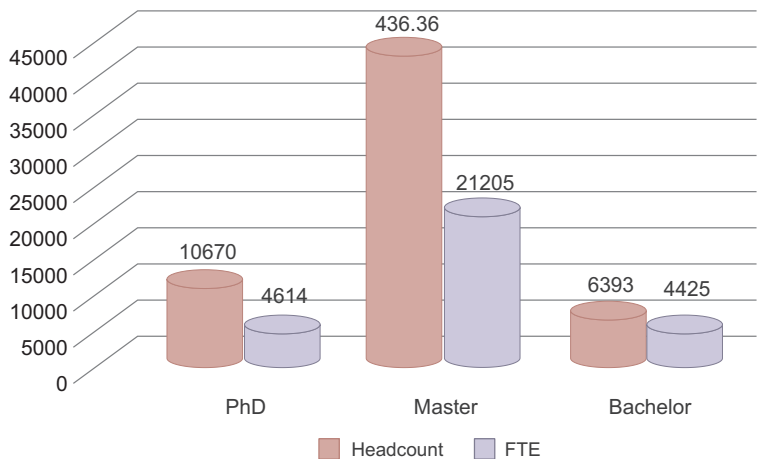
### Human Resource in Research and Development

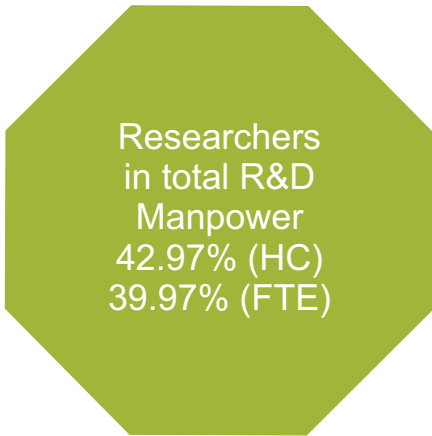
Human resources in research and development is one of the most essential components for innovation and economic growth. R&D and innovation play a vital role in a country's economic development, and the outcome of both of these activities directly depends on the size and quality of available human resources. Human resource indicators are generally presented in two forms i.e. headcounts and the full-time equivalent. 'Headcount' (HC) is the simple counting of the number of people engaged in an activity. The 'full-time equivalent' (FTE) is a method of counting people based on the percentage of time a person devotes to a particular activity. For example, for counting the number of researchers in a university, by 'headcount' method, total number of faculty members of the university will be counted. However, for 'full-time equivalent' method, first, it will be determined by how much time a faculty member spends in research. As a rule of thumb, faculty members are assumed to spend 30% of their time in research. Therefore, in FTE method, 100 faculty members will be counted as 30 researchers.



Figure 4.1 Number of researchers (Headcount and full-time equivalent) by qualification level 2015-16

The vast majority ( 71.89%) of researchers (headcount) in Pakistan are educated up to the level of Master's or equivalent. About (17.57 %) of researchers (headcount) hold the degree of PhD while a small number (10.53%) of researchers hold a Bachelor's degree.





The share of the researchers in the total R&D personnel (manpower) is 42.97% as headcount (HC) which decreased to 39.97% on full-time equivalent (FTE) basis. In case of the technicians, it is opposite as the share of technicians increased when calculated on FTE basis, as compared to headcount.

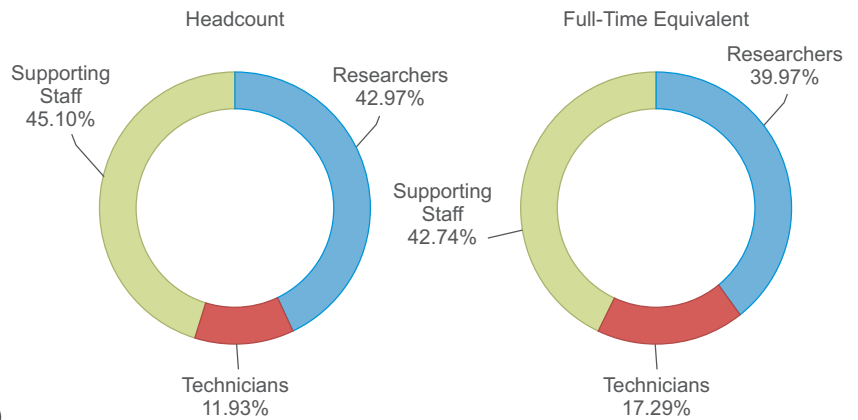
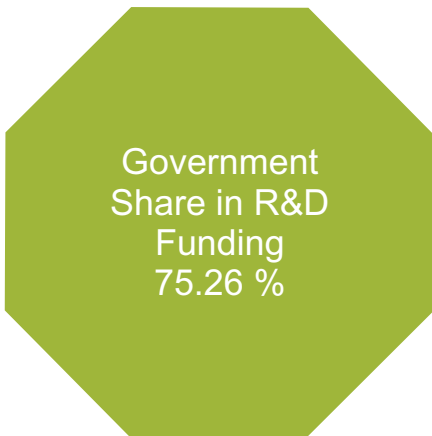


Figure 4.2 Share of researchers, technicians and supporting staff (headcount and full time equivalent in total R&D personnel in Pakistan) 2015-16

### Expenditure on Research and Development

Research, development and innovation are regarded as increasingly important for the social progress and economic growth of countries. Over time, investment in research and development has increased significantly in many parts of the world. Expenditure on research and development is considered to be one of the leading (input) indicators for benchmarking the R&D performance of countries within an international setting. However, the level/intensity of R&D expenditure measured as a percentage of GDP or per capita is often used to compare R&D effort among different countries. R&D intensity, defined as the share of R&D expenditure in gross domestic product (GDP), is also a major indicator for capturing the knowledge-based economy.



Government is the major source of funding of R&D expending fund provider for R&D. However, it should be noted that higher education includes both public and private higher education institutions.

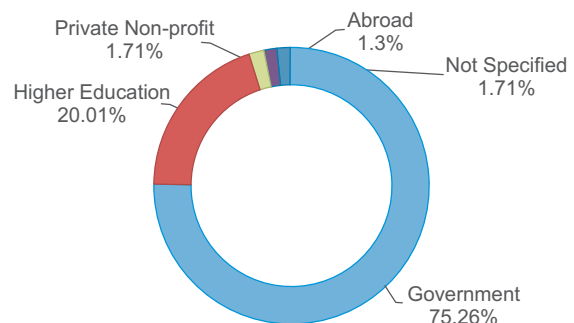


Figure 4.3 R&D expending by source of funding 2015-16

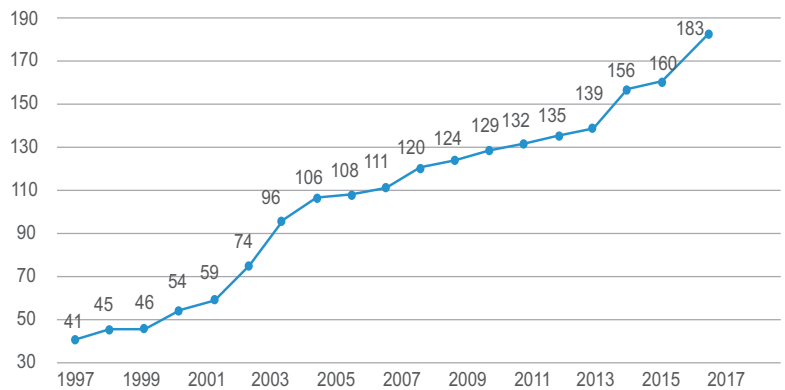
**Bibliometric Indicators**

Bibliometric indicators are generally used in making a systematic comparison of scientific output and to assess the status of S&T across institutions and geographical regions and countries. They provide a quantitative basis to measure the “health of science” in a country, and its strengths and weaknesses on a comparative basis. Two types of indicators, namely absolute and relative indicators are generally used for bibliometric analysis. Publications count, journals count, citations count, institution count, etc. are examples of bibliometric indicators. An example of the 'institution count' indicator is the number of universities in Pakistan. At the time of the creation of Pakistan in 1947, there were only two universities in Pakistan. However, during the last 15 years the number of universities has increased sharply, both in the public and the private sector, and at present the country has 183 universities.



Figure 4.4 The number of universities / Degree Awarding Institutions (DAIs) in Pakistan 1997-2017

The number of universities / degree awarding institutions (DAIs) in Pakistan has increased very rapidly during the last 19 years, especially after the establishment of the Higher Education Commission in 2002



**Graduates of Pakistani Universities**

During the period 2000-2013, around 8,456 doctoral degrees were awarded by Pakistani universities. The number of degrees per year has skyrocketed in recent years, indicating an improvement in the performance of universities, which are an important source of knowledge creation in the knowledge-based economies.

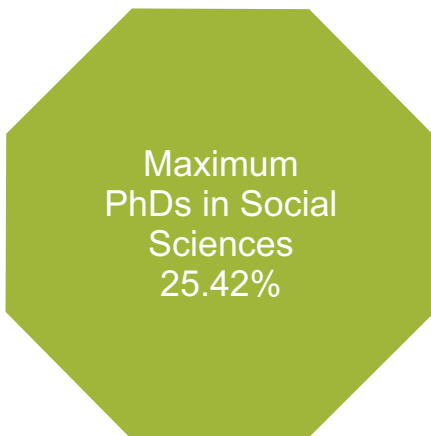
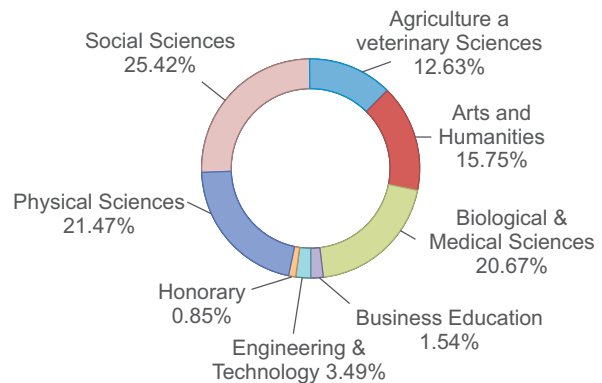


Figure 4.5 Field-wise production of PhDs by Pakistani Universities 2015-16

Pakistani universities have produced maximum number of PhDs, in the field of Social Sciences (24.24%) followed by Physical Sciences (21.88%) and Biological & Medical Sciences (20.67%).









# Profiles of the Selected Resource Centers



### Profiles of the Selected Resource Centers

For the purpose of this study, more than 40 resource centers from public, the private sector were visited and contacted. Special questionnaires have been sent to these resource centers (Appendix-2). Based on these questionnaires, activity reports, strategic plans, interviews and expert meetings, profiles of these centers were prepared. It is worth mentioning that these resource centers represent just a selection from a wide range of institutions.

Table 5.1 shows Pakistan's selected resource centers by priority areas that were described in the previous chapter. In each area, three resource centers have been selected in order to provide a more balanced picture of the institutional capacities that Pakistan possesses, and they are ready to share with other IsDB member countries.

On the other hand, the main criterion of Reverse Linkage interventions is the ability of RCs to co-finance Reverse Linkage projects. As shown in Table 5.3, different sources of funding such as government, donation, foreign resources, international private institutions, development agencies' contributions, and self-funding exist concerning Pakistan's selected resource centers. Generally, the majority of the funding comes from the government and international institutions in selected RCs. In this context, the public sector is continuing to support more and more RCs in Pakistan.

**Table 5.1 - Pakistan's Selected Resource Centers by Priority Areas**

<b>Agriculture</b>	<ul style="list-style-type: none"> <li>▪ Pakistan Agricultural Research Council (PARC).</li> <li>▪ Southern Zone Agricultural Research Centre (SARC).</li> <li>▪ Ayub Agriculture Research Institute (AARI), Faisalabad.</li> <li>▪ Agriculture Research Institute (ARI), Tandojam.</li> </ul>
<b>Agro based Industries</b>	<ul style="list-style-type: none"> <li>▪ Auriga Group of Companies.</li> <li>▪ Millat Tractors Ltd.</li> <li>▪ Agritec Industries Ltd.</li> <li>▪ Pakistan Central Cotton Committee (PCCC), Multan.</li> <li>▪ National Textile University (NTU), Faisalabad.</li> </ul>
<b>Pharmaceuticals Industry</b>	<ul style="list-style-type: none"> <li>▪ Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD).</li> <li>▪ AMSON Vaccines &amp; Pharma (Pvt.) Ltd.</li> <li>▪ Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Science and Technology, Islamabad (NUST).</li> </ul>
<b>Information Communication Technolgy (ICT)</b>	<ul style="list-style-type: none"> <li>▪ Faculty of Computing &amp; Information Technology (FC&amp;IT), University of Gujrat.</li> <li>▪ The Department of Computer Sciences and Engineering (DCS&amp;E), Air University.</li> <li>▪ Al-Khawarizmi Institute of Computer Science (KICS), University of Engineering and Technology.</li> <li>▪ Latif Ebrahim Jamal (LEJ) National Science Information Center.</li> </ul>

Table 5.2 Short Description of Selected Resource Centers

## 1 - Agriculture



Pakistan Agricultural  
Research Council  
(PARC)

Pakistan Agricultural Research Council (PARC) is the apex national organization working in close collaboration with other federal and provincial institutions in the country to provide science-based solutions to the agriculture of Pakistan through its statutory functions. PARC mandate is to undertake, aid, promote and coordinate agricultural research including plant sciences, natural resources, animal sciences, social sciences and agricultural engineering.



Southern Zone  
Agricultural Research  
Centre (SARC)

The Southern Zone Agricultural Research Centre (SARC) has a multi disciplinary team of scientists working to address different issues being faced by the agricultural sector of the southern part of Pakistan, which includes the country's coastal region. The institute succeeded in developing many technologies including new cultivars of different crops, organic pesticides, methods of post-harvest pest management, the introduction of new plants in the coastal belt, the genetic preservation of native livestock breeds, and the preparation of disease-free plants through tissue culture and special techniques and baits for the control of rodents, porcupine and wild boar.



Ayyub Agriculture  
Research Institute  
(AARI), Faisalabad

Ayub Agricultural Research Institute (AARI), Faisalabad, is the premier institute generating agricultural technology, which is acting as an engine of growth in Pakistan's economy. Its mission is to develop new varieties of crops, technologies for food safety and sustainable generation of exportable surplus for economic safeguard, value addition and conservation of natural resources. The institute has more than 4200 publications including 1250 in the journal of international repute.



Agriculture Research  
Institute (ARI),  
Tandojam

Agriculture Research Institute (ARI), Tandojam started as early as the year 1904, mandated to undertake research activities for different crops for Sindh province. Till 1962, Agriculture Research and Education were operating side by side in the same vicinity but later on separated with an independent identity, named as Agriculture Research Institute, Tandojam (ARI)

### 2 - Agro Based Industries



The Auriga Group of Companies was created to serve farming community by developing different technologies both in plant production and plant protection sectors of agriculture. It has developed innovative agricultural products like fungicides, pesticides, herbicides, growth hormones, different formulations of fertilizers and production of hybrid seed of different crops. Special emphasis has been given to organic farming. The efficacy of products yielded a better income to farmers that are evident from the excellent growth of company in last fifteen years.



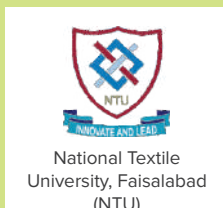
Millat Tractors Ltd, an ISO 9001:2000 certified is Pakistan's leading engineering company in agricultural tractors, machinery manufacturing more than five decades. Forklift Truck, Diesel Generating Sets & matching agricultural implements are also being produced under license. Millat Tractors has played a pivotal role in transfer of technology to farmers and modernizing the agriculture sector across Pakistan.



Agritec Industries Ltd. is a leading producer of high-technology agricultural machinery and instruments, at affordable prices for the farming community. The company's products have led to increasing farm mechanization in Pakistan. The company's different types of sprayers are effective in spraying pesticides. The company produces also preparation equipment and seeding and planting instruments. Its fodder cutter, fodder chopper, binder and packers facilitate silage production.



Pakistan Central Cotton Committee (PCCC), Multan is an apex organization established by the federal government, under the Cotton Cess Act 1923 (adapted in 1948) with the mandate "improvement and development of growing, marketing and manufacture of cotton" in the country. To cater to its given charter, PCCC has developed a network of cotton research institutions across the cotton belt of Pakistan to address different aspects related to this important cash crop of the country. It has four operational sub-committees to oversee agriculture research, marketing, technological research and administrative functions. production.



Since its inception, the National Textile University (NTU), Faisalabad has been the premier institute of textile research & development and education in the country, meeting the technical and managerial human resources needs of almost entire textile industry of Pakistan. It always aligns its efforts and education programs with the needs of textile industry.

### 3. Pharmaceuticals Industry



Dr. Panjwani Center  
for Molecular Medicine  
and Drug Research  
(PCMD)

Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD) puts all its efforts on developing greater and more comprehensive understanding of the pattern and causes of most common diseases of Pakistan in order to develop effective diagnostic tools and affordable treatments by using molecular medicinal, chemical and computational methods. Molecular medicine is an emerging new field, which deals with the understanding of the molecular basis of diseases and then developing appropriate strategies for their early diagnosis, management and elimination. The main objective of PCMD is to train highly qualified manpower in this emerging new fields of molecular medicine and drug development.



AMSON Vaccines & Pharma (Pvt.) Ltd. is one of the leading pharmaceutical companies of Pakistan engaged in local manufacturing and import of finished pharmaceutical products. In pharmaceutical manufacturing, AMSON's distinction is vaccines manufacturing and formulation during the last 20 years. AMSON is a leading company in manufacturing vaccines. The manufacturing facility of AMSON has been awarded 3 ISO Certifications i.e. ISO 9001, ISO 14001 & ISO 18001



Atta-ur-Rehman  
School of Applied  
Biosciences  
(ASAB)

Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Science and Technology, Islamabad (NUST) is the home of Pakistan's largest biotech cluster. By integrative approaches, it is determined to provide economically valuable services mainly to the health care sector and the community at large. At ASAB, various scientists/ researchers are engaged in extensive research activities and creating an internationally competitive research environment that is conducive for the need of nation in the health care sector. It provides excellent research and teaching facilities in the field of applied biology in Pakistan.

4 - Information Communication Technology (ICT)



Faculty of Computing & Information Technology (FC&IT), University of Gujrat is a young, vibrant and one of the fastest growing school in higher learning amongst public sector universities of Pakistan which was established in 2004 within University of Gujrat (UoG). FC&IT is producing and delivering knowledge besides extensively contributing to regional development through Research and Development (R&D), Information Communication Technology, Entrepreneurship and Technology Transfer.



The Department of Computer Sciences and Engineering (DCS&E), Air University was established in 2002 within Air University a federally chartered university in Islamabad. This public sector university has established a decent repute in relatively short time in the areas of Information Communications Technology (ICT).



Al-Khwarizmi Institute of Computer Science (KICS), University of Engineering and Technology (UET), was established mainly for conducting research and development activities in Computer Science (CS) and Information Technology (IT). It was envisioned as an institute for advanced and high quality applied research working in collaboration with industries and other academic institutions on national and international levels to bring about the IT revolution in Pakistan and help build a knowledge-driven economy.



Latif Ebrahim Jamal (LEJ) National Science Information Center was established in 2006 as an integral part of the International Center for Chemical and Biological Sciences. The LEJ Center has state-of-the-art facilities and access to the latest information resources, capable of providing information in frontier areas of science and technology.



Table 5.3 Source of Funding for Resource Centers

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Government</p> 	<ul style="list-style-type: none"> <li>• Higher Education Knowledge Exchange Program (KEP)</li> <li>• Higher Education National Research Program for Universities (NRPU)</li> <li>• Defence and Science and Technology Organization (DESTO)</li> <li>• Maritime Technology Centre (MTC)</li> <li>• Pakistan Atomic Energy Commission (PAEC)</li> <li>• Space and Upper Atmospheric Commission (SUPARCO)</li> <li>• Higher Education Commission (HEC)</li> <li>• Pakistan Academy of Sciences</li> <li>• Pakistan Army</li> <li>• Pakistan Air Force (PAF)</li> </ul>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">International Institutions</p> 	<ul style="list-style-type: none"> <li>• Prince Sultan Advance Tech Research Institute (PSATRI)</li> <li>• National Instruments, USA</li> <li>• Deutscher Akademischer Austausch Dienst (DAAD) - German Academic Exchange Service Federal Ministry of Education National Authority for Science and Technology, Laos</li> <li>• Language Technology Kendra, Nepal</li> <li>• University of School of Computing, Sri Lanka</li> <li>• InfoCon Co. Ltd, Mongolia</li> <li>• Office of Naval Research, USA (ONR)</li> <li>• National Institute of Health, USA (NIH)</li> <li>• National Science Foundation, USA (NSF)</li> <li>• Organisation for the Prohibition of Chemical Weapons (OPCW)</li> <li>• The World Academy of Sciences (TWAS)</li> <li>• International Foundation for Science (IFS)</li> <li>• OIC Standing Committee on Scientific and Technological Cooperation for the Promotion and Cooperation of Science and Technology (COMSTECH)</li> <li>• Islamic Development Bank (IsDB)</li> <li>• King Abdul Aziz City for Science and Technology, Saudi Arabia (KACST)</li> <li>• British Council</li> <li>• Swiss Development Corporation (SDC)</li> <li>• Canadian International Development Agency (CIDA)</li> <li>• United States Agency for International Development (USAID)</li> <li>• International Center for Agriculture Research in the Dry Areas (ICARDA)</li> <li>• International Center for Biotechnology and Genetic Engineering (ICGEB)</li> <li>• United States Department of Agriculture (USDA)</li> <li>• International Development Research Centre (IDRC)</li> <li>• International Centre for Integrated Mountain Development (ICIMOD)</li> <li>• Food and Agriculture Organization (FAO)</li> </ul>

# Agriculture





## Pakistan Agricultural Research Council (PARC)



The Pakistan Agricultural Research Council is undertaking research and development activities in agriculture with a number of satellite institutions established in all ecological regions of Pakistan. PARC has developed a very effective mechanism of research coordination for National Agriculture Research System (NARS) in the country and linkages with the international institutions working in this sector. Over a certain period of time it has developed many high-yielding varieties, crop production and protection technologies, new farm machinery, soil and water management techniques, improvement in livestock sector, and use of biotechnology, to serve Pakistan's farming community.

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### Introduction

The Pakistan Agricultural Research Council (PARC) started out in 1951 as the Food & Agriculture Committee of Pakistan (FACP) and finally evolved into its present status as an autonomous organization in 1981. The Government of Pakistan set up PARC, with its headquarters in Islamabad, to undertake, promote and coordinate agricultural research and development activities in the country.

It has five regional research centers (one in each province) and a number of satellite institutes established in all ecological regions of Pakistan. It has around 3,000 employees, including 530 highly-qualified scientists, 163 with PhD degrees, assisted by parascientific and support staff. Financial resources are mainly provided by the Pakistan government, and some come from development projects funded through the Public Sector Development Programme, MOU/agreements with national/international organizations and by PARC's internal income generation.

### Sectors & Main Activities

PARC has been mandated to undertake, aid, promote and coordinate agricultural research in the country. Its domain of work includes the development of varieties for field and horticultural crops; chemical and biological pest control; bioremediation; farm machinery design and development; development of crop production technologies; soil and water management; climate change; management of natural resources; forestry and range lands; animal breeding health and genetics; dairy technologies; poultry research; fish and aquaculture; policy analysis; specialized diagnostic surveys; impact assessment of different technologies; human resource development/management, and national and international coordination.

### Area of Expertise

PARC has a workforce of about 530 highly-trained scientists in multi-disciplinary areas in agriculture including agronomists, plant breeders, food technologists, plant pathologists, entomologists, horticulturists, soil scientists, irrigation scientists, social scientists, agricultural engineers, bio-technologists, rangeland - forestry scientists, experts in livestock, dairy development and fisheries. PARC functions as a center of expertise for regional, national and international institutions in specialized areas.

### Achievements

Among its achievements are development and approval of 35 high-yielding cultivars resistant to biotic and a-biotic stresses. An indigenous hybrid seed development program is in progress. Certified fruit mother orchards and nurseries have been established. Similarly, it has also promoted high potential minor crops. Other achievements include agricultural machinery and implements developed for diverse ecologies, and varied farm sizes and operations. Cost-effective and environmentally-friendly resource conservation technologies of crop production have also been developed.



Olive plantation has been introduced into the potential ecologies of Pakistan. Environmentally-friendly biofertilizers have been developed and commercially introduced. The technology of bioremediation for heavy metals, and sewerage water for irrigation has been developed and introduced on a commercial scale.

### Why is this institution a Resource Center?

PARC is equipped with highly skilled scientific, parascientific staff, supported with fully-equipped and internationally-accredited laboratories, complete physical infrastructure, and the required land resources. It has facilities available for human resource development and technology dissemination and commercialization. PARC has the only gene bank of Pakistan with a large capacity for the storage of germplasm, which is shared with breeders across the world. Similarly, the only poultry disease reference laboratories of Pakistan were established in PARC, which cater for the requirements of the country. PARC has established a strong national coordinating mechanism to support national agricultural research system and linkages with the international community.

### International Cooperation

PARC has developed a strong network of international cooperation and became an active member of international, regional and sub-regional research organizations like the Consultative Group on International Agricultural Research system (CGIAR). It is also an active member of different institutions and organizations like the Centre for Agri-biology (CABI), the Asia Pacific Association of Agricultural Research Institutes (APAARI), UN system organizations, and has a collaboration with USAID and USDA. It is a focal point of OIC in Agriculture for Pakistan. It has signed a number of MOU's with many international institutions like ASLP, JICA, ICIMOD, and more than 60 bilateral agreements with many countries and their institutions.

### Projects and Programmes

PARC as a national level apex organization has completed many mega projects for the strengthening of the agriculture sector in Pakistan. A few examples are: the National Oil Seed Programme; the Barani Agricultural Research & Development Project (Canadian Support); the Agricultural Strengthening Project (USAID); Management of Agricultural Research and Technology – (USAID); the Pakistan Agri. Research & Development Project (World Bank); the Olive Promotion Project - (Government of Italy); the Wheat Productivity Enhancement Programme (USDA); the Agriculture Innovative Program (USAID): Uplifting of Agriculture set up in Northern Areas – ICIMOD; Foot and Mouth Disease

Control Project – FAO; Avian Influenza Project with different international institutions; the Australian Linkage for Citrus and Mangoes-AUS-AID; Post Harvest and Value Addition (SARC); Agriculture Linkage Programme (USDA) and many other joint ventures with international partners.

### Agricultural Linkages Programmes

PARC is implementing the Agricultural Linkage with the purpose of strengthening agricultural research and development in the country by ensuring adequate financial support for different activities. A fund was created in 2000 with an initial investment of US\$ 23.2 million, invested in government profit-making schemes and the profit/interest earned is used to fund grants. This mechanism was the first of its kind and a unique program supported by USDA and followed by many other donors for various organizations. The priorities for research are set in keeping with national goals. Research proposals are invited from all over Pakistan against those set priorities for open competition. Proposals are scrutinized by the technical divisions of the council involving provincial research leaders. Selected scientists submit full-blown proposals that, after necessary improvements are put forward for the approval of the Technical Advisory Committee, made up of eminent scientists. Proposals cleared by this body are submitted to its Board of Directors (comprised of national provincial research leaders/planners). Approved proposals are funded with a proper accounting and administration system. So far, 374 projects have been completed with total cost of US\$ 14.4 million. Forty-nine projects are on-going with an approved cost of US\$ 3.31 million. A large number of technologies, products, research methods, and information has been developed for the use of different end users.



## Southern-Zone Agricultural Research Centre (SARC)



The Southern Zone Agricultural Research Centre (SARC) has a multi disciplinary team of scientists working to address different issues being faced by the agricultural sector of the southern part of Pakistan, which includes the country's coastal region. The institute succeeded in developing many technologies including new cultivars of different crops, organic pesticides, methods of post-harvest pest management, the introduction of new plants in the coastal belt, the genetic preservation of native livestock breeds, and the preparation of disease-free plants through tissue culture and special techniques and baits for the control of rodents, porcupine and wild boar.

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### Introduction

The SARC is the second largest research establishment of the Pakistan Agricultural Research Council (PARC) established in 1987, with the main campus at the University of Karachi and with two satellite institutions present in different ecological regions of Sindh. There are six institutes at Karachi main campus, working on crop diseases; food quality; vertebrate pest control; new plant introduction; pest management and on-farm outreach activities. The satellite institutes work on sugarcane, tropical horticultural and arid zone research.

There are 63 scientific and 106 parascientific staff with expertise in different specialized areas to undertake any assignment in their related discipline. Scientists are strengthened with 150 support staff. The budget is largely provided by government with some support as grant-in-aid from national and international donors.

### Sectors & Main Activities

This institution is actively engaged in research work, training and consultancy services in the field of Agriculture with special emphasis on agronomy, plant breeding, rangeland management and other related areas like management of post harvest losses and food technology.

Research work includes surveillance of crop diseases, especially regarding new races of rusts, management of stored grain insects, development and production of rodenticide baits. In addition other areas of activities are quality improvement and standardization of food grains, quantification of insecticides residues in fruit and vegetables, testing of adaptability and introduction of tropical plants in coastal areas of Sindh and Balochistan. Efforts to develop new sugar cane varieties, propagation of disease-free bananas through tissue culture, multiplication of plant flora under arid/desert eco-system and preservation of native livestock germplasm are also being undertaken here.

### Area of Expertise

SARC is fully equipped to provide consultancy services to different stakeholders and capable of undertaking any assignment in its domain of work explained in the aforementioned lines.

SARC has multidisciplinary specialized areas of work in agriculture encompassing agronomy, plant breeding, soil management, insect and rodent pests, plant diseases, biological control, water resources management, postharvest management, testing the adoptability of new germplasm and food quality improvement in the field of fisheries and livestock.

### Achievements

The institution has been equipped with an ISO 17025 accredited laboratory for grain quality testing, which is providing services to public and private sectors for testing their material for import and export. In this regard, wheat quality standards for domestic and international marketing have been developed. The SARC has also developed biscuits as functional food, high in energy and low in sugar.

This institution has developed many technologies in different disciplines of agriculture and allied sectors. Out of those some of the achievements include complete technology packages along with PARC Rat bait formulations prepared for control of rodent and porcupine infesting in field crops and horticultural orchards, capsular technique for the control of wild boars and package for control of parakeet and other avian pests.

Plant breeders of Pakistan working in different crops, especially in wheat are supported to screen their material against different disease pressures in southern region of Pakistan.

SARC helps public and private godowns of grain storage with grain protection measures by fumigating them with appropriate techniques i.e. PEPF (Polyethylene Enclosure

for Phosphine Fumigation), and staff of the relevant institutions are also being trained for the purpose. In addition, different products are used for the control of different pests, such as NIMBOLI for household insects, NIBOKIL 60EC for insects at farm level and FERTINEMAKIL for the nematodes.

Bio-pesticide for control of subterranean termite against wax moth larvae, mealy bug and entomopathogenic nematode has also been progressed in the research center. Three sugarcane varieties (Thatta-10, Thatta-2109 & Thatta-326) have been developed and registered for commercial cultivation. SARC also serves as source of fuzz development needed to raise germplasm for sugarcane varietal development. This fuzz is being provided to national and international institutions working for sugarcane breeding.

In addition, a famous race of red Sindhi cattle of Pakistan was preserved through breeding process. SARC is also providing training to different stakeholders for use of different technologies. For these efforts SARC has received many national and international awards.



### Why is this institution a Resource Center?

SARC is equipped with quite a good number of scientific and an allied workforce trained in a wide range of specializations including plant breeding, soil management, plant protection, agronomy, food and water quality management, the development of arid areas, and livestock. This manpower is supported with

fully equipped laboratories and land area or research activities. SARC scientists have more than 300 research papers at their credit during the last years, published in all leading journals of the world. The Centre has conducted international and national workshops, seminars and training programs to share the knowledge generated with other relevant stakeholders. Besides 35 consultancies were provided to public and private sector organizations during the last few years.

### International Cooperation

SARC is actively engaged in developing and executing different research projects and mutual activities including lab accreditation process and testing of samples with Netherlands; grain storage research with United Nations Industrial Development Organization (UNIDO); rust surveillance program with Centro Internacional de Mejoramiento de Maíz y Trigo, International Maize and Wheat Improvement Center known by its Spanish acronym (CIMMYT); a wheat productivity enhancement program with the United States Department of Agriculture (USDA); a grain quality testing training program with Canadian International Development Agency (CIDA); exchange of sugarcane germplasm with national and international institutes; sugarcane development program with China; hybrid rice development program with the help of China; development and dissemination of aromatic Chinese banana in Pakistan under Asian Vegetable Research and Development Center (AVRDC) project and introduction of off-season vegetables.

Meanwhile, various projects as joint venture have been completed which include issues of grain storage and postharvest studies with the financial support from World Bank; six grain storage technologies developed and transferred to end users with the help of the United States Agency for International Development (USAID); fumigation of grains with the help of Official Development Assistance (ODA), UK; research on indigenous plants for the development of bio-pesticide was carried out with support of USAID and Sweden; research on different issues of vertebrate pest control carried out with the support of the Food and Agriculture Organization (FAO).



## Ayub Agricultural Research Institute (AARI), Faisalabad



Ayub Agricultural Research Institute (AARI), Faisalabad, is the premier institute generating agricultural technology, and acting as an engine of growth of economy of Pakistan. Its mission is to develop new varieties of crops, technologies for food safety and sustainable generation of exportable surplus for economic safeguard, value addition and conservation of natural resources.

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### Introduction

In 1962, Ayub Agricultural Research Institute (AARI), Faisalabad was originated after the bifurcation of research and education working under the former Punjab Agricultural College and Research Institute Lyallpur, established in 1905.

AARI was the beacon to the green revolution in the country in the late sixties and since then has consistently played a key role in meeting the post-green revolution productivity challenges and ensuring national food security. Under the administrative control of AARI there are 166 research stations/sub-stations, 25 research institutes and two sections are functioning across the Punjab province. There are 1067 scientists with 4003 supporting staff working in these institutions. AARI's budget is largely provided by the Government of Punjab.

### Sector & Main Activities

AARI is involved in agriculture sector. It undertakes research and development, disseminates knowledge, provides advisory services and organizes training.

### Area of Expertise

The areas of specialties include genetic improvement, developing new varieties; development of crop production and protection technologies; understanding and utilization of soil and water resources; seed provision of new varieties; postharvest technologies and value addition in fruits and vegetables.

### Achievements

AARI has evolved 478 varieties of various crops, fruits and vegetables since 1962, which were highly appreciated and opted by the farmers for general cultivation. Most of the crop cultivated area for wheat, rice, cotton, sugarcane, pulses and oilseeds is with the varieties developed by this institute. AARI is producing basic/pre-

basic seed of various crops approved by the seed council.

With reference to production technology, the appropriate planting time, fertilizer regime, seed rate, sowing method and other technical aspects to maximize the varietal yields are determined in order to help farmers for harnessing potential yield. Tunnel technology for off-season vegetable production was introduced by this institute, and is now widely practiced and profitably by the farmers.

On the basis of comprehensive research activities, a number of chemical sprays were tested in order to combat various insects, fungi, weeds and other pests. Effective plant protection technologies and integrated pest management protocols have also been developed. Microbial cultures are provided to the farmers for biological nitrogen fixation, phosphorous solubilization and the development of growth hormones to improve soil, crops and plant health.

The institute renders advisory services to thousands of the farmers through analysis of soil, water, fertilizer, gypsum and plant samples for efficient use of natural resources and soil reclamation.





## Why is this institution a Resource Center?

The institute has more than 4,200 publications including 1,250 in journals of international repute during the last few years. It disseminates technologies through electronic & print media, seminars, consultation meetings, workshops and farmer days. The research programs are devised in consultation with all the stakeholders based on the current and future needs. This institute has advanced R&D facilities in plant breeding, agronomy, soil science, horticulture, plant pathology, entomology, food technology and agricultural economics.

It also provides advisory, regulatory and plant analytical facilities to the professionals and other stakeholders. Trainings are imparted to agriculture graduates, extension staff, pesticide dealers and farmers.

At district level, 36 soil and water testing labs are involved in analyzing soil and water samples for which farmers are advised accordingly. Regulatory aspects, such as quality testing and quantification of residues in pesticides and fertilizers are carried out at advanced labs.

AARI conducts research and evaluation trials in different agro-ecological zones at its network of 166 stations. The institute has enriched the gene pool of various crops, fruits and vegetables that is well acclimatized to diverse climatic conditions of Punjab. The Pakistan Council for Science and Technology (PCST) has ranked AARI the Top in all R&D organizations of Pakistan in 2013.

## International Cooperation

The institute has cooperation in various R&D projects with international organizations like the United States Department of Agriculture (USDA); International Center for Agricultural Research In the Dry Areas (ICARDA); the International Maize and Wheat Improvement Center (CIMMYT); International Centre for Integrated Mountain Development (ICIMOD); International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); the Borlaug Global Rust Initiative (BGRI); Harvest Plus; the Asian Vegetable Research and Development Center (AVRDC) and member of Hybrid Rice Development Consortium (HRDC), and IRRI, Philippines.

With USDA and ICARDA, the institute collaborated in development of Cotton Leaf Curl Virus (CLCuV) resistance cotton germplasm, watershed rehabilitation and irrigation improvement, improving soil fertility.

A Project on Watershed management approach to mitigate flood hazard and drought was developed in collaboration with United Nations Educational, Scientific and Cultural Organization (UNESCO). There is collaboration of National Science Foundation (NSF-USA)

in 'Development of novel salt tolerant forage and cereal crops' project.

Mung bean production improvement and the protected cultivation of vegetable projects are also ongoing projects with AVRDC and the World Vegetable Centre cooperation.

The following projects were completed with CIMMYT collaboration: Promoting science and innovation in agriculture in Pakistan, heat stress resilient maize for South Asia, Cereal Systems Initiative for South Asia (CSISA) project on wheat research on heat tolerance, Wheat Productivity Enhancement Programme (WPEP), Agriculture Innovation Programme and conservation agriculture activities in rain-fed areas.

Sugarcane plant improvement through traditional and modern breeding technologies was executed in collaboration with Sugarcane Research Institute, UdaWalawe, Sri-Lanka, Philippine and Mauritius. Likewise, Australia Pakistan Agriculture Sector Linkages Program (ASLP) Pak-Australia mango production project was completed in 2015 with the cooperation of Australian Centre for International Agricultural Research (ACIAR).

Olive plant cultivation and a capacity-building program are underway with the cooperation of the Italian government. The Government of Punjab has sponsored this project under Annual Development Programme with specific objectives to achieve olive cultivation on 6,110 hectares by providing 2,038,500 certified nursery plants and water source development with drip irrigation system to farmers of Chakwal, Attock, Jhelum, Rawalpindi and Khushab districts of Punjab.

The aim of the project is to increase local production of premium quality edible oil supporting olive farming, reducing oil import bills. The other boons of the project forming and include utilization of marginal rain-fed land and employment generation.



## Agriculture Research Institute (ARI), Tandojam



Agriculture Research in Sindh, started as early as the year 1904, was mandated to undertake research activities for different crops for Sindh province. Till 1962 Agriculture Research and Education were operating side by side in the same vicinity but later on separated with independent identity, named as the Agriculture Research Institute, Tandojam (ARI)

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### Introduction

Agriculture Research in Sindh, started as early as the year 1904, mandated to undertake research activities for different crops for Sindh province. Until 1962, Agriculture Research and Education were operating side by side in the same vicinity but later separated with an independent identity and mandate.

Agriculture Research was named as the Agriculture Research Institute, Tandojam, with a mandate to develop improved varieties of field and horticultural crops and the development of crop and zone specific production techniques to realize their yield potential. This Institute's staff numbers about 485 scientists, 1,814 parascientific staff/technicians, assisted by more than 2,000 support staff. The scientific team is comprised from different disciplines and includes agronomists, plant breeders, soil scientists, plant pathologists, entomologists, horticulturists and food technologists, among others. This institute has five establishments in the different ecological regions of Sindh and with specific objectives.

### Sector & Main Activities

In the area of agriculture, the ARI undertakes targeted research, develops technology packages and provides training to farmers and end users.

The specific activities of ARI includes the evolution of new high-yielding good-quality varieties that are resistant to biotic and a-biotic stresses for major as well as minor crops; the development package of appropriate improved production techniques for achieving potential economic yield in different new cultivars; conducting studies on crop requirement for important inputs; the dissemination of improved production technologies to the end users; the development of appropriate plant protection measures for controlling weeds, insects pests and diseases; producing BNS pre-basic, basic, and certified seeds for different crops for further multiplication

and making them available to the growers; providing advisory services to the growers regarding field issues; and facilitating farmers with soil and water analysis of their farms.

### Areas of Expertise

The institution possesses specific expertise in developing new improved varieties of field and horticultural crops through selection and hybridization. Studies on agronomic requirements are undertaken for different crops and newly developed varieties viz. seed, sowing time, method, spacing, maintenance of plant population, number of irrigations required with proper interval, use of fertilizer, etc.

Plant protection measures for pest management including integrated management practices to control insect pests, diseases and weeds are also being developed. Biological control of pests through mass rearing of parasites (*Trichogramma*), Predators (*Chrysopa*) is being employed and developed cards are being supplied to growers. Evaluation of new pesticide efficacy and their adverse effects on targeted crops are being tested.

Efforts are made to enhance water use and fertilizer efficiency under diverse ecological conditions and soil types. Reclamation is being done for salt affected soils through effective measures. Farmers are being facilitated while extending soil and water analysis of their farms and development of post harvest technologies to minimize storage loss of different commodities. Human resources are being developed by providing appropriate training to different end users in the relevant fields.

### Achievements

Different Institutions working under Agriculture Research Sindh set up with their headquarters at Tandojam

developed 63 improved varieties of different crops like wheat (11), cotton (10), sugarcane (9), rice (9), vegetables including onion, chilies, okra (7), oilseeds including sunflower, rape seed mustard (5), Sorghum, maize, chickpea (2), and ten varieties of different fruits, which have been well adapted by the farmers of the province. Efforts have also been extended to develop disease-free banana and date palm varieties through tissue culture techniques.

The institution is also producing a large quantity of quality seed for various crops every year and providing it to Sindh seed corporation, private seed companies and progressive growers for further multiplication.

The Agriculture Research Sindh developed full technology packages of various crops for harvesting maximum yield per unit area.

The institute has introduced pest control technologies including Integrated Pest Management (IPM), mass rearing of various parasites and predators, insect control through pheromones etc.

Continuous surveillance of inception of any disease in the province is carried out and accordingly preventive measures are taken to check the spread of that disease. Special techniques have been developed to protect post harvest losses of different commodities during storage.

Technologies/techniques related to cultivation of edible mushroom have been developed and interested farmers are being trained in this field.

Techniques have been developed to produce 'clean' mango nursery and advanced tree husbandry (different from traditional methods) have been developed for preparing high quality disease free planting material and making it available to end users and to the related industry as well.

For biological control of pests, collection of parasitoids associated with multiple fruit flies has been undertaken. A parasitoids *Trybliographa daci* was reared from flies in mango.

Strawberry cultivation in Sindh has been introduced with appropriate technology including integrated nutrients management techniques for better yields with reasonable cost. Integrated techniques to control the pest has been developed to minimize the use of insecticide to avoid environmental hazard.

Sugarcane is one of the major crops of Pakistan and Sindh Province in particular, which meets sugar and sugar byproduct requirements of the country; therefore, a number of sugarcane varieties have been evolved with a potential of high cane as well as sugar percentage.

## Why is this institution a Resource Center?

This institute has five branches in different ecological regions of Sindh with a specific mandate and is equipped with highly skilled scientific, parascientific staff, supported with fully equipped laboratories, complete physical infrastructure, and required land resources.

It has facilities available for human resource development, technology development, dissemination and commercialization. Its laboratories are well equipped with equipment and trained personnel.

The research programs of all institutes are devised in consultation with all the stakeholders based on the current & future needs.

The institute also provides advisory, regulatory and plant analytical facilities to the professional and other stakeholders. Trainings are imparted to agriculture graduates, extension staff, pesticide dealers and farmers. In addition, this institute is part of a national coordinated research setup and works as a focal point in Sindh for research activities for many national and international organizations.

## International Cooperation

The institute has developed a strong cooperation with international organizations in various R&D projects like the US Department of Agriculture (USDA), International Center for Agriculture Research on dry land areas (ICARDA), International Center for Wheat and Maize improvement (CIMMYT), International center for Mountain area development (ICIMOD), Plant Genetic Research Institute (PGRI), Harvest Plus, International Center for Vegetables (AVRDC), Japan International Coordination Agency (JICA), International Rice Research Institute (IRRI) Philippines and number of partnership agreements have been signed with these international partners.

Accordingly this institution has completed many joint projects with International institutions, that includes Wheat Productivity Enhancement Programme (WPEP) with the help of PARC, CIMMYT and USDA; Rice Varietal Programme (with the help of IRRI); the Wheat Varietal Development Programme (with the support of PARC, CIMMYT, ICARDA and the AIP program of USDA); Integrated Pest Management Programme (with the help of different donors); Introduction of new germplasm of Mangoes and establishment of certified nurseries with the help of the Australian Linkage Programme; Sugarcane varietal and technology development program with the help of the Chinese Academy of Agricultural Sciences (CAAS).

# Agro Based Industries





## Auriga Group of Companies



Auriga Group of Companies has developed innovative agricultural products/technologies for plant protection, plant production, plant nutrition and hybrid seed development with special emphasis on organic farming. The efficacy of company's products resulted to yield significantly better and thus increased farm income that is evident from the excellent growth of the company in last 15 years.

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### Introduction

Auriga Group (AG) was established in 2001 with a vision to supply hi-tech agricultural inputs at the doorstep of farmers in the country. The effective product line and efficient management skills popularized the enterprise with an unprecedented growth in a very short span of time. At present, it has three distribution arms: Auriga Chemical Enterprises, Bravo Crop Sciences and Roshan Crop Sciences. Besides, state-of-the-art production facilities and well-equipped quality control and research labs with a human resource of 310 professionals out of which 145 are agricultural graduates. Besides, about 739 field officers are in charge of transferring the developed technologies to farmers.

The allied departments such as finance, logistics, security, production, labs and warehouses at head office and regional level include about 500 staff. The commercial activities of the company generate all the revenue.

### Sector & Main Activities

The AG is involved in research, development, distribution and marketing of agro-based products including pesticides, bio-pesticides, macro and micronutrient fertilizers, biofertilizers, bio organophosphate, plant growth regulators and high-yielding hybrid seeds of different field crops, fodders and vegetables. Its R&D team is involved in the development of highly-effective and innovative products keeping in view the climatic and soil conditions of the country.

The AG's marketing network of technical and stock resources is available at every 25 km in the vicinity to cater for the requirements of farmers and can reach out to any farmer across the country. The marketing network is supported by the development managers and technical staff to address the farm-specific problems, and to keep farmers informed about newly-developed technologies and innovative products of the enterprise.

### Area of Expertise

The group specializes in developing innovative products and technologies for plant nutrition, biocontrol and hybrid seeds, highly effective under local diverse ecological conditions.

### Achievements

The organization was established with the slogan of "Innovative Agriculture". Since inception it proved to be pioneer and trendsetter in developing new technologies on the basis of indigenous work of its research and development. It addressed the issues of the yield barriers, soil problems and insect pest infestation and find out the solutions for these issues. Auriga is pioneer to introduce chelated micronutrient fertilizers in Pakistan to increase the fertilizer use and efficiency of micronutrients in alkaline soils.

Efficiency of phosphate fertilizer was enhanced by introducing bio-organo-phosphate. The macro and micronutrient foliar fertilizers were augmented with plant growth regulators along with balanced nutrition. The organization is also a pioneer in developing biopesticides and biofertilizers that do not have any residual effect or



toxicity to humans and are most effective and economical for organic farming. Auriga gave a breakthrough in the agriculture market by introducing hybrid rice seed that boost the yield of farmers from four ton per hectare to more than 10 ton per hectare.

The research work is being carried out in the area of developing pesticides, effective formulations of bio-fungicides, bio-insecticides, biofertilizers, synergistic



mixtures of plant nutrients and plant growth regulators for foliar applications and chelated micronutrients for soil applications.

The group took an initiative for urban pest management and established a network in major cities of the country. It supplied environmentally-safe pesticides duly approved by the public health department. The enterprise supplies the best products range of termite control and dengue mosquito control in addition to rats, cockroaches, flies and other household pests. The Government of Punjab also took the advantage of AG, infrastructure to effectively control the epidemic situation of dengue virus in Lahore and other affected cities.

The AG has the largest distribution network among all the national and multinational trustful agricultural companies in Pakistan with trustful farm advisory services and high-tech labs. To ensure the quality line at production plants, Auriga has got certified under ISO 9001

### Why is this institution a Resource Center?

The institution has a history of 15 years in research and development. It cooperates with the national universities for internship of graduate, postgraduate and doctoral degrees. The lab facilities were utilized by the students in collaboration with academic institutes to isolate and screen out the beneficial microorganisms to be used for biofertilizers and biopesticides. It has a good collection of microbial strains of bacteria, fungi and other microbes.

The organization has a technical professional team that arranges demonstrations at farmer level, farmer meetings, field days and high profile meetings for training and education for new emerging technologies. The company has a good team of experts and field staff to develop technologies and to make these technologies available on the doorstep of farmers to overcome the yield barriers of different crops by enhancing yield, improving soil conditions and management of insect pest infestations.

### International Cooperation

The organization has joint ventures in seed research with China, India and USA. Company has signed a Memorandum of Understanding with a Chinese provincial government to undertake research for developing hybrid rice. Under this project activities are undertaken at research sites in Pakistan and China. As a result, new hybrid rice varieties have been developed, and are available to farmers for cultivation.

The AG's professionals are in contact with Ministry of Agriculture China for business in customized formulations of Fertilizers. Auriga also has collaborative relations with Chinese Academy of Sciences in training and application of biopesticides and its quality control. (PFF).



### Millat Tractors Ltd.



Millat Tractors Ltd. (MTL) is Pakistan's leading engineering company in the automotive sector engaged in the manufacturing and marketing of Massey Ferguson (MF) tractors more than five decades. Forklift truck, diesel generating sets and matching agricultural implements are also being produced by the company. MTL is regarded as a pioneer for setting up country's automotive vendor base. Establishment of an unmatched, elaborate and extensive network has earned itself a reputation par excellence.

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#### Introduction

Millat Tractors Limited (MTL) is Pakistan's one of the leading engineering company in the automotive sector engaged in the manufacturing and marketing of Massey Ferguson (MF) tractors more than five decades. MTL was established in 1964 with a main goal to introduce and market Massey Ferguson Tractors in Pakistan. In 1972, the company was nationalized and started assembling and marketing tractors on behalf of the government-created Pakistan Tractor Corporation (PTC).

In 1980, the government decided to manufacture the tractor in Pakistan and PTC transferred this role to MTL in 1981. It took one year for MTL to manufacture its own tractors by setting up the first engine assembly plant in Pakistan. In 1984, MTL set up manufacturing facilities for the machining of intricate components not available in Pakistan.

In 1992, MTL was privatized through a management buyout. The company also produces forklift trucks, diesel generating sets and matching agricultural implements. MTL is regarded as a pioneer for setting up the country's automotive vendor base. Establishment of an unmatched, elaborate and extensive network has earned itself a reputation par excellence. MTL is an embodiment of quality control, integrity and highest level of consumer focus satisfying the international standards.

#### Sector & Main Activities

Millat Tractors has played a pivotal role in the mechanization of the agriculture sector and transformation of fledgling local light engineering sector into a robust, vibrant, quality conscious auto vending industry and is considered pioneer in this particular sector in Pakistan. Local content of more than 90% has been achieved by Millat Tractors. The company manufactures tractor models ranging from to 50-85 horsepower, diesel

engines, energy generation sets, forklift truck and farm implements.

#### Area of Expertise

The company provides seven locally-manufactured tractor models ranging from 50 to 85 horsepower, which are globally competitive in both price and quality. Besides these, models of 100 horsepower and higher are being imported to cater to the needs of large farms.

MTL also manufactures a wide range of agricultural implements like chisel, disc and mold board plough, tine tillers, offset disc harrow, ridgers, front blade, multi-purpose rear blade, agriculture loader, commercial loader, farm trailer, hydraulic tipping trailer, water bowser, jib crane, post hole digger, lawn mover, bailer and rice puddler. MTL has also developed a network throughout the country to ensure a wide range of spare parts and trainings for end-users regarding its developed products.

Among the known machines of MTL, the most sought after is a 3-4 cylinder Prime Movers, manufactured with MTL's own 3.152 and 4.248 engines. These are mainly used by irrigation, firefighting agencies etc. Similarly, a 3-





ton forklift Trucks with CKD from Anhui Truck Group China, fitted with MTL's 3.152 engines are also being produced at company's plant. Besides, the diesel power generation sets, ranging 12.5 to 60 kVA with locally manufactured 3.152 engines with Leroy Somer Alternators from France, are also available from MTL.

### Achievements

With more than 60% share of the local tractor market, MTL has integrated and consolidated its technical know-how, expertise and sizable investment to establish allied industries like spares to ensure adequate supplies of quality components by way of establishing four sister companies.

The company has entered into export agreement with its principals, M/s AGCO in Dec 2015. Now, these tractors are being exported to African and Middle Eastern countries, which is a great achievement in itself.



MTL, Pakistan's premium tractor manufacturer have added another feather to its cap by indigenously developing a tractor with specification of EURO Stage II/ US Tier II Emission Compliant Engine for four Cylinders (85 horsepower). This is the first emission compliant engine development project in the country to have been successfully completed by Pakistani engineers. In recognition of the company's excellence, Plimsoll-UK nominated MTL as the 16th largest company in Global Tractor Manufacturing, and Forbes Global magazine included MTL in Asia's 200 "Best Under A Billion" list. Millat Tractors was declared Pakistan's second best company by the Pakistan Stock Exchange, while MTL received an Excellence Award from the Management Association of Pakistan and the Federation of Pakistan Chambers of Commerce & Industry (FPCCI) for Tractor & Agriculture Implements sector in 2016. Brands Foundation Pakistan also bestowed "Brands of the Year Award 2015" in the tractor category.

### Why is this institution a Resource Center?

MTL has integrated and consolidated its technical know-how, expertise and sizable investment by way of establishing four sister companies for allied instrument manufacturing. The company has captured more than a 60% market share in the local market by ensuring adequate supplies of quality products at an affordable price. It has a state-of-the-art assembly plant and a nationwide distribution and support network to cater to the requirements of end-users. It has excellent human resource development facilities available for farmers, technicians, and graduating students from different institutions.

The organization has a team of experts capable of assessing the needs of the market and designing equipment accordingly.

### International Cooperation

MTL is manufacturing tractors under a licensing agreement with Massey Ferguson of the UK owned by AGCO corporation USA. Also, several models are being imported from abroad to cater to the needs of large farms.

A newly-introduced fodder harvesting machine has been developed in collaboration with JF Brazil, and is being used by dairy/livestock farmers in silage making.

Forklift trucks are being manufactured with the collaboration of Anhui Truck Group, China and power generating sets in collaboration with France & Perkins, UK. The company has not only entered into export agreement with M/s AGCO but it also has started exporting its products to Africa and Middle East.



## Agritec Industries Ltd.



Agritec Industries has carried out studies to develop high-tech agricultural machinery, equipment and implements for the farming community. The farmers were cultivating crops inefficiently with outdated method due to lack of knowledge and financial resources to purchase the expensive imported machinery but it was no more possible because of scarcity of labor and adoption of mechanization in the country. Company was visualized to serve the farming community with an aim to produce the economical machinery and make it easily available for farmers of all types of holdings. It introduced the sprayers for all field and horticultural crops to control insect pest infestation.

📍 Agritec Industries PVT Ltd, 47 B-1 Industrial Estates, Multan, Pakistan

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### Introduction

Agritec Industries, a private limited company, was established in 1991 and registered with the Securities & Exchange Commission of Pakistan for the innovation and manufacturing of agricultural equipment and implements. Agritec serves as the leading manufacturer of hi-tech equipment and implements for spraying pesticides on fields and horticultural crops. Also, a variety of sprayers was developed.

Many implements were developed to facilitate farmers for mechanized farming, including soil preparation equipment like cultivators, discs, besides harrows and rotavators, pneumatic precision planter for seeding and band placement of fertilizers, wheat drill, cotton planter, and a double post-hole digger for sugarcane.

The livestock sector was served by the development of a silage-making machine along with associated implements. Agritec is committed to provide environment and human friendly solutions to the farming community of Pakistan and abroad coupled with a healthy workplace atmosphere for its employees to foster a genuine team spirit.

The company is accomplishing its mission across the country with four administrative and six technical departments equipped with 20 personnel in management and 80 in technical departments, supported by other human resources. The company's budget has been managed from its own resources.

### Sector & Main Activities

The principal activities of Agritec Industries include the manufacturing of agricultural high-tech implements and equipment, R&D and training of operators and farmers for use of its equipment. Research department aims to innovate the implements and equipment according to the day-to-day changing requirements of agriculture, to

sustain the maximum farm productivity to meet the increasing requirements of the country and protecting the environment at the same time.



Agritec is engaged in manufacturing the machinery, soil preparation & silage-making equipment and implements to cater the requirements of agriculture and Pakistan's dairy and livestock sectors.

## Area of Expertise

Agritec has specialized expertise in the field of manufacturing spraying equipment to control the insect pest infestation, seed drills and land preparation equipment, fodder cutter and silage-making machines. It has also successfully developed spare parts to provide complete back-up, which is needed to keep the manufactured equipment operational.

## Achievements

Dairy and meat farming is the most important and lucrative sector for the farming community in Pakistan. Based on the basic feed and forage management and in view of storage requirement, Agritec has developed a two-headed fodder cutter; a five-headed fodder mower; a fodder chopper; a silage baler and wrapper to help farmers with fodder preservation. Fodder chopper helps in the cutting of whole corn fodder, which is necessary for the preparation of silage, a perfect feed with protein for livestock.

Agritec has helped farmers to achieve better quality bumper crops by using the precision implements required for different field operations. The farmers have good-quality feed for their livestock and at cheaper rates by using Agritec dairy and livestock management machinery such as a two-headed fodder cutter; a five-headed fodder mower; a fodder chopper; and a silage baler and wrapper.

A range of spraying equipment has been made available to the farmers for use in different situations to control insect pest infestations. Furthermore, the sugarcane cutter and transplanter is under preparation in the R&D department and is expected to be ready in the next six months to serve the farming community.

## Why is this institution a Resource Center?

Agritec manufactures a variety of agricultural machinery and implements, which are now a prerequisite for the farming community. It is doing so in joint collaboration with many institutions like the Pakistan Agricultural Research Council Islamabad (PARC), the Zari Taraqati Bank Limited (ZTBL) and the Agriculture Mechanization Research Institute (AMRI), Multan. Also, the company helps in developing human resources for different institutions and farming community through organizing different training programs. In addition, many internees from different institutions, like agricultural and engineering universities and polytechnic institutions, benefit from the company's facilities.

## International Cooperation

In 1993, work was carried out to develop a precision pneumatic planter for all crops as a joint venture with the Pakistan Oil Seed Development Board, Islamabad. In 1994, the company began a joint venture to develop a self-leveling boom sprayer machine with the German company, Amazonen-Werke GMBH, which was the first ever manufactured in Pakistan. This venture was financially supported by the German Organization for Technical Cooperation GTZ Programme. The soybean thresher was introduced as a collaborative work with the National Oil Seed Development Board (NODP). This equipment is very effective to separating the hull and the seed. In 2010, the UN Food & Agricultural Organization (FAO) made an agreement with Agritec to develop seed graders and wheat threshers for Pakistan's farmers under the Worldwide Partners' Promotion Scheme. USAID also selected Agritec Industries among some companies in Pakistan to train different skilled people, particularly in the field of welding and improve their techniques.



## Pakistan Central Cotton Committee (PCCC), Multan



The Pakistan Central Cotton Committee (PCCC) is an apex organization established by the federal government, under the Cotton Cess Act 1923 (adapted in 1948) with the mandate "improvement and development of growing, marketing and manufacture of cotton" in the country. To cater to its given charter, PCCC has developed a network of cotton research institutions across the cotton belt of Pakistan to address different sectors related to this important cash crop of the country. It has four operational sub-committees to oversee agriculture research, marketing, technological research and administrative functions. Due to the untiring efforts of the PCCC over the last six decades, significant improvement has taken place in the development of new varieties, crop production technologies, and yield per unit area.

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### Introduction

The PCCC is a mono-crop, multidisciplinary research institution established under the Cotton Cess Act 1923 (adapted in 1948) with the mandate to develop the cotton crop and address all its related aspects like development of new high yielding varieties, development of production and protection technologies, quality control and assurance, and product developments.

To sustain the financial support to this work, the PCCC generates its funding through levy of cotton tax on each bale consumed or exported from the country. The PCCC governing body comprises members from the public and private sectors, representing concerned federal ministries, provincial government, and stakeholders from the private sector, including growers and end-users. It has four sub-committees to oversee its different directions on research, marketing and administrative functions.

PCCC Multan has adequate committed manpower with 18 management staff, 350 administrative, and 96 specialized staff in research facilities. The major areas of expertise are in development of cotton varieties resistant to pests, diseases especially the Cotton Leaf Curl Virus (CLCuV), high-yielding cotton varieties with low input cost, and varieties with desirable fiber traits etc.

### Sector & Main Activities

The PCCC undertakes research and development, organizes training and provides consultancy and advisory services in almost all aspects of cotton. Research and Development activities of PCCC include evolution of cotton varieties having high-yielding potential with desirable fiber traits, development of transgenic cotton varieties with genes resistant to insect-pest infestations. The PCCC also prepares pest and disease management strategies, evaluates technologies, for nutritional requirement of cotton, improving agronomic

practices, development of different production technologies for different cropping system, development of national coordination mechanism of across the cotton belt, and launching a cotton promotional program in Khyber Pakhtunkhwa and Balochistan.

Training programs on various aspects of cotton production (seed technology, pests & disease management, agronomic practices, picking and storage etc.) are organized for the farmers across the cotton belt to equip them with up-to-date knowledge. It keeps in close contact with different stakeholders like cotton farmers, agriculture extension specialists, and private seed/pesticide/fertilizer industry to inform them about the latest cotton production technologies to exploit maximum potential of this crop.

### Area of Expertise

PCCC conducts research on all aspects of cotton crop including variety evolution, insect pests and disease management, agronomical measures, dissemination of advanced cotton production technologies, extensive training of farmers and other stakeholders, coordination with national and international agencies and providing platform to act as focal point to address any issue related to cotton. PCCC also acts as cotton related data warehouse for national and international organisations and stakeholders.

### Achievements

Pakistan, the fourth largest global cotton grower and third largest exporter of raw cotton, is among the major growers of cotton in the world. Over the last six decades, the PCCC has played a significant role in addressing different issues encountered by this crop and developed many of new improved high yielding varieties resistant to diseases, crop production and protection technologies

with enhanced crop yield per unit area. As a result, country has harvested around 12 million bales annually during the last decade and sustained to earn foreign exchange through this important cash crop of Pakistan.

The PCCC has so far developed 40 cotton varieties with high-yielding and desirable fiber traits. These varieties also include ten early maturing and four transgenic Bt (*Bacillus thuringiensis*) varieties developed during the last five years. Staple length was increased from 25 mm to 32.5 mm and lint percentage improved from 33% to 41%.

Micronaire and fiber strength was maintained according to the requirements of the spinners. Training programs on various aspects of cotton production like seed technology, pests and disease management, agronomic practices, picking and storage etc. were organized for different stakeholders across the cotton region of Pakistan. PCCC succeeded to manage burning issue of leaf curl virus (CLCuV) through development of resistant varieties and management strategies.

In addition to this, PCCC has developed an excellent bilateral linkage with international organizations like ICAC, ICA, the Berman Cotton Exchange and different cotton-producing or consuming countries.

### Why is this institution a Resource Center?

The PCCC since its establishment in 1948 played a leading role in the evolution of cotton varieties resistant to insect pests and diseases especially the Cotton Leaf Curl Virus disease.

Moreover, the PCCC remained proactive in advising the government for devising cotton policies at the national level. The PCCC has also developed genetic resource center for cotton germplasm and have so far succeeded to preserve more than 5,500 accessions in this facility. This material is made available to the national and international scientists to use in their breeding programs. The seed can be stored for more than 25 years in this facility.

The PCCC also has a document/information depository at its headquarters as well as at the main cotton research institutes in Multan and Sakrand. This institution possesses excellent well-equipped facilities with a highly-trained workforce to address many issues related to cotton and has the capability to undertake any project with international partners.

The PCCC scientists have won much national and international recognition for their contribution in cotton research and development.

### International cooperation

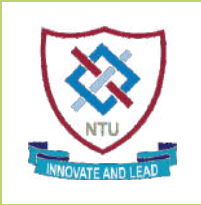
The Central Cotton Research Institute, Multan, the main cotton research institute of the PCCC's, has been recognized as "Center of Excellence in Asia Region" by the OIC. Moreover, most recently, the International Cotton Advisory Committee (ICAC), has also approved the hosting secretariat of the International Cotton Researchers Association (ICRA) in the PCCC for coordinating activities with cotton stakeholders across the globe.

PCCC research institutions are also collaborative partners in various cotton research projects especially with China (in transgenic technology) and African countries (cotton insect pests management e.g. Mealybug etc). The PCCC also provided expertise in cotton research and development programs initiated by the South Asian Association for Regional Cooperation (SAARC).

The PCCC also works as a focal institution for Organization of the Islamic Conference (OIC) to provide training to cotton scientists of the member states of the OIC.



## National Textile University (NTU), Faisalabad



Since its inception, the National Textile University has been the premier institute for textile research & development and education in the country, meeting the technical and managerial human resource needs of almost entire textile industry of Pakistan. It has always retained a close relationship with the industry and industrialists.

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### Introduction

A group of visionary industrialists had the idea of creating a world-class textile institute as long ago as 1954. In order to make this idea a reality, the government of Punjab joined hands with the leading textile industrialists to form an institute of textile technology in Faisalabad (then Lyallpur) and provided 62 acres of state-owned land free of cost. The Government of U.K. provided the bulk of equipment and machinery, along with the services of experts under Colombo Plan. Field Marshal Muhammad Ayub Khan, the then President of Pakistan, laid the foundation stone of the Institute, on the 12 October 1959.

The first batch of graduate engineers passed out in 1966. In 1973, the administrative control of the Institute was transferred to the federal government. In 1992, the college received a comprehensive assistance worth 650 million yen from the Japanese government, through the Japan International Cooperation Agency (JICA), in the form of the latest machinery and equipment.

The college was upgraded as the National Textile University (NTU) on 15 November 2002 through an Ordinance by the President of the Islamic Republic of Pakistan. NTU has a diverse community of human resources, and includes 111 scientists, researchers, 240 administrative staff, and 35 management staff. The team has in-depth expertise in yarn manufacturing, fabric manufacturing, knitting, textile processing, garment manufacturing, textile design, fashion design, and computer sciences.

### Sector & Main Activities

NTU is a leading institute in the textiles sector and is administratively answerable to the Ministry of Textile. NTU conducts education, training and research in every field of textile ranging from yarn manufacturing to the marketing and management of textile business. Research and development is a key component of NTU's mission.

### Area of Expertise

Currently, the university is offering undergraduate, graduate and postgraduate programmes under three faculties i.e Faculty of Engineering & Technology, Faculty of Science, Faculty of Management Sciences, including the departments of Yarn Manufacturing, Fabric Manufacturing, Textile Processing, Garment Manufacturing, Polymer Engineering, Materials and Testing, Applied Sciences, Computer Science, Textile & Apparel Design, Business Administration and Textile Management.

NTU is widely recognised for providing reliable technology transfer that is focused on solving real-industrial problems. Underpinning NTU's technical endeavors are strong partnerships with industry, business and government, which result in outcomes that greatly benefit the broader community region-wide, countrywide and worldwide.

NTU research activities cover diverse areas of expertise including textiles, polymers, chemistry, nanotechnology, management, information technology, fashion designing etc. NTU has developed a mechanism for national and international collaborations in the areas of its concern and many joint ventures are being executed with different R&D organisations.

### Achievements

NTU is producing a number of scholars every year for serving in every sub-sector of textile. These graduates are playing a vital role in betterment and development of textile industry in Pakistan and abroad. More than 3,000 graduates were produced during last ten years. It is also worth mentioning here that the 90% of the main management of textile industry in Pakistan are NTU alumni. These graduates are serving in every textile sector, i.e. yarn manufacturing, weaving, knitting, garment manufacturing and textile processing. NTU is a main contributor to the demands of the textile industry.

NTU is working on variety of research projects mainly related to the real time problems confronted to the public

and private sector of the country. Almost 400 journal publications have been produced during the last five years.

NTU, with the collaboration of HEC and international universities, is also arranging conferences related to the textile sector. These conferences provide a very good platform for researchers and industry to share knowledge and experiences. One of the notable series is COVITEX (International Conference on Value Addition and Innovation in Textiles). NTU is also promoting the technical textile sector in Pakistan. The first National Conference on Technical Textiles (NCTT) was organized at NTU during 2016 with the support of the National University of Science & Technology, Islamabad.

Textile testing facilities are also rendered to the local industry, and this immensely helps their export efforts. The National Textile University has an ISO-17025 accredited testing lab to offer commercial testing services to the textile industry on various aspects related to fiber, yarn and fabric.

### Why is this institution a Resource Center?

Pakistan is the fourth largest producer of cotton in the world. The NTU is the only public sector university imparting education related to textiles in the country. It has a strong liaison between industry and academia. Being the oldest textile education center, it possesses a strong base in the textile sector. Considering its eminent position in textile sector, the institute could be a good platform in promoting the agro-based industry related to the cotton sector. The NTU is well equipped to undertake many types of joint venture and assignments and to provide the necessary training in the field of textile at all levels. The following factors make the NTU an effective resource center for cotton based agro industry:

**Technical and Human Support:** The NTU has a large number of technically-sound human resources in different sectors of cotton and textile. This factor is crucial in advancing the agro-based economy in the region.

**Testing Facilities:** NTU offers a variety of testing facilities for cotton. These tests measure almost all parameters of cotton i.e. fiber length, strength, color, moisture etc. Based on these tests, NTU can provide guidance and support to cotton sector.

**Market Research Facilities:** One important aspect that NTU undertakes market research for agro based economy. NTU conducts research on different aspects of the market through student projects and research groups. This type of research is helpful in spotting the weaknesses and opportunity areas in this sector.

**Guidance and Consultancy:** NTU offers support and guidance for the promotion of cotton sector. Importantly, NTU performs a mediating role between cotton sector and associated industry.

### International Cooperation

A four-member team from the Korean International Cooperation Agency (KOICA) visited the National Textile University on 18 May 2015 to finalize the plan for the establishment of the Pak-Korea Technical Textile Centre.

A delegation from Wuhan Textile University (WTU), a leading textile university in China, headed by the WTU President, visited NTU for strengthening mutual collaboration in academic and research areas and agreed to launch a student exchange program at under graduates and post graduate level.

National Textile University and Dice Foundation signed MOU to establish DICE-Textile Innovation platform at NTU and host an annual DICE-Textile Innovation event starting from 2016, which will act as a single focused platform for textile-related innovations and collaboration among academia, industry, government, entrepreneurs, expatriate community and other stakeholders.

The Department of Knitting and Garments Manufacturing signed a memorandum of understanding with KLASH (Pvt.) Ltd. for human resource development, process control and optimization. KLASH is a vertical knitwear manufacturing unit founded in 1990 in the United Kingdom, while in Pakistan operations started in 2003 and now has become one of the largest knitwear manufacturing units in the country.



# Pharmaceuticals Industry







## Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD)



Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD) was established in 2004 through a generous donation and patronage of Ms. Nadira Panjwani (Chairperson of Dr. Panjwani Memorial Trust) in the memory of her beloved father, Dr. Mohammad Hussain Panjwani, a leading scholar and philanthropist. The Center initiated a number of scientific programs with the objective of finding possible treatments for often-neglected but prevalent diseases in Pakistan, as well as the associated human resource development.

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### Introduction

The main objective of the Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD) is to train a highly-qualified workforce in the emerging fields of molecular medicine and drug development. The efforts of the Center are mainly focused on developing comprehensive understanding of the pattern and causes of most common diseases in Pakistan so it can develop effective diagnostic tools and affordable treatments by using molecular, chemical and computational methods.

The mission of the Center is to foster excellence and achieve international recognition in the targeted areas of graduate training and research, which are relevant to national needs.

PCMD is also a preeminent academic research and teaching institution, recognized as a major contributor to the advanced research in the frontier fields of science and technology. PCMD also provides a forum for the exchange of information between academic disciplines, and for raising general awareness about the diseases, their prevention and cure. The Center has state-of-the-art research and training facilities and employs 30 engineers including technical staff, 45 faculty members and research officers. Most of the research projects are funded by international and national agencies like Higher Education Commission (HEC), Pakistan Science Foundation (PSF), among others.

### Sector & Main Activities

PCMD imparts quality research training to students in frontier areas of molecular medicine, which includes molecular biology, cell biology, pharmacology, neurosciences, structural biology, computational medicinal chemistry and bioinformatics, focusing mainly on molecular aspects of prevalent diseases. In addition, the PCMD regularly organizes international conferences, symposia and workshop related to various topics and

techniques in molecular medicine and drug discovery process.

### Area of Expertise

The PCMD specializes in neuropharmacology, neurosciences, regenerative medicine, molecular enzymology, molecular oncology, molecular immunology, structural biology, metabolic disorders, cellular physiology, genomics, computational medicinal chemistry, computational biology and bioinformatics, microbiology, and preclinical and clinical studies on herbal medicine.

### Achievements

The PCMD, as an integral part of the International Center for Chemical and Biological Sciences (ICCBS), University of Karachi, is one of the premium academic research institutions in molecular medicine in the region. The Center has emerged as region's leading biomedical research establishment with the country's largest doctoral program in molecular medicine.

Since its establishment in 2004, it has produced around 60 world-class PhD and MPhil graduates. The PCMD faculty has won international recognition producing over 500 research publications in top international journals and has several international patents. A complete list of patents is available at the ICCBS Center website. A number of projects funded by international and national agencies have also been completed. The center has achieved widespread recognition by several international organizations.

### Why is this institution a Resource Center?

PCMD is one of the premium academic research institutions in molecular medicine in the region. It is the only institution in Pakistan that is producing a PhD level

workforce in the field of molecular medicine. It has trained young graduates in various skills, thus helping in generating employable skills in the country. It is a UNESCO Category II center. It is a Third World Academy of Sciences (TWAS) Center of Excellence for training of scholars from Africa. Large number of scholars from Muslim and neighboring countries visit the PCMD for research training. The genome of the first Muslim and Pakistani (9th nation in the world) was completely mapped in collaboration with Beijing Genomic Institute, China.

### International Cooperation

The Center is involved in many collaborative activities, which includes exchange of scientists, scholars, students and technicians to work on collaborative research projects in key frontier areas of molecular medicine. The Center has signed memorandums of understanding with leading universities and research institutes.

PCMD also provides training services to Bangladesh (Dhaka University of Health Sciences), Egypt (National Research Centre, Alexandria University), Italy (TWAS), Jordan (Jordan University, University of Petra), Kazakhstan (Al-Arabia Kazakh National University), Malaysia (University of Putra) and several others.

The PCMD is working to build scientific collaborations and institutional linkages with top-class research and development institutions. The Center also has collaborations with many institutions in the developing countries in capacity building and infrastructure development. PCMD also has a joint initiative with the Center for Science and Technology of the Non-aligned and other developing Countries (NAM S&T Center), headquartered in Delhi, India. The PCMD is in the final phase of negotiations with the Pasteur Institute in Paris to be the part of the Pasteur network.

### Facilities

The PCMD has state-of-the-art research and training facilities that are at par with top-class academic institutions in the region. This includes the next generation DNA sequencer; an animal facility (safety level II); patch

clamp facility; imaging facilities including Atomic Force Microscope (AFM), live cell imaging, fluorescence microscopes; a Clinical Research Centre with a 120-bed hospital and bio-analytical facilities; a diagnostic laboratory, a flow cytometry facility; animal cell culture units; a general practical laboratory equipped with instruments for common research purposes; cold rooms of 4°C and -20°C temperatures; a biobank containing animal cell lines and molecular bank containing molecular entities including chemical compounds; and a computational facility.

### Services to the Community

The PCMD provides diagnostic, analytical and clinical testing services to a broad range of clients in the public and private sectors. The PCMD has established the first clinical trial and bioequivalence facility of the country currently used for services of pharmaceutical industries and clinical trials of potential drug candidates. This effort has enabled the Center to achieve a degree of financial sustainability that is unique among Pakistan's research institutions.

The diagnostic laboratory also organizes three free medical camps every year for its staff. Also, a summer internship program for hands-on training to final year graduate students in various research laboratories of PCMD is a flagship public service program of the Center.



## Amson Vaccines & Pharma (Pvt) Ltd.



Amson Vaccines & Pharma (Private) Limited is one of the leading pharmaceutical companies of Pakistan engaged in local manufacturing and import of finished pharmaceutical products. In pharmaceutical manufacturing, Amson's distinction is in vaccines manufacturing/formulation over the last 20 years. Amson is presently manufacturing/formulating Tetanus Toxoid, Typhoid vaccine, Hepatitis B vaccine and Anti-Snake Venom Serum. Product portfolio of pharmaceuticals comprises of corticosteroids, anti-malarials, anxiolytics, antitussives, hepatoprotectants, anti-anaemics, anti-ulcers, antibiotics, etc. In private sector, Amson is the only company in Pakistan manufacturing vaccines. The manufacturing facility of Amson has been awarded three ISO Certifications i.e. ISO 9001, ISO 14001 & ISO 18001.

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### Introduction

Amson established its manufacturing facility of vaccines & pharmaceuticals in 1995. In 2008, Amson entered the field of hospital consumables by launching the first locally manufactured Auto Disable Syringe in Pakistan as a "Pioneer Industry". Technology for production of Auto Disable Syringes has been acquired from M/s Star Syringes, UK and M/s Destroject, Germany. Amson's Auto Disable Syringes have been pre-qualified by World Health Organization (WHO).

Amson's vision is about achieving excellence in vaccines, hospital consumables and pharmaceutical production by way of basic manufacturing and formulation plus having local and international distribution. It continues to associate with renowned organizations for technology transfer to meet national requirements of vaccines and pharma products. At Amson, this vision is intrinsic to the company culture. It spurs the desire for action and is the driving force behind every move. Amson remains focused on customer satisfaction, and a commitment to exceed international regulatory and quality standards through motivated, empowered and dedicated team members.

### Sector & Main Activities

Amson manufactures supreme quality products that meet most of national and international standards. Each product passes through extensive screening, quality checks and testing parameters before release in the market. The activities at Amson comprise manufacturing, research and development, training of production staff/quality testing, and technology commercialization. While undertaking these activities, Amson complies with the standards of the Drug Regulatory Authority of Pakistan.

Amson ensures it meets applicable regulatory requirements and system standards and remains safe and environmentally-friendly toward employees and the community.

### Area of Expertise

In the health sector, Amson's expertise encompasses the development and manufacturing of life-saving drugs, disease prevention vaccines and healthcare products.

### Achievements

Amson is the first and the only manufacturer of vaccines and Auto Disable Syringes in private sector of Pakistan. Amson is a pioneer in setting up vaccines testing, animal house and cold-room facilities in Pakistan. It is also pioneer exporter of hepatitis B and tetanus vaccines.

The manufacturing facility has been awarded two ISO Certifications i.e. ISO 9001-2008 and ISO 13485-2003 and all the products are also CE (European Conformity) marked. The state-of-the-art manufacturing facility has been declared as a model plant by the Licensing Board of the Drug Regulatory Authority of Pakistan. The products have also embarked marketing authorization from Medicines and Healthcare Products Regulatory Agency (MHRA), UK.

Also, Amson is manufacturing certain novel and patent pharmaceutical products like INVENTIVE (Dimemorfan Phosphate), Foro B12 (Iron, Orotic acid), Hyzonate (Hydrocortisone Sodium Succinate), VIDA (Multivitamins), etc.

It is the only manufacturer in Pakistan with its four products pre-qualified by WHO and all the products are European Conformity (CE) marked. Amson's products are also registered with MHRA, UK.

Cold rooms have been set up at the plant and head office of Amson and refrigerated vehicles are used to maintain the cold chain during transportation of vaccines. Special vaccine carriers and ice plates have been developed to ensure the maintenance of temperature for 72 hours during transportation. Arrangements have been made with specialized couriers for reliable handling and prompt

delivery of vaccines to far-flung areas.

An indigenous designing and printing facility has also been established to cater products packaging and promotional requirements. Innovative and unique features of packages have been developed in order to counter availability of spurious drugs.

Effective measures for risk management, disposal of liquid and solid wastes, Personal Protective Equipment (PPEs), control of noise and gaseous emissions are strictly applied to meet the standard requirements.

Amson is a regular supplier of products to the Expanded Program on Immunization, federal and provincial health departments, non-governmental organizations, and autonomous bodies. Recently, Amson signed a Memorandum of Understanding with the Pakistan Red Crescent Society for the provision of vaccination services to the people of Pakistan against lethal infectious diseases.

### Why is this institution a Resource Center?

A well-equipped Research and Development center oversees selection of product/dosage forms, international trainings, designing of new products and re-designing of existing products to further improve their efficacy, presentation and to make them user friendly.

Besides it ensures selection of high-quality material for product designing, safe and economical manufacturing process, analytical product development, packaging components, supervision of clinical studies and post-marketing surveillance are some of the main features which keeps it at the top.

Amson is the only company in Pakistan that has practical knowledge, expertise and technology of vaccines/sera manufacturing. The quality of vaccines manufactured by Amson has been certified by International, WHO-referred laboratories.

The technical team of Amson also has expertise in activities like GMP inspections, clinical evaluation and the proper testing of biologicals.

### International Cooperation

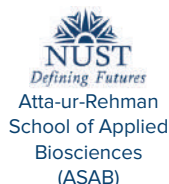
Amson's products enjoy national and international recognition due to the high quality standards. Pakistan has about 600 operational pharmaceutical units, but none of them has ever ventured into the field of vaccine formulation because of stringent national and international regulatory requirements. Amson is the only company that took up this challenge through a collaboration with Novartis (formerly Chiron) and the Green Cross Vaccine Corporation (now a part of Berna Biotech).

Technical collaboration has been established with a number of world renowned vaccine manufacturers (M/s Biological E, India, M/s Serum Institute of India, M/s Omnivest, Hungary, M/s Intervax, Canada, M/s LG Life Sciences, Korea, M/s Kedrion, Austria, M/s Vins Bioproducts, India, etc.) and research organizations (the International Vaccine Institute, Korea, the Developing Countries Vaccine Manufacturers Network, Switzerland, SIGN International, etc.).

In addition to local manufacturing, Amson also represent numerous foreign companies with exclusive marketing rights of vaccines, blood derivatives, hi-tech medical equipment, disposables and disinfectants. Amson is already exporting its products to Africa, South East Asian countries and alliances are being developed in various other countries to explore further export opportunities.



### Atta-ur-rahman School Of Applied Biosciences (ASAB), NUST



ASAB of the National University of Science and Technology, Islamabad (NUST) is a unique and emerging institute of its own kind established in 2007 as NUST Centre of Virology and Immunology and re-named as Atta-ur-Rahman School of Applied Biosciences (ASAB) in 2012 with the aim to develop integrative approaches in the emerging fields of healthcare, industrial and agriculture biotechnology. At ASAB, various scientists and researchers are engaged in extensive research activities and creating an internationally competitive research environment. It provides excellent research and teaching facilities in the field of applied biology in Pakistan. Dynamic interdisciplinary undergraduate and graduate programs prepare the students for pursuits in research and teaching in pure molecular as well as applied biology, with cutting edge innovative technologies. The research and training programs are in collaboration with other research institutes/centers and universities from all over the world.

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#### Introduction

ASAB was established in 2007 as NUST Centre of Virology and Immunology and re-named as Atta-ur-Rahman School of Applied Biosciences (ASAB) in 2012. ASAB is the home of Pakistan's largest biotech cluster. By integrative approaches, it is determined to provide economically-valuable services to healthcare, the agriculture sector and to the community. The school provides excellent research and teaching facilities in the field of applied biotechnology in Pakistan. Curriculum is designed to provide students with theoretical knowledge and practical hands-on skills in the fields of healthcare, industrial and plant/agriculture biotechnology.

Currently 25 faculty members, along with postgraduate research students are carrying out research in diverse fields of biotechnology. The interdisciplinary research programs at ASAB reflect the richness and diversity of research endeavor that attain world standards. Being the first and unique of its kind in South Asia, ASAB aims to prepare the students for pursuits in research and teaching in applied biosciences.

#### Sector and Main Activities

ASAB is mainly involved in human resource development in the field of Healthcare, Agriculture and Industrial biotechnology, to carry out applied research to develop products and community service for supporting public and private organizations.

For efficient dissemination of scientific information, ASAB is publishing a multi-disciplinary nature of journal, the NUST Journal of Natural Sciences (NJNS).

#### Area of Expertise

The school has established an expertise across a broad range of issues under the biotechnology field. Areas of expertise include healthcare biotechnology, industrial biotechnology, and food and plant biotechnology. The major focus is biochemical therapeutic modalities

(antibodies, peptides, proteins, chemical drugs, natural products, etc.) against different infections, inflammation, cancers, cardiovascular and metabolic diseases, burns as well as immunological and neurodegenerative disorders.

#### Achievements

ASAB has established five degree programs, including the Bachelor of Science (BS) in Applied Biosciences, the Master's of Science (MS) in Healthcare, Plant and Industrial Biotechnology and the Doctor of Philosophy (PhD) in Applied Biosciences. As of the fall of 2016, a total of 25 PhD graduates, 193 MPhil/Masters and 186 BS students have graduated from ASAB, while about 400 students including 80 PhD students are enrolled in different programs at ASAB.

ASAB graduate and postgraduate programs are designed to provide a more rigorous preparation for advanced study in the applied biosciences. The programs are tailored not only to students who intend to pursue a career in academic or research but also for students who obtain employment in biotechnology industry.

At present, 15 research groups are working on specialized projects in different laboratories of ASAB and have published their research in high-impact peer-



reviewed scientific journals with a cumulative impact factor reaching 800. In the academic year 2015-2016, researchers of ASAB published more than 60 articles in renowned journals, in addition to presenting their data at prestigious national and international conferences.

So far, ASAB has completed more than 20 projects while 28 are underway. All these projects are funded by national and international funding agencies like the Higher Education Commission (HEC) Pakistan, Pakistan Science Foundation (PSF) Pakistan, the Pak-US Science and Technical Cooperation, the National Academy of Sciences (NAS) USA, and the Third World Academy of Sciences (TWAS).

The ASAB Diagnostics facility was established in 2008 and provides the highest standards of care and quality laboratory services to patients, physicians, and allied hospitals at subsidized rates.

### Why is this institution a Resource Center?

ASAB is a leading institute in the field of biotechnology catering to developmental strategies to address the health, industry and agriculture associated issues that can aid the treatment and prevention of various infectious, immunogenic, metabolic and neoplastic diseases in the country.

The school is currently undertaking research and development activities to develop prophylactic and theranostic agents as along with investigation of therapeutic potential of medicinal plants. The graduates from ASAB are providing their services, in various disciplines and are extraordinary members of the scientific society in Pakistan and abroad.

### International Cooperation

Besides working in partnership with some key national institutes, ASAB has active international collaborations with several foreign universities including centers of excellence in China, the US and Europe. These collaborations enable students to go abroad for training to acquire professional skills.

One of the key events recently held at ASAB-NUST was an International Brain Research Organization-Asia Pacific Regional committee (IBRO-APRC) Associate School of Neuroscience workshop on "Molecular Basis of Behavior". The workshop was sponsored by IBRO-APRC through a competitive grant.

ASAB- NUST, in collaboration with the National Academy of Young Scientists (NAYS), Pakistan, organized a three-day course on basic biotechnology techniques, funded by International Centre for Biotechnology and Genetic Engineering (ICGEB), Trieste, Italy.

### Cell Culture Facility

At ASAB, cell culture facility is well equipped for mammalian and insect cell lines, growing either attached or in suspension. This facility has the potential to carry out various projects e.g. studying cell biology, interactions between disease-causing agents and cells, effects of drugs on cells, process and triggering of aging and nutritional studies, toxicity testing, anti-cancer effects and anti-viral testing.

### ASAB Laboratory Animal House

The laboratory animal house at ASAB provides a conducive environment, housing and care that permit animals to grow, mature, reproduce, and maintain good health. The facility is being used to conduct the animal testing as well as development of different disease models like diabetes, rheumatoid arthritis, Alzheimer's disease. These animal models help in understanding disease pathogenesis and effect of various therapeutic interventions including mouse model for skin cancer, drug safety testing of probiotics/cancer therapy in mouse, efficacy of drug encapsulated with virosomes against asthma and mice model of Diabetes Mellitus type II/ rheumatoid arthritis.

### Community Services

NUST has aligned itself to the spirit of the times and chalked out a well thought out community service framework with the right strategy. ASAB is committed to imparting the message of serving the community and payback. In this regard, a community service course is mandatory for all the students who are enrolled in ASAB. Most of the projects are associated with public awareness, for example Emerging Viral Threats: Ebola and Congo, NUST Emergency Medical Training and the Clean Water Project, etc.



# Information Communication Technology (ICT)







## Faculty Of Computing & Information Technology (FC&IT), University Of Gujrat



Established in 2004, within the University of Gujrat (UoG), the Faculty of Computing & Information Technology (FC&IT) is young and vibrant and one of the fastest growing schools in higher learning among public sector universities of in Pakistan. The FC&IT is producing and delivering knowledge besides extensively contributing to regional development through Research and Development (R&D), Information Communication Technology, Entrepreneurship and Technology Transfer.

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### Introduction

Information Technology is a driving force behind a successful economy and has led it to grow beyond borders. Faculty of Computing & Information Technology (FC&IT) at University of Gujrat (UOG) was established with the aim of producing quality professionals in computing, who would have the skills needed by industry and contribute to the national economy. The programs offered within the Faculty are designed to teach the latest technologies to produce a well-qualified human resource. The faculty offers BS/MS/MPhil and PhD degree programs in different disciplines, as well as offering Information Technology (IT) services and solutions for the digital transformation of government and private sector setups.

FC&IT is committed to provide dynamic teaching and research opportunities for students. The Institute encourages them to undertake applied research in producing turnkey solutions for the socio economic indigenous and International problems. FC&IT is equipped with state-of-the-art IT Infrastructure, high performance computing laboratories, multimedia-equipped classrooms and an experienced faculty to produce market-oriented graduates.

FC&IT enables students, researchers to acquire fundamental knowledge, critical thinking and software development skills to excel in their profession. Academic staff members are dedicated not only to deliver technical knowledge but also transfer social skills to enable the students to explore the potential of society. The institute is not just involved in producing and providing knowledge through education and research but has also advanced to contribute to regional development. It is supported by a combination of government and private grants and contracts, private philanthropy and financing from the endowment fund.

### Sectors & Major Activities

FC&IT provides both skills and infrastructure to empower students in achieving their educational goals and learn technologies to function effectively as computer professionals throughout their careers. As well as imparting higher education, the institute is supporting business process innovation across the country to create knowledge and develop human capital. FC&IT is committed to provide dynamic teaching and research opportunities for students.

FC&IT has enthusiastic and talented scholars, researchers, and industry practitioners comprising of eight PhDs and 47 MS/MPhil, specializing in the Internet of Things (IoT), mobile computing, data sciences, image processing systems, technology management, data center operations & management, socio-economic impacts of technology and knowledge engineering expert systems. Their commitment to winning grants and transforming research has put FCT&IT among the top-ranked research institutes in Pakistan.

Strategically located within the industrial triangle of Gujranwala, Gujrat and Sialkot, the institute's mandate is to bridge the human resource and technology gap between academia and industry. It also offers technological solutions for better education management, thereby leveraging IT for the efficient management of academic activities. FC&IT frequently holds national and international conferences on IT, Big Data, the Internet of Things (IoT), virtual reality and other fields.

### Area of Expertise

FC&IT's distinguishing feature is its emphasis on research. Apart from a number of internal research projects, the institute conducts research in collaboration with external partners, both national and international institutions. FC&IT's expertise includes cloud computing, the Internet of Things (IoT), Big Data, mobile computing,

deep learning, expert systems, software testing and reliability, business intelligence (BI), mathematical modeling and numerical analysis.

### Achievements

The Business Incubation Centre (BIC) within FC&IT aims to promote entrepreneurship among the student and research community. FC&IT provides an entire technology infrastructure to incubate start-ups. Currently 15 start-ups have been registered at the BIC of which two start-ups have received generous funding from some of the country's top venture capitalists. FC&IT Tech Start-ups have won Distinguished Innovations, Collaboration & Entrepreneurship (DICE) and were finalists of Momentum at Karachi.

### Higher Education Learning Platform (HELP)

The Higher Education Learning Platform (HELP) is a component of the Managed Learning Environment (MLE) while the remaining components are the Campus Management System (CMS), Enterprise Resource Planning (ERP) and the Capacity Planning System (CPS) and they complete the ecosystem of Managed Learning Environment (MLE). HELP is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments. Standardization is one of the key components in HELP to bring all universities on one platform for the reusability of course content, uniformity in assessments, a course planner, classroom management and performance appraisal at all levels. The idea behind providing teachers with the tools is to create sequences of powerful activities to engage students in active collaborative learning environment.

### Capacity Planning System (CPS)

The higher education sector in Pakistan has undergone great leaps forward over recent years. A growing demand for higher education requires a balanced growth in staff, facilities and infrastructure while the socio-economic relevance leads to the need for a more diversified student specialty. The purpose of the Capacity Planning System (CPS) is to develop, expand, enhance and manage the HEI's activities and to link these accomplishments directly to the educational, social and economic priorities of the University and its broader community. The CPS is also responsible for assuring that the quality of services and research that reflects the highest international standards and advances the stature of the HEI's among the world's best research institutions.

### Why is this institution a Resource Center?

FC&IT's particular focus is technological innovation to foster a culture of analysis and innovation that can make evidence-based decisions to introduce modern

innovative IT-based solutions with the help of technology transfer centers. Similarly FC&IT has taken several initiatives like Higher Education Learning Platform (HELP), the Office of Research Incubation & Commercialization Automation System (OAS), the Capacity Planning System (CPS) and the Single Sign On (SSO) across the university and all sub-campuses to facilitate the learning environment with technological innovations.

The faculty and student chapters of world-renowned technical societies like the Institute of Electrical and Electronics Engineers (IEEE), the Association for Computing Machinery (ACM) and the Open Source Foundation Pakistan (OSFP) are also active at FC&IT and contribute regularly.

FC&IT has equipped the youth to compete at the international level; achieve excellence in research and teaching in various disciplines; develop a world-class center of excellence in the industrial triangle of Gujranwala, Gujrat, Sialkot and around the world to help industry and society at large through Information Communication Technology research-based initiatives. FC&IT's vision is to work closely with industrial partners and international collaborators to push the developed technologies from labs to the market, so establishing the institute as a means to build the economy.

### International Cooperation

FC&IT has received various research grants from different international organizations and signed different memoranda of understanding with international institutes through the Office of Research Innovation & Commercialization (ORIC). It also received a grant from the US State Department to establish a broadcasting and TV studio jointly with the University of Oklahoma to initiate distance learning and e-learning programs in the region. FC&IT students participated in the 2016 Microsoft Global Education Partner Summit (GEPS) held in the USA.



## Department of Computer Sciences and Engineering (DCS&E), Air University (AU)



The Department of Computer Sciences and Engineering (DCS&E) was established in 2002 within Air University, a federally-chartered university in Islamabad. This public sector university has established a good reputation in a relatively short time in the area of Information Communications Technology (ICT).

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### Introduction

The Department of Computer Sciences and Engineering (DCS&E) was established in 2002 within Air University, a federally-chartered university in Islamabad. The department has established a good reputation in a relatively short time.

DCS&E has strong ties with AU's Research and Development (R&D) office, the Office of Research Innovation and Commercialization (ORIC), and the Quality Enhancement Cell (QEC) that add significantly to the teaching and research activities at Air University.

The computer science program integrates technical computer science requirements with institutional requirements and electives to prepare the student for a career in the computer field and for further study in computer science. Hands-on experience is provided throughout the program. Students are also encouraged to gain practical work experience at local companies. To maintain a competitive edge, our industries and commerce must continue to make creative scientific and engineering advances as well as produce high quality products. More than ever, there is a demand for a prepared work force with the scientific and technical training necessary to perform effectively on the job. The Computer Science department is the center of cross-disciplinary research at Air University.

### Sector & Main Activities

DCS&E has a well-established reputation in the fields of Image processing, artificial intelligence, data mining, machine learning, data science, computer vision and bio-medical image processing. This department conducts academic activities such as workshops, benefitting both the students and the faculty.

DCS&E faculty has 12 members - five PhDs and seven MS/M.Phils – supported by technical and administrative staff. The specialization areas include image processing,

artificial intelligence, data mining, machine learning, computer vision, bio-medical image processing, big data, algorithms, image analysis and deep learning, multimedia communications, project management, software engineering, computer engineering, embedded system and control engineering, and interactive and cognitive environments.



The office of ORIC & QEC are working rigorously with DCS&E to conduct research activities in collaboration with its national and international partners.

The office of Research & Development envisions and supports faculties of basic, applied and social sciences with purpose to cultivate research environment at the university. For this purpose, DCS&E has its robust R&D Policy which encourages conducting research besides commercialization and training.

DCS&E with a proactive approach has established links with international organizations through ORIC Institutions in the UK, Sweden, the USA, China and Turkey that have been engaged in different academic and research activities over recent years. The scope of these activities

includes student and faculty exchange programs, joint research ventures and split-degree programs that reflect the future viability of this office.

### Area of Expertise

DCS&E excels in Software Development, Computer Vision, Biomedical Image Processing and Analysis, Surveillance Systems, Machine Learning, Pattern Recognition and Architecture Centric Engineering of Hybrid Systems, Data Mining, Data Science and Artificial Intelligence through faculty and students.

### Achievements

DCS&E has the honor of winning and successfully completing national and international research projects.

Some projects are Computer Aided Morphological Analysis and Classification of Human Spermatozoa Based on Novel Shape Descriptors (sponsored by HEC), Automatic and Real-time Car Number Plate Recognition for Security and Surveillance for law enforcement agencies (sponsored by HEC).

A Novel 3D Automated Live Cricket Batting Coach: Skeletal Joint Analysis of Batting Players against Textbook Cricket Shots by Experts - sponsored by National Information Communication Technology Research & Development Fund (ICTRDF).

Automatic Crowd Estimation in Khana Kaba (HajjCore) Computer Aided Sperm Analysis - sponsored by National Information Communication Technology Research & Development Fund (ICTRDF), Echocardiography on smart devices, European Regional Development Grant, E-assessment (sponsored by Air University), Uncontrolled eye-movement detection for Nystagmus disease (sponsored by HEC NRPU), Robust crop disease detection through computer vision - sponsored by HEC National Research Program for Universities (NRPU).

Multi-Camera person tracking and re-identification in surveillance videos (sponsored by Air University), Intelligent Crop Disease Detection System (sponsored By Air University), Design and Development of Semantic Portal for Online E-Learning, (sponsored By Air University) Development of High Performance Computing (HPC) Lab.

The Department has won numerous national and international competitions involving student projects and research.

### Why is this institution a Resource Center?

The DCS&E is immensely important not only for Air University but also for other public organizations because it is serving as a state-of-the-art ICT resource center. AU

CS has been privileged to receive recognition by various national and international organizations for its contribution towards economic development, poverty reduction and information dissemination to all spheres of society. Academically rich brains with the highest education and expertise are working at AU CS and organizations like PAF, PAC Kamra, PAEC, NESCOM, ICT R&D, HEC and many others are gaining substantial support from this resource center. AU CS faculty is also serving as a guest and adjunct faculty at national and international research and academic institutions for mutual learning and collaboration at all levels. The AU CS faculty has advanced knowledge of ICT and highest qualifications from more academically advanced countries like US, UK, Germany and other European countries.

### International Cooperation

DCS&E undertakes International cooperation with a number of organizations. They include the Institute for International Buildungs Koperations (IBK) at the University of Applied Science, Merseburg (Germany), Kingston University London, the Blekinge Institute of Technology Sweden, Nanjing University of Science & technology (NUST), China. The University of Southampton in the UK, Gediz University, Turkey, the University of Nova Gorcia, Slovenia. The National University of Singapore, the Chinese Women's University, Wynn State University School of Medicine in the USA, Prince Sultan Advanced Technology Research Institute (PSATRI), King Saud University, Akdeniz University, Turkey, Istanbul University, Turkey, Hassan II University in Casablanca, Morocco. Jiangxi, University of Science & Technology, China, Sidi Mohammad Bin Abdullah University, Morocco, Mississippi State University, USA, and National Instruments, USA.



## AI-Khwarizmi Institute of Computer Science (KICS), UET



The AI-Khwarizmi Institute of Computer Science (KICS), University of Engineering and Technology (UET), Lahore, was established in August 2002. KICS is a government research institute. The institute is named after one of the greatest Muslim scholars, Muhammad ibn Musa al-Khwarizmi (780 AD - 850 AD), to commemorate his outstanding contributions in the field of mathematics. Al-Khwarizmi's work laid the foundations for the building of computers, and the creation of encryption in the 20th century.

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### Introduction

The AI-Khwarizmi Institute of Computer Science (KICS), University of Engineering and Technology (UET), Lahore, was established in August 2002, and is a government research institute. The institute is named after one of the greatest Muslim scholars Muhammad ibn Musa al-Khwarizmi (780 AD - 850 AD) to commemorate his outstanding contributions in the field of mathematics. Al-Khwarizmi's work laid the foundations for the building of computers, and the creation of encryption in the 20th century.

KICS was established mainly for conducting research and development activities in computer science (CS) and Information Technology (IT). It was envisioned as an institute for advanced and high-quality applied research working in collaboration with industries and other academic institutions on national and international levels to bring about the IT revolution in Pakistan and help build a knowledge-driven economy.

### Sector & Major Activities

The core objective of this institute is undertaking world-class applied research in algorithms, software engineering and digital control systems. It bridges the existing gap between Pakistani academia and industry by training the young graduates accordingly and promotes the culture of results-oriented research and development activities using Information Communication Technology (ICT) for the socio-economic development of Pakistan.

KICS has trained resources to prepare for the advanced technology needs of the future. Besides, It has also delivered technical help to government sector organizations such as security, energy, power transmission, communications, health, agriculture and education departments.

### Area of Expertise

KICS has formed itself as a center of quality in computer science (CS), high performance computing, telecommunication, e-services, local language engineering, network and security, virtualization, renewable energy, and embedded systems. The expertise of this institute is widely recognized in the said areas for providing a platform of research, technology innovation and industrial collaboration.

### Achievements

In research and development (R&D), KICS has published 86 journals, steered 233 conferences and 430 journal citations. It has trained more than 7,000 people, both nationals and internationals. KICS has deployed more than 100 experts in different domains to provide consultancy services.

The Data Processing and Invoice Processing Automation System (IPAS) is an Enterprise Management Information System (EMIS), which was designed and developed according to the architecture defined by the Water and Power Development Authority (WAPDA), the Central Power Purchasing Agency (CPPA), and the National Transmission and Despatch Company (NTDC). The objective is to implement the rules and regulations specified in the standard Power Purchase Agreement (PPA) of NTDC, WAPDA Pakistan and tariff determination by the National Electric Power Regulatory Authority (NEPRA). The system fetches data in real time from Independent Power Producers (IPPs) and processes it in a central location. The system was designed and developed by the institute and now being deployed in WAPDA to keep track of the real-time power purchase record. This is a national level achievement because the government itself is the beneficiary of the project that helps to avoid fraud and overbilling of IPPs.

Similarly,  $\mu$ HandS (Ubiquitous Help and Safety) is a new system that is designed to help people in emergency

situations. The objectives of this system are to design a state-of-the-art model architecture for a ubiquitous emergency management based on Service-Oriented Architecture (SOA), using mobile phones as a medium to access the emergency services deployed by the government agencies for the citizens. The system has an intuitive interface. The system enables people to get timely help in emergencies and is reachable and accessible to everyone at any time.

The KICS has provided technical support to the Energy Department, Government of Punjab, for more than 50 projects on implementation of renewable energy technologies. The Institute has been declared as the best service provider by the Energy Department of the provincial government.

In addition, Huawei University of Engineering & Technology (UET), Joint Telecom IT Centre (HUTIC) was established in 2004. The center has trained more than 6,000 engineers from various universities and institutions of Pakistan since its inception. The center has been declared by Huawei as the best Huawei Authorised Learning Partner (HALP) in the Middle East Region. The center has the status of a Huawei Authorized Network Academy (HANA).



In the field of language processing, the Centre for Language Engineering (CLE) was also established, which is an advanced technology center at KICS. The center has developed various Urdu services for the promotion of the local language and to address the country's large population. KICS has deployed numerous projects in various public and private organizations such as Weather Information System (WIS). It is being developed with the collaboration of the Pakistan Meteorological Department (PMD), providing an interface to access weather information in the local language through mobile phones or landlines.

KICS has developed an enterprise solution for the government-owned NTDC, the power distribution company of Pakistan. It is a national level project that provides real-time metering of the power producers to

NTDC. Hence, this project has a national impact with overbilling and frauds being controlled.

### Why is this institution a Resource Center?

KICS is envisioned as playing a key role in taking the country towards a knowledge-based economy and competitive industrialization. It helps in providing Pakistan with the human capital required for the development of high-tech products and become a major player in the global ICT market.

Through dedication to the KICS's mission of promoting applied research in different domains of ICT, the institute has made unwavering progress since its inception. Team KICS is confident that this growth and success will accelerate in coming years. It will gain further recognition as a center for technology innovation in the world as one of best resource centers in ICT, not only within the research community but also within the industry.

### International Cooperation

KICS has a fully-functional International Cooperation Office (ICO) inside UET. The institute also engages in activities outside the country in the USA, the UK, China, Germany, Oman, Malaysia, Canada and many more.

KICS has a number of partnership agreements signed with international partners including development of analysis node for bioinformatics patterned with MIT and Harvard. They include:

- The development of a real-time infectious disease surveillance and response system for Pakistan, partnered with Purdue University, USA.
- The establishment of a Hybrid Electric Vehicle (HEV) lab in collaboration with automotive experts in the Control and Signal Processing Research Group (CASPR), the Capital University of Science & Technology (CUST), Islamabad, and the Center for Automotive Research (CAR) at Ohio State University.
- A PAN Localization project, an initiative of International Development Research Centre (IDRC). The objective is to build local language computing capacity in regional institutions of Asia.



## Latif Ebrahim Jamal (LEJ) National Science Information Center



The Latif Ebrahim Jamal National Science Information Center was established in 2006 as an integral part of the International Center for Chemical and Biological Sciences. The LEJ center has state-of-the-art facilities and access to the latest information resources, capable of providing information in frontier areas of science and technology.

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### Introduction

The Latif Ebrahim Jamal (LEJ) National Science Information Center was established in 2006 as an integral part of the International Center for Chemical and Biological Sciences. The LEJ center is a public institution with state-of-the-art facilities and access to the latest information resources, capable of providing information in the frontier areas of science and technology, as well as social and management sciences.

The Center houses not only one of the largest knowledge centers of the region, but also has a mechanism and capacity to assist other campus-based R&D libraries through resource sharing and applications of new technologies. The Center is now helping a large number of researchers in education sector of Pakistan. The LEJ center has a large team of enthusiasts in all departments including 30 engineers and technical staff, 118 administrative staff and 30 managerial staff. The Center has major expertise in deploying hybrid solutions in the field of information communication and technology.

### Sector & Major Activities

In distance learning, the Center provides access to online resources to support teaching, learning and research activities. To provide such access, the Center builds cutting-edge connectivity platforms, establishes partnership with the sources of educational materials, and organizes access to online resources.

### Area of Expertise

The LEJ areas of expertise include massive on-line education programs, video conferencing, webinar technology and digital libraries. This Center offers various online and offline education programs to universities and R&D institutions all over Pakistan through a video conferencing facility and through webinar technology.

### Achievements

The LEJ Center uses the latest information and communication technologies in order to provide full access to the world's largest digital resources. It is also the national focal Center for the Higher Education Network of Pakistan (THEN) and its subsidiary program, the Virtual Education Project Pakistan (VEPP).

VEPP is an interactive distance-learning program, deployed on a world-class ICT infrastructure, which can be of huge benefit to the students and faculty members in the country to improve the quality of education. Eminent scientists are invited to deliver online lectures/courses in different fields of science and engineering from foreign as well as local universities and academic institutions. Through these programs, the Latif Ebrahim Jamal National Science Information Center is organizing regular online degree courses, skills and language development courses, online lectures, seminars, conferences, and workshops at both the international and national level.

The Pakistan Biotechnology Information Center (PABIC) located at the LEJ center is working under the umbrella of the International Service for Acquisition of Agri-Biotech Applications (ISAAA) with the aim to enhance the awareness and disseminate the bio-tech knowledge, both at the local and international levels.

This library provides a range of resources in the print media to support teaching, learning and research activities for the young students of the nation free of cost.

The LEJ is a knowledge hub for integrated and open learning program launched by LEJNSIC (ICCBS) at University of Karachi in 2013 by the President of Pakistan. The program includes access to on-line, interactive and recorded courses and mentoring and assessment system.

Eminent scientists and scholars from Pakistan and other countries (Germany, Brazil, Australia, the UK, Spain,



Turkey, Thailand, Hungary, Portugal, Japan, Switzerland, Italy, France, Egypt, the USA, Mexico, Malaysia, Bangladesh, Iran, and India) are invited to conduct online courses, lectures, workshops. More than 6,000 lectures related to variety of disciplines (natural sciences, life sciences, engineering sciences and social sciences) have been successfully conducted in few years.

Several skill development courses were offered nationwide in different languages such as English, Chinese, German, French, and Arabic in collaboration with experts in the respective languages. Now these lectures and courses can be delivered through video-conferencing and much more cost-effective webinar technology.

Since 2015, series of webinars have been initiated in collaboration with the Sandia National Laboratories (SNL), and CRDF Global (Civilian Research and Development Foundation), the USA, and successfully organized various training courses on chemical industry standards.

State-of-the-art video conferencing facility at the LEJ is used to conduct online courses, workshops and specialized skill development courses, workshops by eminent scientists in key areas of science and technology.

This Center houses a massive on-line education program, known as the LEJ Knowledge Hub for the global community, which is an integrated searchable website ([www.lej4learning.com](http://www.lej4learning.com)) initiated in 2013, which contains large open online courses of top universities of the world (MIT, Udacity, Stanford Engineering Everywhere (SEE), Open Yale Courses, the Khan Academy and the Virtual University of Pakistan). These digital resources are available to everyone in Pakistan and abroad.

The Center has one of the largest digital libraries in Pakistan, containing more than 23,000 online journals and 88,709 e-books, fully accessible to everyone round the clock. Along with this, top-class scientific databases such as science finder and chemical abstracts are also available in the center.

### Why is this institution a Resource Center?

The LEJ Center is offering education programs through the VEPP. The aim of this program is connecting high quality faculty from across the world with students in Pakistani universities. Complete courses are conducted by eminent scholars from USA, Europe and other part of the world which are listened live and interactively by students in Pakistan. These are followed by examinations under the supervision of the foreign scholars and the universities in Pakistan grant credits to those students who pass these courses. Students may

ask questions through video conferencing. There are currently 70 local Pakistani universities participating in the VEPP programs.

This Center also offers a vast array of technology services, including state-of-the-art digital libraries of full time access, high-speed internet, a secure campus wide network, in house built-in servers, high throughput, emails accounts access, in house deployed File Transfer Protocol (FTP) server to facilitate users for storage of important files and documents.

### International Cooperation

The LEJ Center is the integral part of ICCBS which is recognized as the OIC Centre of Excellence, Third World Academy of Sciences (TWAS) Centre of Excellence, World Association of Industrial and Technological Research (WAITRO) Centre of Excellence, COMSATS Centre of Excellence and recently been recognized as UNESCO category II institution.

The education programs conducted at the LEJ Center are offered to all member countries of these organizations. These programs allow the interaction of scientists of member institutions of developing countries with the top most foreign experts/ educationalist of advance countries.

Through a distance-learning program, successful collaborations have been established with several partners such as Sandia National Laboratories, USA; Asian Institute of Technology (AIT), Thailand and Global Young Academy (GYA).



# The Way Forward





The untiring struggle and immeasurable sacrifices of Muslims destined them to have a federal parliamentary republic with a population exceeding 200 million people with a geographical area that makes it the 36th largest country in the world. Pakistan has a high economic potential in different fields and sectors such as energy, agriculture, human resources, and a vast trading region. However, being at different levels of economic development, the IsDB member countries, do not constitute a homogeneous economic group but instead a mixed set-up reflecting a high level of heterogeneity and divergence in economic structure and performance. Such a state of affairs creates a high potential for utilizing the existing resources and capacities within the IsDB community through strengthening technical cooperation in the group in different fields and areas. In fact, the mixed set-up and the high level of heterogeneity and divergence in economic structure and performance of the group of the IsDB member countries allow them to have a successful model of South-South cooperation.

In the view of the above, this study aims at identifying areas where the IsDB's Reverse Linkage interventions will have the greatest impact through supporting knowledge sharing, networking, mutual learning and the exchange of best practices. In this context, Pakistan has become one of the key Southern providers of development assistance as well as valuable sources of technical knowledge and information. Pakistan hosts some of the leading resource centers with the potential to transfer some of their successful models, mechanisms and best practices to other IsDB member countries. This study provides an example of such a transfer where selected and profiled resource centers in Pakistan will enable the replication and scaling up of effective development solutions in other IsDB member countries.

As it has been shown in the study, over the last decade, many resource centers in Pakistan at different fields and areas have become more open and contribute significantly to international cooperation development cooperation outside the country. These centers are also ready to share information and collaborate with international partners. As observed in many resource centers, Pakistan possesses "knowledge hubs" opportunities in several sectors, namely agriculture, agro-based industries, medicine; and information communication technology.

This study showed that only 16 out of approximately 45 resource centers from the public and the private sector have the requisite institutional infrastructure for the exchange and sharing of skills, knowledge and experience with other partners. It has been observed that the skills, knowledge and experience of the rest of the resource centers not shortlisted in this study are not yet documented or modeled and human resources are not sufficient to enable the sharing of information and knowledge with international partners. Therefore, restructuring and reforming these resource centers must occur in order to improve the institutional capacities to share Pakistan's experience. An increase in the overall number of resource centers specializing in different fields will improve the diversification of approaches and models for development cooperation in IsDB member countries.

With the experience gained in Pakistan, IsDB will continue its cooperation in undertaking additional mapping studies in other IsDB member countries in order to build a database of RCs that can participate in technical cooperation and Reverse Linkage projects.



# Appendixes

The background features a large teal triangle pointing downwards from the top right. In the bottom left corner, there are overlapping geometric shapes: a red triangle pointing upwards, a grey triangle pointing downwards, and another grey triangle pointing upwards, creating a complex geometric pattern.



## Appendix-1

## The Steps on Mapping Resource Centers in IsDB Member Countries

- 1. Identify the themes that will be mapped in the MC:** The themes for which a mapping study will be conducted do not necessarily have to be the same in each Member Country. Since each country would have its own areas of strengths and weaknesses, a country-specific set of themes for each MC will be identified. The identification should include a review of the Member Country Partnership Strategy (MCPS) for that country, taking into consideration the priority sectors of the Bank, the country's own economic development strategy, and studies conducted by other development agencies reflecting the economic strengths and comparative advantages of the country. For each country, three to five themes will be selected. Prior to embarking on the mapping study, the selected themes will be validated with the IsDB Governor's Office.
- 2. Identify the authority for each theme:** Once the themes are identified, the next step is to cooperate with the IsDB Governor's office of the MC to identify the authorities (Ministry, University, bilateral development agency, etc.) in charge of each theme.
- 3. Contact and meet the head of the authority:** Once the authorities for each theme are identified, contact should be established (through an official letter sent to the head of these institutions followed by a meeting) in order to:
  - a. Explain the purpose of the mapping exercise,
  - b. Describe how the information collected will be utilized,
  - c. Describe what the benefit will be for the country using the marketing material created for this purpose (e.g. opportunities that may be created when RCs are linked with other MCs),
  - d. Ask for a meeting with the authority in order to identify technical focal points that will assist in identifying the Rcs.
- 4. Set up an expert level meeting:** Once technical focal points are identified, the mapping team/consultant should arrange meeting(s) with them in order to:
  - a. Identify a long list of RCs that have the potential to be selected for mapping based on set criteria. Institutions that meet the following broad criteria will be included in the long-list. The long-list will be limited to 40 institutions.
    - i. The institution is involved in international cooperation,
    - ii. It has a minimum of 15 staff,
    - iii. It has been in existence for at least three years,
  - b. The consultant will prepare an independent list based on a desk review and enhance/validate this list during the meeting with the technical experts of the authority concerned,
  - c. The consultant/team should also validate the questionnaire (see page) that will be sent to the RCs in order to collect key information that will feed into the RC's profile.
- 5. Contact and visit the RCs:** Once the list of RCs is validated with the authority concerned for each theme, the consultant will contact the RCs and set up meetings in order to:
  - a. Describe the purpose of the mapping study,
  - b. Discuss the benefits of the study and the mapping exercise for the RC using the marketing material created for this purpose,
  - c. Describe the information required from the RC in order to prepare their profile for mapping,
  - d. Explain the process that will be followed in selecting the RCs that will be mapped (this is required in order to inform the RC that not all will be mapped, and the selection will be on a competitive basis based on the data provided)

For each meeting with an RC, the consultant shall be asked to provide a brief report on the outcomes of the meeting



- 6. Collect and consolidate the information from RCs:** The consultant will follow up with all RCs that have received a questionnaire, collect the data and consolidate it in a report to be submitted to the authority of each theme, and the IsDB. If there are any gaps in the data provided in the questionnaires, the consultant will contact the RCs in question and request additional information to close the gap.
- 7. Assessment of the data and shortlisting the RCs:** Once collected, the information on RCs will then be reviewed and assessed by the authority, the IsDB and the consultant. The parties will develop, in cooperation, a shortlist of RCs that qualify to be mapped. The information provided by the RCs will be scored and shortlisted based on a pre-defined set of objective criteria and a scoring scheme, which will be used for all mapping exercises.
- 8. Send short-list of RCs to IsDB Governor's Office:** Once the short-list of RCs is prepared, it will be sent to the IsDB Governor's Office of the MC concerned in order to seek their views and endorsement.
- 9. Prepare final report on RCs with their profiles:** Upon receipt of no-objection from the IsDB Governor's Office in the MC concerned, the consultant will prepare a final report on the RCs along with their profiles. The profiles of the RCs will be designed in a manner consistent with the requirements of the online geo-mapping platform so that the data can be integrated with this system seamlessly.
- 10. Validate the profiles with RCs:** Prior to publishing the RC profiles, the consultant will share the draft material with the RCs for validation.
- 11. Publishing of the RCs' profiles and integration with geo-mapping platform:** The RC profiles that are selected for mapping and validated by the RCs will be published in booklets, which will be distributed internally within the IsDB and externally to relevant partners. In addition, the data collected for the RCs will be put in a form consistent with "IsDB's Sector Classification" and then uploaded to the geo-mapping platform.
- 12. Launching event for mapped RCs:** Launching event for mapped RCs: The published reports and the online platform with the mapped RCs will be showcased during a launch event. RCs that are mapped, representatives of the authorities in the MC, and government representatives from MCs with RCs to be mapped later will be invited to these launch events.

Appendix-2

The Questionnaire for Resource Centers

**Section 1: Basic Questions on the Institution**

1) Name of the Institution

.....

2) Date of establishment

.....

3) Location of the institution (main address as well as branches, if any)

.....

4) Current mandate of the institution

.....

5) Type of institution: Government, NGO, private, etc.

.....

**Section 2: Sectors and Areas of Expertise**

1) What are the sector(s) the institution is involved in (e.g. health, education, infrastructure, etc.)?

.....

.....

2) Please describe the area(s) of expertise for each of the sectors the institution is involved in (for instance, health could include: (i) contagious diseases, (ii) maternal health, (iii) cancer screening, etc.). Please limit to 5 areas of expertise per sector.

.....

.....

3) Please list and describe the principal activities that institution undertakes in relation to the area(s) of expertise. Activities can include: (i) research and development, (ii) training, (iii) service delivery, (iv) consulting/advisory services, (v) technology commercialization, as well as any other activity the institution undertakes.

.....

.....

**Section 3: Institutional Structure**

1) What is the current organizational structure of the institution? Please attach a schematic of the organizational structure of the institution along with the answer.

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.....

2) If a governmental institution, what's the reporting structure to the government?

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.....

3) If a NGO or a private institution, are the institution's activities overseen by a Board?

.....

.....

## Section 4: Institutional Capacity

1) What's the total staff size of the institution? Please break down as follows:

.....  
 .....

a. No. of staff in management

.....

b. No. of administrative staff (e.g. accountant, executive assistance, and other staff supporting the main functions of the institution)

.....

c. No. of specialized staff and their areas of expertise (e.g. technical experts, researchers, scientists, etc.)

.....

2) Please specify the physical facilities owned/operated by the institution. Physical facilities could include: (i) research and development facilities, (ii) training facilities, (iii) laboratories, etc.

.....  
 .....

3) What is the total annual budget of the institution? Please provide a breakdown of the budget based on the percent allocated to: (i) administrative expenses, (ii) operational expenses.

.....  
 .....

4) Please describe the source of funding of the institution. Please provide a breakdown of the sources of funding provided, percentage-wise, through:

.....  
 .....

a. Self-funding through income generation

.....

b. Government

.....

c. Local private institutions

.....

d. International private institutions

.....

e. Development agencies

.....

**Section 5: Institutional Achievements**

1) Please describe the five main achievements of the institution (inside the country of establishment) related to the areas of expertise identified earlier. For each achievement, please provide supporting facts and evidence.

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.....

2) Please quantify the principal activities conducted over the past 10 years (total) using the example indicators below:

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.....

a) R&D (No. of research activities, avg. No. of citations per article, No. of patents)

.....  
.....

b) Training (No. of trainees, No. of institutions trained)

.....  
.....

c) Consultancy (No. of consultancies conducted, No. of experts deployed)

.....  
.....

d) Service delivery (No. of beneficiaries reached)

.....  
.....

e) Technology commercialization (No. of patents, No. of commercialized products)

.....  
.....

f) Other activities

.....  
.....

3) Please list certificates (i.e. quality certification, etc.) the institution has earned in regards to its performance and quality standards.

.....  
.....

4) Please list the local and international awards the institution has received as a result of its achievements over the last 10 years. For each award, include a brief description of the reason(s) for the award.

.....  
.....

5) Please list the membership(s) of the institution in international associations and cooperation platforms relevant to the sector(s) and area(s) of expertise it is involved in.

.....  
.....

## Section 6: International Cooperation

1) Does the institution have a department dedicated to international cooperation? If yes, what's the staff size of the department?

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.....

2) If a specific department for international cooperation does not exist, are there staff responsible to implement/follow up on projects outside the country of establishment? If yes, please indicate how many staff work in this area.

.....

.....

3) What's the total budget allocated for international cooperation by the institution?

.....

.....

4) Does the institution engage in activities outside the country of establishment? If yes, please provide the following information:

.....

.....

a. List of the countries in which the institution has activities

.....

.....

b. Scope of the engagement in other countries

.....

.....

c. Number of partnership agreements signed with international partners

.....

.....

5) Please list and describe the projects/programs that are being implemented in cooperation with international partners (up to 5).

.....

.....

6) Please describe the five main achievements of the institution related to the areas of expertise identified earlier outside the country of establishment.

.....

.....

7) Does the institution co-finance projects/programs with other partners? If yes, please provide an annual average of how much the institution:

.....

.....

a. Contributes from its own financial resources to international projects?

.....  
.....

b. Leverages from international partners to fund international projects?

.....  
.....

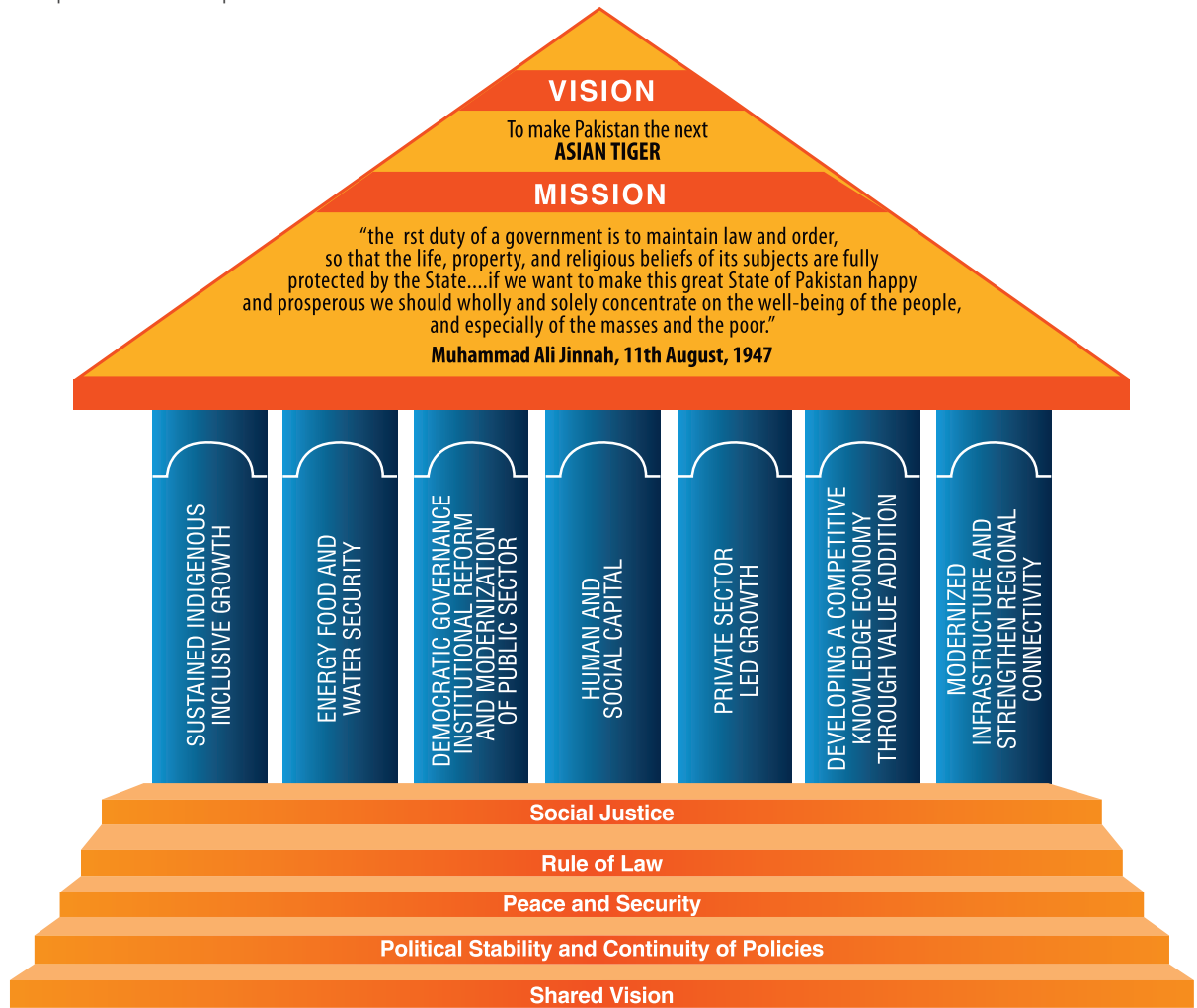
8) Please provide an example of a detailed implementation model that the institution has developed in order to undertake projects with international partners. The outcome of the project should be highlighted.

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.....

## Appendix-3

### Pakistan's Vision 2025

For a nation to progress it must have a clear idea of its destination. Without this, it will be unable to prepare a roadmap and to implement the policies that would lead it there. As we pass through an era of unprecedented change and complexity, it is imperative that we refresh our framework for national development to create a robust platform and to place Pakistan in the league of Upper Middle Income countries by 2025. However, our ultimate destination is to see Pakistan among the top ten economies of the world by 2047 the centennial year of our independence. Vision 2025 has identified five key enablers and seven pillars of development.



#### PILLAR I

##### Putting People First - Developing Human And Social Capital

The first priority is to provide every citizen with the ability to improve his/her choices and quality of life. This requires capitalizing upon and strengthening existing social capital, improving the human skill base of the population, and providing access to opportunities for advancement. It involves a rapid scaling-up of investments in education, health and social development, generating jobs and prospects for the youth bulge, harnessing the rising power of a socially aware population, gender equality and women's development, inclusion of vulnerable segments, interfaith harmony and religious diversity, promotion of art, culture and heritage, raising sporting standards, and moving towards a knowledge-based, ethical and values driven society.

### PILLAR II

#### Achieving Sustained, Indigenous And Inclusive Growth

Pakistan Vision 2025 seeks to revive and sustain the growth momentum consistent with environmental limits and equity considerations. The objective is to provide better living standards to every Pakistani irrespective of caste, creed, or domicile, or religious or political affiliation. Every effort will be made to overcome the manifold inequalities horizontal and vertical, intra and inter-provincial, or rural and urban inequalities. The Vision envisages a strategy for developing a united and equitable society through a balanced development approach, social uplift and rapid broad-based growth. This includes resource mobilization through improved tax collection, export orientation, mobilizing the diaspora and attracting private sector investment, radical improvements in productivity, the provision of opportunities to all segments of society, formalizing the parallel economy, urban development and smart cities and social protection frameworks.

### PILLAR III

#### Governance, Institutional Reform And Modernization Of The Public Sector

The third pillar aims to ensure good governance; strengthen institutions such as parliament, judiciary, police, and the civil service; and deliver the benefits of the devolution of powers to provincial governments as prescribed in the 18th Amendment. The Vision seeks an efficient and transparent government, which operates under the rule of law and provides security of life and property to its people. Good governance encompasses excellence in the management of political, economic, and administrative infrastructure, the development of a skilled, motivated, results-focused, “high performance” civil service, elimination of corruption, flat, agile, streamlined and tech-enabled public sector, transparency on government performance, and the building of an effective regulatory framework that leverages supporting technology and global best practices.

### PILLAR IV

#### Energy, Water And Food Security

Pakistan Vision 2025 recognizes that sufficient, reliable, clean and cost-effective availability of energy, water and food – for now and the future – is indispensable to ensure sustainable economic growth and development. There is a need to fill the enormous gaps in these areas, while simultaneously making efforts to respond to the looming threat of climate change. There is a renewed national consensus—as articulated in the manifestoes of all leading political parties to commit major new resources through public and private sector collaboration in these areas and ensure required production and storage capacities. At the same time, efforts will be made towards conservation, efficient distribution and usage of resources, and preventing contamination and environmental degradation.

### PILLAR V

#### Private Sector & Entrepreneurship Led Growth

Vision 2025 aims to make Pakistan a highly attractive destination for private sector investment, with conditions that allow private investors to successfully participate in its development. This will require a concerted focus on the areas that inhibit the private sector, including the energy deficit, lack of security labor skills, slow and costly judicial procedures (contract enforcement), macroeconomic instability and ad hoc regulations. Public sector enterprises will be made profitable and efficient through a combination of restructuring, partial and outright privatization. Public private partnerships will be promoted through a comprehensive policy regime. Attracting private sector investment will be a key priority and driver of growth. SME sector will be aggressively developed and entrepreneurship enabled.

### PILLAR VI

#### Developing A Competitive Knowledge Economy Through Value Addition

National competitiveness refers to the ability to produce and deliver products and services effectively and profitably relative to competing countries. Improving national competitiveness is critical to ensure we utilize our resources in a productive manner – based on merit, quality and innovation instead of unproductive rent seeking. Vision 2025 envisages investment in the determinants of national competitiveness, especially skill development, information and



communication technologies, and engagement in international markets. The foundations of a knowledge economy will be laid and Industry-Academia linkage strengthened. Cluster based development approach will be used and value chain improvements incentivized. Innovation, technology adoption and value addition will be encouraged.

In order to realize Vision 2025 effectively, a well-defined coordination mechanism is required to translate the Vision into implementable strategies, the 11th Five-Year Plan (2013-18) has been formulated. It defines a comprehensive roadmap and sets timelines for achieving high growth rate. The Plan provides the operational details to achieve Upper Middle Income Country status for Pakistan by 2025. Action plans are being recommended to implement a shift towards the knowledge economy with an entrepreneurial culture in an effort to increase the industrial competitiveness and utilization of our natural resources. In addition, plans for developing an enabling investment environment by crowding-in foreign investment have also been formed to reduce the country's reliance on foreign assistance for economic growth. Improvement in the governance system is envisioned to be a major driver of the economic progress. In this regard, civil service reforms have been initiated to modernize the public sector and improve its service delivery.

## PILLAR VII

### Modernizing Transportation Infrastructure And Greater Regional Connectivity

Successful countries have invariably built upon the dynamism of their regional contexts. Pakistan is situated at the nexus of the four most dynamic regions of the world—China, South Asia, the Middle East, and Central Asia. Vision 2025 aims at the establishment of an efficient and integrated system of communications and transport, in order to both benefit from and contribute to the regional dynamism. Key related targets are reduction in transportation costs, safety in mobility, effective connectivity between rural areas and markets/urban centers, inter-provincial high-speed connectivity, integrated road/rail networks between economic hubs (including air, sea and dry ports), high-capacity transportation

## Appendix-4

### The list of Resource Centers Focal Person

NO.	Institution	Name	Title
SN 01	Pakistan Agricultural Research Council (PARC)	Dr. Kamal Sheikh	TSO to Chairman PARC
SN 02	Southern zone Agricultural Research Centre (SARC)	Dr. Amjad	Director General
SN 03	Ayyub Agriculture Research Institute (AARI), Faisalabad	Dr. Abid Mahmood	Director General
SN 04	Agriculture Research Institute (ARI), Tandojam	Mr. Noor M. Balouch	Director General
SN 05	Auriga Group of Companies	Dr. Irfan-ul Haq	GM Technical
SN 06	Millat Tractors Ltd.	Mr. Humayun Khan	Regional Manager
SN 07	Agritec Industries Ltd.	Capt. Shahid Rahim	CEO
SN 08	Pakistan Central Cotton Committee (PCCC), Multan	Dr. Khalid Abdullah	Vice President
SN 09	National Textile University (NTU), Faisalabad	Dr. Tanveer Hussain	Rector
SN 10	Dr. Panjwani Center for Molecular Medicine and Drug Research (PCMD)	Pro. Dr. Iqbal Chaudhary	Director
SN 11	Amson Vaccines and Pharma (Pvt.) Ltd.	Mr. Nauman Khan	Director
SN 12	Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Science and Technology, Islamabad (NUST).	Dr. Peter John	Principal ASAB
SN 13	Faculty of Computing & Information Technology (FC&IT), University of Gujrat	Mr. Arshad Manzoor	Director IT
SN 14	Department of Computer Science and Engineering (DCS&E) Air University	Dr. Mehdi Hassan	Dean
SN 15	Al-Khwarizmi Institute of Computer Science (KICS), University of Engineering and Technology.	Mr. Muhammad Asif	Registrar
SN 16	Latif Ebrahim Jamal (LEJ) National Science Information Center	Dr. Asmat Salim	Director

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