Building Knowledge-Based Economy in Pakistan: Learning from Best Practices

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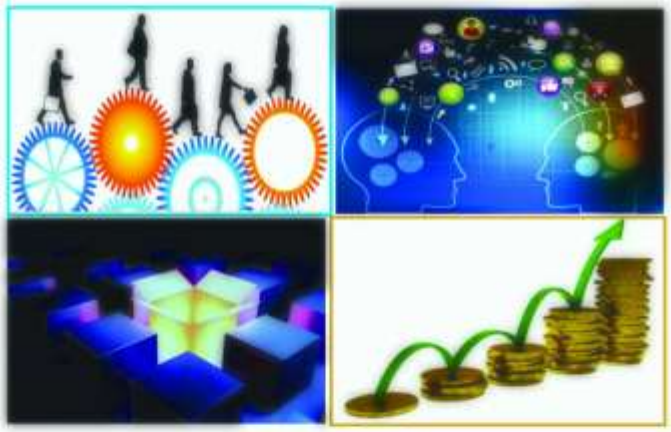

Building Knowledge-Based Economy in Pakistan: Learning from Best Practices

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This book is based on the papers presented at the two-day national conference on "Building Knowledge-Based Economy in Pakistan: Learning from Best Practices" held on September 9-10, 2015 at Serena Hotel, Islamabad. The conference was jointly organised by the Islamabad Policy Research Institute (IPRI) and the Hanns Seidel Foundation, (HSF), Islamabad.

The organisers of the conference are especially thankful to Mr. Kristof Duwaerts, Resident Representative, HSF, Islamabad, for his cooperation and sharing the financial expenses of the conference.

For the papers presented in this book, we are grateful to all participants as well as the chief guests and chairpersons of the different sessions. We are also thankful to the scholars, students and professionals, who participated in the conference.

The successful completion of the conference owes much to the efforts and logistical support provided by the IPRI and HSF staff. Finally, our thanks is due to all those whom it would not be possible to thank individually for their help in making the conference a success.■

Acronyms

ADB	Asian Development Bank
AKIS	Agricultural Knowledge and Information System
AKST	Agricultural Knowledge Science and Technology
CASA	Central Asia South Asia (Hydel Electricity Project)
CPEC	China-Pakistan Economic Corridor
ESCR	Economic and Social Research Council
FAB	Frequency Allocation Board
FCT	Fuel Cell Technologies
FDI	Foreign Direct Investment
FDP	Fertilizer Deep Placement
GDP	Gross Domestic Product
GHI	Global Hunger Index
HDI	Human Development Index
HEC	Higher Education Commission (Pakistan)
HRD	Human Resource Development
HS	Harmonised System
IASP	International Association of Science Parks and Areas of Innovation
ICT	Information and Communications Technology
IMF	International Monetary Fund
ITIC	Information Technology Infrastructure Capability
KAM	Knowledge Assessment Methodology
KBE	Knowledge-Based Economy
KEI	Knowledge Economy Index
KI	Knowledge Index
LNG	Liquefied Natural Gas
MDGs	Millennium Development Goals

MNC	Multinational Corporation
MTDF	Medium Term Development Economics
NARS	National Agricultural Research Systems
NSTP	National Science and Technology Park (NUST, Pakistan)
NTC	National Telecommunication Corporation
NUST	National University of Sciences and Technology
OBOR	One Belt One Road
OECD	Organisation for Economic Cooperation and Development
PAEC	Pakistan Atomic Energy Commission
PARC	Pakistan Agricultural Research Council
PCSIR	Pakistan Council of Scientific and Industrial Research
PCST	Pakistan Council for Science and Technology
PIDE	Pakistan Institute of Development Economics
PPP	Purchasing Power Parity
PTC	Pakistan Telecommunication Corporation
PYD	Positive Youth Development
ROK	Republic of Korea
SMEs	Small and Medium-sized Enterprises
STPs	Science and Technology Parks
TAPI	Turkmenistan-Afghanistan-Pakistan-India (Gas Pipeline)
TFP	Total Factor Productivity

Introduction

Ambassador (R) Sohail Amin,
Muhammad Hanif and Aasia Perveen Mahar

This book is based on the papers presented at the two-day national conference on "Building Knowledge-Based Economy in Pakistan: Learning from best Practices" organised by Islamabad Policy Research Institute (IPRI) in collaboration with Hanns Seidel Foundation (HSF) on September 9-10, 2015 at Serena Hotel, Islamabad. The conference comprised of four working sessions in addition to inaugural and concluding sessions. The presentations made by the eminent scholars covered various themes ranging from "Building Knowledge-Based Economy in Pakistan: Potential and Prospects" to "Imperatives of Building Knowledge-Based Economy in Pakistan" and from "Building Knowledge-Based Economy in Pakistan: Modernising Important Sectors of the Economy" to "Building a Knowledge-Based Economy: A Way Forward." The conference helped in initiating a timely and informed debate on the subject and suggested plausible recommendations to facilitate transformation of Pakistan's economy into a Knowledge-Based Economy.

Since the middle of the second half of the 20th century the world has been witnessing a knowledge revolution where seeking, disseminating and consuming knowledge—especially higher and technical—industrial technology, innovative technology, Information and Communications Technology (ICT) have gained prominence while impacting all spheres of human activity including the socioeconomic development of the countries. Knowledge, therefore, has become the key driver of economic growth taking precedence over traditional drivers of growth, such as physical capital and low-skilled labour. In this context, countries which have taken the lead in using knowledge for their economic development have progressed rapidly leaving others behind. Thus, this trend of seeking, disseminating and using knowledge for economic development by some countries has given rise to the concept of a Knowledge-Based Economy (KBE), as opposed to agricultural and industrial economies.

Although a number of general definitions of KBE are available, in the descriptions of the World Bank and the Organisation for Economic Cooperation and Development (OECD), the term KBE is defined as an economic structure that has the ability to create, store, share and analyse knowledge through networks and communities making predominant use of the ICT. The Economic and Social Research Council (ESCR), UK has

defined the KBE as the economy where economic success is increasingly based on capitalising intangible assets, such as knowledge, skills and innovative potential, as the key resources for competitive advantage. Therefore, in the modern age, human skills, innovation and ICT are considered the key drivers of growth and economic development in the knowledge-based economies.

Recent positive developments in national security and economy have placed Pakistan in a favourable position to build up structures pertaining to knowledge economy. Its economic development should be based on the four pillars of a knowledge economy, which are listed below:

- Economic incentives and an institutional regime to provide incentives
- An educated and skilled population
- An efficient innovation and technology adoption system
- ICT infrastructure

Presently, the Government of Pakistan has reduced the budget deficit from 8 per cent of GDP to 5 per cent; inflation rate from 10 per cent a year to 5 per cent; and enhanced the foreign exchange reserves from US$11 billion to over US$17 billion. The IMF has projected real GDP growth for Pakistan to rise from current 4.24 per cent to 4.7 per cent in 2016. In future, Pakistan's growth rate is likely to accelerate as investors' confidence is expected to raise due to Pakistan Army's recent successes in the war on terror; improved relations with Afghanistan; and Chinese investment in China-Pakistan Economic Corridor (CPEC). A recent US Government report by its National Intelligence Council has also included Pakistan in the "Next Eleven Economies," which will collectively overtake EU-27 in global power by 2030. These favourable economic developments go hand in hand with one of the youngest populations in the world, which commands an increased degree of education.

In this context, it is a good omen that the successive governments in Pakistan during the last decade have woken to the growing significance of making Pakistan a knowledge-based economy. For instance, in 2005 and 2007, the government had charted a roadmap of making its economy knowledge-based. In this regard, Medium Term Development Framework (MTDF), 2005-10; Vision 2030 Approach Paper; and IT Policy were prepared and sanctioned. Similarly, the present government has also geared up and approved the Pakistan Vision 2025 which delineates the vision and strategy to transform Pakistan's economy into knowledge-based economic system. To implement Pakistan Vision 2025, Pakistani government and relevant public and private sectors and institutions need to devise and carry out a comprehensive and time-bound action plan. In this regard, best

practices from other countries should also complement Pakistan's aspirations in becoming a KBE.

The book has two parts. The first includes the Welcome Address and Vote of Thanks by Ambassador (R) Sohail Amin, President IPRI; Opening Remarks by Mr. Kristof W. Duwaerts, Resident Representative, HSF; Inaugural Address by the Chief Guest, Ahsan Iqbal, Federal Minister for Planning, Development and Reform; and Concluding Address by the Chief Guest, Dr. Miftah Ismail, Minister of State/Special Assistant to the Prime Minister/Chairman of Board of Investment. The second part of the book consists of the papers read at the conference. These are briefly described in the following paragraphs:

Dr Usman Mustafa, Head Department of Economics and Chief, Training and Project Evaluation Division, Pakistan Institute of Development Economics (PIDE), Quaid-i-Azam University Campus, Islamabad, spoke on **"An Overview of Pakistan's Economy: Current Use of Four Pillars of a Knowledge Economy and its Further Promotion."** In his presentation, he described a knowledge-based economy as an economy in which the generation, distribution and use of knowledge was the main driver of growth, production of wealth and employment across all industries.

Highlighting the example of knowledge as a main driver of growth, he stated that forty years ago, Ghana and the Republic of Korea had virtually the same income per capita. By the early 1990s, Korea's income per capita was six times higher than Ghana's. Some reckon that half of the difference was due to Korea's greater success in acquiring and using knowledge. While explaining the era of knowledge-based development and growth, he stated that initially, the economy revolved around agriculture, however, after the industrial revolution, wealth became associated with manufacturing and commerce. He further stated that in the current era, wealth was linked with the 'ownership of knowledge' needed to produce goods and services.

Discussing the four pillars of knowledge-based economy, he concluded that knowledge was not a power until it was applied. It played the predominant part in producing wealth. Therefore, there was a need to strengthen all pillars of knowledge-based economy in order to be a part of the Asian century.

Dr. Asad Zaman, Vice Chancellor, Pakistan Institute of Development Economics (PIDE), Quaid-e-Azam University Campus, Islamabad, delivered presentation on the **"Significance of Using Knowledge in the Economy of Development: Current State and Future Strategy of Knowledge Management and Dissemination."** He said that knowledge was a power but the acquisition of knowledge did not necessarily mean the

acquisition of power also. He contended that knowledge had always been a driver of overall growth. However, there were many different types of knowledge in the market of ideas. The most important element was to select the real and valuable knowledge. Currently, Gresham's law operates while cheap imitations of knowledge have driven out the genuine article from the market.

Highlighting the evolutionary process of knowledge, he stated that the most historic episode in the development of knowledge was the emergence of Islam, resultantly Muslims created their own civilisation, which dominated the world for thousands of years. In this context, the importance of knowledge in Islam could be judged from the Hadith that "the ink of the scholar is more precious than the blood of the martyr." Moreover, according to the secular historians, the characteristics of the earlier Islamic history showed that people were motivated by their thirst for knowledge. While tracing the source of today's backwardness of Muslims, he identified that lack of interest in the acquisition of knowledge was the major reason of their problems. Highlighting the rise of Western society, he quoted the Rostow's stages of economic growth model, which indicated the Western economic progress from scratch to the world leadership.

He further stated that across the world, students are more inclined towards obtaining their degrees and passing their exams without any clear objective. Therefore, the idea of getting knowledge to bring transformation is lost.

Mr. Azhar Majeed Shaikh, Former Vice President/Executive Committee Member Federation of Pakistan Chamber of Commerce and Industry (FPCCI), and Director, Arzoo Textile Mills Limited, Faisalabad, made a presentation on **"Modernising Industry and Trade Regime: Using Modern Technologies, Innovations and ICT through Public Private Partnership."** He discussed the challenges faced by textile sector due to which the sector had remained stagnant for last five years. One of the most severe challenges the textile sector and exporters faced, apart from the energy crisis, was the US$1.5 billion stuck, in terms of sales tax and custom duty refund, with the Federal Board of Revenue for refunds.

He reckoned that the state of textile industry in the country was heading towards deterioration, which needed to be addressed on immediate basis. Moreover, Pakistan being the fourth largest producer of cotton in the world ought to have large exports; whereas, its total textile exports were only about US $13 billion which were quite low. Comparing the regional textile and clothing growth in exports with Pakistan, he highlighted that Pakistan's growth was about 22 per cent, whereas growth in exports of India, China and Bangladesh was 94 per cent, 97 per cent and 160 per cent respectively.

He further noted that now the textile business had become a competitive one.

He concluded that if only Pakistan achieved the value addition level of China in textile export, the country would be able to touch upon the figure of US$52 billion of textile exports.

Dr. Tariq Bashir, Head of the Science Section, Pakistan Council for Science and Technology (PCST) spoke on **"Considering Local Dimensions in Building Knowledge-Based Economy in Pakistan."** During his presentation, he referred that at the global level, the competitive knowledge-based economies, governments, knowledge-generating institutions (universities/research and development organisations) and industry worked together to create regional hubs of knowledge. In fact, knowledge hub was a region with communally knowledge-intensive organisations located in both public and private sectors. The knowledge hubs had three major functions: a) to generate knowledge, b) to transfer knowledge at the place of application and c) to transmit knowledge to others in the community through education and training. In this regard, universities and research and development organisations had a central role to play.

He discussed seven different international models and practices on the basis of bilateral and multilateral partnerships between and amongst the private companies, universities and governments to enhance the regional knowledge hub such as strategic partnership between Proctor and Gamble and Durham University; North Carolina research triangle; initiative led by business sector (Information technology business network); initiative led by provincial government (Alberta's innovation economy plan); city government led initiative (Jena, East Germany); Okanagan high technology council; and enterprise development hub (Middlesex University). These models and practices exemplified one way in which universities, industries and governments had collaborated to create dynamic technology-based economies.

Quoting the on-going practices in Pakistan, he said that presently there were no large-scale research and development institutions; he found limited bilateral and multilateral partnership between and amongst the private companies, universities and governments to enhance the knowledge centers. Thus, regional knowledge hubs should be properly institutionalised for innovation-based knowledge development.

Mr. Amer Hashmi, Advisor NUST; President/Senior Fellow, NUST Global Think Tank Network; Secretary General, NUST Corporate Advisory Council and Chairman Executive Committee, NUST National Science and Technology Park, delivered presentation on **"Enhancing the Role of Higher Education, Science and Technology and Innovation."** Explaining

the role of higher education in socio-economic development, he quoted the example of Massachusetts Institute of Technology's entrepreneurship that had been involved in 25,800 businesses and was annually generating US$2 trillion revenue and offering 3.3 million jobs, whereas, Stanford University's entrepreneurship was involved in 39,900 businesses, generating US$2.7 trillion revenue and offering 5.4 million-jobs annually. While China's Tsinghua University's entrepreneurship was involved in 2979 businesses, it was also annually generating US$ 0.4 trillion revenue and providing 125,000 jobs.

While acknowledging the role of think tanks in developing the knowledge-based economy, he stated that there were 6500 think tanks in the US, whereas, during the last ten years China established more than 2000 think tanks. In the case of Pakistan, there were less than half dozen think tanks like IPRI, which were focusing on knowledge-based economy. He further stated that 'triple helix' culture—i.e. university-industry-government triadic relationship—was evolving in Pakistan and some universities such as NUST started bilateral collaborative research and studentship programmes with industries.

Dr. Ather Maqsood Ahmed, Head Department of Economics, School of Social Sciences and Humanities, National University of Sciences and Technologies (NUST), in his presentation on **"Boosting Growth Rate and Export Earnings: Application of Information and Communications Technology (ICT)"** identified that fluctuations in growth and declining trend of growth rate were major stumbling blocks in the economic development of Pakistan.

He elaborated that the basic ingredients of modern growth theory were: accumulation of physical capital with the understanding that there were diminishing returns; accumulation of human capital; interplay between per capita income and growth rate of population; technological progress stemming from increased specialisation of labour; discoveries of new goods and methods of production (productivity enhancing factors); and the role of resulting power as an incentive for technological advances.

Besides, investment in education, health and nutrition and related social infrastructure, productivity growth through investment in research and development, innovations and entrepreneurship had taken central position in the growth equation, which could not be overlooked in the process of economic development.

Discussing Pakistan's trade profile, he stated that the country had relied too heavily on traditional products. He concluded that there was a need to build a knowledge economy for which Pakistan needed to rid itself of constraints of a natural resource driven approach to socio-economic

development and focus on strengthening the 'triple helix' (university-industry-government relationships) of the knowledge economy.

Dr. Vaqar Ahmed, Deputy Executive Director, Sustainable Development Policy Institute (SDPI), Islamabad spoke on **"Capacity Building of Human Resource and Services Sector: Improving Education and Technical Skills, using Innovations and ICT."** He said that the role of state would continue as a paramount driver of capacity-building, particularly in services sector due to its contribution in economy; the sector was contributing about seventy per cent to the GDP in Pakistan. Unfortunately, national policy on the services sector has not been devised. Therefore, he suggested formulating national policy for services sector and recommended three policy papers for having the ideas of enhancing the capacity-building of services sector. These were: Poverty Reduction Strategy Paper prepared by Finance Division of Pakistan; Pakistan: Framework of Economic growth; and Vision 2025 prepared by Planning Commission of Pakistan.

While explaining the state of Human Resource Development (HRD) index in Pakistan, he said that the improvements were being made on the vocational training side but more budget was needed for it.

Dr. Umer Farooq, Member Social Sciences Division Pakistan Agricultural Research Council, Islamabad presented his views on **"Revolutionising Pakistan Agriculture by Increased Use of Knowledge, Science and Technology and ICT".** He gave an overview of agricultural sector of Pakistan, its significance for Pakistan's economy and the need to revolutionise the agricultural sector. It was stated that agriculture was the backbone of Pakistan's economy; the sector provided the largest source of employment and was a major contributor in the GDP of the country.

It was pointed out that Pakistan's spending on agriculture was only 0.18 per cent. Besides, in Pakistan obsolete methods of farming were being employed and there was a mismatch between technology generation and farmers' needs. Due to the prevailing poor farming techniques, Pakistan was fast losing competitiveness in production and exports.

Therefore, there was a need for higher investment in agricultural research and development by the government as well as the private sector. The capacity-building of all stakeholders through the use of ICT and training in modern farming techniques was required. Through web/mobile-based applications, different analytics and other information like domestic, regional, and international prices/stocks could be shared. It was informed that cell phone based agricultural extension model had been launched in Khyber Pakhtunkhwa by Telenor Pakistan. The same model could be replicated in other parts of the country for timely transmission of information to the stakeholders.

Dr. Sohail Naqvi, Vice Chancellor, Lahore University of Management Sciences (LUMS), Lahore during his presentation on **"Transforming Pakistan's Economy into Knowledge-Based Economy: Existing State and Promotion of the Role of Research and Development (R&D) in Science and Technology and ICT",** viewed the low literacy rate in Pakistan as a major impediment in the country's progress. He opined that despite knowing the fact that the school education (not university) had a direct bearing on the socio-economic development, in Pakistan over the years, the graph of education had fallen.

Another aspect highlighted for improving the educational standards and statistics was the type of courses being taught at various colleges/universities of Pakistan. In Pakistan, unemployment was on the rise. Building universities of applied sciences was not the solution; rather re-defining the role of educational institutions was the need of the hour. There was a need to develop vocational training centers. The societal mind-set wherein, everyone wants to be a doctor or engineer also needs to be changed and people should be encouraged to study other subjects as well.

Dr. Gulfaraz Ahmed, Former Federal Secretary, Ministry of Petroleum and Natural Resources, Islamabad gave a presentation on **"Reforming Energy Sector: Exploring Fresh Sources of Energy Production Using Modern Technologies".** In his presentation, he described the symbiotic connection between knowledge and energy. Both follow similar trajectory of growth. It was stated that the depletion of conventional sources of energy and the excessive emissions of carbon dioxide, compelled the scientists and policy makers to devise new ways. This led to innovations in technology. The increase in gas prices was a driving factor behind the discovery of shale oil and gas reserves. The US, Russia, China, Argentina, Libya, Venezuela, Mexico, Canada and Indonesia have discovered shale reserves. Shale reserves (worth of 9.1 billion barrels) have also been found in Pakistan. The discovery of shale oil put Pakistan on prospective international oil map.

Regarding the energy demands of Pakistan, it was reiterated that exploring indigenous resources and enhancing energy conservation mechanism as well as conservation awareness would be useful in countering the energy crisis. Meanwhile, the regional options to meet energy needs should be explored. The government efforts to import Liquefied Natural Gas (LNG), build the energy pipelines (TAPI-Turkmenistan-Afghanistan-Pakistan-India and Iran-Pakistan Pipeline), Central Asia South Asia (CASA) hydel electricity project and the China Pakistan Economic Corridor (CPEC) were steps in this direction.

Mr. Umer Shehraz, Senior Policy Analyst at COMSTECH Secretariat, Organisation of Islamic Cooperation, Islamabad discussed the **"Use of**

Foresight in Formulating and Implementing a National Policy". He described the best foresight as a combination of different methods. It was opined that multiple perspectives would give a bigger picture, and would thus contribute towards making of successful policies.

He highlighted that in Pakistan, the fragmentation in resources and research efforts is due to the absence of a knowledge exchange system at the micro level, and the communication gap between the different tiers of stakeholders.

The talk concluded that a foresight, in which views of all the stakeholders were catered, followed by a coordinating mechanism was required. The wider involvement of the society would bring political support. This in turn, would increase awareness, and mobilise academia and public bodies. Thus, with focused research and development, funding could be carried out in the right direction, and future policies could be implemented.

Mr. Zhao Lijian, the Political Counselor of the Chinese Embassy, Islamabad delivered a talk on **"Learning from Best Practices: Economy of China".** While referring to China's growth potential (GDP US$10 trillion), he remarked that China's growth was the driving force for the world economy. According to the IMF statistics, China's contribution to global GDP was around 28.2 per cent. China's major trading partners included Japan, Hong Kong, EU, the US, ASEAN, and the total import and export stood at US$4.3 trillion.

China's endevaour to move away from 'made in China' to 'created in China' was in line with the emerging trends. He highlighted that China's One Belt and One Road initiative was aimed at creating strategic channels, trade and industrial hubs, and regional integration. He said, that the Silk Road Economic Belt, the Maritime Silk Route—often termed as the One Belt One Road (OBOR)—and the Vision for 21st Century Eurasian Connectivity will connect markets of Asia, Europe and beyond. The energy cooperation would accelerate the pace of economic development besides contributing towards regional connectivity.

The China-Pakistan Economic Corridor (CPEC) was also discussed. The project would connect Chinese province Xinjiang with the Pakistani port Gwadar, and would boost several economic zones and links between various regions of the world.

Mr. Takashi Harada, Economic Counselor, Head of the Economic and Development Section, Embassy of Japan, Islamabad shared his views on **"Learning from Best Practices: Economy of Japan".** He said: "the present day Japan is robust with a flourishing economy". However, seen in the historical context, Japan was completely devastated after the World War II. The country had to start from the scratch. Since then, Japan had made

tremendous progress. The infrastructural development, network of roads spread throughout the country and the progress in the field of science and technology reflected Japan's booming growth. To reach this level, Japan had employed the knowledge-based practices in its policy making. For example, in Japan, public and private sectors worked in coherence with each other. The public sector was responsible for disseminating knowledge while the private sector ensured its effective consumption. The smooth functioning between the various stakeholders transformed Japan's construction sector into a potent industry. Due to Japan's expertise in the construction field, Japan in collaboration with the Asian Development Bank (ADB), had been chalking out a plan to provide Asia with innovative infrastructure financing at a scale of US$110 billion per year.

Note: We are thankful to Dr. Asad Zaman, Mr. Azhar Majeed Shaikh, Mr. Amer Hashmi and Dr. Sohail Naqvi for presenting their valuable ideas in the conference, in the form of extempore speeches. Since they have not provided their research papers, their presentations could not be included in the book in the form of chapters. However, the introduction of the book encapsulates salient points of their presentations.■

Welcome Address

Ambassador (R) Sohail Amin
President IPRI

Honourable Mr. Ahsan Iqbal, Federal Minister, Planning, Development & Reform/Deputy Chairman, Planning Commission of Pakistan,
Mr. Kristof W. Duwaerts, Resident Representative,
Hanns Seidel Foundation (HSF), Islamabad Office,
Excellencies,
Distinguished Scholars,
Ladies and Gentlemen,
Good Morning and Assalam-o-Alaikum!

It is a great pleasure for Islamabad Policy Research Institute to host this two-day conference in collaboration with the Hanns Seidel Foundation on 'Building Knowledge-based Economy in Pakistan: Learning from Best Practices'.

Today's conference is aimed at highlighting a unique concept. When we think of Pakistan's economy, we think on traditional lines. We think of formal and informal economy. What we strive for is to increase our industrial and agricultural production and make improvements in the quality of our goods and services. The purpose is to improve our micro and macroeconomic indicators. However, the means that we employ for achieving these objectives are traditional, which are capital and labour intensive.

The main objective of the two-day conference is to stir innovative thinking and incorporate it in the traditional approach. While we have no shortage of manpower, the state and the individuals do have scarcity of capital. According to the Western scholars, the share of labour in GDP is declining in 42 of the 59 countries that they have studied, including China, India and Mexico. The progress in the digital technology has been described as the main cause of this decline. Similarly, computers, software and technology automation are creating digital capital for economic progress thus reducing dependence on having capital in terms of money.

In such circumstances, the concept of knowledge-based economy becomes relevant in Pakistan. This is an economy which is based on knowledge and the major input for that is the power of mind; a mind that can innovate and create new products, services and business models. In

knowledge-based societies, it has become possible to codify many goods and services. After their codification, these are digitised and can, therefore, be replicated at no cost and can also be delivered digitally anywhere in the world.

I will just give one example. A photo sharing application Instagram was developed by 14 persons with a small capital. After a few months, they sold their company for 750 million dollars when Kodak which had 145,000 employees and assets worth billions of dollars was declared bankrupt.

The power of the mind that I mentioned earlier can be developed through knowledge and therefore, creation of a knowledge-based society for the development of a knowledge-based economy is the most important requisite.

During the last four decades, seeking knowledge, particularly on technical instructions, industrial technology, innovations, and Information and Communications Technology (ICT), has gained prominence all over the world. The countries taking lead in using knowledge for their economic development have progressed rapidly and their products have become more competitive in the world market.

Our economy has been put on the right track. In this context, the 'Pakistan Vision 2025' delineates the strategy to transform Pakistan's economy into a knowledge-based system. To implement the 'Pakistan Vision 2025', all the public and private sector institutions should evolve a comprehensive and time-bound action plan. In this regard, the Planning Commission, Ministry of Science and Technology and Higher Education Commission have to play a key role. Moreover, in view of the 18th Amendment 2010, after which some roles have been devolved to the provinces, we need to ensure that the efforts to transform our economy into a knowledge-based economy remain inclusive.

According to estimates, the economy of Pakistan is expected to achieve the growth rate of more than 5 per cent in 2016. To maximise the growth rate, it is necessary to base Pakistan's economic development on the four pillars of a knowledge economy, which are:

- Economic incentives and an institutional regime to provide incentives;
- An educated and skilled population;
- An efficient innovation and technology adoption system;
- An effective ICT infrastructure.

I am confident that the recommendations of this conference will provide valuable input to our decision makers.

I once again warmly welcome Mr. Ahsan Iqbal for agreeing to grace this occasion with his inaugural address.

I also welcome all the speakers who will enrich the conference proceedings with their valuable insights. I am sure that all the participants will benefit from the expert views of the distinguished scholars. I extend a very warm welcome to the invitees who have spared their time to contribute during the question-answer sessions.

Thank you.■

Opening Remarks

Kristof W. Duwaerts
Resident Representative, Hanns Seidel Foundation (HSF), Islamabad

Respected Mr. Ahsan Iqbal,
Ambassador Sohail Amin,
Speakers,
Dear Friends of IPRI and Hanns Seidel Foundation,
Ladies and Gentlemen,
Good Morning!

Pakistan recently has achieved economic stabilisation, which may prove to be an important landmark in the history of the country. Being the 6th most populous country in the world with an overwhelming majority of young people, who still have their whole lives before them, a stable economy is of utmost importance for the wellbeing of this nation. However, there are many infrastructural decisions, which need to be taken, such as a decentralisation of responsibilities to the level they can best and most responsibly be taken at; to the provision of physical security through the abolition of terrorism, crime and other factors of instability; on the economic level, getting rid of the evil of nepotism and corruption in order to generate a chance for an equitable growth and wealth. In the knowledge economies—in which we count most of the 'successful' economies in the world including, for instance, Germany—there is also a need of taking more strategic decisions.

Pakistan can become the 18th most important economy by 2050 as predicted by the economists, but it cannot do so by relying solely on its agriculture. The economists speak of three different sectors of an economy: the primary sector being agriculture, the secondary pertaining to industries, and the tertiary sector dealing with service delivery. Current knowledge economies employ an overwhelming part of their population in the tertiary sector. For instance, Germany's workforce is made up of almost three fourths in the tertiary sector with just 0.9 per cent contributing to agriculture, more than two-fifths of Pakistan's population at present work in the primary sector, generating nearly 25 per cent of the GDP and almost half of the population is delivering services accounting for 16 per cent of GDP. France, which has a comparably important agricultural sector like Pakistan, employs 3.8 per cent of its labour force in the primary sector, contributing 1.9 per cent of GDP, whereas 80 per cent work in the tertiary

sector contributes 72 per cent of GDP.

One of the most important strategic decisions for a nation to become a knowledge economy hence is to take labour out of the primary sector, probably jump from the secondary sector to a large extent, and then employ people in the tertiary sector, while preserving the agricultural output. Technological innovations have made this preservation possible, but a change from primary to the tertiary sector brings with it enormous challenges to the demography of a country. In order to at least partly settle for this huge challenge, the second and most important strategic decision to be taken, is the provision of education beyond primary schools in order to create the knowledge which transforms an economy into a knowledge economy. Such changes do not take place within days, educating and resettling people is a long-term, an ongoing and difficult process to handle. Jobs need to be created in order to prevent unrest and provide people with sustainable livelihoods. Such steps cannot be taken by a government; a government can only implement some strategic decisions thereby hopefully providing the ground for others to genuinely transform the economy. Those "others" are predominantly made up of economic actors, businesses, investors. If they feel secure then the economy will largely be regulating itself towards the tertiary sector.

In a knowledge economy, the specialised labour force is characterised as computer literate and well-trained in handling data, developing algorithms and simulated models, and innovating on processes and systems. A third important key factor, which again falls within the purview of education, is to change the overall approach to how management works. Here again, the government can put incentives, but not enforce any kind of development, as it might prove to be unsustainable otherwise.

With its young and aspiring population, Pakistan currently is in a good position to lay the groundwork for transforming itself into a knowledge economy. I hope that this publication will bring plenty of insights into how economic, political, and societal forces can interact in order to build this knowledge economy, while always keeping in mind that there is not the driving force, and that there is certainly not a blueprint, which can just be implemented. Lastly, we all should keep in mind that even with the economically stable countries of Europe, the process of becoming knowledge economies has taken more than half a century. Pakistan might not have to wait for that long, but it would certainly not be a matter of days, weeks or even months.

With that, I would like to thank the Islamabad Policy Research Institute for bringing together the experts from all over Pakistan from diverse backgrounds in order to have the first ever discussion on building a knowledge economy in Pakistan. As always, it is sincerely hoped, that the

recommendations from this conference and the publication would be widely read, understood, and implemented.■

Inaugural Address

Ahsan Iqbal
Federal Minister, Planning, Development and Reform/Deputy Chairman,
Planning Commission of Pakistan

Ambassador (R) Sohail Amin, President IPRI,
Mr. Kristof Duwaerts, Chief Executive of Hanns Seidel Foundation in Pakistan,
Distinguished guest,
Ladies and gentlemen,
Good Morning!

I would like to take this opportunity to express my sincere gratitude to the President IPRI and the organising team for the invite and a generous introduction. I certainly want to make my contribution in the development of this country, for I am indebted to this country for all my achievements in life.

Therefore, I sincerely believe if my education could bring me to this level, every Pakistani—male or female—should have the equal opportunity to advance in life by acquiring quality education. The knowledge economy has been a mission for the present government. We started speaking about knowledge economy in 1998 when Vision-2010 had been devised. The essence of the vision was to foster a knowledge-based economy. As in the late 90s, the world was waking up to the call of knowledge economy, this concept was at the center of discussions in all academic and intellectual circles. We have been fortunate to seize upon this idea early and to develop a road map as well.

In 1998, a study was conducted in Pakistan to find out the number of PhD teaching faculty members nearing their retirement. The study revealed that Pakistan would lose 70 per cent of its PhDs, who were at the last stage of their retirement. Therefore, the Government of Pakistan launched two schemes for the teachers and future PhD scholars, namely Teachers and Researchers Overseas Scholarship Scheme (TROSS) and the Indigenous Scholarship Scheme, in July 1999.

Dr. Atta ur Rehman, during his service in Committee on Scientific and Technological Cooperation (COMSTECH) and later in Gen. Musharraf's Cabinet, revived those two projects. At that time, we had 350 PhDs in science and technology; later, due to the strenuous efforts by the

government, the number of PhDs rose to 7500. So this area gave us some dividends.

However, the key element of knowledge economy is that we must create synergy and alignment between the platforms of knowledge and production. This is at the heart of knowledge economy: how we create an architecture which will make knowledge a productive force while creating tangible products and services in the economy. This whole knowledge chain starts from education. Not only entire education value chain has to be developed, we need to create linkages. Only then this education value chain would start to contribute towards the productive sector. As the production and knowledge run in harmony and support each other.

Another study was conducted to find out the number of PhDs in the textile sector. The textile sector contributed 65 per cent foreign exchange during 1998-99. In the study, we discovered, to our dismay, only two PhDs in this sector. Therefore, having only two PhDs in a sector which yielded 65 per cent foreign exchange only revealed the disparity between our production and knowledge platforms.

Therefore, in order to bridge the gap between knowledge and production, PhD scholarship schemes have been initiated; through these programs, the government will focus on those areas which will have a direct bearing on the development of Pakistan. We, as a developing country, cannot afford the luxury of pure research like more advanced countries. We have to be very focused on every rupee which goes into research; it must contribute directly in improving the quality of our lives, while amplifying our economic growth. Focus has been the key element of that strategy, due to losing that focus the result is, although today we have 7500 PhDs in science and technology, the number of PhDs in the textile industry, which is the backbone of the country, is far less than the number of PhDs in Science and Technology. Therefore, this synergy between knowledge and production platforms is at the heart of Vision-2025 that we have developed.

The first and foremost challenge to knowledge-based economy is that we have to change the paradigm of education from memorisation towards developing creativity, innovation, critical thinking, and problem-solving skills. These are the fundamental elements of a knowledge economy. The developed as well as fast-developing countries of the world are focusing on the improvement of their school systems. We also need to think of ways to upgrade our school system so that we can align it with the requirements of knowledge economy i.e. creativity and innovation. Not only we have to revise our curriculums to best attain the rudiments of a knowledge economy, we also have to change our social norms. So the whole notion of knowledge economy has to be transformed.

The basic aspects of learning according to Quran are: observation, inquiry and learning. This is what Allah has used as narrative in Quran for His own lordship to be recognised. Therefore, these attributes must be revived. Contrary to this, our education system — designed by our colonial masters — was basically an attempt to create submissive slaves, not critical thinkers who could think for themselves. It was aimed at producing an educated class for the East India Company. The mistake on our part is that we adhered to that education system so dearly. Therefore, in order to transform our curriculum, which carries no tint of colonial legacy, we have formed National Curriculum Council in partnership with the provinces. All the provinces will collaborate in designing a national syllabus in which education curriculum of Singapore, Malaysia, all the Scandinavian countries and the best countries of the world will be reviewed in order to see how these countries are inculcating creativity and innovation; afterwards, we will realign our curriculum with those curricula. So these are most fundamental changes we are making. Its impact will be visible in the coming decades. We will benefit from our coming generations which will be equipped with creativity, innovation and critical thinking.

Simultaneously, we have collaborated with the provinces, to evaluate our examination bodies as there is a lot of variation within the boards in one province. So a project has been initiated to work with the provinces, through inter-province committee, to reform our boards of intermediate and secondary education to form one standard, and start taking exams in the new mode of learning which we are introducing in our curriculum.

Moreover, we have set up a Rs. 1 billion technology innovation fund; this fund will offer research grants to 7500 PhDs i.e. if they have projects which have direct application to our industry and agriculture. The research fund will provide research grants to those scholars who can apply knowledge to increase production and effectiveness through innovative research, while contributing to Pakistan's economy. This will bridge the gap between knowledge and production platforms.

The present government has also introduced Science Talent Farming Scheme this year; the project will select 300 promising science students from high schools and they will be raised under the scheme up to PhD level to become world class scientists, with a mission to bring solutions to Pakistani social and economic problems. Out of this new crop of 300 scholars, we will be able to produce more scientists like Dr. Abdus Salam.

We are also initiating a one-semester certificate program to reskill the students of Arts: Urdu, Persian etc. The program will run in collaboration with LUMS, IBA, Institute of Management Sciences, Peshawar and Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS). These programs will be conducted in

batches of 120. Under this program, the general graduates will be given certificates of technical skills which will prepare them to make contribution into the economy of the country. This is not a small challenge: it requires a major change in the societal thinking since presently the majority of youth acquires education to enter prominent professions, namely medicine, engineering etc, whereas for building a knowledge economy, properly skilled manpower in diverse fields is required. The present government has taken the first steps in the right direction.

As Turkey's PM has also shared the secret of Turkey's recent success in economy while enlisting three factors: one, democratic stability which ensures continuity in the government policies as well as stability; second, they had strategic economic plan i.e. they had clear goals and right set of policies; but more importantly, what really helped in the growth of Turkey's economy was the positive attitude of its people. Pakistan can also increase its economic growth by following Turkey's model.

In 2013, when PM Nawaz Sharif came to power, Pakistan was entangled in several problems. However, the current government has successfully turned the tide. Now Pakistan's economy is not only set on the path of recovery, but also poised for significant growth. For previous five years, Pakistan's GDP has remained under 4 per cent. However, we have crossed the threshold of 4 per cent and we are set to reach 5 per cent this year. Our foreign reserves are going to reach 20 billion dollars from 7 billion dollars. Now, foreign investors are keen to invest in Pakistan.

In addition, China Pakistan Economic Corridor has provided yet another landmark opportunity for us which has helped us dispel the tarnished image of our country. Previously, Pakistan was viewed as a safe haven for terrorists and terrorist activities in the world, whereas now Pakistan is considered as a potential market for their billion dollar investments. So we have to dispel any notion of pessimism and negativity, whether it is from our media or international media.

The leadership of our country has also realized that it has to work together. Despite political differences, all the political parties have matured enough that they agree upon the major national policies. For that reason, we have been able to attain success in peace and security area. For instance, security situation in Karachi and Balochistan has improved a great adeal. Pakistan will soon become Quaid's country where every Pakistani regardless of his/her ethnicity, religion, language, will have access to equal rights.■

Concluding Address

Dr. Miftah Ismail
Minister of State/Special Assistant to the Prime Minister/Chairman of Board of Investment, Pakistan

Ambassador Sohail Amin,
Mr. Kristof Duwaerts,
Distinguished ladies and gentlemen,
Good afternoon!

I am really pleased to be here today at the forum of Islamabad Policy Research Institute.

Being an economist, I would discuss the economic aspect of this argument i.e. knowledge-based economy. I will pose a few questions as well as give a narrative of what the government of Pakistan has accomplished in the last few years since Mian Nawaz Sharif came to office in the June of 2013.

If we look around at the countries of the world, we find some countries to be very rich like Japan, Norway, Finland; other countries such as Pakistan, India, Nigeria, Indonesia, and many countries of Africa are not so rich vis-à-vis per capita GDP, or any human development index. There is a huge difference between these countries. Why are some countries rich and others poor, in comparison to each other? Is the difference natural resource? Is it the case that for instance, Finland has very good forestry resources and Norway has some forestry resources, while Nigeria and Indonesia do not have such resources. Nigeria is rich in oil resources. Pakistan is endowed with a number of natural resources. India has a lot of natural resources. Japan has a very few natural resources. Although resources play an important part whether a country is well off or not, they are not the determining variables.

Countries do not become rich on the basis of natural resources only. It is the demography, the right mix of human resource in terms of young and old, which contributes to a country's wealth along with other factors. In countries like Japan, majority of population is not young, whereas in countries like Pakistan, India, and Nigeria, majority of population is young. For instance, 60 per cent of the Pakistanis are under the age of 25. The number of workers in comparison to the number of retired persons is very high. While in other countries, this ratio is very low. Yet many Western countries besides Japan tend to be very rich. Similarly, Singapore has very

few human resources as it has a small population; it can't really grow by itself. Yet it is very well off as compared to large countries like Pakistan and India and very small countries like Djibouti. So it's not just human resources or natural resources which are the telling factors of an economy.

The management of economy is the key to economic growth. For instance, Nigeria or Venezuela more recently are not as well-managed economies as some of the other oil-producing countries are. Although Nigeria has a lot of oil wealth, there is still shortage of petrol in the country despite it being an oil-exporting country. Similarly, Indonesia has a lot of oil but over the years, especially during Suharto government in Indonesia, resources were not managed so well. Therefore, good management of resources is more crucial than the amount of resources. On the other hand, Gulf states—Saudi Arabia, Qatar, Kuwait etc.—are reasonably well managed economies as these states utilise their resources to build good economic foundation. These countries have administered their economies better than countries like Indonesia and Nigeria over the last 30 years. So management is one important factor which cannot be overruled.

In the case of Pakistan, our country has all three things going in its favour: natural resources; human resources; and management of economy. Below is an analysis of how a knowledge-based economy can help optimise the above mentioned resources.

Natural Resources

- Pakistan has 6th largest coal deposits of the world in the province of Sindh i.e. 180 billion tons of coal, having the value of 9 trillion US dollars. This is a huge amount of money; it is equal to China's or USA's GDP per year.
- We also have the 4th largest copper deposits of the world. The area of copper deposits in Pakistan is 30, 000 square km in Balochistan. It is the same tectonic plate that is running from Europe. In Chile, for instance, the area of copper deposits is also 30,000 square km. Chile has 7 to 8 per cent GDP which comes from copper mining.
- Less than 0.1 per cent of our GDP comes from mining whether it is copper, iron, minerals etc., whereas we are blessed with a huge amount of copper resources, oil etc.
- On the Indus Cascade, we can make 80,000 megawatts of electricity. Although we have some eastern rivers which are dry like Ravi, we can still produce 80, 000 megawatts of electricity from our western rivers; we can store millions of acre foot of water.

- The one resource which we have been utilising well is our canal irrigation system. We have 40,000 km long canal system in Sindh and Punjab, which is one of the largest irrigation networks in the world. And that makes the huge agricultural lands of Punjab, the most productive lands in the world. For that reason, we are among the top ten producers of milk; food grains especially wheat, rice etc.; fruit and vegetables.
- Pakistan is also blessed with oil and gas resources. We have 9 largest shale oil deposits in the world. Also we have very large deposits of shale gas. Further, we have 150 cubic ft. of conventional gas whereas we have only explored 30. And out of these, we have taken 4 trillion cubic ft. of gas. As many deposits as we have, we are actually a net deficit country. Currently, we are importing LNG. Our daily production of gas in Pakistan is 4 billion cubic ft. which is not small. But our consumption is 6 billion ton; we need 2 billion cubic ft. of gas every day. Therefore, we need more energy terminals: such as in Iran-Pakistan pipeline and TAPI-Turkmenistan-Afghanistan Pakistan-India gas pipeline. We need those gas pipelines to bring gas and also explore our own gas which is in the tribal areas, the most difficult areas. These are huge resources that we are blessed with and yet we are a poor country.

Human Resources

- We have 70 million people in the middle class; the people who can afford consumer durable goods, so we have a huge market. In 2025, we will have a 100 million people in our middle class – the fifth largest middle class in the world which will turn Pakistan into a huge market for foreign investment. As we have a large sized population, we give them economy of scale; the international markets would want to set up their factories in Pakistan, just to be able to sell to Pakistanis. And when they sell to Pakistanis, their size will become bigger and the cost of their production will go down and eventually they will be able to export to the rest of the world. So the human resource gives us a huge market but it also gives a large, well skilled labour force which is not so expensive; besides being factory workers, they and their families are the consumers. Moreover, Pakistan offers an enabling work environment, as there are no labour strikes.

Therefore, Pakistan has good human and natural resources as enumerated above. But still it is a poor country because its economy has not

been managed well. But after the present government took over (in June 2013), the management of economy greatly improved. In 2013, however, we ended up with extremely high budget deficit: i.e. 8.2 per cent of the GDP. Next year, the budget deficit was reduced to 6 per cent of GDP while in 2014, it was brought down to 5 per cent of the GDP – which is a remarkable achievement. At the same time, the growth of economy also accelerated. In 2014, it was 4.24 per cent, the highest in last 8 years. Yet 4 per cent is not enough; we need at least 6 per cent growth to absorb all the people coming in the labour market. In order to make any significant dent in poverty and illiteracy in Pakistan, we need growth of 8 to 9 per cent as 6 per cent will only keep us in equilibrium. In comparison to previous 8 years, however, 4.24 per cent growth is an achievement. If we look at the inflation rates, they were 1.77 per cent during July 2014 to July 2015. The fact that the international oil prices have decreased, and other commodity prices have come down, has really helped us.

Although the oil and grain prices have decreased throughout the world, if we look at South Asia: India, Pakistan, Bangladesh, Sri Lanka, Bhutan, Nepal, we will see that inflation rates have receded perceptibly only in Pakistan. So this government has actually managed the economy well. While we are contracting the fiscal stimulus that this budget deficit used to provide and bringing prices down, we have still kept the growth rate to a reasonable level, though not to the desired level. But our first task after coming to power was to stabilise the economy, which we have done so far. The arduous task which we have to take up now, is to increase the growth of the economy. Stabilising the economy is easy, but to grow an economy, we need to motivate 180 million people. We need to empower them, give them easy access to education, and provide them better health facilities. This is much more difficult task; the government is geared towards bringing growth to a high level in next three years of its term.

The countries like China have achieved growth rate of 10 per cent. The countries like Costa Rica, Latin America and South America have also attained growth rate of 8 to 10 per cent. In 1960s, 1980s, we had also achieved the growth rate from 7 to 7.5 per cent while our neighbour, India had growth rate of 4 to 5 per cent only. Now India's growth rate is 7 to 8 per cent, whereas our growth rate is 4 per cent.

Similarly, in 1950s we had a share of world exports greater than South Korea, now it is much less. In 1990s, our exports were more than Vietnam's. Now Vietnam has exports of more than 90 billion US dollars, whereas our exports are only about 25 billion dollars. Likewise, India was behind us in per capita GDP, now it is ahead of us vis-à-vis growth in economy.

Therefore, we must increase our growth rate. There are two equilibriums which contribute in a country's economy and growth rate: natural and human resources and good management of economy.

In order to extract benefits from the wealth of natural resources, we need to have the technology and training; if we lack in this, natural resources cannot yield desired economic growth. Similarly, human resource will also not contribute into our growth rate, until we know how to turn it into an asset, for human resource can be an asset or a liability. Only knowledge-based economy can catapult us from a 4 per cent growth to an 8 per cent growth. We do not necessarily have to be the producers of science but we can be consumers of science. Obtaining good technology is an example of consumption of science. We need to have thinkers who think of solutions, and make us consumers of science. We need to bring knowledge in our economy as this is the only way to reach at 8 per cent growth rate.

For that reason, after building Indian institutes of technology, India achieved high growth rate. In 70s and 80, India had very low growth rate but they spent money on education, and built IITs. And today the new CEO of Google is from an IIT. But we do not have similar IITs in Pakistan. If we look at China, it has one of the largest forces of engineers in the world.. These countries have attained high growth rate because they have incorporated education, science and technology into their economy. We have not been able to do that. For this, a two-year, or five-year plan of a one-term government will not bring any significant change; it is the national plan which can transform this country and bring real results. It should be the national agenda which all political parties must follow.

We must give priority to education, particularly science. We have to produce world-class scientists like prof. Abdus Salam. So we have to rethink and re-evaluate ourselves. We need to give freedom of thought to our professors and universities. Our students need to learn science for science sake and free their minds. We need more PhDs in basic biology, physics, and science as we need more PhD engineers, as this country will only grow if we bring knowledge into our economy. It may take the time and resources, it needs. It is not whether we can put resources into this; it is, whether we can afford, not to put resources into it. There is no other way or shortcut. The countries do not grow because of natural or human resources only or entirely due to good management of economy, they only grow because of good knowledge-based economy. When there are knowledgeable workers, productivity increases while accelerating economic growth.■

Vote of Thanks

Ambassador (R) Sohail Amin
President IPRI

Honourable Minister for State, Special Assistant to the Prime Minister and Chairman Board of Investment, Dr. Miftah Ismail,
Mr Duwaerts, Resident Representative HSF,
Members of the Diplomatic Core,
Distinguished participants,
Good afternoon!

I thank you for your participation. Holding this conference has been a great experience. I wish that we are soon able to realise our dream of creating knowledge-based economy in Pakistan.

However, in order to develop a knowledge-based economy, we need to create a knowledge-based society first. The idea of creating a knowledge-based economy is not a novel idea. Every country wants to raise its economic standing through knowledge-based practices. As discussed in the inaugural address by Mr. Ahsan Iqbal, Federal Minister for Planning, Development and Reform, the government has been making efforts to introduce knowledge-based practices. Pakistan's Vision-2025 is primarily focused on knowledge-based economy. The views expressed by the distinguished speakers, university vice chancellors and the chairman HEC also support the idea of building knowledge-based economy. The representatives of China and Japan, the leading economies of the world, shared their countries' experiences of employing the knowledge-based practices. Unfortunately, this has not been a very attractive subject for the think tanks in our country. Yet, it is up to the think tanks to create awareness; their primary responsibility is to develop a concept or an idea into a concrete policy.

It is a moment of great achievement for IPRI to be able to hold this conference. I was keen to hold this conference because during my tenure with the government, I had the privilege of having seen some knowledge-based economies, since I was posted to countries which have knowledge-based economies. In Germany, for instance, alongside motorways, every inch of land has been utilised. If you enter into their industry, you will find everything working on the basis of knowledge-based technology. So I carried this dream, eventually, today we have been successful in developing this concept through this conference.

The only problem which we encounter is as Mr. Ahsan Iqbal said, although we have 7500 PhDs in science, we have not established a link between knowledge and production. Therefore, we need to create connectivity between this knowledge base and the production units. Once we are able to establish this link, we will be on the path towards developing a knowledge-based society, which will eventually lead to a knowledge-based economy in Pakistan.■

Recommendations

Globalisation and advancement in communication systems has brought about a revolution in the way major economic systems work today. This is all a product of cutting edge research and development of technologies while incorporating them in our daily lives – a phenomena that is fundamentally linked to knowledge-based economies.

Knowledge-based economy and ensuing non-linear economic growth is a concept that a country like Pakistan, with a very high ratio of population under the age of 30, ought to have adopted earlier. The purpose of this conference has been to highlight this concept which remains neglected in Pakistan even today.

Pakistan is undergoing a watershed moment as both economic and security situation are stabilising. This is a point where a strategic decision to develop and transform our knowledge systems will provide huge dividends for not just economic growth but for the development of society, fighting radicalisation and human development.

Renowned experts and academics, made enlightening presentations and produced creative ideas throughout the conference. In the light of their innovative, yet well-researched concepts, following recommendations are put forward that can vastly improve the state of Pakistan's knowledge generation infrastructure and transform it into a knowledge economy.

- The significance of transforming primary education and raising the literacy rate remains indisputable. The Central Asian Republic, Tajikistan had 100 per cent literary rate and its HDI was 30 per cent more than Pakistan. Meanwhile, the countries like Vietnam, Philippines and South Korea also had high literacy rates and progressed smoothly. Despite knowing the fact that the school education (not university) had a direct bearing on the socio-economic development, in Pakistan over the years, the graph of primary education has plummeted. In addition to improving our primary education, a paradigm shift needs to be brought in the way we learn – away from memorisation to critical thinking, innovation and creativity. We have to reform the schooling system. Similarly examination bodies need to be reformed, regulated and synergised to bring a national level standard. Although the government is geared towards upgrading the education system, long term continuity in the educational policies is required to bring a visible

change. Moreover, literacy rate needs to be increased and brought to a level where the youth bulge of Pakistan becomes an asset instead of a liability.

- Higher Education has a direct correlation with innovation and GDP growth. Higher education is not just university education, producing more PhDs, scientists, doctors or engineers but also technical education to facilitate and narrow down the gaps between highly educated and illiterate or just primary educated sections and provide other connecting colours to complete the spectrum. Thus focus should not only be on developing more universities or schools but also colleges. There was a quality versus quantity debate during the conference highlighting different approaches to advance higher education in the country. The government's 'Education at your Doorstep' initiative that envisages a rapid increase in the number of universities in the country by establishing one university per district was criticised. Though noble sounding, this initiative will consume scarce resources because the high quality graduates are still not being produced by the existing universities that have been established more than decades ago. Instead the government should focus on improving the quality of research being conducted in the existing universities by providing them higher resources and expanding their ambits.
- To use the complete landmass and population of the country as a resource, national policies should be directed towards the rural sections as much as the urban sections. Pakistan is not a homogenous country, and different sections of society feel alienated in our national knowledge-based economy. The local knowledge needs both in terms of capacity-building and industrial needs vary in different parts of the country demanding advanced intervention from the government. Hailed nationally for accepting the rights of the provinces, the 18 amendment, nevertheless is becoming a hurdle for the practitioners who want to streamline national strategies for knowledge generation and job provisions by matching labour with jobs according to their skills. Correction of this anomaly would need government's close attention.
- Focused and objective-driven research is an area that was neglected in the past, but the current government is working towards streamlining the needs of the industry and research conducted in the universities. Even though the number of PhDs in the country has gone up from 300 in 1998 to 7500 today, knowledge platform and production platform is not

synergised. Thus, the kind of research being conducted here and abroad by HEC scholars is not contributing to an agenda-driven knowledge economy. There should be a mechanism that helps to synergise the so called triple helix's interests and strategies, where the government should outline strategic goals as in the vision 2025, the industry should highlight areas where fresh graduates and researchers could contribute and the universities or research institutes should conduct latest research which is based on the vision and requirements of the government and industry respectively; this would provide value addition to the commodities being produced in the country.

- At the heart of knowledge-based economy lays advancement of science and technology leading to improvements and value addition. Pakistan is ranked very low vis-à-vis innovation and competiveness, internationally. This translates into low end production of cheap goods and inefficient energy consumption ratio, crippling the economic growth. STPs or Science and technology parks have been used across the world to resourcefully produce and consume knowledge for socio-economic growth. STPs are a potential source of knowledge-based industries, and are increasingly viewed as an essential component of the knowledge economy. STPs cluster together the industries and scientific institutions, universities or research facilities. In addition to having a common vision, this also helps to facilitate learning, technology transfer, leading to knowledge-based industrial growth. Today, the total wealth of the world is US$15 trillion and two-thirds of it comes from science and technology parks. Pakistan entered the process with a delay of nearly fifteen years. The potential even with the current resources and manpower is great and should be tapped into. To give a perspective on what knowledge hubs can and have achieved internationally the examples of MIT, Stanford and Tshingua Universities should be considered. Massachusetts Institute of Technology's entrepreneurship department has helped create 25,800 new businesses. It is annually generating US$2 trillion revenue and offering 3.3 million jobs; similarly Stanford University has created 39,900 new businesses, while generating US $2.7 trillion revenue annually and offering 5.4 million jobs. While China's Tsinghua University has created 2979 new businesses. It is annually generating US $0.4 trillion revenue and offering 125,000 jobs.

- For Pakistan to move from a low value added agriculture economy to a high value added knowledge economy, further investment and resource allocation is crucial. Pakistan should allocate a big portion of its budget on further development of existing universities and research institutions as well as organisations such as PCSIR (Pakistan Council of Scientific and Industrial Research), PARC (Pakistan Agricultural Research Council), and PAEC (Pakistan Atomic Energy Commission) etc. Also new institutions particularly in emerging technologies such as nanotechnology, space technology, genomics and bioinformatics etc. should be established and high quality professionals should be produced from these institutions by providing state of the art R&D facilities. This will help strengthen the supply side of the knowledge economy. In addition to this, creating suitable demand of their skills in the market by creating effective relationship of research institutions with industry; providing incentives to the private sector to also conduct research and provide financial support for capacity building and helping create laboratories and technology parks in the private sector as well, will complete the circuit and become the foundational step towards knowledge economy. In this regard, different international models and practices on the bases of bilateral and multilateral partnerships between private companies, universities and governments were discussed e.g. strategic partnership between Proctor and Gamble and Durham University; North Carolina research triangle; initiative led by business sector (Information technology business network); and initiative led by provincial government (Alberta's innovation economy plan) etc. These models and practices epitomise the ways in which university, industry and government can collaborate, for creating a dynamic technology based economy.

  Additionally, the role of think tanks in developing the knowledge-based economy is not appreciated in Pakistan. There are 6500 think tanks in the US, whereas during the last ten years, China established more than 2000 think tanks. Pakistan has less than half a dozen think tanks which unfortunately do not meet the international standards of research and analysis. The government should, therefore, improve the research facilities and train the staff in the existing think tanks for more productive research and more think tanks may be created to conduct focused research on knowledge economy related subjects.

- Preservation of precious resources is also much needed in Pakistan as repetition instead of diversification of product development is a common phenomenon. One way to curb this is doing patent analysis thoroughly and codifying and regulating the technologies that local firms are working on. Innovative thinking is not only required for developing state-of-the-art technologies but also in creating a national vision and delineating priorities for future.
- Agriculture is the backbone of Pakistan's economy; it provides the largest source of employment and is a major contributor to the GDP of the country, but is chronically neglected and under-invested. Obsolete methods of farming are being employed and there is a mismatch between technology generation and farmers' needs. There is also a downward trend in international donors' support to the agricultural research. Therefore, the agricultural sector needs to be revolutionised by introducing knowledge-based reforms and ICT application in farming. For example capacity building of all stakeholders through the use of ICT and training in modern farming techniques is required. Through web/mobile based applications, different analytics and other information like domestic, regional, and international prices/stocks could be shared. It was informed that cell phone based agricultural extension model had been launched in Khyber Pakhtunkhwa by Telenor Pakistan. The same model could be replicated in other parts of the country for timely transmission of information to stakeholders.
- The textile sector constitutes a predominant portion of Pakistan's exports and it has remained stagnant for the last five years. Pakistan is the fourth largest producer of cotton in the world yet its total textile export is only about US$13 billion which is very less as compared to many other countries. Although the stagnation is attributed mainly to the energy crisis but there are many other contributing factors to the deterioration of the textile sector. One of the most severe challenges the exporters face, apart from the energy crisis, is US $1.5 billion stuck (in terms of sales tax and custom duty refund) with the Federal Board of Revenue for refunds. If this capital is refunded, it will not only be reinvested in textile sector but also contribute in research and development programmes.
- Product diversification is also required for socio-economic growth. Although agriculture and textile exports are major contributors to our GDP we need to invest more in the development of value added and medium to high-tech products, particularly in the ICT.

Investment in the information and communications technology and easy access to the internet has transformed societies across the globe. This factor has primarily led to globalisation and building of knowledge-based economies. Pakistan should revamp its digital capital policies and allocate more resources for this sector. Currently, Pakistan does not even have process of codification of components and subcomponents of ICT technologies. The nation's digital capital should be enhanced at a comparable level of its physical infrastructure.

- In addition to diversification, the existing economic sectors also need attention from the perspective of knowledge economy. The ICT technologies like access to 4G networks and android phones need to be introduced in agricultural sector. It is also imperative to reinstate the need for non-conventional entrepreneurship in the agricultural sector.
- There is a symbiotic connection between knowledge and energy. Both follow similar trajectory of growth. As stated in the conference, the depletion of conventional sources of energy and the excessive emissions of carbon dioxide have compelled the scientists and policy makers internationally to devise new ways of energy generation. This has, eventually, led to innovations in technology. The increase in gas prices has been the driving factor behind the discovery of shale oil and gas reserves. Shale reserves (worth of 9.1 billion barrels) have also been found in Pakistan. The discovery of shale oil will put Pakistan on the international oil map. Thus, in order to exploit the shale oil potential, Pakistan needs unprecedented business, security, regulatory and investment reforms and technological capacity. In addition, a balanced energy mix, exploring indigenous resources and enhancing energy conservation mechanism as well as conservation awareness would be useful in countering energy shortage. Pakistan has eight coal based power plants. Modern techniques can make coal more effective and less polluting.
- International cooperation is fundamental in learning international best practices. Pakistan should strive to enter into partnerships with international technology leaders and provide opportunities to young scholars to collaborate with international universities and industries and explore new ventures of advancements that are taking place in multiple fields. In this regard, China-Pakistan Economic Corridor (CPEC) has a great potential to help

accomplish Pakistan's goal of becoming a knowledge-based economy.

- The American model of using academics and technocrats as policy makers can be adopted; advisory councils for the legislators can also be created leading to more informed decision making. There are eleven federal ministries that should coordinate for a free flow of ideas and resources and this process should be followed at lower level of governance. Unless the mindset of the decision-making elite is changed industry and academia will remain helpless. The selection process of our public sector CEOs needs to be changed; it should be based on merit while skills of the CEOs should correspond with the requirements of the organisation. Bureaucracy should contribute as a facilitator in promoting knowledge-based economic growth of the state; unfortunately its current structure obstructs the efficiency of knowledge generation and introduction of new ideas. Civil service structure should also be transformed and the 'Rules of Business' document needs to be revamped as most of its provisions are obsolete now.
- Operationalising the vision documents and policy papers such as vision 2025 can be done only through five-year plans that are more concrete and should also incorporate budgetary allocations for specific projects. Additionally, coordination gaps between policy papers of different ministries and finance sectors need to be plugged. For example three policy papers— about enhancing the capacity-building of service sector, namely, Poverty Reduction Strategy Paper prepared by Finance Division of Pakistan; Framework of Economic growth; and Vision 2025 prepared by Planning Commission of Pakistan—have conceptual gaps or incoherence. In order to have a common national strategy for human resource development, knowledge economy and services sector, these gaps need to be filled.
- Around 51 per cent of the country's population is affected by food insecurity. The government should work on the "Zero Hunger Programme" presented by Dr. Abid Qaiyum Suleri, which had already been approved by the Ministry of Food Security and Research, but no budget yet, is allocated to this programme.
- Both China and Japan present great models for Pakistan to learn from. Basic infrastructure development of highest quality and durability has led to the rise of modern Japan. In terms of quality versus quantity debate the Japanese model opted for the former. Pakistan should also follow the same trajectory. Similarly, Pakistan

should also learn from China which has moved from ‘Made in China to Created in China Model’, and should strive to create products in Pakistan – not just make or reverse-engineer international technologies.■

CHAPTER 1

An Overview of Pakistan's Economy: Current Use of Four Pillars of a Knowledge Economy and its Further Promotion

Dr. Usman Mustafa

Abstract

Knowledge is the key for growth and development of any country. Historically, only those countries succeeded and advanced which based their economies on knowledge. For generation of knowledge, research and development (R&D) is a prerequisite. The paper highlights the significance of knowledge and provides an overview of Pakistan's economy. Also described are four pillars of knowledge economy i.e. education and training, information infrastructure, economic incentive and institutional regime, and innovation systems. An educated and skilled population is needed to create, share and use knowledge. While a vibrant information infrastructure-ranging from radio to internet is essential to enable the effective communication, dissemination and processing of information. A regulatory and economic environment that facilitates the free movement of knowledge, supports investment in Information and Communications Technology (ICT), and inspires entrepreneurship is fundamental to the knowledge economy. Whereas, a system of research centers, think tanks, universities, community groups, and private enterprises is necessary to access the and utilise the emergent stock of global knowledge, integrate and tailor it to native requirements, and generate fresh knowledge, assimilate and adapt it to the local needs, and create new knowledge. In addition, economic performance of the country will also be described along with the budgetary allocation to R&D. A comparison will also be made between the developed and developing countries about the allocation of budget to R&D. The R&D with special reference to agriculture as a case study from Pakistan is discussed. The paper also lays out some policy recommendations for knowledge generation and promotion.

Introduction

Knowledge is the acquisition of facts, information, and skills through experience or education; the theoretical or practical understanding of a subject. Knowledge can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic (Oxford Dictionary, 2015)
Knowledge and innovation are extensively acknowledged as strategic carters of growth and development. Since the middle of the later half of the 20th century the world has witnessed a knowledge revolution where seeking, disseminating and using knowledge, especially higher and technical education, industrial technology, innovations, Information, and Communications Technology (ICT) have gained prominence that is impacting all spheres of human activity including the socioeconomic development of countries (ADB, 2014, Altbach et al., 2009, Khan, 2004). Knowledge has, therefore, become the key driver of economic growth taking precedence over traditional drivers of growth, such as physical capital and low skilled labour. In this context, countries which have taken the lead in using knowledge for their economic development have progressed rapidly leaving others behind. Thus, this trend of seeking, transferring and using knowledge for economic development by some countries has given rise to the concept of knowledge-based economy (ADB, 2014, OECD, 1996).

Knowledge is being used to accelerate and advance the growth process. Once practical for all types of innovation, it becomes a main resource for generation of capital and employment opportunities. Obviously, numerous kinds of knowledge, including highly traditional, can be of use; at the same time there is a requirement to spend in the best modern technologies to be part of the global economy (WBI, 2007).

The use of knowledge is currently well recognised to be one of the basic foundations of progress in the overall economy. The term Knowledge Economy (KE) has been coined to reveal this enhanced significance of knowledge. A knowledge economy is one where administrations and societies gain, create, disseminate, and practice knowledge more effectively and efficiently for greater economic and social development (OECD, 1996 and APEC, 2000, Mustafa, 2015).

This 'knowledge revolution' has diverse manifestations: there are closer associations among science and technology; invention is imperative for economic growth and effectiveness; there is greater importance of education and life-long learning; and extra investment is undertaken in intangibles (R&D, software and education) which is even greater than investments in fixed capital. Also, there is the Information and

Communications Technology (ICT) explosion which brings worldwide interdependency and connectivity (World Bank, 2015).

There is a substantial increase in the importance of knowledge which provides abundant prospects for nations to reinforce their economic and social development by providing effective methods of generating goods and services and providing additional benefits successfully and cost-effectively to a large number of people. Though, it results in an increasing 'knowledge divide' among progressive states, which are producing greatest amount of this knowledge, and emerging countries – many of which are unable to tap the vast and mounting stock of knowledge due to their lack of awareness, meagre economic incentive systems, and weak institutions. Along with trade policy liberalisation, the knowledge revolution is important for globalisation and enhanced global competition, which is eroding the natural sources and low labour cost gain of most of the developing countries.

The term "knowledge work" was invented by Peter Drucker (1959, 1964, 1973) to what was then a novel development, an imperative division of the staff concerned mostly with knowledge and the management of information (rather than people, produce or things). Charles Savage (1995) described knowledge, as the third wave of human socio-economic development.

The first phase in the human civilisation, was the "Agricultural Age" in which wealth was associated with the possession of land. In the second trend, the "Industrial Age", wealth was grounded on the ownership of capital, i.e. factories. In the "Knowledge Age", fortune is founded upon the control of knowledge and the aptitude to use that knowledge to create or improve goods and services. Product expansions contain cost, stability, and relevance of delivery and security (Nonaka, 1991, SciDev, 2015,.University of Pennsylvania, 2015).

Retained knowledge provides an organisation with knowledge assets, part of the overall value of its intellectual capital. In some cases organisations create patents around their assets, at which point the material becomes restricted intellectual property. In these knowledge-intensive situations, knowledge work plays a direct, vital role in increasing the financial value of a company.

Rapid global expansion of information-based transactions and interactions has dramatically increased demand for a workforce that is capable of performing these activities. Presently, North America might conceivably be termed as the hub of knowledge work.

In the light of above discussion, the main objectives of the paper are: to highlight the importance of knowledge and KBE, especially with reference to Pakistan; to describe four pillars of KBE and Pakistan's standing; and to discuss "Asia 2050: Realising the Asian Century".

The format of the paper is divided into six sections. The first section introduction briefly highlighted the important of knowledge and KBE. Acquiring Knowledge is well recognised in Islam as well in almost all religions; this part is briefly covered in second section, followed by Pakistanis' perspective of KBE. In this section the current as well as historical economic performance of Pakistan's economy is discussed. The need for KBE is also emphasised in the section. The fourth section elaborates the four pillars of KBE and Pakistan's standing in these pillars. Followed by the second last section i.e. "Asia 2050: Realising the Asian Century". This section describes the perspectives of Asia in future and role and significance, knowledge will play in it with special reference to Pakistan. In this section two case studies of Asian emerging economies i.e. South Korea and Singapore are also discussed. The last section is punctuated by conclusions and recommendations.

Islamic Perspective of Knowledge

Islam gives utmost importance to seeking knowledge. One of the distinguishing features of Islam is its stress on knowledge. The Holy Quran and the Prophetic tradition encourage Muslims to pursue and attain knowledge and wisdom; the religion of Islam holds men of knowledge in high esteem.

In the Holy Quran, the word "al-Ilm" i.e. knowledge, and its derivatives are used more than 780 times. The first few verses that were revealed to our Holy Prophet (peace be upon him) highlight the importance of reading for human beings:

> *"Read! In the Name of your Lord Who has created (all that exists). He has created man from a clot (a piece of thick coagulated blood). Read! And your Lord is the Most Generous. Who has taught (the writing) by the pen. He has taught man that which he knew not." [Quran, 96: 1-5]*

And the Prophet used to supplicate the following:

> *"Rabb e Zidni Ilma" (O my Lord! increase me in knowledge) [Quran, 20:114]*

In the prophetic traditions, there are numerous words of praise for knowledge and the one who seeks knowledge:

- "It is an obligation for every Muslim to seek knowledge."
- "Seek knowledge from the cradle to the grave."
- "Scholars are the heirs of the prophets."

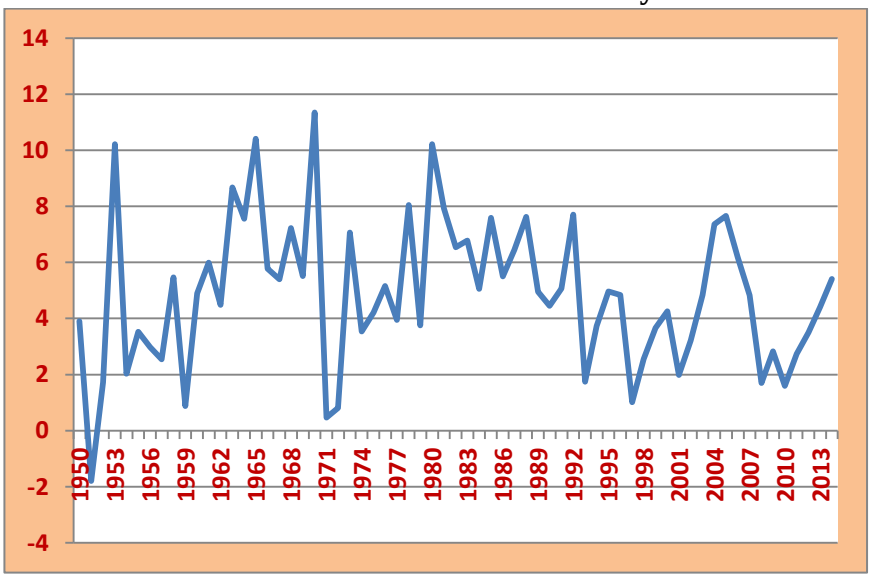
- "The ink of the learned will be weighed with the blood of the martyrs on the Resurrection Day; and then, the ink of the learned would be preferred to the blood of the martyrs."
- "Anyone who pursues a course in search of knowledge, God will ease his way to paradise."
- "The most learned of men is the one who gathers knowledge from others on his own; the most worthy of men is the most knowing and the meanest is the most ignorant."
- "Acquire knowledge, it enables its possessor to distinguish right from wrong; it lights the way to heaven"

It is worthwhile to state that in almost all the religions, knowledge has importance. Knowledge may be implicit as one of the vital components of religiosity. Religious knowledge itself may be broken down into four dimensions i.e. content, frequency, intensity, and centrality. The content of one's religious knowledge may differ from person to person, as will the amount to which it may be retained in the person's mind (frequency); the amount of the knowledge, and the significance of the information i.e. in that religious tradition, or to that individual (Verbit, 1970, Küçükcan, 2010).

Pakistan's Perspective of Knowledge Economy

The economy of Pakistan has been full of ups and downs. At the time of independence, Pakistan had to pull off its economy on meagre resources. Pakistan had 30 million people with per capita income of US$ 100, now we have 180 million people with per capita income greater than US$ 100. Pakistan is the 3rd largest exporter of rice. Three million tons of rice is exported, it is the 5th major textile producing country in the world. Pakistan is the 5th largest milk producing country in the world. After sixties and up to seventies, the economy performed well with an average growth rate of more than six per cent and was one of the leading economies of Asia. In 1969, Pakistani exports of manufactured goods were higher than the combined exports of Indonesia, Malaysia, Philippines, and Thailand. South Korea emulated Pakistan in its 5 year development plan during 1960. The nationalisation of major private industries during Bhutto's regime adversely impacted the economic growth of the country. After that the growth pattern remained sluggish. It is a tragedy that Vietnam, completely devastated by war earlier, has now overtaken Pakistan. India, which was way behind Pakistan during 1990, is now way ahead. But recently, the economy has started its upward movement (Figure 1).

Figure-1
Pakistan's Economic Growth (1950 -2013)
from Different Economic Surveys



Source: Government of Pakistan, 2015

Presently, the economy is reviving, the budget deficit has decreased from 8 per cent GDP to 5 per cent, and inflation has also decreased to 5 per cent. The foreign reserves have increased from US$ 11 to 20 billion. Real GDP growth has increased from 4.24 per cent to 4.7 per cent in 2016 (Government of Pakistan, 2015). Still the most serious constraints of the economy are the twin deficit, namely budget and balance of payments; we consume more and save less, saving is only 15 per cent of GDP. Besides, the government spends more than it earns (tax to GDP ratio is lowest in the world i.e. less 9 per cent) and we import more and export less. Besides, these the economy is facing following issues:

- Pakistan's global competitiveness has seen some erosion. Its share in the world trade is shrinking. In 1990 it was 0.2 per cent and now it is 0.12 per cent. During the same period Indian shares increased from 0.7 to 1.4 per cent.
- Foreign competition has increased.
- Owing to globalisation and liberalisation, Pakistan has to look for new products and services that will offer some competition in the global market.
- There is a need to seek higher value-added, partly to offset high costs.

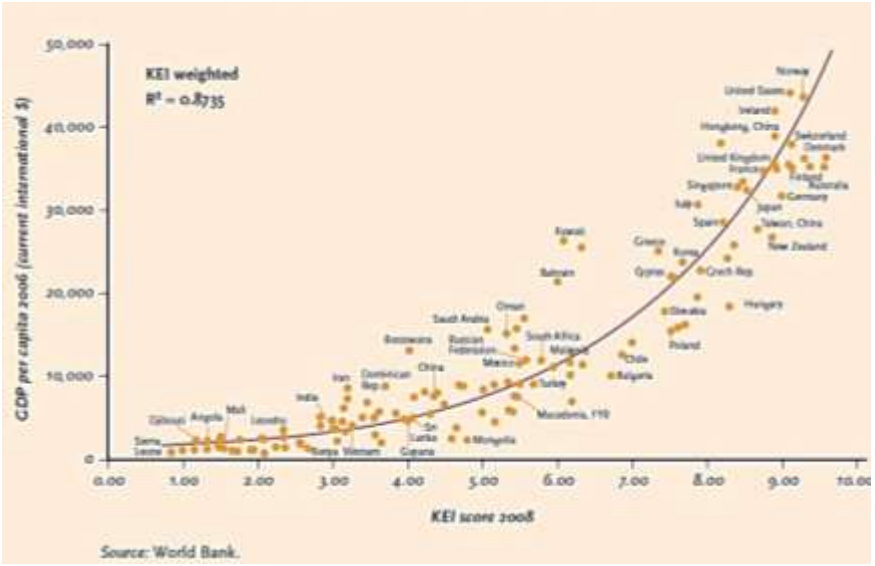
- There is a need to move into more profitable and wealth-generating stages of production.
- The "social indicators" need to be improved.
- Energy and water shortages require permanent solutions.
- New sources of growth are required.
- There is a need to meet the challenge of higher Total Factor Productivity (TFP).
- Bad governance, menace of conflict, and poverty issues need to be addressed.

In order to catch the pace of development and eradicate poverty in the country, Pakistan needs minimum annual growth rate of seven per cent. Pakistan has the youth dividend, its majority of the population consists of young people and it is an opportunity to harvest it, through knowledge and skill (Sathar et. al., 2013).

It is worth mentioning that forty years ago, Ghana and the Republic of Korea had virtually the same income per capita. By the early 1990s Korea's income per capita was six times higher than Ghana's. The difference is due to Korea's greater success in acquiring and using knowledge (World Bank, 1998 and WBI, 2007). The knowledge economy and current economic performance is highly correlated. Norway, US, Ireland and China have the highest GDP per capita and KEI standing (Figure, 2).

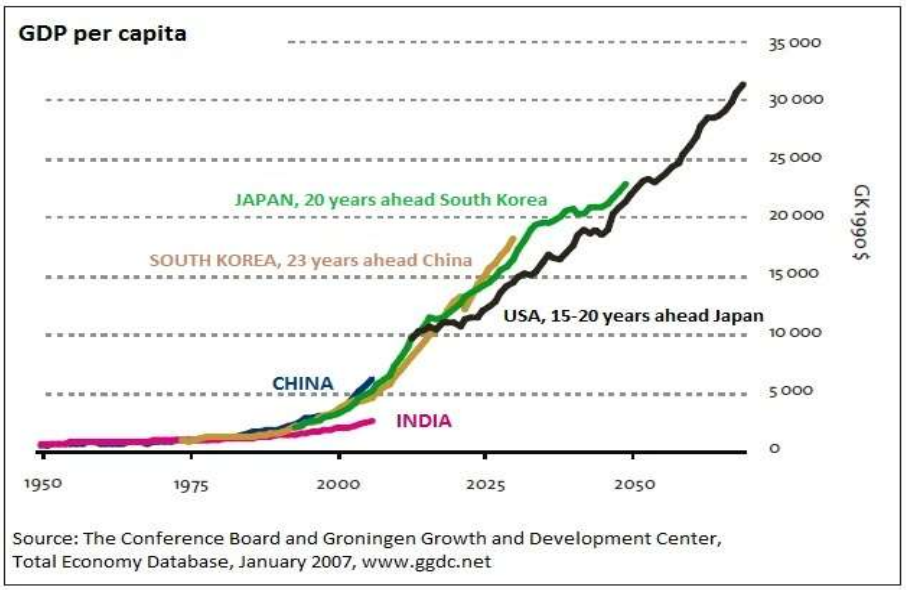
Pakistan has long way to go to compete with developed countries. South Korea is 23 years ahead of China. While Japan is 20 years ahead of South Korea, whereas, USA is 15-20 years ahead of Japan (Figure 3).

Figure-2
The Knowledge Economy and Current Economic Performance



World Bank, 2008

Figure-3
The GDP per Capita and China, South Korea, Japan, and the US' Standing

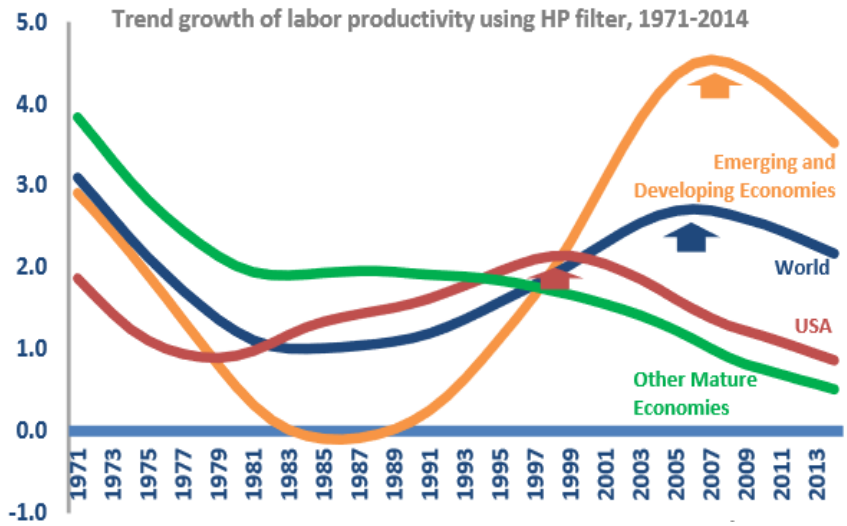


Source: Ark and Erumban, 2015

As discussed earlier Pakistan has youth bulge, which can be harvested; as after 1990 the emerging and developing economies' trend in growth of labour productivity is higher and further growing as compared to the US, and other developed countries (Figure 4). Therefore, Pakistan has also an opportunity to harness the youth productivity (Sathar et. al., 2013).

Figure-4

Trend of Growth of Labour Productivity Using HP Filter, 1971-2013

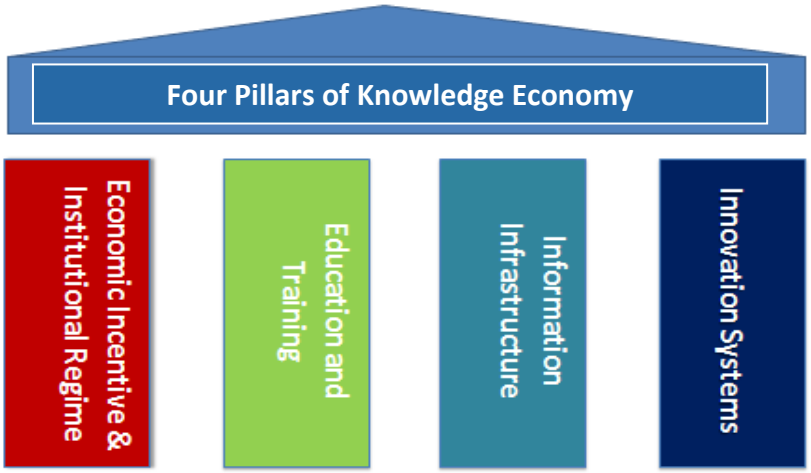


Source: Ark and Erumban, 2015

Four Pillars of KE and Pakistan's Standing

A knowledge economy (KE) depends on knowledge as the fundamental force for economic progress. It is an economy in which knowledge is attained, distributed, and applied to boost economic development., The ideal situation for a knowledge-centerd development practice would comprise of an educated and skilled labour force, a compact and modern information infrastructure, an effective innovation system, and an institutional regime that offers incentives for the efficient production, dissemination, and use of existing knowledge (WBI, 2007). Following are the four pillars of knowledge-based economy (Figure 5):

Figure-5
The Four Pillars of Knowledge Economy (KE)



Economic Incentive and Institutional Regime

A regulatory and economic environment that enables the free flow of Knowledge, supports investment in ICT, and encourages entrepreneurship is central to knowledge economy and its rudiments: creation, diffusion, and utilisation of knowledge.

i. **Education and Training:** An educated and skilled population is needed to produce, share and use knowledge. In this connection, establishment of research centers, universities, think tanks, consultants, etc. which apply and adapt global knowledge to local needs to create new technology are required. The generation of technical knowledge will lead to productivity growth.

ii. **Information Infrastructure:** A dynamic information infrastructure, ranging from radio to internet is required to facilitate the effective communication, dissemination and processing of information. Decreasing transaction costs would help increase communication, productivity and output.

iii. **Innovation Systems:** A network of research centers, universities, think tanks, private enterprises and community groups is necessary to tap into the growing stock of global

knowledge, assimilate and adapt it to local needs, and create new knowledge.

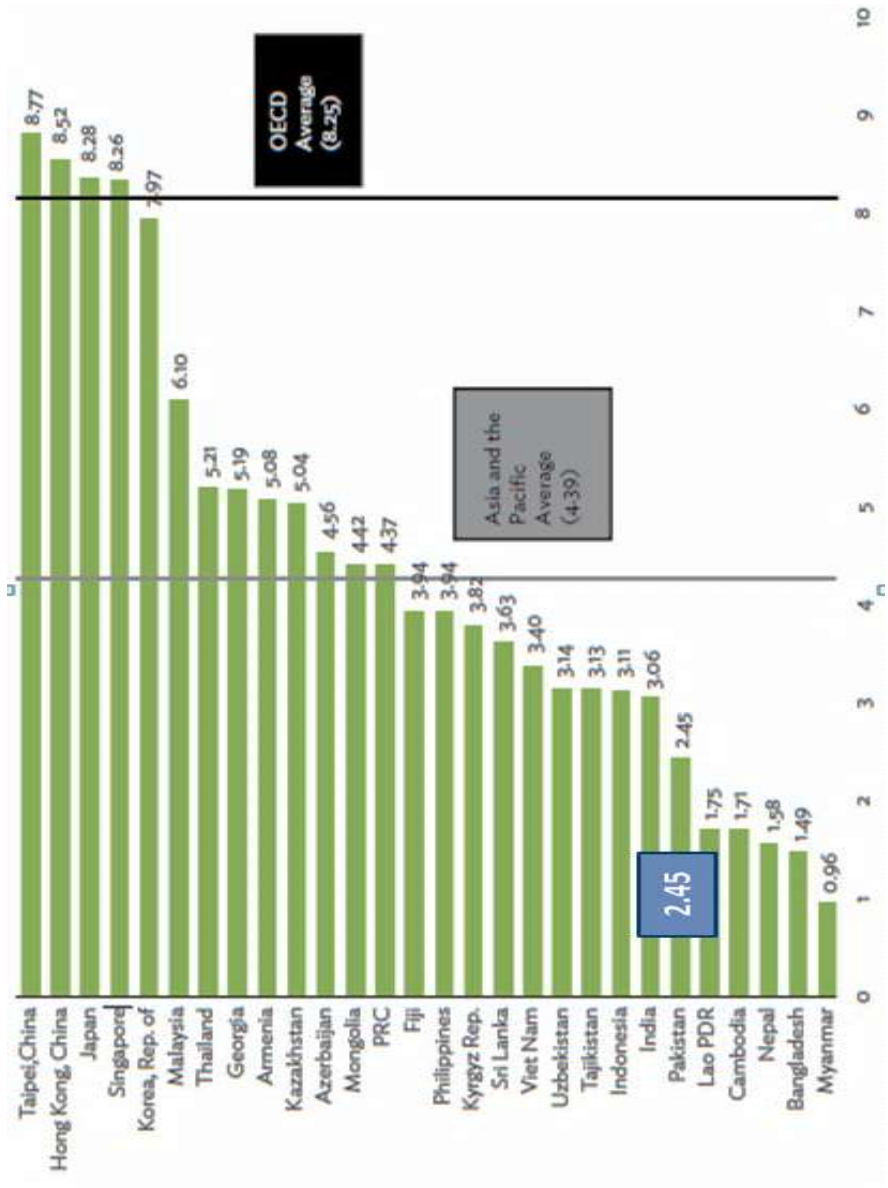
The Knowledge Economy Index (KEI) and Knowledge Index (KI) by different countries are presented in Table 1 and Figure 6 (Wikipedia, 2015). Denmark is ranked as number one knowledge-based economy according to 2008 ranking. Pakistan's standing was 115th while India scored 100; Sri Lanka, 82; China, 77; South Korea, 31; and US, 9. Pakistan's score was a little higher only in the ICT i.e. 272 than that of India i.e. 2.59. In the Innovation Sub-index Scores Asian Countries average is 4.3, Pakistan scored only 2.4, and the Organisation for Economic Co-operation and Development (OECD) average is 8.49, the highest score reported is China's score (Taipa) 8.77 (Figure 6).

Table-1
Knowledge Economy Index (KEI) and Knowledge Index (KI) Scores by Various Countries

Country	KEI	KI	Economic Incentive	Innova-tion	Educa-tion	ICT	2008 Rank
Denmark	9.58	9.55	9.66	9.57	9.80	9.28	1
South Korea	7.68	8.38	5.57	8.47	7.97	8.71	31
USA	9.08	9.05	9.16	9.45	8.77	8.93	9
China	4.35	4.46	4.01	5.12	4.11	4.16	77
Sri Lanka	4.16	4.07	4.44	4.44	4.91	2.85	82
India	3.12	2.94	3.67	3.97	2.26	2.59	100
Pakistan	2.24	2.18	2.43	2.75	1.07	2.72	115

Figure-6

Knowledge Economy Index Score of Asian Countries, Pakistan and OECD Average



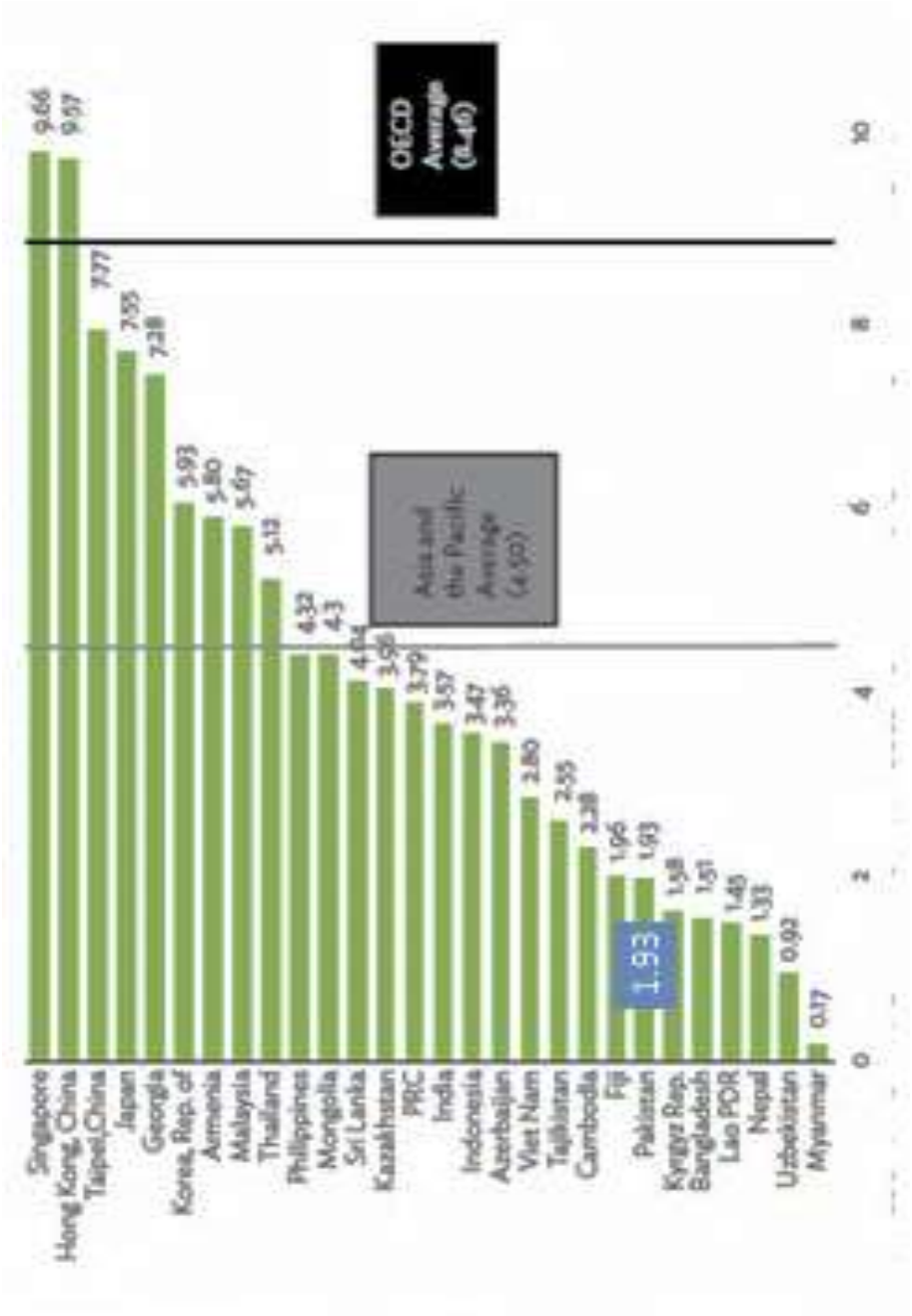
Source: ADB, 2014

The following sub sections describe four knowledge pillars especially with reference to the Asian countries along with Pakistan's standing:

Economic Incentive and Institutional Regime

The ADB (2014) report on the economic and institutional regime sub index score of Asian countries revealed that Singapore is providing the highest score of 9.66; whereas, Asia and the Pacific's average is 4.5 and OECD's average is 8.46. Pakistan scored only 1.93 in this category (Figure 7). This means that we lag in economic incentive and institutional regime which is necessary for a knowledge-based economy.

Figure-7
Economic and Institutional Regime Sub-index Scores of Asian Countries, Pakistan, and OECD Average



Source: ADB, 2014

Education and Training

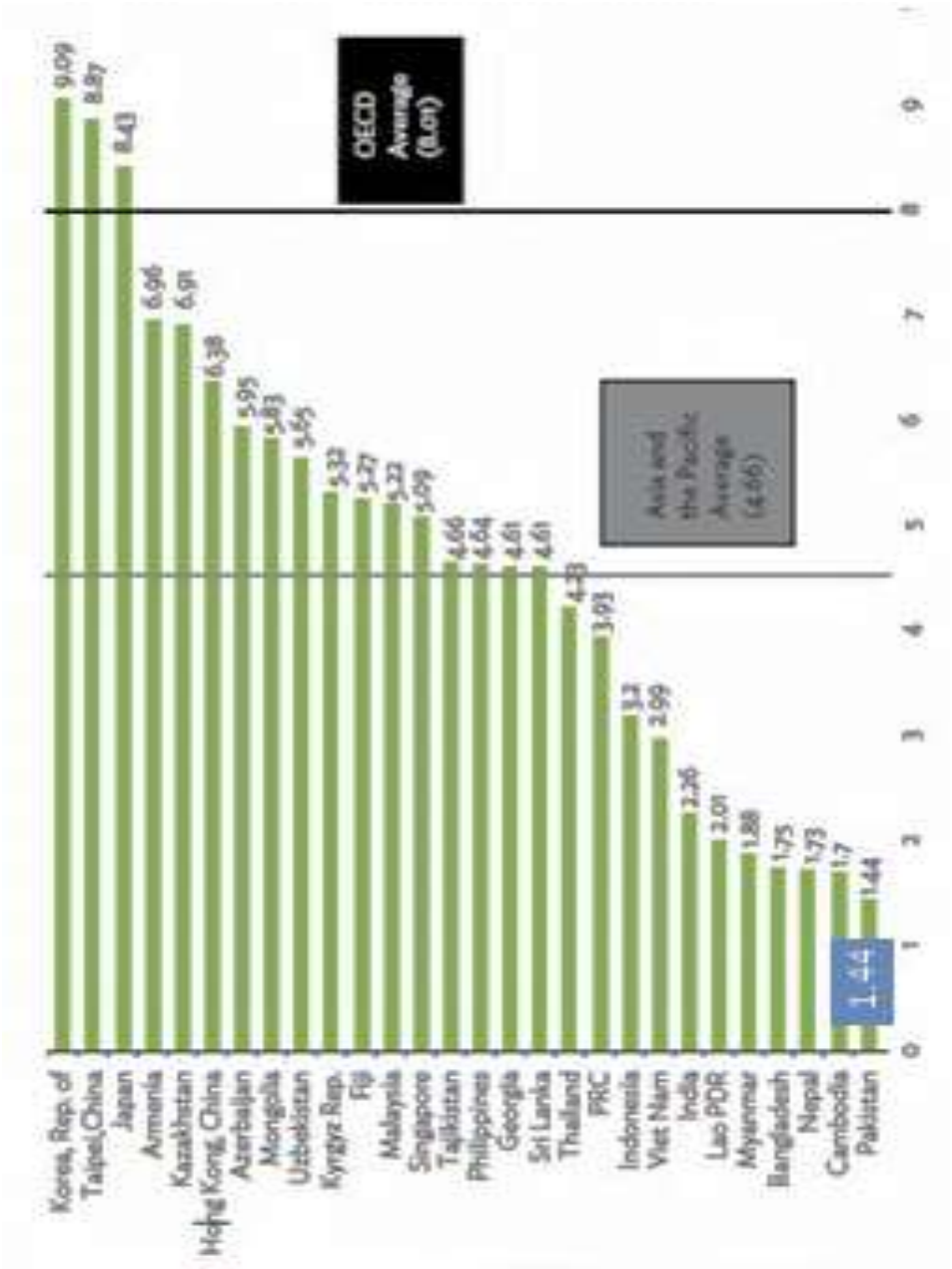
Education and training are among the core components of knowledge-based economy. Training is immediate, task-oriented and targeted on accomplishing a transformation of attitude and skills; whereas, knowledge is gained in a precise area and is generally job-oriented. Education is a lifelong investment and inclines to be instigated by an individual in the capacity of his/her concern. And development is a long term investment in human resources (Tesorero, 2013).

According to the ADB (2014) report on education and skill sub-index score of Asian countries, the Republic of Korea has the highest score of 9.09, whereas, Asia and the Pacific's average is 4.66 and OECD's average is 8.01. Pakistan's score in this category is the lowest i.e. 1.44 only (Figure 8).

The Education and Skill Pillar

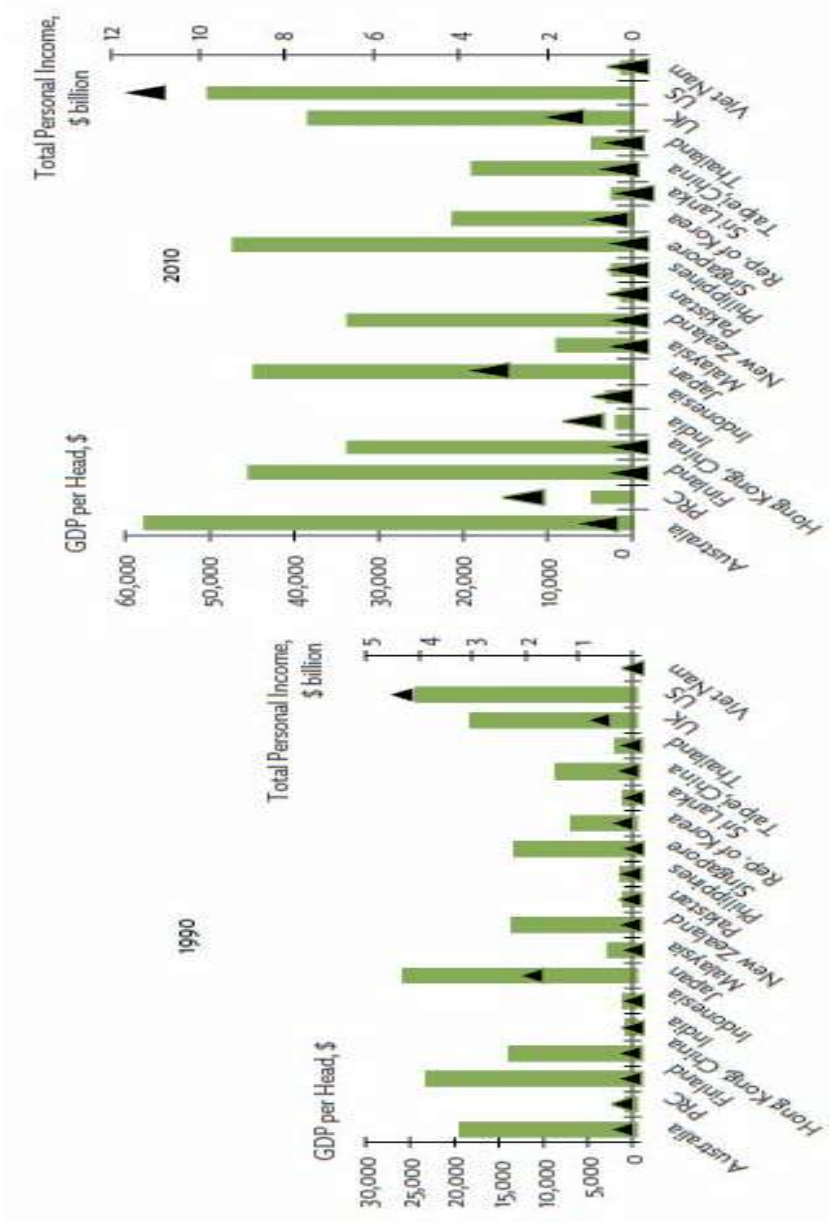
The various dimensions of different countries from 1990 to 2010 are presented in Figure 9. It is clearly visible that what countries spend and share on education is substantially increased over time. There is a direct correlation between the GDP and education expenditure. Total spending on education as percentage of GDP of various countries is presented in Figure 10. Total spending was increased in the People's Republic of China from 233 to 853 billion CYN from 2010 to 2012, whereas, in other countries it is very high. In Pakistan, the education share in GDP is less than 2.5 per cent in 2013-14 (Government of Pakistan, 2015).

Figure-8
Education and Skill Sub-index Scores of Asian Countries, Pakistan and OECD Average



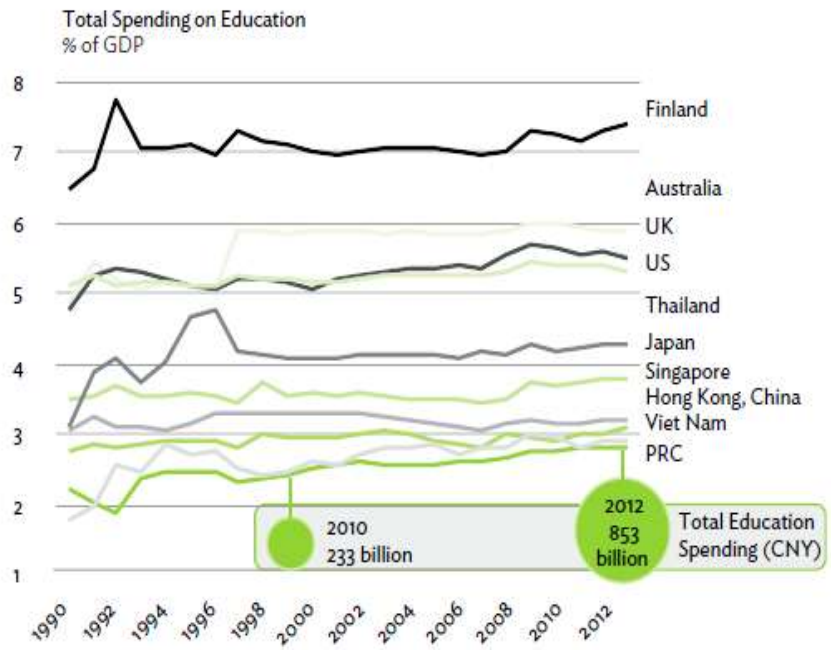
Source: ADB, 2014

Figure-9
Education and Skill Pillar: Various Dimensions



Source: ADB, 2014

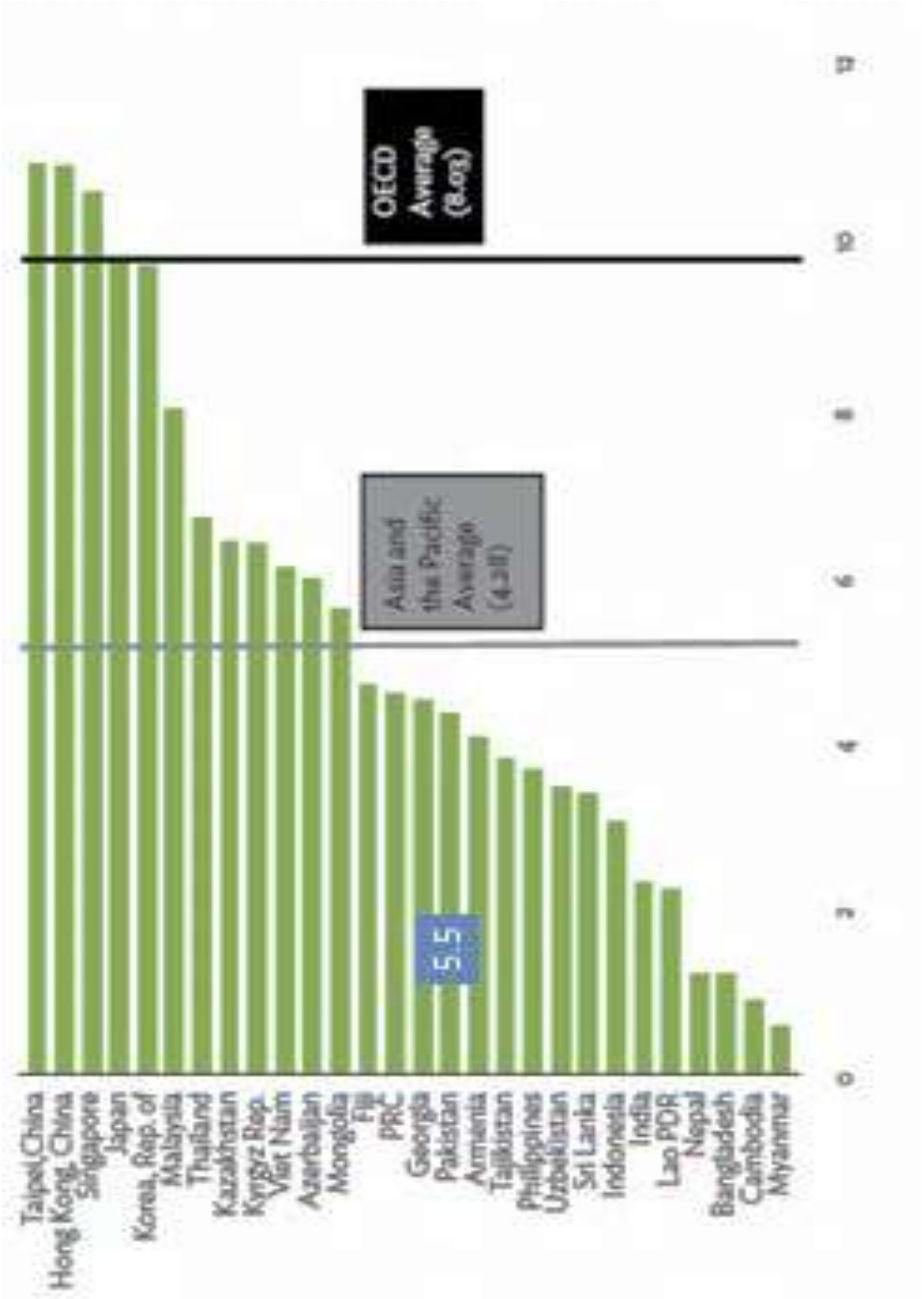
Figure-10
Total Spending on Education: Percentage of GDP of Various Countries (ADB, 2014)



Information Infrastructure

Information Technology Infrastructure Capability (ITIC) is said to play a substantial role in management. As a major contribution to a firm's long-term achievement, ITIC has emerged as a foremost antecedent of organisational performance (Gheysari et. al., 2012). The ADB (2014) report on ICT sub-index scores of Asian countries has revealed that China (Taipa) is providing the highest score; whereas, Asia and the Pacific's average is 4.28 and OECD's average is 8.03. Pakistan's performance is better than the average of Asia and the Pacific i.e. 5.5 (Figure 11). This is the only pillar where Pakistan performance is little better than that of India and some other countries.

Figure-11
ICT Sub-index Scores of Asian Countries, Pakistan and OECD's Average



Source: ADB, 2014

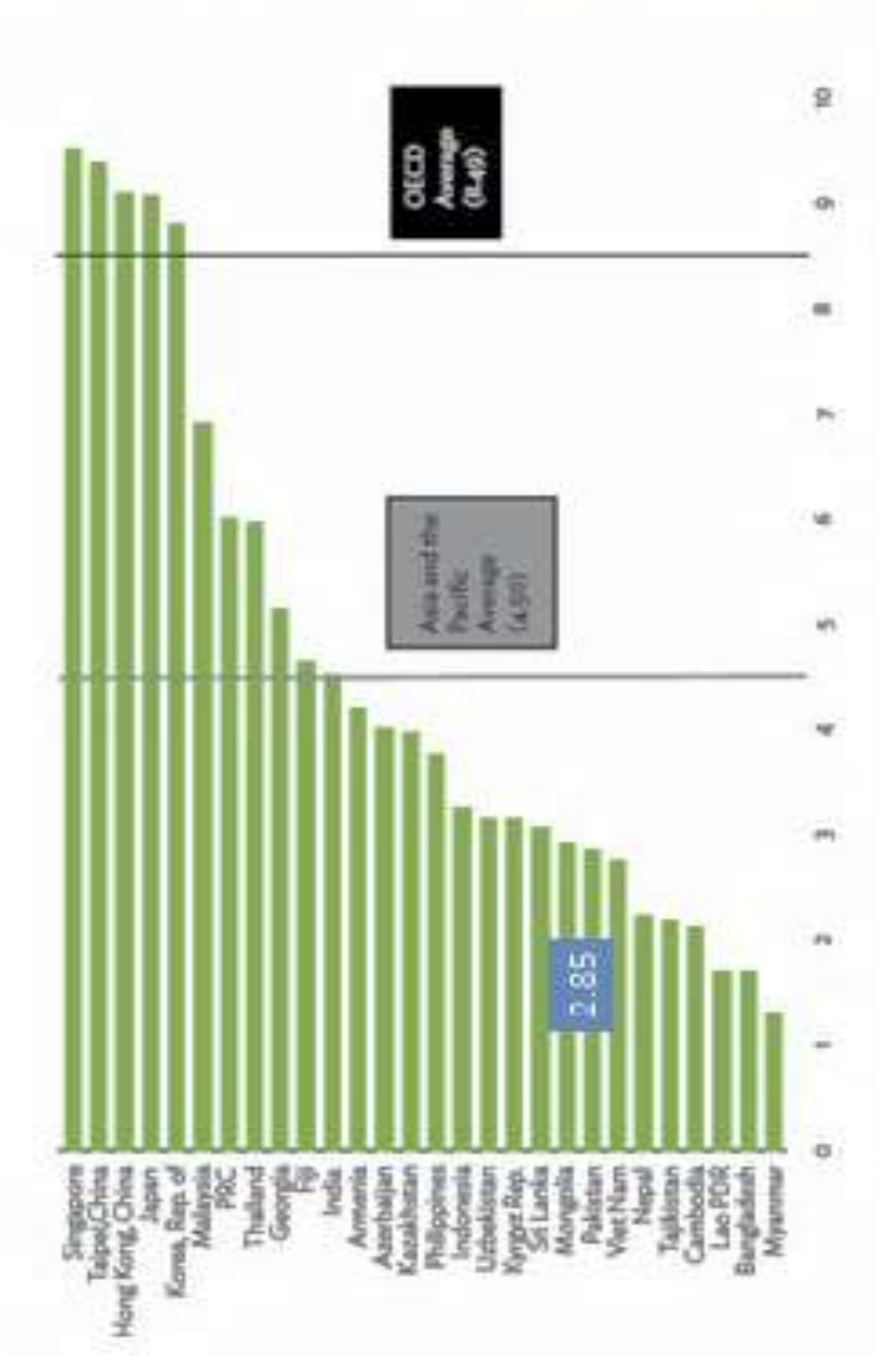
Innovation Systems

Innovation is manipulating novel ideas leading to a fresh invention, development or establishment of a facility. It is not just the discovery of an innovative knowledge that is imperative, but it is essentially "bringing it to market", putting it into practice and manipulating it in a way that brings forth original products, services or schemes that enhance value or improve quality. It conceivably encompasses technological revolution and managing restructuring. Improvement also means manipulating innovative technology and retaining out-of-the-box thinking to produce new value and to carry out significant alterations in the society (Shukla, 2009).

This is an era of competitiveness; efficiency, innovation, updated knowledge and skill in production, manufacturing, and marketing give a competitive edge. No enterprise/business can survive without it. The studies have established that all businesses aim to be more innovative. Almost 90 per cent of businesses consider that innovation as a priority for them. Hence, its significance is growing. In the present-day economic development, innovation has become a major aspect in swaying the strategic planning. It has been recognised that bringing innovation translates to wealth formation. However, productivity is crucial for achieving sustained progress in the businesses (Shukla, 2009 and Mustafa, 2015).

The ADB (2014) report on innovation sub-index score of Asian countries revealed that Singapore has the highest score, whereas, Asia and Pacific's average is 4.50 and OECD's average is 8.49. Pakistan's score in this category is very low i.e. only 2.85 (Figure 12).

Figure-12
Innovation Sub-index Scores of Asian Countries, Pakistan and OECD Average

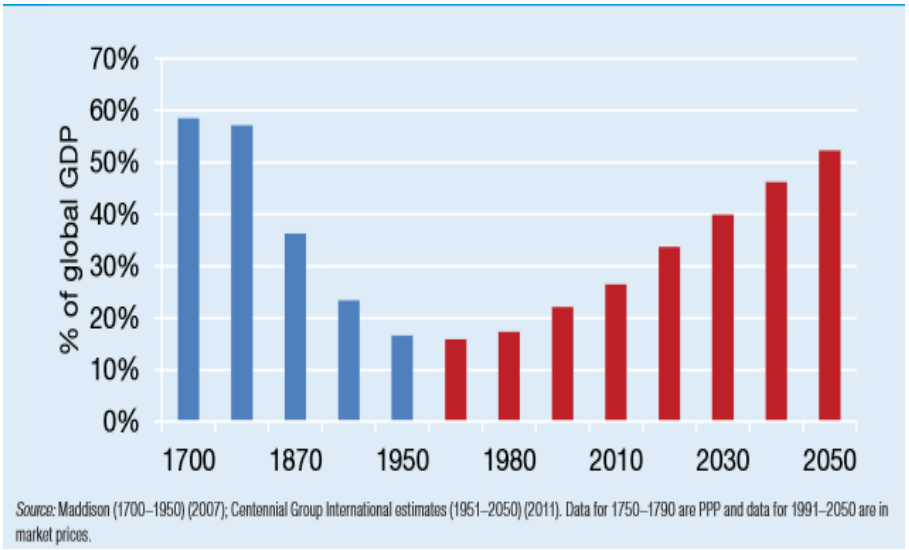


Source: ADB, 2014

Asia 2050: Realising the Asian Century

Asia is in the middle of a historic transition. If it continues to follow its current trajectory, by 2050 its per capita income could raise six fold in purchasing power parity (PPP) terms to reach Europe's levels today (ADB, 2011). It would additionally make some 3 billion Asians affluent by current standards. By nearly doubling its share of global gross domestic product (GDP) to 52 per cent by 2050, Asia would regain the dominant economic position it held some 300 years ago, before the industrial revolution (Figure 13).

Figure-13
Asia's Share of Global GDP, 1700-2050



Source: Maddison, 2007

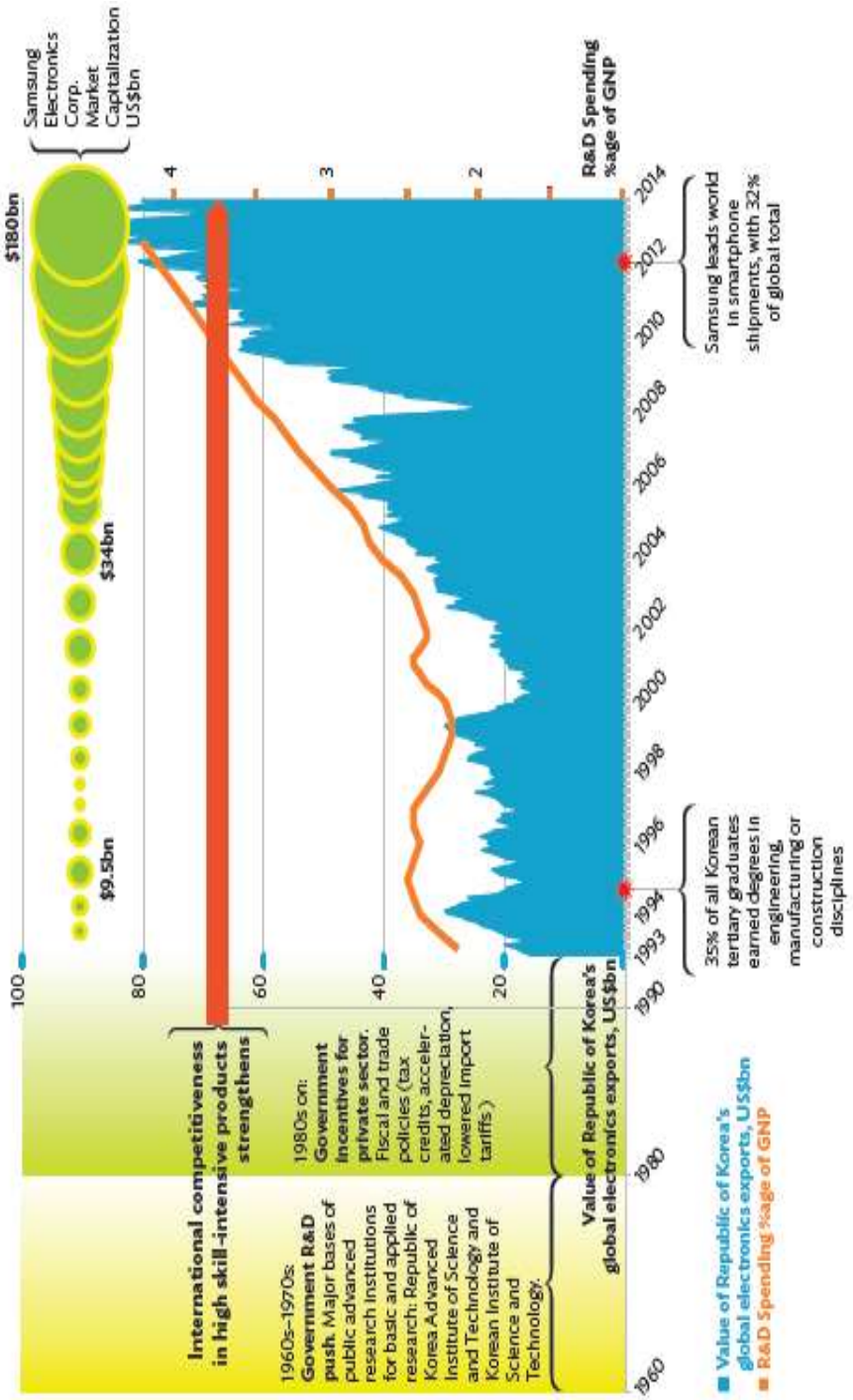
By nearly doubling its share of global GDP (at market exchange rates) from 27 per cent in 2010 to 51 per cent by 2050, Asia would regain the dominant global economic position it held some 250 year ago, before the Industrial Revolution. Some have termed this possibility the "Asian Century". Asia's GDP (market exchange rates) would increase from $16 trillion in 2010 to $148 trillion in 2050, or half of global GDP (ADB, 2011). More than 4 billion people are living in Asia which is higher than 60 per cent of the total world population, yet its effect in world affairs rests disproportionately small. The Asian century will be built on human capital, if this resource is well utilised and properly trained (Lutz and Samir, 2013).

The Republic of Korea (RoK) has made an extraordinary transition to a knowledge economy in less than two decades. It has adopted Pakistan's

five-years development plan; it has also followed a fast industrialisation procedure built on technology, labour-intensive exports, import of capital goods from the developed countries. Construction on import of capital goods and accredited know-how, with major emphasis in the private sector has been their priority. During 1960s and 1970s, the RoK has set up major government Research and Development (R&D) centers for basic and applied research. There has been a substantial increase in the R&D share as a percentage of GDP: 0.5 per cent in 1965, 2.5 per cent in the year 1997, and 3.7 per cent in 2010 respectively. They are planning to increase it to 5 per cent of the GDP. Special attention and investment have been provided to the ICT sector, which is even higher than that of the advanced economies (Joonghae and Chen, 2007).

The education and training pillar of KBE in Korea has been very much emphasised. In this connection, a number of reforms—tax credits, permitting augmented depreciation, lowering import tariffs, etc—and links between tertiary and employer-based training have built the human capital base required for the country to transform itself into a knowledge economy. The R&D is very much encouraged; in some cases, small and medium-sized enterprises (SMEs) spend as much as 10 per cent of total sales on R&D. Korea's international competitiveness in high skill-intensive products has been strengthening since 1991. The share of tertiary graduates in engineering, manufacturing, and construction was 35 per cent during 1995. Presently, RoK's higher education enrolment is amongst the highest in the world (Figure 13) (ADB, 2014).

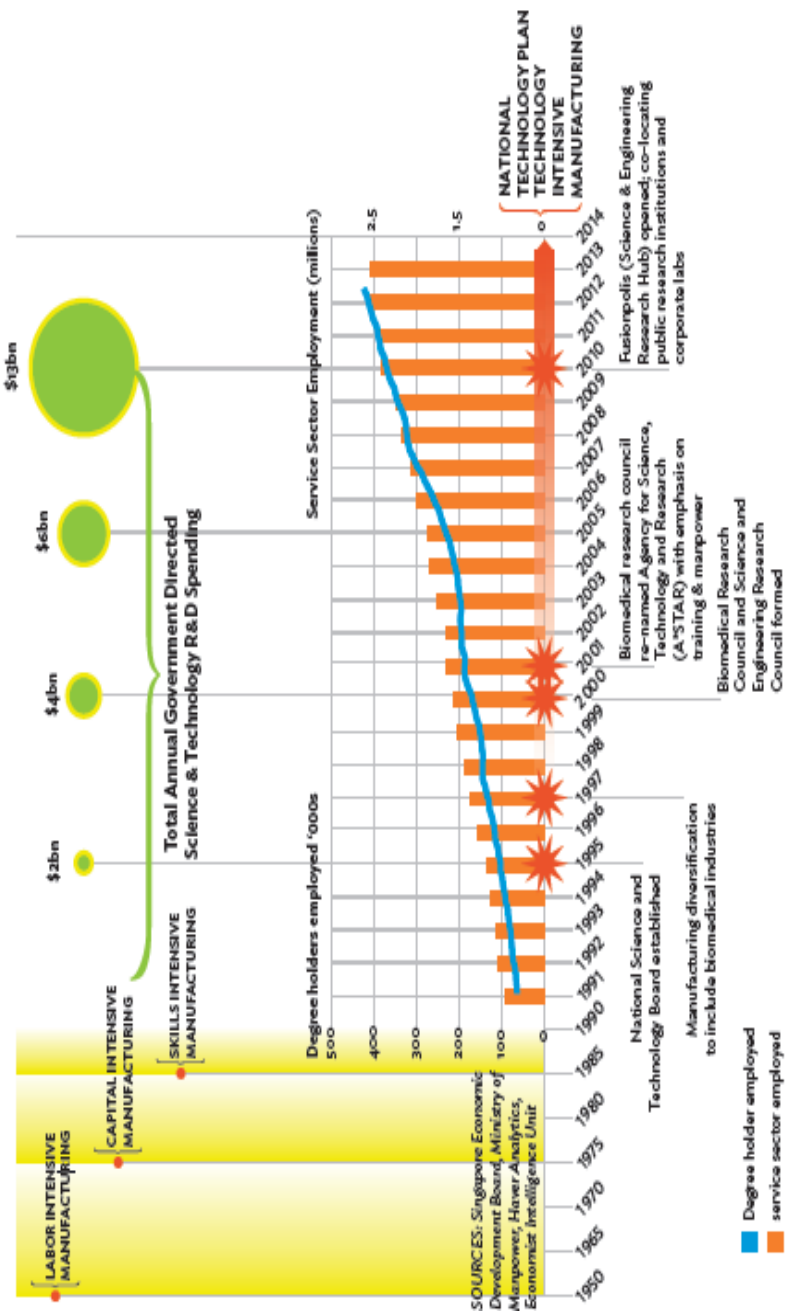
Figure-14
The Republic of Korea: Journey to a Knowledge-based Economy



Source Joonghae and Chen, 2007

Likewise, Singapore is a small country of Asia but it has transformed itself from a labour intensive industry to a KBE. This transformation is the process of a series of economic policies and development, each roughly a decade in length. Foreign Direct Investment (FDI) has played a major role, in 1990; there has been a coordinated shift to focus on technology as it is one of the prerequisites of a KBE. The R&D expenditure being 0.5 per cent of the GDP in the early years has steadily grown to 2.3 per cent of the GDP and 3.5 in 2015. The Singapore Economic Development Board has harmonised investment in R&D and technical education and in the elevation of high-tech industries for Singapore's forthcoming strength. The use of ICT in the government, industry, and society has been stressed. The government financed technical education and subsidised multinational corporation (MNC) training to nurture the skills of its workforce. The leading educational institutions of the world have been engaged for enhancing the accessibility of talent pools for a KBE. The industries have been stimulated for value chain with new competencies in semiconductors and aerospace engineering. The science and engineering research hubs have been added to boost technologies and KBE in the country. Singapore's journey to becoming a KBE is captured in the Figure 14.

Figure-15
Singapore's Journey to a Knowledge-Based Economy



Source: ASTR, 2011

It is evident that economies—both from Asian as well as from other parts of the world—have been successful in orienting themselves towards innovation; This is achieved through R&D employing broad-based strategy across the KEI pillars with a strong emergency commitment.

Asia has a lot of potential to advance; Japan, China, South Korea, India, Indonesia, and a number of other countries are already in pace of development and have robust economies. Still Asia needs to develop more explicit and stronger strategies for KBEs because it is the emerging feature for development. The most advanced economies, namely Finland, Japan, South Korea, and USA are the economies that have accomplished economic achievement through synchronised strategic determinations. It is also worth mentioning that emerging Asian countries that obviously escort development across all four pillars of the KEI will not only extract benefits from the interactions among these pillars, they will also have to hasten their overall KBE determinations.

Conclusion and Recommendations

There is a substantial scope, multiple opportunities and pathways for developing Asia in general and Pakistan in particular into knowledge-based economies. By the middle of this century, Asia might be contributing half of the global output, trade, and investment, while also enjoying widespread affluence. It is important to mention that Asia's rise is by no means preordained. The main emphasis of most policy makers and political leaders during the last 50 years has been on domestic economic and social development; for these nations have been endeavouring to eliminate poverty and pacing up with the advanced nations. It was also conceivable to fix consequently when Asia's inclusive footprint was lesser. However, as the center of gravity of the world economy moves to Asia, capping its segment of expanding global GDP to half or more, will no longer be probable or appropriate. It is, therefore, imperative that Asian strategy makers look beyond their national borders. The overall strategies for Asia are to cover three areas: national action; regional cooperation; and collective action on the global agenda.

Moreover, these sustained developments will require Asian countries to combine the full potential of technological change, innovation and entrepreneurship. Otherwise, these countries would be entangled in a "middle income trap" where efficiency and growth will deteriorate for extended periods. Each country's economy has its own requirements to outline its priorities and ways to build on a number of aspects and harvest its share.

Pakistan has a number of positive aspects in its economy despite constraints. These include: its strategic location; resilient economy, which is confronted with terrorism, conflicts, natural disasters, complex political transitions; but it is still surviving and growing despite all the impediments. Pakistan has a large area which includes almost all types of agro-climate zones; it is endowed with four seasons, suitable for cultivating various kinds of crops; it has potential in food production, export and mining. The country has substantial natural and human resources; it receives nearly US$20 billion in 2015 in foreign remittances. Pakistan has a history of development in leading Asia during the 1970s and 1980s. In addition, recent China–Pakistan Economic Corridor (CPEC) will be a good example of regional integration. The ultimate objective of CPEC is peace, prosperity and well-being of the people of the two countries, the region and the world.

Since the middle of the second half of the 20th century, the world has witnessed a knowledge revolution where seeking, disseminating and using knowledge, especially higher and technical education, industrial technology, innovations, Information and Communications Technology (ICT) have gained prominence that is impacting all spheres of human activity including the socioeconomic development of the countries. Therefore, in order to cope with the situation and take the share from "Emerging Asia", Pakistan should improve its Knowledge Indexes, designed as an interactive tool for benchmarking a country's position vis-à-vis others in the global knowledge economy. Unfortunately, Pakistan's standing is very poor; and out of the four pillars of KBE, the country lags in majority of them from Asia's average score. In "Education and Skill", Pakistan's score is the lowest i.e. only 1.44. It requires special attention and urgent policy measures to upgrade it, otherwise we will not be able to compete the Asian countries.

To conclude, there are three broad ways in which developing countries of Asia and the Pacific in general and Pakistan in particular can follow KBE progress in the present stage:

i. Learning from the KBE journey of advanced markets and creating suitable investments to minimise lags and gaps and embark on policy reforms; hence, the emerging KBEs need to learn from the best practices.
ii. Optimising the unique strengths and advantages of Pakistan by pursuing strategies that enhance such strengths; these include location, population dividend (youth), enhancing education and skill, expanding consumer markets, growing R&D capabilities, ICT, etc.; and

iii. Leveraging game-changing trends in knowledge and business processes that can facilitate developing economies to possibly advance technological development and connect with the cutting-edge i.e. investing in ICT, cloud computing, IT in manufacturing and fast-track modernisations for bottom of the pyramid markets.

The Government of Pakistan has realised the significance of making Pakistan's economy as knowledge-based economy. The first step was taken by establishing "Higher Education Commission" (HEC), which is an independent, autonomous, and constitutionally established institution for primary funding, overseeing, regulating, and accrediting the higher education efforts in Pakistan. The commission is responsible for formulating higher education policy and quality assurance to meet the international standards as well as providing accrediting academic degrees, development of new institutions, and uplifting of existing institutions in Pakistan.

Similarly, in 2005 and 2007, the government had chalked out a roadmap for making its economy knowledge based; consequently, Medium Term Development Framework (MTDF), 2005-10, Vision 2030 Approach Paper and IT Policy were prepared and sanctioned. The present government is geared up towards transforming Pakistan's economy as knowledge-based economic system. To implement Pakistan Vision 2025, Pakistan government and relevant public and private sector institutions require devising and carrying out a comprehensive and time bound action plan. In order to realise this vision of developing Pakistan's economy as knowledge based, the Ministry of Science and Technology and HEC have to play a critically important role to implement all the initiatives.■

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CHAPTER 2

Considering Local Dimensions in Building Knowledge-Based Economy in Pakistan

Dr. Tariq Bashir and Tariq Mahmood Ali

Abstract

In a 'knowledge-based economy', a high proportion of economic wealth is derived from the creation, exploitation, transfer and distribution of knowledge and information. As the knowledge and information can flow from one place to another at a great speed in this age of globalisation and rapid growth of ICT; the role of local actors (local governments, universities, R&D organisations, industry, community) is sometimes overlooked in the context of globally competitive knowledge-based economy. This paper highlights the role of regional knowledge hubs in the development of local communities and hence in national knowledge-based economy. In this regard, it presents some examples to explain that how local knowledge centers in different parts of the world are contributing to the development of respective local communities. The paper indicates that all regions in Pakistan are not equally 'well-equipped' to participate in the national knowledge-based economy. It suggests that knowledge gaps and needs of different regions should be identified to address the problem of local development from the knowledge perspective. The paper also suggests that government needs to play its due role in transforming different industrial clusters into regional knowledge hubs. It presents the example of Sialkot where government has not been able to establish universities and R&D organisations corresponding to the needs of the local industrial clusters.

Introduction

The realisation of the importance of knowledge for economy or the utilisation of knowledge in economy, is not new. A major step in the development of the modern concept of 'knowledge economy' occurred during the era of industrial revolution in the mid of the eighteenth century, when productivity of the textile industry in the United Kingdom significantly increased as a result of technological progress. Although the economists like Adam Smith, Thomas Malthus and David Ricardo had

discussed the role of technological progress/knowledge in output/production which brought about the industrial revolution, till the beginning of the 19th century when the realisation of the importance of knowledge for economy has somewhat diminished. However, it attracted a great deal of attention when the Robert Solow (1956) presented a growth theory (exogenous growth theory), in which he, for the first time, used technological progress/knowledge in the production function as an input with formal inputs like labour and capital. He empirically proved that 87.5 per cent increase in production during the period 1909-49 in the US was due to the technological progress. This led to initiating a debate on the modern concept of a 'knowledge-based economy' which was directed later towards further development and giving new shape and understanding by many economists including some Nobel laureates. During this period, the new growth theory (endogenous growth theory) (Arrow, 1962; Lucas, 1988; Romer, 1996) was also presented as a reaction to omissions and deficiencies in the Solow-Swan neoclassical growth model (Solow, 1956; Swan, 1956). Although, the endogenous growth theorists proposed some improvements in the exogenous growth theory but they faced a lot of criticism from the established economists who were proponents of neoclassical theory like Scott, Auerbach, Srinivasan, Fisher and Olson**.** However, both concepts were running parallel side by side at the end of the 20th century (Chand, 2015).

The use of new technologies in the production process by industries as well as in every other field of life has been increasing rapidly since the last decade of the twentieth century. At the beginning of 21st century, new inventions in the fields of engineering, agriculture, industry, pharmaceuticals, health, biotechnology, electronics, airspace science and, especially in Information and Communications Technology (ICTs) revolutionised the production process of the industry as well as social well-being of the people. With the enhanced role of technology and knowledge in production process and in our social life, the concept of knowledge-based economy has become the most dynamic area of research for the economists, researchers, policy makers and planners. Several questions are raised in the concept of knowledge-based economy such as why some economies are richer and others poorer? Are the cross-country income differences based on the accumulation of knowledge or production of knowledge by the countries? Why is the technological gap between developed countries and developing countries stretching rather than shrinking? Whether and how far, the creation, adoption, and diffusion of new technologies by individuals of a country play key role in the economic growth of nations, in the long run?

A vast majority of the countries in the world has very limited capacity to create new technologies; however, if they enhance their capacity to

adapt, diffuse and absorb new technologies developed by the advanced countries, they can make significant economic gains from the global knowledge economy. Most of the developing countries have abundant natural resources but they are unable to take advantage of these due to lack of capacity of applying knowledge for value addition. The developing countries need to realise that they cannot uplift their socioeconomic conditions unless they create value of their natural resources with the application of knowledge. The advent of knowledge-based economy has provided the developing countries the opportunity to base their economies on knowledge instead of natural resources, thus shifting to production of knowledge-intensified goods while utilising their natural resources.

After recognising the growing significance of knowledge and technology for economic growth, the advanced countries have engaged themselves in production, distribution and use of knowledge more than ever. In the past few decades, the high-technology share of OECD manufacturing production and exports has increased manifold. The knowledge-intensive service sectors, such as education, communications and information, are growing even faster. It is estimated that more than 50 per cent of the GDP in the major OECD economies is now knowledge-based (OECD, 1996). In fact, the emergence of knowledge-based economy is linked with never-ending productivity gains and fast non-inflationary growth (Qamruzzaman and Ferdaous, 2014).

The knowledge-based economy is characterised by the high levels of skills and education, constant learning and, innovation as the key drivers of growth with competitive advantage based upon institutional excellence and human recourses. Wyllie (1998) identified thirty-three distinctive trends, each of which had potential ramifications for the individuals, organisations and government. David Skyrme (1999) identified five megatrends to describe the features of a knowledge-based economy which are given below:

1. Every industry is in the process of becoming more knowledge-intensive.
2. Smart products are present that use information or knowledge to provide better functionality or service and can command premium prices.
3. Higher information to weigh ratios exists in this (knowledge-based) economy.
4. Value in intangibles.
5. Trade in the intangibles accelerates in the knowledge-based economy.

As knowledge is now recognised as the driver of productivity and economic growth (OECD, 1996), many frameworks have been presented which provide the basis for the development of knowledge-based economy. However, these frameworks are generic in nature and do not provide the exact picture of any country and its specifics. In order to facilitate countries trying to make the transition to the knowledge economy, the World Bank has developed a Knowledge Assessment Methodology (KAM). It is designed to provide a basic assessment of a country's readiness to transform itself into a knowledge economy. It identifies sectors or specific areas where policymakers may need to focus more attention or future investments (Chen and Dahlman, 2005). Based on this methodology, the World Bank has developed a Knowledge Economy Index which is based upon following the four pillars:

- Economic Incentive and Institutional Regime
- Innovation and Technological Adoption
- Education and Training
- Information and Communications Technology (ICT) Infrastructure

In today's world, building strong STI capacity is important for mobilising gains from the globalised and knowledge-based economy (UNCTAD, 2012). It has also attained pivotal importance for eradicating poverty and achieving sustainable development (UNDESA, 2013). For developing countries to transform their economies into knowledge based, they have to improve their scientific, technological and innovative capabilities at gross root and local level as advanced countries have done. Pakistan, like many other developing countries, has weak educational, information and communication infrastructure; and even weaker economic and innovation system. It has to overcome institutional deficiencies and shortcomings in order to convert its economy into knowledge based.

In the knowledge-based economy, a high proportion of economic wealth is derived from the creation, consumption, transfer and distribution of knowledge and information. The knowledge and information can flow from one place to another at a greater speed in this age of globalisation and rapid growth of ICT. Therefore, sometimes the role of local actors—local governments, universities, R&D organisations, industry, community—is overlooked in the context of globally competitive knowledge-based economy. The present study highlights the role of local actors and sheds light upon the local dimensions in building knowledge-based economy in Pakistan. It also indicates that all regions in Pakistan are not equally 'well-equipped' to participate in the national knowledge-based economy and suggests that knowledge gaps and needs of different regions should be

identified to address the problem of local development from a knowledge perspective. The paper also suggests that the government needs to play its due role in transforming different industrial clusters into regional knowledge hubs and presents the example of Sialkot where government has not done enough for establishing knowledge generating institutions (universities and R&D organisations) to support local industrial clusters.

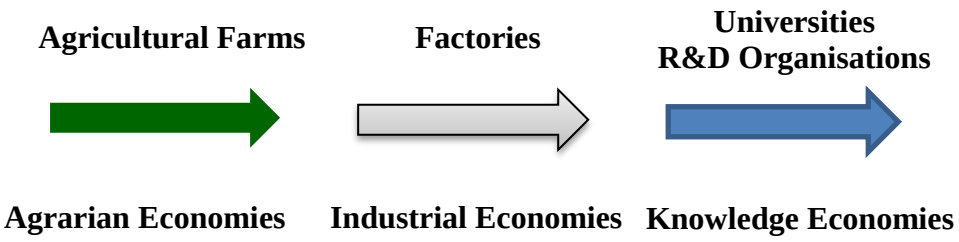
Local Dimensions of Building National Knowledge-Based Economy

Strength of Knowledge-Based Economies

It is now widely recognised that global competitiveness of a nation is dependent on its capacity to produce, distribute and use knowledge as the main driver of economic growth, wealth creation, social welfare and employment across all sectors. In the knowledge economies, wealth is increasingly derived from ideas, therefore, those countries and regions would have better chances to prosper which can attract those who have innovative ideas. In other words, the most important element of the knowledge-based economy is the human capital; especially those who have ideas i.e. the creative class. The developed world has fully realised this; hence, many advanced countries have initiated various programmes to attract brilliant minds from around the world and, especially from the developing countries. The countries in the advanced world are in a competition to attract the 'creative class'. But the question arises, what can attract this class?

The agrarian economies are based on the agriculture, industrial economies on industry and knowledge economies on knowledge generating institutions. Therefore, the symbol and source of strength in knowledge economies are knowledge generating institutions, namely universities and R&D organisations; agricultural farms and factories are the main force in agrarian and industrial economies. Hence, in the knowledge economies, if we want to attract the creative class, we can do so only in the universities and R&D organisations; probably more so in universities than in R&D organisations due to more autonomy and freedom of work in the former.

Figure 1
Symbols and Sources of Strength in Different Economy



Local Knowledge Hubs

In globally competitive knowledge-based economies, governments, knowledge-creating institutions—universities/R&D organisations—and industries work together to create local 'knowledge hubs'. Knowledge hub is a region with communally knowledge-intensive organisations located in both public and private sectors (Turpin et al, 2002). The knowledge-intensive organisations include both research-intensive knowledge producers, namely research organisations and universities and knowledge users i.e. industries and service providers such as hospitals etc. The knowledge hubs can also be considered as the local innovation systems that are nodes in networks of knowledge production and knowledge sharing. They are characterised by high connectedness and high internal and external networking and knowledge sharing capabilities (Evers, 2008). A typical knowledge hub performs three major functions:

- It generates knowledge.
- It transfers and applies knowledge at the places where it is required.
- It transmits knowledge in the community through education and training.
  (Turpin et al, 2002; Evers, 2008)

Role of Knowledge Generating Institutions (Universities and R&D Organisations) in Local Knowledge Hubs

Education and training is one of the main pillars of knowledge economy. An efficient and effective education system is the key factor in enhancing the human skills, learning and creative thinking and consequently in the creation of an innovative culture in the society which is crucial for building knowledge-based economy. Knowledge generating institutions perform a pivotal role in the development and support of knowledge hubs. However, it

needs to be understood that the knowledge generating institutions are only one part of a knowledge hub. A true knowledge center cannot be established unless the opportunities for employment are not generated in the local industries and a conducive environment is not created where 'knowledge workers' can be employed and retained; besides, the environment should draw in 'the creative class' from other localities, regions and from abroad.

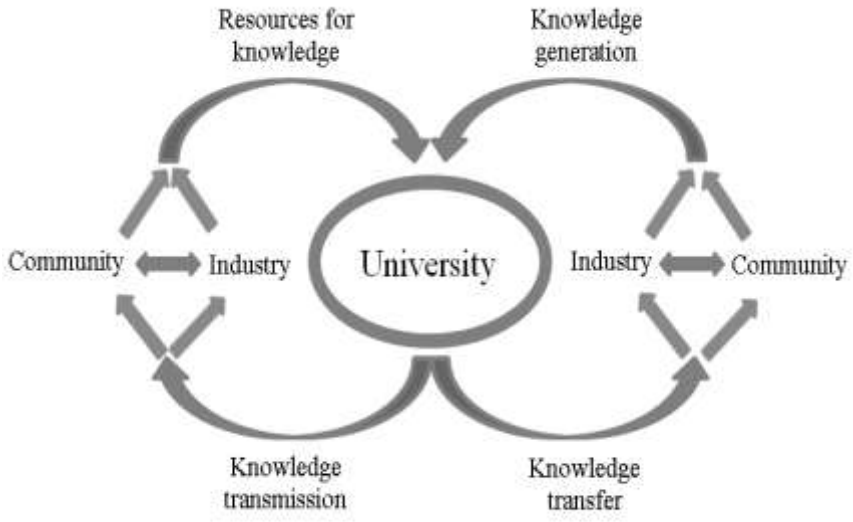
Knowledge generating institutions, especially universities, have a role to play in all three major functions of a knowledge hub as mentioned in the previous section. They may play this role directly or indirectly as indicated below:

- **Direct contribution of knowledge generating institutions**
  - Setting-up firms owned by the knowledge generating institutions themselves or their employees.
  - Transfer of technology developed by these institutions to the private industry through licensing or other mutually agreed arrangements.
  - Provision of technical assistance to industry through consultancy, personnel training etc.
- **Indirect contribution of knowledge generating institutions**
  - Developing regional innovation capabilities through knowledge innovation, technological innovation etc.
  - Analysis of regional economy for its strengths, weaknesses, knowledge gaps and knowledge requirements.
  - Development of innovation norms of openness, trust and cooperation in the society; thus creating and cultivating innovative society.

Universities' contributions in the local development can be more productive if they have well-established linkages with the other major local stakeholders i.e. industry and community. Their linkages and mechanisms of communication with the industry and community are crucial for their role in knowledge generation, knowledge transfer and knowledge distribution as well as for ensuring resources of knowledge-generating activities. The Figure 2 illustrates that the knowledge generated by universities can be useful for the local industry and community only if it is as per their needs. The universities can determine the knowledge needs of the local industry and community if they have linkages with them. Hence, establishing linkages with the local industry and community is of utmost importance for the universities so that they can produce knowledge corresponding to the requirements of the local industry and community. Such knowledge produced by the universities is transferred to the local

industry and community through technology transfer mechanisms, technical assistance, consultancy services or voluntary support and, is utilised for local socio-economic development. The universities, not only generate knowledge themselves, but they also obtain knowledge produced elsewhere, nationally or internationally, and develop it further to meet specific local needs. Thus the knowledge generated at the national or international level is translated, applied or transferred into locally useful knowledge for supporting local industries, shaping public policies and meeting other needs of community such as health, education, urban planning and ensuring environmental sustainability. The universities also transmit knowledge to the local industry and community through their graduates who are educated and trained in the universities and, then go back and become part of the industry and community. These higher education institutes play a pivotal role in the lifetime learning processes of people by providing trainings to the employees of various industries, government agencies, community-based institutions and social service providing institutions such as hospitals, educational institutions etc. In short, well-established linkages of universities with industries and communities also help them to acquire all important financial resources for their knowledge generating activities.

Figure 2
Knowledge Linkages of a University in a Knowledge Hub



Factors Influencing Role of Knowledge Generating Institutions in Local Development

It has been explained in the previous sections that the knowledge generating institutions, especially universities, are one of the most important players in a knowledge hub. It has also been explained that they can make both direct and indirect contributions in building knowledge-based economy at the local level. However, there are a number of factors which may affect and influence their participation and effectiveness in the local development. Some of the important factors are given below:

- **Institutional Factors**

  These are the factors which are from within the institution and they influence participation of the institution in the local development.

  - The capacity of the institution is one of the basic factors. If an institution does not have the internal capacity, it cannot perform its role in the development of knowledge-based economy appropriately.
  - The orientation of the institution's management to engage in the local development has primary importance. If the senior management, especially the head of the institution, is inclined towards playing his role in the local development, the institution would play its due role in the growth and development of the local industry and community more effectively. If the situation is otherwise, the institution would not be able to make its due contribution in the local development, even if it is sufficiently equipped otherwise to do so.
  - However, mere inclination of the head of the institution towards local development is not enough; it is equally important, if not more important, that the head of the institution has the ability to perform the role of a contributor. If he is able to make contributions to align activities of the institution towards local development in a systematic way, without undermining any other role of the institution, only then desirable results can be achieved.

- **Local Factors**

  These are the factors which are unique to a region or locality. For example, local industry landscape and communal conduct are important factors which influence the role of knowledge generating institutions in a knowledge hub.

- The local industry landscape is an important factor which determines the involvement of universities and R&Ds in the local industrial development. If there is a well-developed industrial base in the region, there is more room for the knowledge generating institutions to participate in the local development. Similarly, the level of knowledge-intensiveness of the local industry has great impact on the performance of these institutions vis-à-vis their contribution in the growth of local industry.
- Cultural characteristics of the local community are also an important factor which affect the interaction and collaboration between academia and community as well as industry. If people are more open, accept change more easily and, are ready to trust each other, there are greater opportunities for knowledge generating institutions to collaborate with the local industry and community and participate in local knowledge-based development.

- **Common Factors**

  These are the factors which exist both within the institution and the region and have an impact on these.

  - History of academia-industry linkages—i.e. non-existence, existence, magnitude—in the region is an important factor which influences the development of such linkages in the future. If there is a strong tradition of academia-industry linkages in the region, it would be much easier for the knowledge generating institutions to develop these linkages further. However, in the absence of such a tradition, the institutions have to make greater efforts while the chances of success would also be narrow.
  - Another important factor which impacts the establishment of academia-industry linkages is the presence of "champions" within the institution and in the region. If there are some prominent personalities, within an institution or region, who advocate the cause of collaboration between academia and industry, there would be broader chances of success. The degree of success of collaborations between academia and industry would depend on the degree of influence of the champions within the institution, industry or community.

- **Environmental Factors**
  These are the factors which exist both within the institution and the region and also influence these.
  - The changes in the economic and political environments at the national or regional level affect the collaboration between academia and industry. The change in the political regime has greater importance in the developing countries, like Pakistan, where incoming government generally does not subscribe to the policies of the outgoing government if they belong to different political parties.
  - The polices of the government (national, provincial, local) greatly influence the collaboration between academia and industry; therefore, the extent of participation of knowledge generating institutions in the local development should be increased.

Academia-Industry Collaboration

The idea of government-academia-industry collaboration has long been regarded as a means through which complex problems can be addressed. Such problems are often beyond the scope of any one particular stakeholder; this promotes cooperation with other stakeholders in order to attain success (Ackoff, 1981; Van de Ven, 2000). The concept of collaboration between government, academia and industry brings opportunities for each of the three actors of collaboration as well as for the community and society. Each stakeholder brings to the table its own talent, resources and perspective, which together, creates a robust system of tackling problems of economy and society. For example, the government often has resources, which along with academic creativity, can be applied to real problems identified in the industrial contexts (Vogel, 2004).

The academia-industry collaboration has existed for a long time; however, it has become very prominent in the last few decades within the context of knowledge-based economies. The governments and higher education policy-makers are increasingly acknowledging the importance of higher education institutions as the strategic actors in national and regional economic development, due to their potential to upgrade knowledge within the labour force and to contribute to product and process innovation through the technology transfer. The potential benefits of the academia-industry linkages for both the stakeholders can be summarised as under:

Benefits to Academia

- Opportunities of obtaining funding for research.
- Commercial exploitation of research findings and increase of consultancy opportunities.
- Awareness of what goes on in industry and the need to stay abreast with current technological change, particularly in the innovative research.
- Access to company's research facilities.
- Better chances for students in terms of job opportunities, trainings for graduates, exposing students to real world research problems.
- An opportunity to contribute more directly to the community and economy.

Benefits to Industry

- Tapping of scarce scientific expertise.
- Graduating and upgrading their staff.
- Cost saving and risk reducing.
- Access to new technology, skills, information and opportunities for increasing R&D capacity.
- Maintaining and monitoring technical advances in specific research areas.
- Enhancing the scope and testing of in-house corporate activities.
- Concentrating manpower in a strategic area as opposed to dividing the research team among several areas.
- An outward sign that the firm has a civic responsibility and supports its community.
- Government provides incentives to participate in collaborative research.

Although there are many benefits for both universities and industries to collaborate; however, there are a number of barriers as well which hinder the collaborative process. The barriers for both the stakeholders are summarised below:

Barriers for Academia

- The needs of the business do not align with the mission and strategy of the institution.
- The institution has already committed its resources and does not have the available capacity to meet the needs of the business in the given timeframe.

- The institution does not have the skills or the facilities to meet the needs of the business.
- Where external funding is required, the bidding cycle does not meet the timescale the business needs.
- The institution is unable to provide the service required at the price the company is willing to pay.
- The investment required by the institution to provide the service does not have an acceptable payback period.
- Expectations of outcomes from collaboration are not mutually recognised.
- Failure to agree on the future sharing/consumption of the intellectual property that may be generated.
- Contrasting views on the management of indemnities and liabilities between prospective partners is also a huge barrier.

Barriers for Industry

- What matters for a company, is not the outcome but the impact which the collaborative research brings forth.
- Collaborative projects may produce interesting outcomes – but these outcomes may have minor or no impact on the company.
- How knowledge derived from collaboration will contribute to company's performance?
- Will new products be possible?
- Will new and more effective manufacturing processes be possible?
- Will there be any patents, designs or processes that would enhance competitive advantages of the company?
- Will working with academia enhance company's goals?

The government has a very important role in forging linkages between the academia and industry as it can create an environment which is conducive for such connections. Following are some of the ways for the government to facilitate linkages between academia and industry:

- Building appropriate legal frameworks to facilitate partnerships and mobility, and encourage entrepreneurship in the universities and R&D organisations.
- Giving incentives to both the university and industry for collaboration.
- Providing platform for dialogue among government, academicians and industry.

- Building capacity within the universities and public sector R&D organisations.
- Facilitating movement of professionals between industry and university.
- Providing funding on preferential basis, for collaborative university-industry research projects.

Best Practices Demonstrating Contributions of Knowledge Generating Institutions in Local Development

In this section, different models and best practices from around the world, demonstrating contributions of knowledge generating institutions in local development, are presented. These examples are from the advanced countries, therefore, they are not meant to be imitated by the developing countries as such; instead, they may be utilised to obtain ideas and derive useful information for the development of appropriate frameworks and mechanisms of collaboration keeping in view local conditions in the developing counties.

Example 1: Strategic Partnership between University and Industry (Siemens-University of Lincoln)

The Siemens and the University of Lincoln have formed a strategic partnership which involves multiple layers across a broad spectrum of activities. Their collaborative R&D projects generated six times more turnover than in the original business plan. The partnership contributed significantly in increasing research outcomes for the university. While collaboration was so attractive for Siemens that it co-located its office with the University of Lincoln's engineering department which provided them the opportunity to engage in the teaching of students, provision of scholarships, internships and consultancy projects and contributing in producing graduates, who were 'industry-ready'. In return, the Siemens' technology needs were included in the Lincoln's engineering undergraduate programmes.

Example 2: Strategic Partnership between University and Industry (Proctor & Gamble-Durham University)

A Master Collaboration Agreement established Durham University as a core strategic research partner of Proctor and Gamble (P&G). The research needs and research capabilities of both the partners were mapped and core areas of mutual interest identified. More than 80 Durham academics were linked with a similar number of P&G researchers in different locations. The

partnership secured more than £5.7 million in external funding for a series of projects and studentships.

Example 3: Collaboration among Universities (North Carolina Research Triangle)

The North Carolina Research Triangle in the US exemplifies one way in which a university, industry and government have collaborated to create a dynamic technology based economy– one of the fastest growing economies in the US. Three universities—North Carolina State University, Duke University and University of North Carolina, Chapel Hill—provided an academic base for industrial collaboration. Each of the three universities had a different academic profile and different historical trajectories but had complementary missions. Over the past few years, the universities in the triangle have attracted over US$ 400 million annually in sponsored research. The economic development in the region, regarded as the nation's 'Entrepreneurial Hot Spot', was attributed directly to this effective organisational partnership.

Example 4: Initiative Led by Business Sector (Information Technology Business Network)

The Ottawa-Carleton region in Ontario provides an example of a more complex and organic approach for developing a regional knowledge system. The business sector took a leading role in the establishment of its own network or consortium of organisations as a source of entrepreneurs to lead economic growth in the region. Various other actors and agencies, including the universities, contributed substantially to the process. An important feature of the collaboration had been a high degree of mobility and exchange among researchers and academic staff at each of the three sets of R&D institutions: universities, industry and the federal laboratories. The business sector provided the impetus for collaborative development in the region, although the public sector and universities were essential players in achieving a critical 'knowledge mass' and international reputation.

Example 5: Initiative Led by Provincial Government (Alberta's Innovation Economy Plan)

The provincial government developed a strategic plan to establish Alberta as a leading knowledge-based economy built around value-added resource-based industries and non-resource based knowledge-intensive manufacturing industries. The primary driver of the business growth and success in the plan was the investment in science and R&D. The government put in place an ambitious programme to raise the level of investments by innovation-based company in R&D and training from 10 per

cent to 20 per cent of gross sales. In terms of GDP, the target was to raise the 'innovation-based economy from its present 7 per cent of GDP to 25 per cent of GDP by 2020. The strategy adopted was the recognition that it was not simply an increase in R&D or technical training which was necessary to generate economic development, but the linkages between knowledge producers, diffusers and users were equally important.

Example 6: City Government Led Initiative (Jena, East Germany)

Jena, a small city with a population of 100,000 in the former East Germany, became one of the most important cities in the region; it hosted a large part of region's high-tech industry and public R&D capacity. Around 200 new firms had been set up in the city over the past few years and nearly 6,000 new jobs were created by the new start-up firms. Much of this development had been stimulated by the policies directed towards making Jena a 'learning city' by the city government. The local university played a major role in this process. The city embarked on a conscious policy of supporting industrial development in the activities associated with the major industry sector in the region, principally around one firm, Carl Zeiss, and its successors. This approach served to transform an entrenched vertical industry structure to a more horizontal structure with an increasingly wide range of specialisations.

Example 7: Okanagan High Technology Council

In the Okanagan Valley, university and industry cooperation became increasingly important component in its development. The Key components in the system included the Okanagan High Technology Council comprising a group of industry executives, academics, research institutions, government leaders and resource agencies. The council sponsored projects for human resource development, promoted research and development partnerships, and served as a liaison between the technology, industry and Okanagan's communities.

Example 8: Enterprise Development Hub-Middlesex University, London

The Middlesex University's Business School students, alumni and staff adopted a simple approach to contribute to local development in which they supported access to workshops, one-to-one mentoring and networking opportunities, as well as informative events such as seminars with successful entrepreneurs-support and advice to turn an abstract idea into a solid reality.

Example 9: University of Lincoln's State-of-the-Art Technology Hub
The University of Lincoln's School of Architecture & Design contributed in local development by offering free access to 3-D printers, colour scanners and laser cutters, as well as a chance to benefit from the university's expertise in art, design, media and heritage sectors.

Example 10: Cooperative Education- University of Waterloo, Canada
The approach adopted by the University of Waterloo was that they had made possible the rotation of students to industry and back to the classroom which solidified their already close relations with the local industry. This allowed the upgradation of university curriculum to keep up with the ever-changing technological frontiers of industry while the industry funded the acquisition of technology to enhance classroom learning. Thus, the exposure students had in the early days of computer technology, laid the foundations for a technological leap that shaped the industrial development of the region from the 1970s onward.

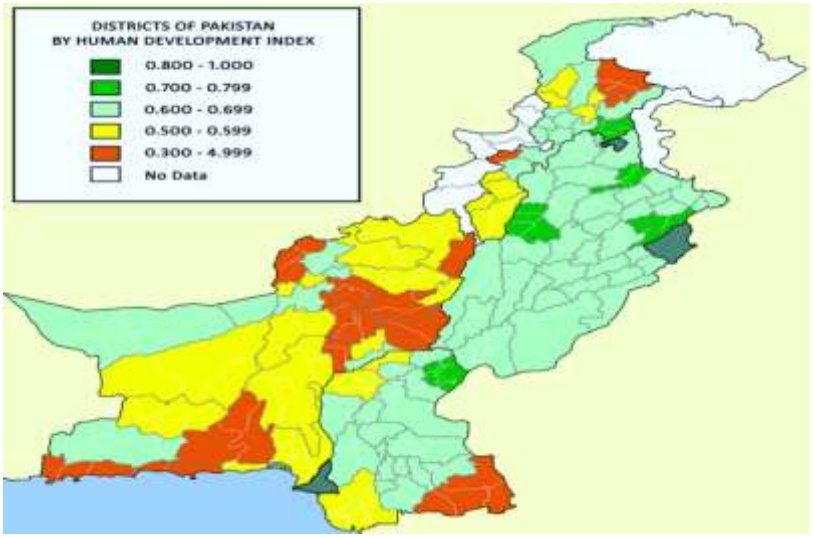
Local Dimensions of Building Knowledge-Based Economy in Pakistan

The consideration of local dimensions in building national knowledge-based economy is crucial for any country. But it is even more important for Pakistan as it is not a homogenous county. It is composed of different ecological, geological and climatic regions having different types of flora, fauna and other natural resources. This indicates existence of diverse indigenous knowledge in different regions of the country. For building knowledge-based economy in these regions, identification of strengths of local knowledge is the first step, so that corresponding industries could be set up in those regions. Various regions in Pakistan are also suitable for growing different types of crops and rearing livestock. Correct application of knowledge would inform us which regions are suitable for growing which crops and rearing which animals. Ignoring this knowledge will result in making wrong decisions which may have long term implications.

Similarly, all regions in Pakistan are not equally "well-equipped" to participate in the national knowledge-based economy. Figure 3 presents Human Development Index of different districts of Pakistan which shows that different districts of Pakistan widely differ in human development (Wikipedia, 2015). The Human Development Index (HDI) is a composite indicator based on life expectancy, education and per capita GNI and, reflects the human development of the concerned region. As per estimation of 2012, only three districts Islamabad, Karachi and Lahore have very high HDI value while a small number of districts such as Sheikhupura, Jhelum, Rawalpindi and Ghotki have high HDI value. Most of the districts have

medium HDI value. Among the districts which have high-medium HDI value, a large number is in the Punjab province followed by the provinces of Sindh and Khyber Pakhtunkhwa. Very few districts have high-medium HDI value in Balochistan. A large number of districts in the province of Balochistan have low-medium or low HDI value. The districts with low HDI value also exist in the provinces of Sindh and Khyber Pakhtunkhwa. However, there is no district with low HDI value in the province of Punjab.

Figure-3
Human Development Index of Different Districts of Pakistan



Source: Wikipedia, 2015

This clearly illustrates that different districts and regions in Pakistan are not equally prepared to participate in the knowledge-based economy. Therefore, knowledge gaps of different regions should be determined and, deliberate efforts should be made to bring those regions which have lagged behind at par with the other regions of the country which have high levels of human development.

Pakistan is also a country of diverse ethnic groups; these groups speak different languages and have different cultural characteristics. If it is not ensured that every ethnic group is fully engaged in the national knowledge-based economy, it may generate the feelings of "social exclusion" in that ethnic group which may give rise to a "political conflict". It is, therefore, important that an environment is created in which people

belonging to any "nationality" and living in any region, have the equal opportunities to participate in the knowledge-based economy.

Different areas and regions in Pakistan have strengths in different industries and knowledge needs of all these industries may not be same. For example, knowledge needs of the following industries located in different areas would be completely different.

- Cement and Steel industry in Karachi
- IT industry in Lahore
- Textile industry in Faisalabad
- Sports and Surgical industry in Sialkot
- Livestock "industry" in Tharparkar
- Electrical goods industry in Gujrat
- Heavy machinery industry in Gujranwala
- Coal "industry" in Thar
- Handloom industry in Swat
- Lacquered woodwork, glass and ivory ware industry in D.I. Khan
- Marble industry in Mardan
- Gold and copper mining industry in Reko Diq (Chagai)
- Fisheries "industry" in costal belt of Balochistan

As explained above, Pakistan has a stern knowledge divide among its different regions and, the main industries of these regions are also diverse, therefore, it may not be appropriate to concentrate universities and R&D organisations in a few locations and expect that they would adequately meet needs of all the regions.

The Case of Sialkot

The district of Sialkot has a population of about 3.3 million with a literacy rate of about 59%. Approximately, 25% population of the district of Sialkot is urban while 75% is rural and, the total workforce is about 0.2 million (FPCCI, 2015).

Sialkot is a hub of business and industrial activities and the annual export earnings of Sialkot stand at US$ 1.5 billion (The Nation, 2014), which makes it the second largest exporter in the country after Karachi (UNESCO, 2010). Its per capita income is among the highest in the country (FPCCI, 2015) and has incredible export revenue per capita of US$ 4,000 (The Express Tribune, 2014). The main industries of Sialkot are sports goods, surgical instruments and leather products.

The history of sports goods industry in Sialkot dates back to 1895 when it started becoming famous for manufacturing tennis racquets. Later on it also started producing cricket bats made from imported English willow which were used inside the country and were also exported to other countries in South Asia and beyond. In 1922, a local manufacturer was also awarded the British Empire Export Award for supplying footballs to the British Army. Over the years, the industry has grown to include a variety of wood and leather-based sports equipment and, has diversified into related industries such as cricket balls, volleyballs, field hockey sticks, polo sticks, recreational fishing equipment, sports apparel and horse riding equipment and even the Scottish bagpipes. The most successful sports manufacturing firms now have international collaborations with the well-known sports brands, namely Adidas (Germany), Puma (Germany), Nexo Sports (Canada), Nike (USA), Dita (UK), Mikasa Sports (Japan) and Slazenger (UK). CA Sports is an example of local company with world class reputation (PTDC, 2015). There are over 3,000 small and medium-sized industrial sports goods units of some 50 well-established industries functioning in Sialkot. The Sialkot Chamber of Commerce and Industry has 2002 members registered as sports goods and sportswear manufacturers (FPCCI, 2015).

The surgical instruments in Sialkot are made from stainless steel by over 300 manufacturers who outsource work to about 1500 small enterprises specialising in particular stages of the production process. Alongside these manufacturers and their sub-contractors, there are an estimated 1000 suppliers of inputs and over 800 units providing various types of services. There is intense competition in all stages of the local value added chain but there is also cooperation both of the vertical and horizontal kind. Over 90 per cent of Sialkot's output is exported and around 90 per cent of these exports go to Europe and North America. The surgical instrument industry of Sialkot is estimated to account for over 20 per cent of the world exports, making Pakistan the second largest exporter of surgical instruments after Germany (Nadvi, 1996; Schmitz, 1997). In 1995-96, Sialkot cluster exported US$ 125 million worth surgical instruments (Nadvi, 1999) which increased to US$ 260 million in 2010-11 (Akhtar, 2012).

The leather industry, including leather products, is among the top five export earning sectors of Pakistan (SMEDA, 2015). Leather industry in Sialkot contributes nearly US$ 457 million in the total export of leather goods from Pakistan. The leather industry consists of six sub-sectors, namely tanning, leather footwear, leather garments, leather gloves, leather shoe uppers, and leather goods. Pakistan is among the leading countries in the production of leather garments and gloves. The leather industry plays a

significant role in the economy of Pakistan and contributes a good share in the GDP (SCCI, 2015).

The Sialkot industrial clusters have been able to make all these magnificent achievements without much government support. These clusters face many problems and governments have rarely taken initiatives to solve these problems; mostly the initiatives have come from within the clusters themselves even for improvement in collective services (Nadvi 1996). For instance, most of the local manufacturers in Sialkot had a problem in getting their products dispatched quickly to their overseas customers. In order to remove this bottleneck they built a local 'dry port' which allowed speedier and more cost efficient handling, custom clearance and transport to the air or seaports of Lahore or Karachi (Nadvi 1996).

During the mid-1990s, the sports industry in the Sialkot clusters faced international media allegations of child labour. Between 2003 and 2007, the international donor support for the implementation of the Atlanta Agreement (AA) for eradicating child labour was also ended and, the ILO, UNICEF, and SCF-UK withdrew from the cluster at the beginning of this period. In order to avoid an international boycott of soccer ball exports, the cluster itself took the initiative and two new local organisations, namely the Independent Monitoring Association for Child Labour (IMAC) and the Child and Social Development Organisation (CSDO) were formed in Sialkot to sustain the monitoring mechanism and the social protection agenda respectively (UNIDO, 2009).

Another example of government's neglect is the fact that Sialkot had the second highest road density after Lahore in 1992-93 with road density equal to 90% of Lahore. But, by 2005-06, Sialkot's road density had fallen to below 50% of Lahore (Burki, 2010).The Sialkot cluster has the potential to significantly increase the volume of its exports with the improvement of quality and diversification in different range of products, specially garments and footwear (SCCI, 2015), however, for that it needs support from government in terms of establishing knowledge generating institutions (universities and R&D organisations) in the region. Unfortunately, up till now the successive governments have failed to realise and paly their role in transforming the Sialkot industrial clusters into world class knowledge hubs. There are 39 universities and 32 R&D organisations in Karachi, 33 universities and 20 R&D organisations in Lahore, 20 universities and 34 R&D organisations in Islamabad/Rawalpindi. (UNESCO, 2010; HEC, 2015) In comparison to that a city (Sialkot) which is the second highest exporter and foreign exchange earner in the country has only recently established Women University and sub-campuses of three other universities and no significant R&D organisation. This clearly demonstrates that the

government has not been able to provide "knowledge support" to Sialkot industrial clusters corresponding to the needs of its local industries.

Conclusion

The local industrial clusters have been at the center of national developments. In the context of globalisation of industries, technologies and knowledge, it appears that they may have lost their significance and may not be relevant in the era of global knowledge economy. However, they still remain a strong factor in bringing innovation and competitiveness due to the intensity of interactions they have among actors of an industrial cluster. While national economies are becoming more open to international economic players, local levels appear to be acquiring a renewed importance. It needs to be remembered that even the international companies do not spread out their organisation homogeneously throughout the world, but decide on the location of their different units aiming to capture the local natural and human resources. Therefore, the developing local industrial clusters and transforming them into local knowledge hubs is imperative for building a knowledge-based economy.

As Pakistan has a knowledge divide among its different regions and, the main industries of different regions are also diverse, therefore, it is not appropriate for Pakistan to ignore local dimensions while endeavouring to build knowledge-based economy. Knowledge gaps and needs of different regions of Pakistan should be identified so that corresponding regional knowledge hubs are established and utilised for regional development and meeting needs of the local communities. It is also strongly recommended that while deciding about knowledge parks, technology parks etc. regional strengths should be given due weightage and the basis of location of knowledge generating institutions should be technical rather than political.■

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CHAPTER 3

Boosting Growth Rate and Export Earnings: Application of Information, Computer, and Communication Technologies

Dr. Ather Maqsood Ahmed

Introduction

Sustained economic growth is the most important determining factor of the living standard. What determines growth and how to achieve sustainability in growth is an ongoing quest that each economy is pursuing. From classical view on agriculture productivity to industrial revolution, the notion of the so-called engine of growth has changed quite dramatically over the years. Undoubtedly, the present era is an era of information and communications technology (ICT), which affects growth, both directly and indirectly. Its direct effect is captured through investment in ICT capital that generates economic growth on its own. On the other hand, its indirect effect flows through spill-over and network externalities emanating from the use of ICT-based innovative technologies. Over the last two decades, sufficient evidence has emerged from international literature indicating that countries which have invested heavily in ICT based technologies have reaped remarkable benefits as compared to those countries which did not invest sufficiently in the ICT.[1] Apparently, the developing and the least-developed economies are the major losers in this age of innovation and technological advancements.

The present study aims at establishing a link between adoption of ICT based technologies and growth in Pakistan. It is argued that the use of ICT based technologies in industrial and agricultural sectors boosts productivity that in turn promotes exports and growth. Within the services sector, the impact of ICT is overarching even though Pakistan has yet to exploit its full potential. We proceed with a brief review of the growth profile of Pakistan which is followed by the performance of the international trade sector. Since Pakistan's exports are plagued by limited product and market diversification, it is maintained that the missing link has been the continuous focus on agrarian and low-tech products with very little attention on ICT based products. It is fairly obvious that Pakistan has failed

[1] The major beneficiary being the US followed by the EU countries [see studies by van Ark and Inklaar (2005), OECD (2003), Pilat (2003), and Timmer et. al (2003)].

to channelise its human resources into these productive areas partly because the education system in the country, especially in the public sector domain, has failed to evolve from traditional to modern. Similarly, there are concerns with respect to non-availability of the sophisticated capital to produce high-tech products. Despite these constraints, it is but natural to enquire as to what constitutes ICT, using internationally recognized goods classification scheme so that we understand what has been the performance of Pakistan on ICT embodied products. This analysis may enable the policy planners to design a future course of action to promote economic activity and exports. The present study uses the OECD's definition of ICT goods to highlight Pakistan's trade position vis-à-vis the world in the ICT products.

Growth Profile of Pakistan

Pakistan has a checkered growth record. Even though there are years when the economy recorded reasonably high growth of eight to nine per cent, but the country has also witnessed periods of extremely low growth rates. The decade-wise average growth fluctuated between 4.6 per cent and 6.8 per cent during 1960s and 1990s [Ahmed (2015)]. An important aspect of relatively high growth in 1960s and 1980s was over-performance of the manufacturing sector. In a way it was industry-led growth along with a significant contribution originating from agriculture and services sectors. On the other hand, in the decades of low growth, the industrial sector appeared to have performed rather poorly. There is no denying the fact that every economy faces business-cycle fluctuations. However, two aspects are relatively more important for the developing economies like Pakistan as compared to any developed economy: first, for considerable improvement in the living standard of rapidly growing population, there has to be a relatively long period of sustained economic growth in per capita terms so that there is quick increase in per capita income: second, the growth trend has to rise in view of the growing economic challenges. Sadly, Pakistan's economy has missed these two points. The growth profile of the country in two distinct areas, namely historical and relative performance, has been reviewed below.

Historical Growth Profile

Figure 1 portrays the historical growth in per capita terms from 1971 till 2013 on year-on-year basis. It is evident that Pakistan's economy has the capacity to bounce back after every setback, the most recent being the

financial crisis and commodity price slump of 2007-09. This resilience is a brighter aspect of the economy which has been acknowledged by a number of authors in the past.[2] However, the worrying part of this growth pattern is the absence of sustainability. While the economy has the capacity to recover from adverse shocks, it lacks the capacity to sustain the upswing for a reasonably long period of time, thereby leaving little or no impact on prosperity and welfare of a large segment of the population. In fact, there are only two stacks of years where the per capita growth has exceeded three per cent for at least three or more consecutive years.

It is no secret that growth is fundamental to protect and promote human life. A rapid and sustained growth in per capita income is a pre-requisite for improving living standards of the people.[3] According to Barro and Sala-i-Martin (2004), government policies that have even a small effect on long term growth rates contribute much more to the standard of living of the population than the standard counter-cyclical policies. Despite this, it is amazing to see economic managers of troubling economies such as Pakistan stressing on stabilisation rather than growth. Even a casual review of the so-called structural adjustment programmes of leading financial institutions reveals that in an effort to reduce structural imbalances, particularly the fiscal deficit position, the recipient countries are forced to reduce development expenditures, thereby adversely impacting the stock of human capital and infrastructure development. Knowing very well that the low level of literacy and human health is a sure recipe for disaster, there is limited realisation that doing so will reduce a country to a mere recipient of technology and become 'technology-user' rather than an innovator and 'technology-producer'. This skewed policy design and its implementation has pushed Pakistan's economy on the brink of triviality where a good majority of population is desperately trying to maintain a respectable living standard.

Figure 2 highlights another disturbing feature of the economy. It shows that the trend of growth has been falling over time not only in the

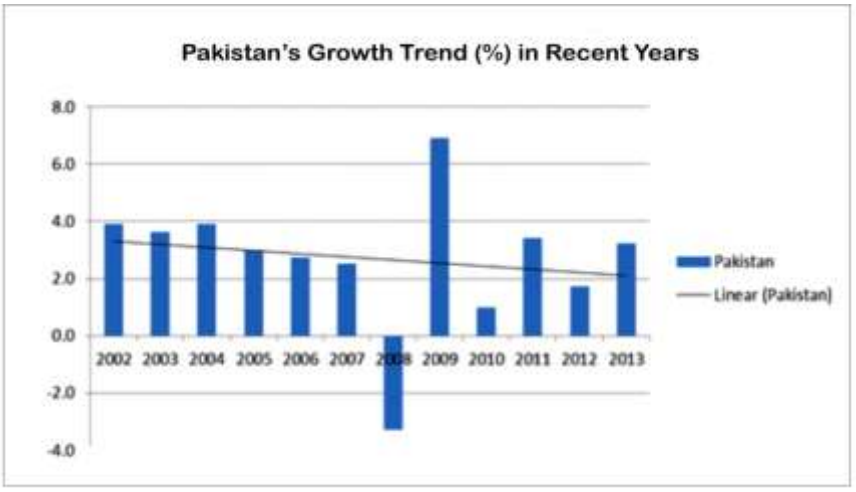
[2] See for example World Bank (2013) and references cited there in.

[3] This point can be proven through an illustration from Barro and Sala-i-Martin (2004) who have stated that the real per capita GDP of USA grew by a factor of 10 between 1870 and 2000 (from $3,340 to $33,330), yielding growth rate of1.8% per annum. Had it grown at a rate of 0.8%, the rate experienced by Pakistan (0.88%) and the Philippines (0.86%), its per capita GDP in 2000 would have been $9,450, and USA would have been ranked 45th in a comity of 150 countries. On the other hand, had it grown at a rate of 2.8%, the rate experienced by Japan (2.95%) and Taiwan (2.75%), its per capita GDP in 2000 would have been $127,000, well outside the historical experience.

past historical context but also in more recent years.[4] This declining trend reflects a steady erosion of productive capacity of the economy which might have originated from the agriculture sector where the most productive prime agricultural land is being used for housing and commercial purposes or for industrial and services sectors where obsolescence and ignorance rules the most.

Figure-1
Year-on-year Historical Growth of Per Capita Income in Pakistan 1971-2013

Figure-2
Growth Trend of GDP in Pakistan 2002-2013



[4] See Lopez-Calix, Srinivasan, and Waheed (2012).

Relative Growth Performance

The second concern about growth in Pakistan is its performance relative to its immediate competitors, China and India and its neighbours in the South Asian region. Figure 3 shows that the average per capita growth in Pakistan since late 1980s has consistently been lower than China and India. Based on the World Development Indicators (2013) dataset, it is quite clear that the per capita income (in purchasing power parity in 2005 US$) of Pakistan was higher than these two countries. However, initially China overtook Pakistan in 1991 and then in 2003 India also overtook it. By 2010, the divergence has grown much wider for two reasons: first, the two neighbours have been able to maintain and sustain a very high growth in terms of real GDP; second, they have adopted policies which have enabled them to reduce growth rate of population.[5] In contrast, Pakistan has yet to work on both these counts.[6] The obvious outcome is that Pakistan might take much longer to double its per capita income as compared to its neighbours even if it attains a fast growing growth trajectory immediately. Figure 4 also shows a similar picture when Pakistan's growth performance is compared with countries in the South Asian region. The decline in Pakistan's per capita growth since 2009 has been quite alarming.[7]

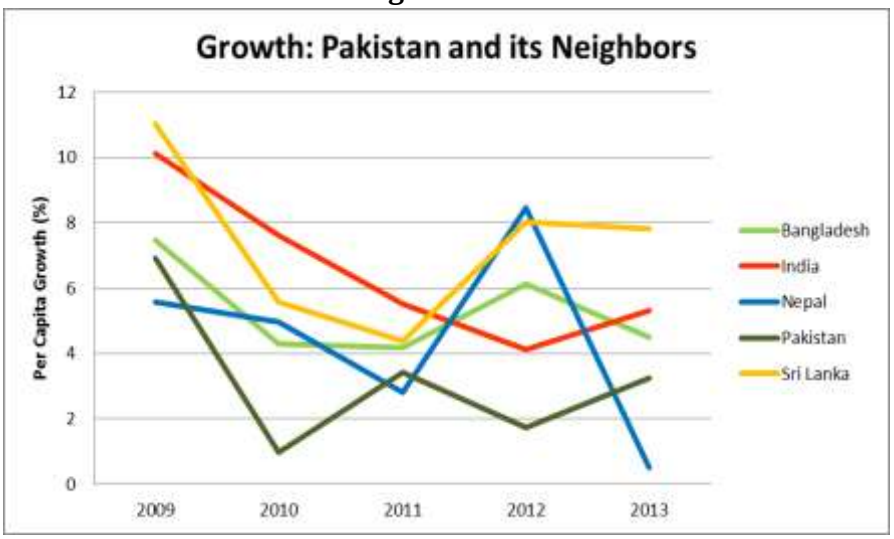
Figure-3
Growth Trend of GDP in Pakistan and its Competitors 1988-2013

[5] It may be added that China's one-child policy which has been recently reversed was controversial ever since it was launched.

[6] Despite the estimates, the exact growth rate of population is unknown in the country as the latest population census in Pakistan was held in 1997. Since then the recount is being evaded for one reason or the other.

[7] The current controversy with regard to financial sector led growth is not totally unfounded. Rather it needs to be taken seriously.

Figure-4
Growth Trend of GDP in Pakistan and its South Asian Neighbours 2009-2013



Based on this analysis, it appears that failure to maintain growth momentum and declining growth trend are the two major stumbling blocks for Pakistan. Within this scenario, the transition from traditional to a knowledge-based economy appears difficult. Unfortunately, in the absence of well-defined growth drivers the standard of living in the country might drop further leading to a cycle of low growth economy.

Theoretical Developments and Empirical Support

What are the possible reasons for low growth in Pakistan? It may be pertinent to rely on theoretical and empirical literature to find solutions for this apparent failure. Over the years, vast amount of literature has been written where new insights are provided to promote growth. A steady transition has taken place from the standard Solow-Swan Growth Model to Endogenous Growth Theory. The basic components of modern growth theory are:

- Accumulation of physical capital with the understanding that there are diminishing returns,
- Accumulation of human capital,
- Interplay between per capita income and growth rate of the population,

- Technological progress stemming from increased specialisation of labour and discoveries of new goods and methods of production (productivity enhancing factors) and
- The role of monopoly power as an incentive for technological advances.

It is obvious that the emphasis is now on technological improvement and excellence through investment in research and development (R&D), innovation, and entrepreneurship besides investment in physical and human capital. Modern thinking calls for incentives to produce and innovate. The same has been confirmed through cross-country empirical support. The so-called East Asian miracle is a classic example of high achievers who channeled high savings to productive investments which, in turn, resulted into extraordinary export performance. In order to remain competitive, these economies continued to import equipment embedded with advanced technologies and soon after the process of replication progressed to innovation. As a result, these countries are now fully integrated with the advanced world economies.

The lesson that can be learnt is straightforward. Besides investing in education, health and nutrition, and related social infrastructure, bolstering productivity growth through investment in R&D, innovations, and entrepreneurship is the key to success in growth equation. The ICT is the backbone of R&D and innovations. Unfortunately, the same has been overlooked in Pakistan with the consequence that exports are nearly stagnant and growth has also declined.

Trade Profile of Pakistan

Pakistan's international trade performance has not witnessed noticeable change for a long period of time. The country continues to be an exporter of agricultural products (raw cotton and basmati rice) and low value-added products (textile and food products). On the other hand, its major imports include petroleum, chemicals, and food products. The data presented in the Table 1 shows the extent of divergence between value of exports and imports since 2001-02. Whereas, the exports have gone up from US$9 billion in 2001-02 to US$25 billion in 2013-14, the value of imports has jumped quite dramatically during this period from US $ 10 billion to nearly US $ 45 billion. As a result, the trade deficit is hovering around US $ 20 billion which is close to the figure of foreign-exchange reserves held by the government. In fact, workers' remittances are the major saviour for Pakistan; otherwise by now the external indebtedness would have grown

out of proportion as a result of serious balance-of-payments crises, notwithstanding the IMF support.

Table 1
Value of Exports, Imports, and Trade Balance
(Billion US$)

Year	Exports	Imports	Trade Balance
2001-2002	9.14	10.34	-1.21
2007-2008	19.05	39.97	-20.91
2008-2009	17.69	34.82	-17.13
2009-2010	19.29	34.71	-15.42
2010-2011	24.81	40.41	-15.60
2011-2012	23.62	44.91	-21.29
2012-2013	24.46	44.95	-20.49
2013-2014	25.13	45.11	-19.98

Source: Pakistan Bureau of Statistics

Figures 5 and 6 confirm the extent of limited product and market diversification for exports and the fact that the composition of exports and markets has not changed over time. Figure 7 further shows the stagnation of Pakistani exports in capturing the world market share. Compared to Pakistan, its competitors like Turkey, India and Vietnam are doing much better. Even Bangladesh has started to sneak past Pakistan in recent years. This outcome highlights the fact that domestic policies are not conducive for investment. A number of studies have confirmed that the cost of doing business in Pakistan is much higher compared to its competitors. The three policy areas of concern are gross inefficiencies of public sector entities; particularly in the energy sector, inconsistent and rudimentary taxation policies, where distortions are the order of the day; and inadequate attention given to infrastructure development for smooth supply of goods.

Figure-5
Limited Diversification of Export Basket between 2001-02 and 2014-15

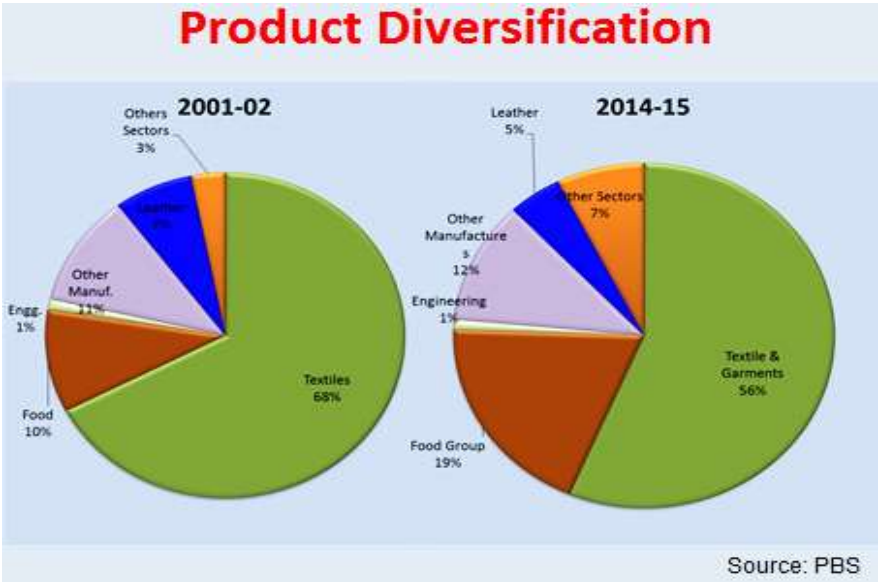


Figure-6
Limited Diversification in terms of Export Markets between 2004 and 2014

Figure-7
Pakistan's Export Share vis-à-vis its Competitors in World Exports 1999-2013

To summarise, Pakistan's trade profile is not promising. There is limited product and market diversification. This pattern has not changed because the country continues to rely on traditional products where incentives for diversification and profit-making are limited due to myopic policy prescription. One of the important concerns is the failure to recognise that ICT is the missing in this equation. Maintaining status quo appears to be the rule of the game. The urgency for transition from traditional to knowledge- based economy is neither evident from government's trade and investment policies nor from the private sector, which seems reluctant to invest in Pakistan.

What is ICT?

What constitutes ICT Sector (goods versus services) is not readily comprehensible due to its ever evolving nature. Despite ambiguity of the concept and its diversity, the most widely accepted and used definition is given by the OECD (2003) which states 'ICT manufactured products must either be intended to fulfil the function of information processing and communication by electronic means, including transmission and display, or use electronic processing to detect, measure and/or record physical

phenomena, or to control a physical process. ICT services must be intended to enable the function of information processing and communication by electronic means. Products of the ICT sector should facilitate the processing, transmission and display of information'.

ICT Goods and Services: Even though few studies have attempted to highlight the significance of exports of modern services and how emerging and developed Asian economies are capitalising on this opportunity, there is little or no evidence on export of goods and their impact on growth.[8] The focus of the present study is the identification of ICT-traded goods and Pakistan's relative position in the world. This identification should enable us to explore how ICT-related goods could boost Pakistan's overall exports and promote economic growth.

ICT Classification of Goods: According to the OECD definition, all ICT goods, as identified in the Harmonised System (HS) of coding scheme, are classified into five categories [See Appendix A of Aalbers, Mulder, and Poort (2005) for details]. These five categories pertaining to Chapters 84, 85, and 90 of Customs Tariff are:

- Telecommunications Equipment;
- Computer and Related Equipment;
- Electronic Components;
- Audio and Video Equipment; and
- Other ICT Goods.

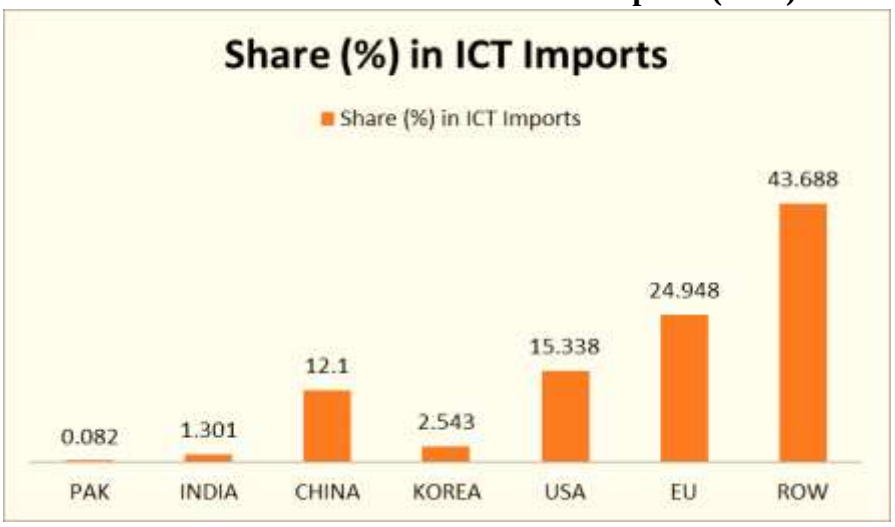
Using UN Comtrade data on international ICT related trade flows, relative shares of exports and imports of major trading entities, including the US, China, the European Union (EU, South Korea, and the rest of the world (ROW) are calculated. The trade flows originating and destined for Pakistan and India have also been included separately to understand their relative position. This exercise has been carried out for data for most recent years, i.e., 2012, 2013 and 2014. Based on these shares, the first observation that can be made is that there is not much difference in relative shares of these entities in ICT exports these three years. Hence to avoid repetition, data for 2014 are presented in Figures 8 and 9. It is clear that China is the world leader in exporting ICT goods (26%). It is followed by the EU (24.7%) and other countries, including ROW. In comparison to this, Pakistan has only a negligible share of ICT related exports of goods in the world, its share being only 0.004%. On the other hand, while the EU – the union of 27 countries, imports bulk of the ICT related goods (24.9%), this is

[8] For exports of services see Nasir (2012) and Nasir and Kalirajan (2014).

followed by the USA (15.3%) and China (12.1%). It may be added that the largest share of ICT imports of nearly 44% goes to ROW that constitutes a group of most of the emerging and industrialized economies. Unfortunately, Pakistan's economy has limited capacity to absorb ICT related goods, which is critical for future growth prospects.

Figure-8
Pakistan's Relative Position on ICT Exports (2014)
Source: Based on Appendix Table 1A

Figure-9
Pakistan's Relative Position on ICT Imports (2014)



Source: Based on Appendix Table1A

Further analysis of five categories of ICT goods is equally revealing. Further distribution of major export items within the five categories of ICT goods shows that nearly 68 per cent share of ICT goods comes from 20 commodities. The names of these commodities along with HS Codes and export shares for year 2014 are presented as follows:

Telecommunication Equipment

HS Code	Commodity Name	Share (%) in 2014 within Category
852910	Aerials and aerial reflectors	25.0
854420	Co-axil cables and co-axil conductors	23.8
854470	Optical fibre cable	23.3
851711	Telephone sets (cordless)	9.2
853310	Electronic resistors	2.0
Sum of Share of Five Major Commodities		83.3

Computer Related Equipment

847130	Portable digital computers	33.5
847330	Parts and accessories of automatic data processing machines	25.5
847170	Computer data storage units	15.2
847150	Digital processing units	10.6
847149	Digital processing units, nes	4.5
Sum of Share of Five Major Commodities		89.3

Electronic Components

854140	Photosensitive semiconductor device, photovoltaic cells and light emitting diodes (LED)	19.5
852990	Parts suitable for use in commodities under headings 85.25 to 85.28	18.9
853400	Printed circuits	17.0
853224	Electrical capacitors, fixed …	4.2
854110	Diodes other than LED	5.0
Sum of Share of Five Major Commodities		64.6

Audio and Video Equipment

851830	Headphones and earphones etc.	15.8
855721	Radio receivers …	15.1
852190	Video recording and reproducing equipment	14.1
851822	Multiple loudspeakers …	10.2
852290	Parts and accessories of items used in headings 85.19 to 85.21	9.0
Sum of Share of Five Major Comodities		64.2

Other ICT Goods

903289	Automatic regulating and controlling equipment	11.2
903180	Measuring or checking instruments … nes	10.3
852691	Radio navigational aid apparatus	5.9
902780	Instruments and apparatus for physical and chemical analysis	5.5
901819	Electro diagnostic apparatus nes	5.5
Sum of Share of Five Major Commodities		38.4

Source: UN Comtrade Dataset.

Pakistan's share of exports of telecommunication equipment to the world is only 0.06%; for computer related equipment, it is 0.01%; for electronic components, 0.01%; zero per cent for audio and video equipment; and for other ICT goods it is 0.39%. This state of affairs is hardly satisfactory to promote non-traditional exports and create employment opportunities and accelerate the growth process in the country.

Concluding Observations

Of US$18.7 trillion worth of exports (and imports) in 2014, the value of export of ICT related goods was US$1.07 trillion [UN Comtrade]. The worth of Pakistan's exports in 2014 was US $ 24.7 billion out of which ICT related exports were valued at US $ 26.4 million.[9] Even though the share of ICT related goods in total exports in the world was 5.7%, but for China it was 13.3% followed by South Korea (6.2%) and USA (6.1%). On the other hand, Pakistan's share was only 0.11%. Given that there is significant demand for ICT related goods in the world, countries that have invested heavily in nascent industry of ICT are reaping extraordinary rewards. How

[9] The difference in terms of trillion, billion, and million US $ should be quite obvious to the reader.

Pakistan can benefit from this opportunity should not be too difficult to comprehend. To put it in simple words, it has to be realised at the highest level that transition from traditional to a knowledge-based economy is not possible unless there is investment in factors, promoting growth such as accumulation of physical and human capital, technological progress stemming from increased specialisation of labour and discoveries of new goods and methods of production, especially the ICT related commodities, and population control. In order to achieve these objectives, the mindset that stabilisation first and then growth has to give way to alternative thinking. The policy of slashing development expenditure to reduce budgetary deficit has to be revisited. Non-productive expenditures should be reduced. Finally, to motivate private sector to invest in ICT based technologically advanced industries, a system of incentives and market power will have to be devised along with an appropriate level of regulatory mechanism to defeat rent seeking and extortion.■

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Appendix Table 1A: Total and ICT Goods Trade in the World

Country/ Region	Year	Total Trade (US $ Thousand)	Total ICT Trade (US $ Thousand) (Enlisted Codes)	Percentage Share of ICT in Total (%)
World Exports	**2012**	**18,199,256,134**	**1,028,684,617**	**5.65**
	2013	18,609,806,536	1,018,818,158	5.47
	2014	18,682,444,395	1,059,519,207	5.67
Pakistan's exports to the world	2012	24,613,676	11,265	0.05
	2013	25,120,883	20,123	0.08
	2014	24,722,182	26,364	0.11
Pakistan's imports from the world	2012	43,813,262	596,529	1.36
	2013	43,775,183	601,534	1.37
	2014	47,544,889	899,869	1.89
India's exports to the world	2012	289,564,769	2,106,489	0.73
	2013	336,611,389	2,548,338	0.76
	2014	317,544,642	2,340,296	0.74
India's imports from the world	2012	488,976,378	13,748,413	2.81
	2013	466,045,567	13,821,607	2.97
	2014	459,369,464	13,460,024	2.93
China's exports to the world	2012	2,048,782,200	299,412,931	14.61
	2013	2,209,007,280	301,958,864	13.67
	2014	2,342,807,785	311,552,979	13.30

China's imports from the world	2012	1,818,199,200	144,923,807	7.97
	2013	1,949,992,315	146,696,620	7.52
	2014	1,962,085,985	150,713,549	7.68
South Korea's exports to the world	2012	547,854,448	31,660,657	5.78
	2013	559,618,559	35,327,312	6.31
	2014	573,091,134	35,297,166	6.16
South Korea's imports from the world	2012	519,575,597	25,299,484	4.87
	2013	515,572,970	25,246,436	4.90
	2014	525,563,837	25,620,674	4.87
USA's exports to the world	2012	1,545,565,186	99,473,934	6.44
	2013	1,578,001,362	98,840,508	6.26
	2014	1,622,657,461	99,691,972	6.14
USA's imports from the world	2012	2,333,805,233	165,467,594	7.09
	2013	2,328,328,633	162,308,201	6.97
	2014	2,408,098,712	167,196,172	6.94
EU (27)'s exports to the world	2012	5,774,461,125	235,773,318	4.08
	2013	6,047,083,450	230,894,921	3.82
	2014	6,121,028,542	238,873,370	3.90
EU (27)'s imports from the world	2012	5,809,610,910	273,984,888	4.72
	2013	5,863,633,642	261,264,120	4.46
	2014	5,959,504,857	270,562,135	4.54

Source: UN Comtrade dataset.

CHAPTER 4

Capacity Building of Human Resource and Services Sector: Improving Education and Technical Skills, Using Innovation and ICT

Dr. Vaqar Ahmed

Pakistan's services economy now accounts for 59 per cent of national income and is host to several large, medium and small sub-sectors. It is, therefore, important to view capacity building through a sector-specific lens, and have a tailored strategy for each service sub-sector's labour supply needs. This study aims at providing an analysis of public sector services. This is not a comprehensive research-based analysis rather a synthesis of current thinking on this subject. We rely mostly upon the recently produced analyses by various government departments, development partners and academia.

Across the discourse on public sector's capacity-building programmes, there is a near consensus that availability of funding has never been a binding constraint to improve public sector human resource. Ahmed (2015) explains that repeated capacity building programmes in the public sector, without comprehensive civil service and accountability reforms, have resulted in several Millennium Development Goals (MDGs) being missed.

The country continues to maintain high public investment in higher education–relative to the countries in the region except China and India. However, there is some criticism on this model as the educated people with advanced degrees have been gradually moving abroad due to low economic growth and job opportunities inside Pakistan. The 'brain circulation' argument has also not benefitted the local economy as there is limited benefit (to local sources of economic growth – capital and skilled labour) of the human capital leaving the country. Khan and Ahmed (2015) demonstrate using a long term econometric analysis that migration has had negative or no relationship with capital stock and literacy rates respectively. In fact, capital stock has been found to deteriorate with higher levels of emigration.

Contrary to higher education, Pakistan has one of the lowest investments in vocational training and even little in innovation and ICT based capacity-building. Even these low levels of investment are prone to downward reduction as Pakistan is exposed to shocks originating from

global financial crisis, low demand in advanced economies, and natural disasters (see Ahmed and O' Donoghue 2010).

It is important to link capacity building reforms with key pillars under Human Resource Development (HRD). HRD is certainly not limited to education (see key education indicators in Table 1) or skills development. The state of nutrition and health has a large role to play in how humans will respond to future socio-economic and environmental challenges. The Planning Commission's Vision 2025 document informs that 60 per cent of the population is food-insecure. In 2014, Pakistan's score on Global Hunger Index was 19.3 which is below the alarming levels of this index. The high malnutrition rates are contributing to 44.5 per cent stunting and 15.1 per cent wasting. The recent literature on Pakistan has termed food insecurity as a non-traditional security threat (Suleri 2010).

Table-1
Pakistan - Key Education Indicators

Indicators	Year - 2013
Government expenditure per student, secondary (per cent of GDP per capita)	10.4
Government expenditure per student, tertiary (per cent of GDP per capita)	75.2
Government expenditure on education, total (per cent of government expenditure)	11.6
Government expenditure on education, total (per cent of GDP)	2.5
Current education expenditure, secondary (per cent of total expenditure in secondary public institutions)	99.6
Current education expenditure, tertiary (per cent of total expenditure in tertiary public institutions)	71.5
Current education expenditure, total (per cent of total expenditure in public institutions)	75.4
Literacy rate, youth female (per cent of females ages 15-24)	64.5
Literacy rate, youth male (per cent of males ages 15-24)	80.3
Literacy rate, youth total (per cent of people aged 15-24)	72.6

Literacy rate, adult female (per cent of females ages 15 and above)	43.1
Literacy rate, adult male (per cent of males ages 15 and above)	69.9
Literacy rate, adult total (per cent of people ages 15 and above)	56.8
Primary school starting age (years)	5
Primary completion rate, female (per cent of relevant age group)	67.1
Primary completion rate, male (per cent of relevant age group)	78.6
Primary completion rate, total (per cent of relevant age group)	73.1
Primary education, duration (years)	5
Children out of school, primary	5544789
School enrolment, tertiary (per cent gross)	9.8

Source: World Development Indicators 2015

The high infant mortality rate and recurring instances of polio in Pakistan also point towards the need for more effective health policies that can guarantee a healthier labour force in future. Ahmed et al. (2014) showed that the expanded programme for immunisation in Pakistan suffers (at federal level) from: lack of long-term health policy and planning, minimum service delivery standards, and timely releases of funds and inventories. At the provincial and lower levels of administration, issues such as: low staff motivation, distorted incentive structure of the staff, lack of monitoring and evaluation of outputs and outcomes contribute towards low return to public investment on immunisation activities.

The donor-funded projects on capacity building have until now taken a myopic view of the current challenges. For example the World Bank-funded programme on Public Sector Capacity Building Project in Pakistan (2004-09) was aimed at improving the government's capacity to implement its on-going economic reforms. Three distinct capacity building objectives were laid out, which included: a) professional training of officials in public sector, b) capacity enhancement in key ministries and departments; and c) strengthening of regulatory bodies in Pakistan. The main criticism on such programmes is that they do not address the issues related to: a) certainty of tenure after a civil servant has received training; b) incentives for post-training retention in the service.

While the government has a policy package for agriculture and select

industries e.g. textile, the services sector is unable to secure such fiscal incentives. This partially explains low levels of Pakistani export of services. On improving the supply side of services, what may be a framework towards capacity building in services sub-sectors is discussed below.

First, ministries dealing with key services sectors, namely transport, communications, domestic commerce, infrastructure development services, banking, finance and insurance, will need to formulate long term policy vision for these sectors. Such vision should be based on least possible regulatory role of the government, where private sector should remain the engine of growth for the services sector. A clear fiscal policy system should be promised for the long term productivity, labour market and export development under these sectors. In this regard, it is important for the government to have a clear understanding of the entire 'supply chain of capacity building'. The Malaysian model of brining 'knowledge to practice' provides important insights.

Several of the above mentioned services sub-sectors also require policy at provincial level. For this, relevant departments in the provincial governments need to carry out a clear assessment of irritants which lead to higher cost of doing business in services economy. The identified factors should be addressed expediently by the government. In order to attract new investment for capacity building in these sectors, particularly foreign investment, the provincial governments will need to transform the boards of investment into entities capable of globally marketing the Pakistani brands.

Second, there are cases of market failure when it comes to providing capacity-building services. This implies that government should continue to be the driver of human resource development and continue expanding the skilled labour pool for key exporting industries of Pakistan. However, in the past, the government has not adapted its supply of capacity-building and skills training to changing market demand. It is therefore proposed that all training initiatives—even vocational trainings—should have a role for the private sector. The public-private partnership in skill-building can ensure funding for such initiatives and also provide latest market information. The current public sector initiatives under Technology Upgradation and Skill Development Company, National Vocation and Technical Training Commission, and provincial programmes such as Technical Education & Vocational Training Authority, need to work in close collaboration to increase economies of scale in their service delivery.

The provision of vocational training through ICT tools has proven to be more cost and time effective for both the provider of training and the learning community. The success of online web portals such as *coursera*, shows the appetite among working class to upgrade their skills base. There is a huge demand for such portals if provided in local languages.

Third, social accountability programmes need to be scaled up to provide timely feedback to public sector education, health, water and sanitation service providers. Social and community mobilisation is an important innovation in the prudent and cost-efficient accountability. Communities, for instance, through well-functioning parent-teachers committees, can demand improved education facilities in their vicinity. Hoffmann (2014) provides examples of social accountability practices at grass roots level to improve social sector outcomes. The ICT tools that provide easy access to output and outcomes based data have also increased the efficiency of supply and demand side accountability measures (e.g. Pakistan data portal).[10]

Fourth, a parliamentary supervision and ownership of a national capacity-building effort is essential. We propose a Parliamentarian Caucus for Human Resource Development in Pakistan, which should have the mandate to: a) demand information from the government, related to spending on capacity-building for uplifting the services sector, b) protect allocation for services sectors in particular education, skills development and health, and c) monitor outcome-based indicators on capacity building annually.

Fifth, there are pockets of knowledge-based economies, slowly emerging in the various parts of Pakistan. These successful experiments need to be diffused across the country through government support. The private sector's success of export-oriented industries in Sialkot has given rise to several services in the district and the vicinity. The rise of Institute of Business Administration in Sukkur has allowed businesses to move in to this district and find easy availability of business graduates and incubation services. The University of Agriculture, Faisalabad, has given the entire province new ways to approach agricultural extension services. The university now advises government on important policy matters including regional trade and value chain development in agriculture. There are examples where local business community has also contributed to the capacity building of skilled and semi-skilled labour in the conflict-ridden areas of Pakistan (Khan and Ahmed 2014).

Finally, low cost initiatives to link Pakistan's labour market in services sector with foreign initiatives can be helped through the large diaspora abroad. Pakistani experts are leading engineering and medical services initiatives abroad. A directory of such experts should be regularly updated at the Ministry of Overseas Pakistanis and HRD. This directory should also be available to the private sector, for business-led initiatives in capacity-building.■

[10] www.data.org.pk

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CHAPTER 5

Revolutionising Agriculture in Pakistan by Increasing the Use of Knowledge, Science and Technology and ICT

Dr. Umar Farooq

Abstract

Agriculture was and shall remain a vital sector for Pakistan's economy for broad-based national development, food security, supporting manufacturing sector, and increased products based export earnings. Growing urbanisation, changing consumption patterns, rising per capita income and globalisation has further increased the scope of agriculture. However, it has major challenge of enhancing production in a situation of dwindling natural resource base and climate change. The growing demand for agricultural products, particularly high quality/value farm products, also offers opportunities for producers to sustain and improve the livelihoods of rural communities. On the other hand, the process of agricultural development, which began with Green Revolution seed-fertiliser-water technology package, is now over. Now, farming has become more scientific and knowledge-based application of agricultural inputs, better handling of harvested output, opting for improved marketing channels and value chains options are required. The farmers' dependence on purchased inputs and farm machinery services for the crop and livestock production has also considerably increased. In future, marginal farmers (owning upto 5 acres) in particular and small farmers (owning upto 12.5 acres) in general shall gradually transform into part-time or absentee landlord type of farming by almost fully relying upon inter-connectivity with different stakeholders. Therefore, intensive use of knowledge, science, technology and ICT is the reality of future farming in Pakistan.

Information and communication have always mattered in agriculture. Ever since people have grown crops, raised livestock and caught fish, they have sought information from one another. Now access to scientific and technical knowledge is necessary at pre-field, field and post-field stages of technology generation, dissemination and output handling till it reaches in the hands of ultimate national/international consumers. The ICT revolution of

Pakistan can be used for the development of agriculture sector as the entire world is a global village. With more than 116 million CNIC-verified mobile subscribers, teledensity of 64 lines/100-persons, fast penetration of broadband technology now provided sufficient base for using these options in the development of Pakistan's agricultural sector. Though the task is not as easy as it looks so, but it is not impossible. Various suggestions are put forward: increased funding to agricultural R&D and more involvement of private sector; creation of discipline and product-based centers of excellence for the generation of information; reverse engineering; development of web/mobile based AKIS/AKST systems; implementing grades and standardisation in agri-business; and training of different farmers and other stakeholders in utilising smart phones and internet. It is also suggested to replicate Telenor Pakistan model in Khyber Pakhtunkhwa with due modifications/ adaptations/lessons learnt from similar attempts made in Africa.

Key Words: Science and Technology, AKIS/AKST system, ICT, Teledensity, Broadband Penetration

Introduction

Pakistan sized 79.6 million km^2, is the custodian of nearly 192 million people as the world's 6th most populated nation. The uncompromising primary responsibility of Pakistan's agriculture sector is to provide healthy, safe and nutritious food and fiber to the growing population, feed and fodder to the livestock, and generate modest export surpluses[1]. For this, increased agricultural production and higher crop yields are essential besides making the production systems less vulnerable to climate change. Therefore, agriculture has special importance for Pakistan's economy, which at present is contributing nearly 21% to national GDP, generating employment opportunities for 44% of the country's labour force and valuable foreign exchange for the country (Government of Pakistan, 2015). It also supports manufacturing[2] and services sectors of the economy by

[1] From exports side, valuable foreign exchange is earned by exporting cotton, yarn, textile goods; rice, vegetables, fruits and processed foods. On imports side, we do import a number of items like edible oil, pulses, milk powder, etc.

[2] For instance, it provides cotton to ginning and textile sector; sugarcane to sugar mills; wheat to flour mills; maize, soybean and other grains to poultry and feed industries; fruits and vegetables to processing industries; and wood to furniture

providing backward-forward linkages in inputs-outputs markets and largest consumer of household durables. Therefore, our agriculture sector can be regarded as a source of numerous economic activities in the country.

Over time, the role of agriculture from mere production enhancement for achieving high national growth targets has now shifted to ensuring food and nutritional security of the countrymen (Byerlee, *et al*., 2009). Managing food and fiber security in future is more challenging and demanding than it has been in the past, keeping in view the quantity and quality of land, water and human labour[3] available. Fortunately, at present, the prime focus of the government is on promoting high value agriculture (i.e. production of horticultural crops and animal-based products) through agricultural diversification. High value agriculture has remarkable potential in Pakistan as it offers more livelihood prospects in their value chains than conventional major crops not only due to its high value but also due to more market integration, product development and product diversification, employment generation, rural industrialisation and poverty alleviation implications. Concerted efforts have been poured in to improve farm level practices and to develop farmers' linkages with market and industry based on new technologies, ideals and future pathways for sustainable growth of agro-industry (Government of Pakistan, 2015).

On the other hand, for decades and even today, agricultural science has focused on boosting production by developing new technologies. The benefits of productivity gains have been harvested by the society at lower food and fiber prices and relative more benefitted the consumers and large farmers than the resource-poor small farmers. Today's agriculture faces issues like unsustainable use of natural resources, impacts of climate change, loss of biodiversity, water availability, global warming, malnutrition and rural poverty. This calls for judicious and wise use of our agricultural resource base for achieving increased productivity on sustainable basis. It is high time to fundamentally rethink the role of agricultural knowledge, science and technology in achieving equitable development and sustainability.

Today's world is also quite different from the world of few decades ago. Now world clearly recognises the importance of knowledge and considers knowledge as an intrinsic part of the economic system and one of the key factors determining the ultimate competitiveness of a country or region or production sector in this global village of today (Khan *et al*.,

manufacturers.

[3] Particularly the declining interest of today's youth to stay in agriculture for economic and social reasons as well as sustainability of their livelihood in farming, its services sectors and as service providers to other farmers.

2007). According to the Guardian's Global Development Professionals Network, six innovations, namely dairy hubs[4], fertiliser deep placement (FDP[5]), mobile apps[6], high roofed green houses[7], new feeding systems for livestock[8], and farm management softwares and training have revolutionised farming in the world. In order to benefit from the new developments in agricultural sciences and technologies, adoption of new production patterns and practices in all agricultural research, development and production systems should be knowledge-based; it should be aimed at educating the farmers for better understanding of plant physiologies, agro-ecologies, climatic changes and site specific resilience strategies, etc. Increasing access to information and technologies to farmers can contribute towards a pro-poor agricultural development. Therefore, the generation of knowledge greatly matters on the one hand (through investment in science, research, technology and innovation); while its authenticity, relevance and dissemination to the target audience at the right time and consequent application in decision making are equally major concerns, on the other hand. In other words, seeking the relevant information out of bombardment of information is also equally important as information generation itself is. The ICT can also play an effective role in rural poverty alleviation, though not guaranteed (as literature shows).

Therefore, prime objective of this paper is to examine how Pakistan's agriculture sector can be revolutionised through increased use of knowledge, science, technologies including Information and Communication Technologies. This paper is divided into nine sections. Section-2 describes the changing farming profile of Pakistan's agriculture and its implications for more and effective access to information and the ICT tools. Section-3 describes the future food security challenges of

[4] In Bangladesh and Pakistan

[5] FDP is used by farmers across Burkina Faso, Niger and Nigeria.

[6] A mobile app called VetAfrica, developed by a software company called Cojengo has enabled animal health workers and famers to accurately diagnose livestock illness and find the most effective drugs to treat the disease. With over 100 million farmers spread across thousands of square miles in east Africa, the developers predict massive growth of mobile and cloud tech solutions in African markets. Another innovative app is "farming instructor" which provides online and offline agricultural information to rural farmers and their communities.

[7] Because of government restrictions, farmers in Turkmenistan often do not have access to large areas of land. Green houses are great ways to increase production, although traditional greenhouses can only grow short tomato and cucumber plants.

[8] That is blending the important nutrients with the conventional feeds and fodders to make sure all animal's nutrient requirements are met. In Pakistan, Urea Mineral Molasses Blocks (UMMBs) and supplemental mixtures are available to feed the animals.

Pakistan. Key challenges to Pakistan agriculture are covered in Section-4. Section-5 describes the sources of agriculture sector development in Pakistan. Section-6 delineates the role of using knowledge, science, technology and ICT in agriculture. How the telecom sector in Pakistan is revolutionised is covered in section 7. Section-8 covers the developmental role of ICT by taking empirics from the world. Section-9 discusses the way forward of how agriculture sector of Pakistan can be revolutionised by using knowledge, science, technology and ICT.

Changing Farming Profile of Agriculture in Pakistan

In the past 65 years, the country's population has increased by about six-folds. Punjab was and remained the most populated province followed by Sindh, Khyber Pakhtunkhwa and Balochistan and their status might not change in future also. It is also anticipated that by 2020, the country population shall be above 212 million, 253 million by 2030, nearly 298 million by 2040 and 350 million by 2050. In other words, the country population shall increase by 82% till 2050 when compared with today's population level of 192 million (Farooq, 2015a).

Regarding rural-urban population composition, considerable changes have been noticed in the past and same shall continue in future also. For instance, during early 1950s, nearly 6 million of the country's population was living in the cities, which is now increased to about 70 million, i.e. an increase of absolute urban population by more than 11 times. Moreover, from 2015 to 2050, the absolute urban population shall increase by 142%. It is anticipated that by 2050, the rural-urban population ratio in Pakistan shall be 52:48 (Farooq, 2015a).

On the contrary, in the last four agricultural censuses, the absolute number of farm households has been more than doubled whereas the average farm size in Pakistan has been halved (i.e. from 13.04 acres/farm to 6.40 acres/farm). It is also anticipated that this population shall further increase by 58% between 2010 and 2050. The low per cent increase in total farm households' population is primarily because potential number of households leaving farming, due to extremely low farm size, shall be relatively high compared to the households staying in farming. As a result, by 2050, the average farm size in Pakistan shall further decline to 4.72 acres/farm. Hence, between 2010 and 2050, the average farm size of Pakistan shall decline by 26% (Farooq, 2015a).

A positive association between average family size farming households and the average farm size prevails in all agricultural censuses of Pakistan. The average family size per farming household has also been increased from 6.59 persons in 1970 to 7.77 persons in 2010 census. By

2050, the average family size shall decline to 7.16 persons/ household. On the other hand, in the past four decades, the farm size composition has been considerably changed in the country. For instance, the marginal sized (upto 5 acres) farming community was just 1 million during 1970, which is increased to more than 5 million in 2010 and it shall further rise to 8.5 by 2050 (or almost equal to the total farm households' population in Agriculture Census, 2010) (Farooq, 2015a).

In 1970, the small sized (less than 5 to 12.5 acres) farming households' population was 1.5 million, which has increased to more than 2 million in 2010 and shall further surge to 3.2 million by 2050. About medium sized (less than 12.5 to 25 acres) farms, their population has declined to 0.56 million in 2010 from 0.8 million during 1970; however, it shall increase to 0.88 million by 2050. This shall be because of more households entering into this bracket from upper groups due to inheritance division of agricultural lands. In large sized (less than 25 to 50 acres) farming households, their total population was 0.29 million in 1970, which has fallen to 0.21 million in 2010, but shall increase to 0.34 million by 2050. In landlords' category (less than 50 acres), their total population was 0.12 million in 1970, which has increased to 0.09 million in 2010, but their population is anticipated to escalate to 0.16 million by 2050[9]. In summary, from 2010 to 2050, marginal sized farm households' population shall increase by 58%, small sized households by 56%, medium sized farm households by 61%, large sized farm households by 68%, and landlords by 58%. It is also worth noting that in future there shall not be any major change in the composition of farming population by farm size groups (Farooq, 2015a).

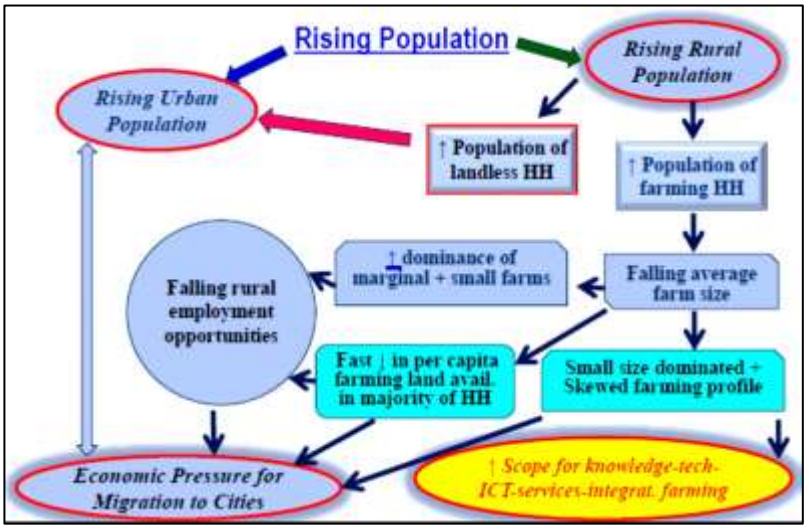
Over time, decline in the farm size coupled with rising family size of farming household has resulted in decline in per capita availability of agricultural lands. For instance, per capita availability of agricultural land declined from 1.98 acres/person in 1970 to 0.82 acres/person in 2010 and further to 0.66 acres/person by 2050. Across farm size groups, on marginal farms, the per capita land availability was 0.42 acres/person in 1970, which has fallen to 0.26 acres in 2010, which shall sustain till 2050. In small farming households, the per capita land availability has declined from 1.29 acres/ person in 1970 to 0.93 acres in 2010, and shall further fall down to 0.79 acres/person by 2050. On medium sized farms, the per capita land availability has declined from 2.29 acres/person in 1970 to 1.85 acres in

[9] The underlying reason of increasing large and landlords' category of population might be attributed to factors like: a) division of their own lands; b) purchasing of lands from marginal class intended to leave farming business; c) buying of larger parcels lands by farmers of peri-urban areas in deep rural areas after selling their lands came under housing due to urban expansions.

2010, which shall further shrink to 1.33 acres in 2050. In large farms' category, the average per capita land availability has reduced from 4.12 acres/persons in 1970 to 3.25 acres by 2010, which shall further reduce to 2.17 acres/person by 2050. In landlord type farming households, the per capita land availability has fallen down from 11.66 acres/person in 1970 to 12.12 acres in 2010, and further to 7.56 acres/person by 2050 (Farooq, 2015a).

The mechanism of all the above described changes in the farming profile dominated by small sized farming is depicted in Figure-1 below. This also implies that staying of marginal farmers in farming on full-time basis in particular and small farmers in general shall be gradually difficult in future. However, there is a considerable scope for them if they operate their farms by using modern inputs and allied technical knowhow (i.e. about quantities and application times) by using modern Information and Communication Technology gadgets, on full or part-time basis (Figure-1).

Figure-1
Changing Farming Profile of Pakistan's Agriculture



In summary, considerable changes in the farming households' profile of Pakistan agriculture have taken place in the past six decades and the process shall continue in future. It is anticipated that gradually, the average farm size shall not only decline, size-based polarization in farming community shall also take place. As a result, the marginal and small sized farming households would become dependent on inputs market for purchased inputs (seed, fertilizer, pesticides) and on large/landlord farmers

for farm machinery services for the seedbed preparation, harvesting/threshing and transportation operations. In future, this spectrum of dependence shall further expand to service providers for operations like nursery and its transplantation, certified nursery of fruits, orchards' pruning, value addition and other agri-business activities. Carrying out such activities requires integration of updated scientific knowledge, efficient technology transfer mechanism, improved connectivity of all stakeholders through ICT tools and gadgets.

Future Food Security Challenges

Food security is the primary concern of almost every developing country of the world including Pakistan. Adequate nourishment in terms of quantity and quality is necessary for sustaining healthy life. Therefore, the availability and accessibility to food is important from the nutrition perspective. However, enough availability of food at macro level does not guarantee that everybody has fair access and share of food, or everyone has an adequate diet. Further, affordable food prices and adequate purchasing power of the people is also equally important (Singh, undated). Pakistan has made significant progress in increasing the per capita availability of all major food items, such as cereals, meats, milk, sugar, etc. over time. At present, per capita calorie intake in Pakistan has been differently reported like 2260 kcal/day in 2014 (Malik, *et al*., 2014); 2412 kcal/day in 2008 (Arifullah, *et al*., 2008); and 1951 to 1908 based on HIES consumption data estimates for the years 2010-11 and 2011-12, respectively.

Nonetheless, changes in dietary patterns in every society are a regular phenomenon and are influenced by many factors and their complex interactions. These include, changes in per capita income, prices, age-based differences, individual preferences and beliefs, cultural traditions, urbanisation, social, environmental, improvements in rural-urban development infrastructure and connectivity, developments in food processing and preservation technologies and penetration of new foods in the developing countries due to proliferation of multinational food chains under globalisation of consumption[10].

About future food demands, it is estimated that nearly 60 million tons of food were annually needed in 2010 and this demand shall increase to 116.41 million tons by 2050. Across food groups, quantitatively wheat/flour is the most demanded product followed by milk, vegetables, other cereals,

[10] For instance the use of various non-traditional foods like pasta items, fast foods (burger, and salads), juices, and biscuits is fast popularising in Pakistan, both in rural and urban societies.

rice, fruits, oils and fats, meats and pulses. This pattern shall grossly remain the same in the next four decades, except reducing the position of rice to little lower levels. In terms of quantity, the wheat demand shall increase from 19.19 million tons in 2010 to 37.5 million tons in 2050; rice from 2.83 million tons to 5.05 million tons, other cereals[11] from 4.12 million tons to 9.12 million tons, pulses from 0.96 million tons to 1.72 million tons, liquid and powder milk[12] from 15.44 million tons to 27.10 million tons, oils and fats from 1.93 million tons to 4.40 million tons, meats from 1.59 million tons to 3.45 million tons, fruits from 2.45 million tons to 5.95 million tons, vegetables (excluding potato) from 6.64 million tons to 14.39 million tons and miscellaneous food items[13] from 3.75 million tons to 7.76 million tons. It means, between 2010 and 2050, wheat demand shall rise by 96%, rice by 78%, other cereals by 121%, pulses by 80%, milk by 76%, oils and fats by 128%, meats by 118%, fruits by 142%, vegetables by 117% and miscellaneous food items by 107%. Comparing the increase in percentage with per cent increase in population (i.e. 82%) during this period revealed that less than proportionate increase shall take place in groups like rice and milk while more than proportionate increase shall take place in food groups like wheat, other cereals, pulses, oils and fats, meats, fruits, vegetables and miscellaneous (Farooq, 2015b).

In order to fulfill rising food demand vis-à-vis the quantity and quality of agricultural resource available today and in future (as more agricultural land shall come under housing) adopting more innovative farming/production, marketing, distribution/processing value addition approaches are needed to cope with the situation. It also highlights the need for R&D support in terms of increased technology generation, methods of post-harvest treatments, processing and preservation of various high value food items etc. An obvious implication is the paradigm shift of farming to more intensive and productive by increased site-specific use of science, technology- based farming, information and ICT tools and gadgets.

Key Challenges to Agriculture in Pakistan

The agriculture sector has received special treatment in all countries at every stage of development due to various reasons like livelihood, food security, large proportion of rural population and political sensitivity, etc.

[11] Other cereals include maize, semolina, flour, vermicelli, noodles, biscuits and other bakery products and potato.

[12] In our estimates, powder milk demand is converted into liquid milk equivalent.

[13] Items included under miscellaneous food group includes sugar/jaggery/brown sugar, jams, jellies, salt, chilies, spices, honey, tea and prepared foods like breakfasts/lunches/dinners/refreshments etc.

The importance of agriculture sector in Pakistan's economy is also a well-documented fact. Pakistan is bestowed with diverse ecologies and different seasons that besides producing five major crops, provide base for the production of more than 30 fruits and the same number of vegetables throughout the country. According to FAOSTAT, 2013, Pakistan enjoys respectable position in the production of many crops like: 2nd in turmeric, 3rd in chick pea and total pulses, 3rd in goat meat, 4th in cotton, buffalo milk and goat milk, 5th in sugarcane, 5th in mango, 6th in dates[14], 8th in wheat[15] production. http://en.wikipedia.org/wiki/List_of_largest_producing_countries_of_agricultural_commodities].

This achievement is quite encouraging when meager resources are allocated for agricultural research as compared to other countries in the region. However, Pakistan has low value addition and less shares in value added export. Moreover, in Pakistan's planning history, agriculture is ignored from time to time and is used only to attract the attention of policy makers when the country has either faced extensive crop failures due to insect/pest/disease attacks or food production falls short of demand.

Agriculture in Pakistan is facing a number of challenges, which are grouped into international level challenges; national level challenges; and, farm/rural household's level challenges.

From international perspectives, Pakistan's agriculture sector is encountering a number of challenges like: i) fast-changing ways of technological developments (e.g. hybrids); ii) despite respectable status in the production of many commodities, we are losing competitiveness in many exportable crops due to falling international prices, e.g. wheat, basmati rice and cotton; iii) changes in policies of Pakistani-products importing countries; iv) Pakistan's stiff trade competition with India (e.g. for basmati rice, wheat, mango etc.) vis-à-vis ad-hocism in imports from India (e.g. potato, tomato, onion, banana); v) falling international donors' support in agricultural research; and vi) difficult access to technologies available with CGIAR/multinationals. As a result, there is a danger of rising food import bills of many crops like pulses, oil, powder milk, etc.

From national perspective, the challenges of Pakistan agriculture pertain to: i) marginalised treatment meted out to agriculture in policy decision making and resources allocation; ii) very low public spending on agricultural R&D vis-à-vis agricultural R&D – GDP ratio, very low private investment in agricultural R&D; iii) serious policy and implementation gaps between center and provinces; iv) mismatch between technology generation and farmers' needs; v) yield stagnation of almost all major crops; vi) large

[14] http://perfectinsider.com/top-ten-dta-producting-countris-in-the-world/
[15] www.statista.com/statistics/237912/global-top-wheat-producing-countries/

yield gaps across research stations, progressive farmers and ordinary farmers vis-à-vis regularly rising input prices; vii) low yields compared to similar agro-ecologies in the region; viii) unequal land distribution and little impact of subsidy policies; ix) agricultural markets functioning at very low efficiency level due to limited information trafficking among producers, marketing agencies, processors and exporters, etc.; x) primitive styled agricultural extension; xi) climate change, floods, natural disasters; xii) National and Provincial Agricultural Research Systems do not fully address marginal and small farming issues; xiii) looming water, micro-credit, scientists' capacity building issues; xiv) extremely low varietal development research in case of pulses, oilseeds and fodder crops; xv) agricultural value chains progress very slowly. Whatsoever progress is achieved, it lacks small farmers' inclusiveness.

At farm/rural households' level, a number of problems are reported in the literature like: i) limited area available for cultivation; ii) cultivated lands suffering from water logging and salinity; iii) extremely slow adoption of innovative and more efficient water management practices due to cost and operational issues; iv) farm mechanisation is confined to tractorisation; v) land preparation practices mainly revolve around the use of cultivator only; vi) dominance of broadcasting in sowing of many major crops; vii) inadequate supply of quality inputs; viii) harvesting operations are predominantly carried out manually, while mechanical threshing is mainly confined to wheat crop only; ix) post-harvest losses are persistently high and not effectively controlled, particularly in case of fruits and vegetables; x) lack of collateral availability with marginal sized and livestock farming households; xi) inadequate/insufficient amounts of production loans available from commercial banks and ZTBL; xii) high interest rates charged by informal borrowing sources; xiii) rural youth facing problems in earning their livelihood in rural setting in a decent manner.

Sources for Agriculture Sector Development in Pakistan

In order to achieve a reasonable growth in the agriculture sector of Pakistan a number of initiatives need to be taken:

i) Increasing funding to agricultural R&D;
ii) Ensuring early transfer of promising technologies from labs to land;
iii) Promoting agricultural diversification—in high value crops and livestock products—for diversifying production, consumption and exports;
iv) Investing in seed production and distribution system;

v) Providing formal credit to marginal and small farmers at low interest rates;
vi) Promoting recently launched credit guarantee scheme for small farmers by the government;
vii) Transforming marginal farms into input-intensive commercial farms;
viii) Encouraging the establishment of farm machinery service centers for cheaper availability of services of various farm machines;
ix) Providing subsidy on resource conservation technologies, seeds, fertilisers etc.;
x) Ensuring availability of quality inputs at affordable prices on inputs-side and implementation of grading and standardisation on outputs-side;
xi) Increasing use of the state of the art knowledge, techniques and tools for technology development;
xii) Promoting information-sharing among stakeholder using latest ICT tools and gadgets.

For increasing production at the farm level, the use of various inputs like land, water, fertilisers, pesticides, seed, machinery and crop management— knowledge about quantity and application time of various inputs —need to be intensified. However, different constraints are associated with the enhancement of these inputs. For instance, there is a limited scope for increasing cropped area for increased production for reasons like limited supply of fertile lands with narrow scope for investing on marginal lands and land use intensity already high on small farms. Further, there is a limited scope for increasing water availability to increase production due to limited supply of good quality water and expensive water conservation technologies. Moreover, there is a limited scope for increased use of fertilisers, mainly because of very high prices of fertilisers (particularly phosphatic fertiliser) and balanced fertiliser use is also difficult as frequent shortages occur at the application times. In addition, high prices, environmental issues, and limited knowledge about right pesticides and their right application time is also difficult because of lack of farmers' knowledge about effective and efficient plant protection measures. There is limited availability of good quality certified seed at affordable prices. Moreover, certified seed availability is confined to major crops only. Getting certified seeds of fodder, pulses and oilseeds is very cumbersome for farmers. Lastly, the machinery available for carrying out various farm operations relatively more suitable for large farming, whereas the small farmers get their rental services only. Therefore, timely availability of farm machinery services to small farmers is a huge concern for them. Hence, due

to aforementioned reasons, marginal and small farmers mostly end up in poor and inefficient management practices, either due to lack of resources or lack of information. Therefore, perhaps the prime challenge for Pakistan is due recognition of imparting knowledge as a valuable input.

Role of Using Knowledge, Science, Technology and ICT[16] in Agriculture

"Knowledge" is perhaps the simplest of words and yet one of the most cumbersome to explain. This is because of its paradoxically straightforward and simple syntax, but profound vastness in terms of its semantics. The role of knowledge in human life has escalated over millions of humans. Knowledge acquisition is based upon complex cognitive processes like perception, learning, communication, association and reasoning (Siddiqui and Khan, 2007). The role of knowledge has now extended to every sector of life. Therefore, according to Charles Leadbeater, *"the idea of the knowledge-driven economy is not just a description of high-tech industries. It describes a set of new sources of competitive advantage, which can apply to all sectors, all companies and all regions, from agriculture and retailing to software and biotechnology".* Knowledge is different from other goods: it has many of the central properties of domestic public goods rather than global public goods. The government has key role in protecting knowledge property rights. Its role in terms of intellectual property rights is far more complicated as in the knowledge-based economy, the danger of monopolisation is perhaps greater than the industrial economies (Aurangzeb, 2007).

Information sharing has always been an important element in agriculture. As agriculture is now facing new challenges like rising food prices that have caused increased poverty, making effective interventions necessary in agriculture. The growing population shall also increase food demands and place pressure on resources. In rural areas, ICT can raise rural households' income by increasing agricultural productivity and introducing income channels other than traditional jobs (Lio and Liu, 2006). Current evidence from individual farmers and fishermen in India supports the conclusion that ICT can improve incomes, reduce price volatility and provide better quality of life the poor living in rural areas (Jensen, 2007; Mittal, *et al*., 2009; Goyal, 2010). Eggleston *et al*. (2002) show that addition of basic telephony services in rural China reduced price dispersion and

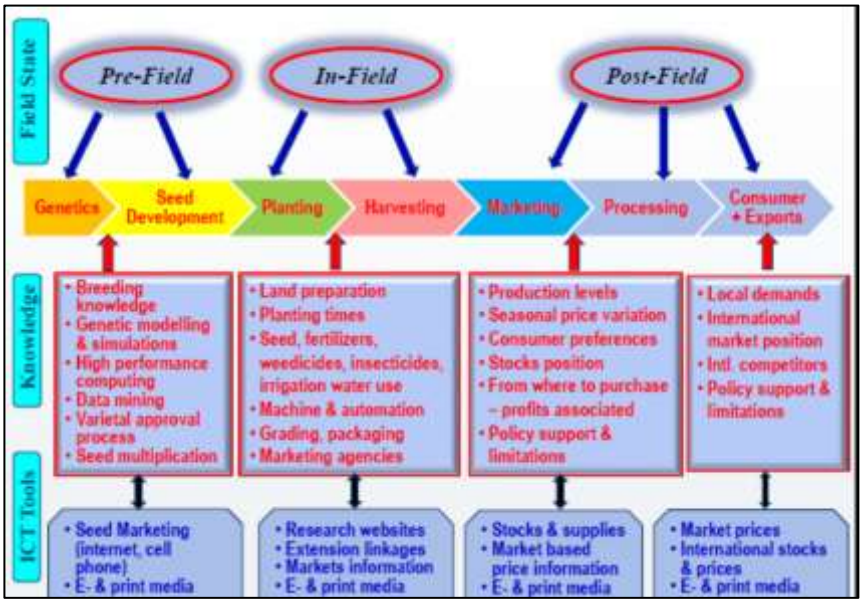
[16] This section is mainly drawn from International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) Global Report 2009 titled "*Agriculture at a Crossroads*".

purchase prices of various commodities. Hirschmann (1967) noticed that a credit market for coffee had developed in Ethiopia after installation of land-distance telephonic network. Many studies on Grameen Phone project in Bangladesh suggest that nearly half of all telephonic calls made through Grameen network were for discussing market prices, employment opportunities and remittances (Richardson *et al*., 2000; Bayes *et al*., 1999).

In agricultural production, marketing and value chains, sound knowledge is needed in the pre-field, field and post-field stages (Figure - 2). At pre-field stage, in-depth scientific knowledge is needed for the generation of technologies (i.e. for seed and breeds development, crop and livestock production technologies). Once the technology is developed, in the laboratories/experiment plots etc., it needs to be transferred at the earliest. Besides the physical transfer of agricultural technologies, knowledge for utilising these technological innovations is equally important. The physical use of developed technologies in their proper manner with due support of relevant knowledge results in improvement in productivity per unit. Then another phase of knowledge starts, i.e. its post-field stage. At this stage, due information about where to sell the produce, how to process the produce to control post-harvest losses and prepare it in a form desired by its ultimate consumers (domestic or international), and how, when and what size/shape it should be presented to the consumer, all require up-to-date knowledge about all its post-field stages. Various information and communication tools can significantly help in acquiring knowledge.

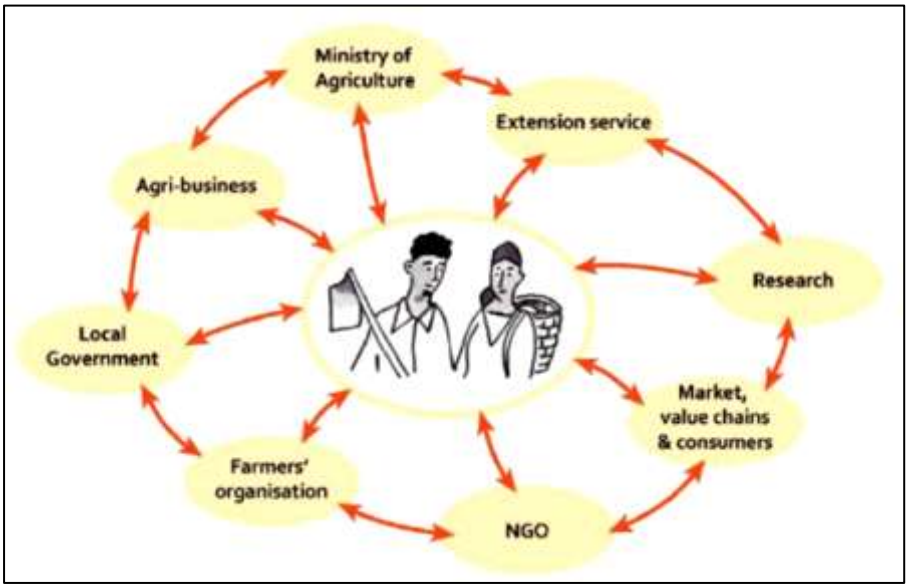
On the other hand, the Green Revolution of 1960s was based on scientific innovations and public determination to increase food production to save humanity from hunger. The National Agricultural Research Systems (NARS) have contributed to agricultural development through technology generation and its transfer to farmers, which has led to their adoption and growth in yield. The technology transfer model, mostly called "linear model for science and technology" have fostered a thinking that agricultural research systems are responsible for generating technologies in physical form which shall be transferred to the farmers through extension system (UNCTAD, 2010). It is also worth mentioning that the challenges at the time of Green Revolution were quite different from the challenges we are facing today. For instance, in case of Pakistan, the per capita availability of water was almost 10 times higher than today. Other challenges are highlighted in section-2 of the paper. Moreover, to make small farmers viable and effective players in the market, it is imperative to ensure their access to inputs; adequate storage capacity; latest market information and extension services; formal markets; clustering and cooperative forms of organisation; and credit (UNCTAD, 2010).

Figure-2
Role of Knowledge and ICT in Agricultural Production, Marketing and Value Chains



Today, this thinking of "linear model for science and technology" has greatly changed. It is now widely recognised that agricultural development in a country greatly depends upon how successfully science-based knowledge is generated and applied. Knowledge-based instruments, which specially focus on the provision of science and technology, have played an emphatic role, in devising strategies that aim at promoting sustainable and equitable agricultural development at national level. The Agricultural Knowledge and Information System (AKIS) framework, which emerged as an alternative to explain the difficulties of NARS framework vis-à-vis agricultural development, is predominantly focused on the importance of agriculture and extension services (Figure - 3). The AKIS framework seeks to integrate the researchers, scientists, cooperatives and extension services in order to generate the kind of knowledge that is crucial for the their improved performance (UNCTAD, 2010). Therefore, generation and dissemination of productive knowledge is now regarded as crucial for modern agriculture.

Figure-3
Inter-stakeholders Connectivity under AKST and AKIS Systems



Source: http://www.agriculturesnetwork.org/resources/learning/mod7-online/learning-block-3/3.4/3.4.2

Agricultural knowledge, science, and technology (AKST) based system pertains to the use of science-based knowledge for the uplift of agricultural and rural economies on sustainable basis towards improved livelihood strategies of farming households. It has certain vital attributes written as under:

i) It clearly recognises the multifunctional role of agriculture;
ii) It also identifies the diverse ranges of farming systems from highly commercialised large-scale systems to small-scale and subsistence systems, though all these are vulnerable to sustainability problems;
iii) It can play a key role in enhancing the quality of natural and human resources as well as access to them;
iv) AKST is also critical for supporting the efforts of the actors— at different levels, ranging from farming household to national and further to global level— in alleviating poverty and hunger as well as improving rural livelihoods and the environment for socially, ecologically and economically equitable and sustainable development;

v) Improved AKST can help in reducing the inevitable tradeoffs between agricultural growth and environmental sustainability at global scale;
vi) Growing pressure on agriculture for food supplies from given natural resources (especially land, water, livestock, fisheries, forests etc.) require more effective planning, new investments[17] and designing new policies;
vii) The AKST recognises the great role of ICT in small-scale farming as their access to valuable information through ICT can contribute in making choices among available production technologies, market for input procurement and output disposal, combining factors of production, selecting optimal combination of various capitals in rural livelihood strategies;
viii) It also recognises the social benefits of involving women at all levels from education to decision-making and work through increased access to AKST and ICT;
ix) Food security strategies require a combination of AKST approaches, including the development of food stock management, effective market intelligence and early warning, monitoring, and distribution systems. The production measures create the conditions for food security, but they need to be looked at in combination with people's access to food (through their own production, exchange and public entitlements) and their ability to absorb nutrients consumed (through adequate access to water and sanitation, adequate nutrition and nutritional information) in order to fully achieve the food security. AKST can increase sustainable agricultural production by expanding the use of local and formal AKST to develop and deploy suitable cultivars adaptable to site-specific conditions; by improving access to resources; by improving soil, water and nutrient management and conservation; by improving pre and post-harvest pest management; and by increasing small-scale farm diversification.

On the other hand, the main challenge of AKST is to increase the productivity of agriculture in a sustainable manner. It must address the needs of small-scale farms in diverse ecosystems and create realistic opportunities for their development where the potential for improved area

[17] In technology generation, technology transfer, changing crop and livestock production systems, food safety measures and regulations, access to markets – particularly of small farmers, etc., mitigating impacts of climate change.

productivity is low and where climate change may have its most adverse consequences. The main challenges for AKST posed by multifunctional agricultural systems include:

i) How to improve social welfare and personal livelihoods in the rural sector and enhance multiplier effects of agriculture?
ii) How to empower marginalised stakeholders to sustain the diversity of agriculture and food systems, including their cultural dimensions?
iii) How to provide safe water, maintain biodiversity, sustain the natural resource base and minimise the adverse impacts of agricultural activities on people and the environment?
iv) How to maintain and enhance environmental and cultural services while increasing sustainable productivity and diversity of food, fiber and biofuel production?
v) How to manage effectively the collaborative generation of knowledge among increasingly heterogeneous contributors and the flow of information among diverse public and private AKST organisational arrangements?
vi) How to link the outputs from marginalised, rain-fed lands into local, national and global markets?

Telecom Revolution in Pakistan

Telecommunication[18] deals with the transmission of information over significant distances to communicate. In earlier times, telecommunications consisted of using visual signals, like, smoke signals, semaphore telegraphs, signal flags and optical heliographs or audio messages via coded drumbeats. Telecommunication also includes the use of electrical devices such as telegraphs, telephones and teleprinters, use of radio and microwave communications, optic fibers and their satellites, and the internet. Today, telecommunication system consists of three different ways of transmitting information, i.e. through cell phones, computers and e-mail.[19] Nowadays, telecommunication services play a key role in the growth of an economy, facilitating efficiency and growth across the wide range of users' industry. The level of telecommunication development is one of the development indicators for an economy and social and cultural development of a country (Khan, undated).

[18] The word telecommunication was adapted from French word telecommunication. The Greek pre-fix *tele-* means "far off", and the Latin *communicare* means "to share".
[19] Before the internet was available, the communications used to be broadcasted.

If we look back into the telecom history of Pakistan, at the time of independence, telecom services were performed by the Pakistan Post and Telegraph (P&T) department. It was first time in 1962, when Ayub Khan Regime decided to split P&T into two separate departments, i.e. Pakistan Post and Pakistan Telephone & Telegraph (PT&T) department. On December 5th 1990, PT&T department was transformed into Pakistan Telecommunication Corporation (PTC); it was formally instituted under Pakistan Telecommunication Corporation (PTC) Act 1991. Pursuing a progressive policy, in 1991, the Government announced its plans to privatise PTCL. In January 1996, Pakistan Telecommunication Company Limited (PTCL) was formally established to undertake the telecommunication business in Pakistan. Under PTCL Re-organisation Act, telecommunication sector was divided into four bodies: Pakistan Telecommunication Company Limited (PTCL),[20] Pakistan Telecommunication Authority (PTA),[21] National Telecommunication Corporation (NTC),[22] and Frequency Allocation Board (FAB)[23].

Despite a long history of telecommunication in Pakistan, until recently, the sector was perhaps never considered important enough for serous investment because it was considered by the policymakers to be a "luxury". Only in the past 10 years, related to the implementation of various reforms, the sector has unshackled its regulatory and policy constraints,

[20] PTCL is the primary provider of telecommunication services in Pakistan. The range of its services includes: basic telephone and telegraph, fax, telex, e-mail, digital cross connect, public data network, internet, ISDN, broadband, IPTV, teleconferencing and other digital facilities.

[21] PTA is a regulatory body responsible for monitoring the telecommunication business in Pakistan. It frames the rules and regulations for private telecom companies like mobile phone companies, internet service providers, paging companies and pay card phone companies. It also issues licenses to the new companies entering into this business.

[22] NTC is responsible to provide the telecommunication services to various departments of government and armed services.

[23] FAB was established under Section 42 of the Pakistan Telecommunication (Re-organization) Act 1996 to take over the functions of the then Pakistan Wireless Board. FAB enjoys exclusive authority to allocate and assign proration of the radio frequency to the Government, providers of telecommunication services and telecommunication system, radio and television broadcasting operations, public and private wireless operators and others. FAB also carry out the task of frequency coordination on satellite systems of Pakistan with various administrations and satellite operators especially the frequency coordination of PAKSAT-1 at 38°E in accordance with Radio Regulations of International Telecommunication Union (ITU). For the protection from new incoming satellites to carry out the analysis of International Frequency Information Circulars (IFIC) of space services published by Radio Communication Bureau of ITU on fortnightly basis (www.fab.gov.pk).

which resulted into telecoms as the fastest growing sector in the country. There are now, above 116 million cell phones and 10 million other phone subscribers in Pakistan (Table 1) making it the 7th largest network in the developing world. The main driver for this rapid growth has been the growth of the mobile phone industry, which began from only 0.3 million subscribers in 1999-2000; it had nearly 140 million subscribers in 2013-14, but due to verification of un-authentic SIMS, the figures of CNIC verified SIMS has gone down to 116 million. This has significantly improved our tele-density over time, and is currently hovering around 64 lines per 100 people; it came down after touching a peak of 80.02 lines/100 in 2013-14 (Figure-4).

Table-1

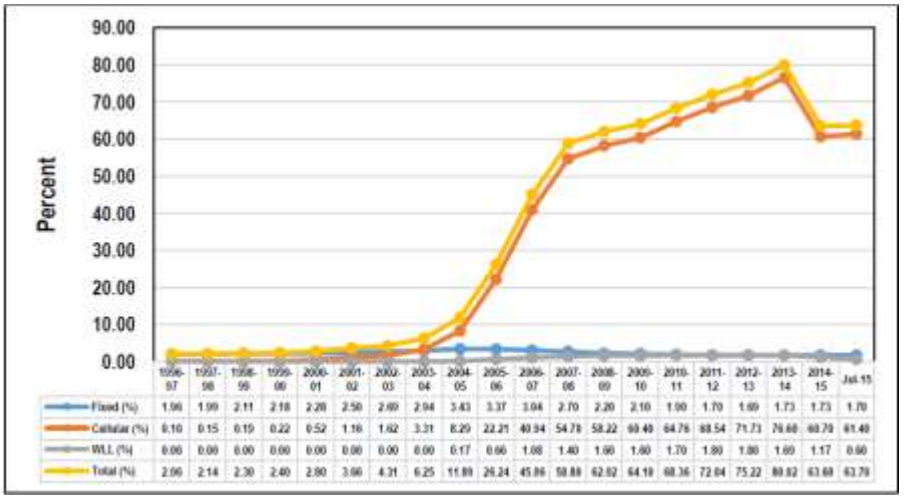
Trends in Phone-subscribing in Pakistan

Years	PCOs	FLL Subscribers	Cell-Subscribers	WLL Subscribers	Broad-Band Subscribers
1995-96	0.000	0.000	0.068	0.000	0.000
1996-97	0.000	0.000	0.135	0.000	0.000
1997-98	0.000	0.000	0.196	0.000	0.000
1998-99	0.000	0.000	0.266	0.000	0.000
1999-00	0.000	0.000	0.306	0.000	0.000
2000-01	0.000	0.000	0.743	0.000	0.000
2001-02	0.000	0.000	1.699	0.000	0.000
2002-03	0.000	0.000	2.404	0.000	0.000
2003-04	0.185	4.501	5.023	0.000	0.000
2004-05	0.279	5.278	12.771	0.265	0.000
2005-06	0.357	5.240	34.507	1.025	0.027
2006-07	0.387	4.806	63.160	1.702	0.045
2007-08	0.449	4.416	88.020	2.240	0.068
2008-09	0.405	3.533	94.342	2.616	0.414
2009-10	0.338	3.418	99.186	2.660	0.901
2010-11	0.314	3.017	108.895	2.728	1.491
2011-12	0.288	2.986	120.151	2.873	2.101
2012-13	0.289	3.024	127.737	3.109	2.722
2013-14	0.145	3.172	139.975	3.108	3.796
2014-15	0.000	0.000	114.658	0.000	16.886
July - 2015	0.000	0.000	116.432	0.000	0.000

FLL = Fixed Local Loop subscribers

WLL = Wireless Local Loop subscribers
Source: Annual Reports of Pakistan Telecommunication Authority, Islamabad.

Figure-4
Trends in Tele-density in Pakistan



	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	Jul-15
Fixed (%)	1.96	1.99	2.11	2.18	2.28	2.50	2.69	2.94	3.43	3.37	3.04	2.70	2.20	2.10	1.90	1.70	1.69	1.73	1.73	1.70
Cellular (%)	0.10	0.15	0.19	0.22	0.52	1.16	1.62	3.31	8.29	22.21	40.94	54.78	58.22	60.49	64.76	68.54	71.73	76.68	60.70	61.40
WLL (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.66	1.08	1.40	1.60	1.60	1.70	1.80	1.80	1.69	1.17	0.90
Total (%)	2.06	2.14	2.30	2.40	2.80	3.66	4.31	6.25	11.89	26.24	45.06	58.88	62.02	64.19	68.36	72.04	75.22	80.02	63.60	63.70

Source: Annual Reports of Pakistan Telecommunication Authority, Islamabad.

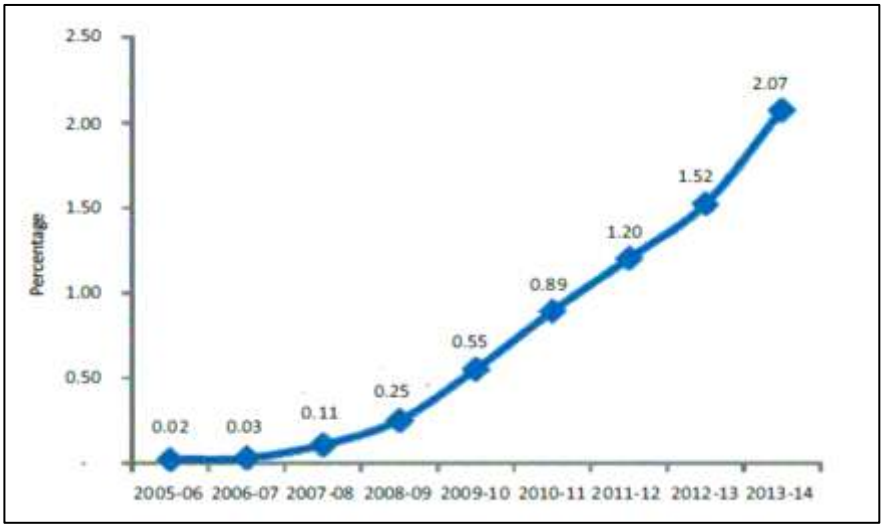
Cellular mobiles are now considered the backbone of Pakistan's telecom sector vis-a-vis their coverage, subscribers, financers and services. The deregulation of the cellular sector in 2004 along with the introduction of new players gave a big boost and new dimension to the telecom sector of Pakistan. Recent development in terms of high speed mobile internet through 3rd Generation (3G) and the 4th Generation (4G shall give another paradigm shift in the telecom sector of the country. However, it has opened new avenues for the provision of telecommunication services. For instance, the average outgoing minutes per subscriber per month have increased while average SMS per subscriber per month has dropped due to increased use of social media applications via internet on smart phones, iPhones, iPads and laptops.

Broadband[24] internet and mobile cellular services have played influential role in connecting lives, establishing online social relations, generating revenues, enabling freedom of speech and developing entertainment hubs in the current century. The rising trend of digitising the services for creating a rich online experience is becoming the primary focus of the new age content providers (Figures 5 and 6). It is expected that the

[24] Broadband is a combination of fixed and wireless technologies.

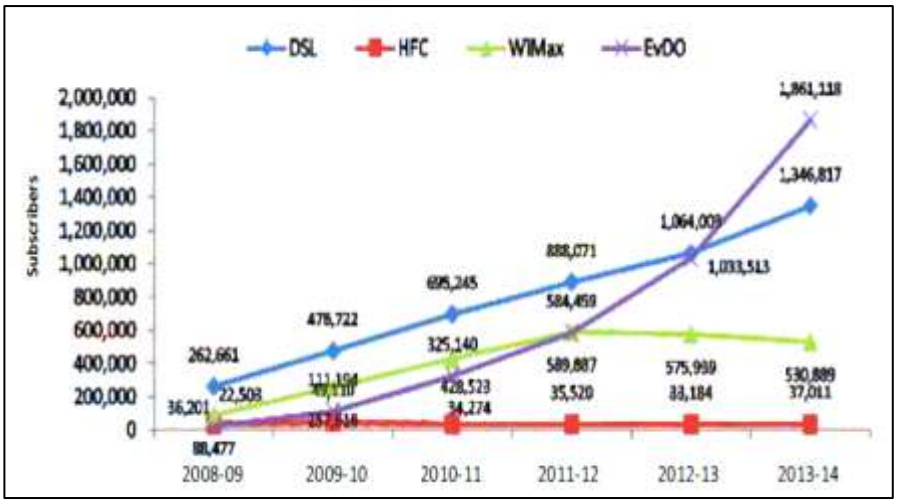
launch of the Next Generation Mobile Services (NGMS) shall play a crucial role in increasing penetration by providing broadband services on smart phones.

Figure-5
Broadband Penetration in Pakistan



Source: Annual Report 2013-14, Pakistan Telecommunication Authority, Islamabad.

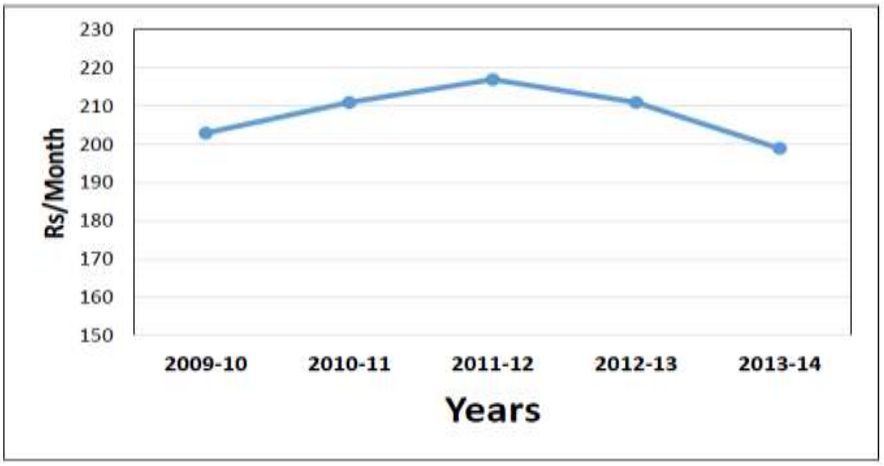
Figure-6
Telecom Revolution – Broadband Technology Trends in Pakistan



Source: Annual Report 2013-14, Pakistan Telecommunication Authority, Islamabad.

It is also worth mentioning here that the provision of telecom services to the consumers within their purchasing power is the prime underlying reason of its fast expansion. For instance, the average monthly expenditure of mobile phone subscribers in Pakistan has virtually remained constant for the last 5 years (Figure-7). This is important when viewed in comparison of rise in inflation during this period.

Figure-7
Average Monthly Expenditure of Mobile Phone Subscribers in Pakistan



Source: Annual Report 2013-14, Pakistan Telecommunication Authority, Islamabad.

Developmental Role of Information and Communications Technology (ICT)

Information is power and it carries value also. This saying is perhaps more valid in the developing countries than the developed world. Hardy (1980)—the pioneer in examining the effect of telephone on economic development—found that despite reverse causality problem[25], countries with advanced telecommunication network have higher GDP and faster economic growth. Norton (1992) after controlling this reverse causality arrived at the same conclusion as of Hardy (1980). Saunders *et al*. (1994) found that investment in telecommunication generated internal rates of return of about 20 per cent. Allerman *et al*. (2002) have suggested that inadequate ICT infrastructure would hamper economic growth. The ICT

[25] That is, whether the faster growth led to increased uptake of tele-communications networks, or did the increased uptake of telecommunications networks lead to higher growth?

can help in improving information flows, reducing search costs and generally contributing to market efficiency. Therefore, the positive impact of ICT on income growth, in developed and developing countries, is now an established phenomenon (Röller and Waverman 2001[26]; Waverman, *et al*., 2005[27]). Madden and Savage (1998), after analysing the mechanism by which ICT might have positive effects on the economic development, have recommended that information flow plays a critical role in the functioning of markets and telecommunications are a powerful tool of information transfer. Bedi (1999) suggested that a minimum threshold of ICT density is needed for these technologies to exert an influence on growth. Moreover, "*firm-level studies indicated that there might be substantial time lags between ICT investment and their positive effects*". The fascinating idea that wider access to the ICT and their use throughout the country will reduce inequalities in income and quality of life between rural and urban residents, is getting strength despite the scarcity of evidence to support this notion (Forestier *et al*., 2002). It inspires widespread policy initiatives to ensure equitable access to the ICT in all areas of a country.

ICT's Role in Agro Production, Marketing and Value Chains Development

The Information and Communication and Technology (ICT) commonly refers to the newer technologies of computers, internet and phones and is also believed to incorporate media such as radio, television and other sources of information, due to their role in the transmission of information. Mobile phone has proved to be a cheaper source of getting information about agricultural production, marketing, market selection for output selling, etc. (Jehan, *et al*., 2014). The role of livestock is important because of, volatile markets, manipulation and un-informed decisions. Farmers' participation in market and transport management is so poor that most of the time they are being forced to sell their produce to local middlemen at very low prices (FAO, 2001). Telecommunication and specifically mobile phones have the potential to provide solution to the existing information asymmetry in the sectors like agriculture (Mittal, *et al*., 2009). Radio and television have been acclaimed to be the most effective media for diffusion of scientific knowledge to the masses;, television is also acknowledged as

[26] Their analysis in OECD countries revealed that about one-third of economic growth could be attributed to investment in ICTs.

[27] Using data from 92 high-income and low-income countries from 1980 to 2003, Waverman *et al*. (2005) examined whether the introduction and rollout of mobile phones added to growth. They found that "*mobile telephony has a positive and significant impact on economic growth, and this impact may be twice as large in developing countries compared to developed countries*."

the most important medium for communicating with the rural populations of developing countries (FAO, 2001). Most often, few agricultural programs are not timed to suit the farmers. Consequently, most farmers are constrained to rely on their parties for agricultural information, which may be biased (Nazari and Hassan, 2011). Improving information services through telecommunication technology has a proven positive impact on rural incomes. In Peru, 13 per cent increase in the per capita farm income was observed due to mobile phone technology (Chong *et al*., 2005). Access to public telephones and especially individual mobile phones improves agricultural productivity, increases market access and expands marketing options for rural producers (Jansen *et al*., 2006). Mobile phone technology has provided opportunities for increasing productivity and reducing socioeconomic inequalities in Bangladesh (Islam and Gronlund, 2011). Literature reveals that that mobile phone has been used for warning against bad weather to the fishing communities. It is necessary to evaluate its role in farmers' decision about market participation (Munack and Speckmann, 2001; Muto and Yamano, 2008).

Revolutionising Agriculture in Pakistan by Increased Use of Science, Technology and ICT – The Way Forward

The generation and transfer of Green Revolution technologies and significant improvements in yields by their successful adoption has developed the concept of linear model for science and technology. Recent developmental thinking is based on the assumption that markets work well with integration of knowledge in ensuring development and poverty alleviation; however information gap is one of the important causes of market failures. So, markets alone are often inadequate. The societies also require policies for easy access to latest knowledge and technology. In this regard, the institutions need to facilitate the acquisition, adaptation and dissemination of technologies with due knowledge. On the other hand, in the last few decades, spectacular developments have taken place in the fields of information technology, agriculture, biotechnology[28], material sciences, health sciences, renewable energy, and other disciplines, which have rapidly changed the face of the globe. The pace of knowledge generation and its impact on new products and process development, the emergence of new interdisciplinary areas, e.g. nanotechnology and post-

[28] In recent years, biotechnology has emerged as a powerful medium for socioeconomic development. A large number of biotechnologies like recombinant vaccines, vaccine in drug-delivery, molecular diagnostics, bioremediation, sequencing of genomes, bioinformatics development, genetically modified crops and recombinant therapeutic proteins (Rahman, 2007).

genomic sciences are providing opportunities for nations to rapidly develop themselves to rise up to the level of scientifically and technologically advanced countries. Information technology has transformed the world into global village while providing numerous opportunities for growth. The ICT has vastly improved productivity in agriculture and industry and has created enormous new opportunities for extending business beyond the national boundaries. The economies of many countries like Ireland, China, India, Vietnam, Egypt and many African states have been significantly transformed with the advent of ICT (Rahman, 2007).

Recognising the key role of science and technology and ICT in the socioeconomic development of developing and developed countries, the following recommendations are suggested for the development of Pakistan's agriculture.

- Increasing public sector investment in agricultural R&D along with educating private sector to develop their own R&D in partnership with public R&D institutions.
- Creation of commodity and discipline based Centers of Excellence in provincial and national agricultural research systems. These centers should serve as hubs of all information pertaining to a particular discipline or commodity. In these centers, basic and applied sciences—agricultural sciences, engineering sciences, material sciences, information technology, biotechnology, pharmaceutical and space sciences etc.—should be effectively linked for generating new production tools and techniques.
- As marginal and small farmers shall increasingly depend on large farmers for various crop and livestock production technologies and farm machinery services. The scale-oriented technologies are mostly not suited to small sized farms. Therefore, due support in technology upgrading is needed through reverse engineering and adaptation trials before disseminating them to the farmers.
- There is an urgent need for developing a system for timely transmission of information to stakeholders ranging from R&D institutions to final consumers via producers, market intermediaries, value chain stakeholders etc. Some important areas in due course include: up-to-date information sharing on prices and stocks at domestic, neighboring countries and international levels; information on commitments and compliances related matters for different agreements, pacts and regulations; information sharing on day-to-day developments in research, markets, prices etc. with different stakeholders; timely information sharing on weather,

insects and disease incidence, precautionary/vaccination measures etc.

- Development of web/mobile based applications to display different analytics and other information to different stakeholders.
- For having effective AKIS and AKST systems, computers of high specifications and/or android based cell phones for all the stakeholders are needed. Unfortunately, the use of these gadgets is far less in rural areas than the cities, in agri-business than the industry. Moreover, low level of education of farmers and local traders slows down their learning to operate these new gadgets. Therefore, capacity-building of all stakeholders in productive use of ICT tools and gadgets along with training in modern farming techniques is required.
- Least practicing of grades and standardisation in the production and marketing of primary agricultural outputs is another obstacle for quick shifting to ICT based agro-marketing systems. It is suggested that all relevant stakeholders (researchers, farmers, market intermediaries, processors etc.) should join hand to develop grades and standards of various farm products along with deciding the cuts for deviation to these standards. The information of these grades and standards should be made accessible to all stakeholders through ICT tools.
- It is suggested that cellular phone[29] based agricultural extension model launched by Telenor Pakistan in Khyber Pakhtunkhwa may be replicated in other provinces by involving other telecom companies in Pakistan. Other models adopted in Africa like Safaricom's mobile cloud-based information sharing, iCow from M-farm, CocoaLink may also be examined in due course for launching purposes.■

[29] Cellular phone revolutionised African agriculture by five ways: i) access to market price; ii) micro-finance and banking; iii) iCow from M-farm; iv) instant weather information; and v) CocoaLink
[www. http://foodtank.com/news/2015/01/ five-ways-cell-phones-are-changing-agriculture-in-africa]

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CHAPTER 6

Reforming Energy Sector: Exploring Fresh Sources of Energy Production Using Modern Technologies and Innovations

Dr. Gulfaraz Ahmed

Introduction

Energy is the vitality to do work. It is the defining nature of life. As the pre-historic man gained more knowledge of his surroundings, he evolved methods for using external sources of energy. Quest for energy has been a part of human history from antiquity. Man relied upon his own elbow grease energy during hunting and gathering stage but soon learnt to use the energy of the beasts, which culminated later in an agricultural revolution.

The commercial sources of energy provided by fossil fuels is a relatively recent phenomenon going back only to about quarter of a millennium. It is generally believed that coal became commercially available in the middle of the 18^{th} century and provided the fuel for steam engine. Oil, which is more versatile and easier to use fossil fuel, entered the commercial market around 1850, with the advent of internal combustion engine, it gave an impetus to the industrial revolution. Co-incidentally, another hundred years later natural gas made the commercial debut in 1950. These three fossil fuels have together provided nearly 90 per cent of the global primary energy up to the present time. Fossil fuels are exhaustible natural resources and are bound to deplete especially at the increasing volume of extraction.

Uranium, the first non-fossil fuel, developed as a technological spin-off of the nuclear fission developed principally for military purposes, entered the commercial market also around 1950. Nuclear civil power is a growing source of electricity but it has not been able to replace the growth of fossil fuels because of limited and difficult access to the guarded technology and high initial investment.

Modern lifestyle is made possible and is sustained by abundant supply and use of energy but the increasing use of fossil fuels has resulted in serious challenges to all forms of life on earth because of threats of climate change resulting from greenhouse gases emissions. Conventional coal is the most polluting fuel with maximum CO_2 emissions; oil produces one-third less CO_2, and natural gas nearly two-third less than coal. It has

become quite evident that conventional use of fossil-fuels-dominated-energy is not sustainable. Besides, there has been an increasing pressure on energy supply raising its price and creating widespread energy insecurity.

Shale Oil and Gas Revolution

Expanding frontiers of knowledge and breakthroughs in technology have led to innovations in new sources of energy. The Oil Crisis of 1973 shook the developed world and created the need for sustainable energy security. The US, a leading energy consuming country, started a quest for augmenting indigenous sources of energy and took progressive initiatives to commercialise unconventional gas like coal-bed methane, natural gas from tight rock including the shale oil/gas. Existence of shale oil/gas was long known but technology did not exist to produce it commercially. Important and far-reaching steps were taken in the US in the establishment of Gas Research Institute in 1976 and passage of Natural Gas Policy Act in 1978. The GRI conducted in-depth research funded by a levy on transportation of natural gas through newly introduced open-access pipelines policy. Nearly 30 years later a new source of commercial energy, commonly termed as the shale oil/gas revolution, became possible. In 2001, the US produced 1.5 per cent of its total natural gas production from shale, 4.5 per cent in 2005 but then revolution struck and the shale gas went up to 37.5 per cent in 2011. It is continuing to increase progressively while making the US from importer to net exporter of natural gas. Shale oil and gas are not natural resources like conventional oil and gas; knowledge/technology plays its role for profitable extraction. Breakthroughs in knowledge and innovations in technology have led to brutal minimisation of cost, making the production of shale oil/gas commercially viable. The US has been the largest importer of fossil fuel energy but the shale oil/gas revolution is fast turning it into the net exporter. This has created an oil supply glut resulting in the sharp fall in its price since the start of 2015.

The shale gas/oil revolution holds a promise for many other countries with huge technically recoverable reserves. This also includes Pakistan, which holds over nine billion barrels of shale oil besides almost 105 trillion cubic feet of technically recoverable shale gas. Many other countries like Canada, Argentina and Australia are in the early stages of commercialisation of shale gas whereas China, Poland and others are in the active exploration phase. The technological innovations that have brought this revolution include three-dimensional seismic survey, horizontal-wells drilling, massive hydraulic fracturing and micro seismic survey etc. The process takes full advantage of the breakthroughs in the knowledge of geology and reservoir engineering. The countries like Pakistan have to

embrace the developments in knowledge and innovation in technology for unlocking the available shale oil and gas resources.

Technological Advances in the Energy Use

The research in the energy sector has also been directed towards improving the efficiency of utilisation of energy. It is interesting to see the periodical behavior of efficiency improvement linked with the price of oil. Since 1973 oil crisis, every time the price of oil went up, efforts also increased to improve the efficiency in the use of energy. This effort eased as the oil price declined because of reduced incentive for investment in efficiency improvement. The reduction in energy intensity or conversely the improvement in energy efficiency in the US is as high as 50 per cent from 1980 to 2015; that they are able to generate same amount of wealth using only half as much energy. Besides saving the amount and cost of energy it reduces emissions to half, a consideration even more important than the cost.

Knowledge and technology are leading to the improved use of conventional fossil fuels in environmentally cleaner and more efficient ways. The conventional coal-burning technology provides largest share of electricity in the world, which is also one of the leading sources of emissions responsible for the climate change. The innovations have led to the development of the advanced coal technology which, although has about 20 per cent higher capital cost, reduces CO_2 emissions and gives higher thermal efficiency in power generation. Further advances have been made in more effective utilisation of coal for power generation in the form of Advanced Coal with CCS technologies, which has about 50 per cent higher cost than the conventional coal use. The new technologies have higher thermal efficiency and produce more electricity with the same amount of coal and with much less CO_2 emissions. The new coal burning technology can also enable effective CO_2 capture leaving little or no CO_2 emissions. It is for these reasons that the global use of coal has resurged since 2000 and its share in the primary energy mix is on the rise.

Knowledge and technology are also leading to the development of modern renewable sources of commercial energy including wind, solar and bio-fuels. These sources of energy are in the developmental phase and cost more for the same amount of power produced than the matured technologies of the thermal plants, but their principal advantages are that these are renewable and have little to no carbon footprint. Since the renewable energy sources may not yet be cost-competitive with fossil fuels these are subsidised presently but may be more competitive in certain locations having no power grid. The composite power centers with wind,

solar and biomass plants could be set up within areas of local micro-grids. In such applications these are quite cost-competitive and give means of providing power to remote and unconnected communities.

Wind Energy

Wind electricity is a spin-off development of the space-age technology. The turbines are made of ultra-modern materials having honeycomb internal structures. These are ultra-light yet very strong materials. Most modern turbines in megawatt capacity range have blade spans of over 100 meters and safely withstand the air current and even storms. These are clearly the products of evolving technology. The height of turbines is an important parameter as the wind stream is always slower near the surface but increasing of the height to trap faster wind stream also creates serious issues of strength of materials and designs of the turbines. Technology has provided creative solutions to these challenges which have rendered wind energy nearly competitive with the thermal power in unit cost of generation. Consequently installed wind capacity is growing exponentially in the world. For instance, Spain gets more than 50 per cent of its electricity from wind which attests to its large scale feasibility.

Pakistan is bestowed with a large belt, starting from the coast in the Sindh province, which has harvestable wind-speed feasible for power generation. It has taken a start and over 100 MW of wind power is feeding the national grid. Special transmission circuits are required for wind power which could add to the end cost of the wind electricity. As the size of wind farms is increasing with increasing rows of turbines, it is becoming difficult to predict the production capacity for sales contracts because of the disturbances created by the turbines in their wake. New generations of more powerful and faster computers are needed to simulate the generation of electricity from large wind farms and minimising the wake-effect. It is expected that with further technological breakthroughs, wind power would become preferable to thermal power in cost besides the benefit of little or no carbon footprint.

Solar Energy

Sun is the sole source of all forms of energy in the solar system. The solar energy reaches the earth in the form of electromagnetic ways that produce light and heat, which sustain all forms of life on earth. It is possible to produce electricity from solar energy through two different processes called solar thermal and solar photovoltaic. The electricity is produced only during the day and has to be evacuated directly to the main grid or the mini grid.

Electricity can also be stored in batteries for sustainable supply but it adds to the cost of the solar electricity. In certain cases, solar electricity is used to pump the water to a higher reservoir during the day, which is then used for generation of hydel electricity during the night to sustain regular power supply.

Till recently the cost of photovoltaic cells was too high but technological advancement and mass production by China has brought about a revolutionary reduction in the price of solar panels to less than half. This is making the solar power quite attractive especially for installation at users' end in houses, offices, industries and remote localities. It is possible to overcome the electricity crisis in Pakistan through household solar power revolution that would be cheaper than grid power. Recent approval of introducing two-way electricity meters will enable the sale of surplus power to the main grid which will further improve the economics of household solar electricity. It needs to be promoted through effective policies by creating technological awareness, authorising competent service providers, giving commercial loans and some tax incentives.

In the case of solar thermal, large mirrors capture the heat waves and reflect these to focus on tubes carrying water which on heating produce steam, used for generating electricity. Electricity thus generated is more expensive than photovoltaic electricity but is used in certain conditions.

Biofuels

Technology has advanced to commercially extract biofuels like methanol, ethanol, biodiesel etc. from certain plants. These fuels are renewable and cause lesser pollution than the fossil fuels. The economics vary from region to region and depend upon the available land acreage and appropriate climate. In European Union Countries mixing of 10-15 per cent of biofuels is mandatory in the petroleum products for diversity, sustainability and environmental reasons.

Knowledge Economy

Since the start of the 21st century a new form of economy has started making visible contributions especially in the countries of the Organisation for Economic Cooperation and Development (OECD), which may be known as the knowledge economy. It essentially aims at generating greater wealth from less energy. This is achieved by reducing energy intensity, using technologically advanced industrial processes that are much less energy intensive and recycle waste energy more cost-effectively.

Historically, there existed a correlation between energy consumption and wealth generation. Greater supply and the use of energy led to greater GDP and affluence manifesting in greater national power and significance. The world could be divided in developed category represented by the OECD and the rest as developing. It is interesting to note that the same line that divides the world map into higher and lower energy consumption per capita also divides the world in higher and lower GDP per capita. According to this model, the only way to increase GDP was to increase the energy consumption per capita.

Since 2000, the developed countries of OECD have climbed a new trajectory where knowledge economy is making increased contribution creating a paradigm shift. The economies of OECD countries, projected upto 2030, are continuing to grow but the energy consumption is not only levelling off but declining, breaking the age-old correlation. On the other hand, the developing world is still on the old track and their economies are projected to grow only with corresponding increase in energy consumption. The knowledge economy trend provides an opportunity to the developing world to take the leap and catch up with the use and benefits of knowledge economy.

Nuclear Energy

Einstein had shown that energy and mass are interchangeable forms of matter. He had established a relationship between mass and energy through his epochal equation. Even a miniscule quantity of matter can be transformed into enormous amount of energy through nuclear fission, a technology that produces mass destruction nuclear weapons. There has, however, been a spin-off benefit of peaceful use of fission energy for power generation. Nuclear power made the debut in 1950 but it has not been able to achieve universal application because of difficult access to sophisticated and sensitive technology and capital cost. Pakistan has taken a solid start in peaceful nuclear energy. It has a record of safely operating civil nuclear reactors for over 40 years and has over 750 MW producing capacity, 700 MW at advanced stage of completion and another 2200 MW under construction. The new and larger plants of 1100 MW capacity being installed in Karachi are the products of new technology and are more cost-effective in lower unit generation cost. Pakistan aims at producing 30 per cent of its electricity needs from nuclear plants by 2030 that will require it to go much more advanced in this technology.

Hydrogen Energy

Hydrogen is the most abundant element in the universe. Hydrogen fusion is the main source of energy in the stars that generate the electromagnetic waves that provide heat and light. The Sun is a medium-sized star and produces energy through nuclear-fusion of hydrogen atoms. The scientists have been trying to develop nuclear fusion at achievable temperatures for production of electricity, for over half a century. A breakthrough has not yet been achieved and experimental nuclear fusion reactors take more energy to raise the temperature for the onset of fusion than the electricity these would generate. These are still energy sinks and not sources. However, there is a possibility of cold fusion in later half of this century that could become a new breed of useable energy in the form of electricity.

There is another direct way for the use of hydrogen and the production of electricity from fuel cells. The Fuel Cell Technologies have been around for over half a century. The main issues in commercialisation of the use of hydrogen for production of electricity have been the cost and efficiency. Breakthroughs in knowledge and innovations in technology are creating new waves in commercialisation of hydrogen energy. A number of advanced countries have charted courses for using hydrogen as a fuel for the vehicles and experimental hydrogen dispensing stations are operating for hydrogen-fueled cars.

New research and technological breakthroughs are expected in the reduction of cost and increase in efficiency of fuel cells. The present generation of fuel cells uses Platinum catalysts, which makes the generated energy very expensive. New research promises bio-metallic iron based catalysts with over 30 times improvement in efficiency. It is expected that hydrogen energy would make inroads by the middle of this century and may provide up to 90 per cent of the global energy needs by 2100.

Carbon on combustion produces pollutants and Carbon Dioxide that constitutes the bulk of emissions and is responsible for the consequences of the changing climate in the form of droughts, excessive rains, destructive floods and cyclones threatening all forms of life on earth. On the contrary, hydrogen on combustion produces clean water as a by-product for generation of electricity, which in drought would be very valuable. Looking beyond this century, it may not be fiction, that humanity will achieve a presently unimaginable level of sovereignty of abundance in the most crucial realm of energy.

Knowledge and Energy

Knowledge and energy have followed a symbiotic linkage since pre-history. Developments in knowledge have led to the advent of better means of energy. In turn, more energy reduced the pressures of subsistence and survival freeing up man's time for expanding frontiers of knowledge and technical innovations. It is interesting to compare the historical growths of knowledge and commercial energy. Growth of knowledge followed a linear and progressive curve from antiquity up to 1950 and so did the growth in the global consumption of commercial energy. However, 1950 provided a jump-off point. The post-wars reconstruction and development buoyed by Marshal and McArthur Plans, led to the cascading use of energy and the growth became steeply exponential. Mimicking the explosive energy growth take-off, knowledge growth curve also became steeply exponential in 1950 in what seems to be a connected phenomenon of a symbiotic relationship. Both are growing to new heights, knowledge doubles in less than a decade promising the future sovereignty of abundance through the bounty of knowledge.

Way Forward for Pakistan

In the energy sector, the greatest challenge faced by Pakistan is the low consumption of energy per capita at one-fifth of the world average. Since, for a developing country, increase in energy consumption is essential for increase in GDP generation, Pakistan needs at least two-fold increase in the per-capita energy consumption within a decade to increase wealth generation for eradicating the endemic poverty and improving social indicators. While Pakistan needs to double or treble the per-capita energy consumption, it is unable to supply energy to meet even the present level of very low energy consumption. Energy management worldwide has become a very crucial aspect of national management and needs greater focus in Pakistan. Energy management can be improved essentially by enhancing the energy sector capacity by appointing competent heads of institutions on merit through a transparent and open competitive process. There is also a need to make energy more affordable through least-cost power generation, optimal inter-fuel substitution, and imports on the basis of end-use cost and efficiency. The present practice of using 40 per cent of the imported oil to generate over 36 per cent of expensive electricity has resulted in recurring circular debt rendering the energy nearly insolvent and unsustainable.

Least-cost electricity can be achieved by selecting the right technology, using the optimal fuel, exploiting the economies of scale in plant size and picking the best location for new power plants that is closer

to consumption centers. Least-cost power generation is seriously pursued in the world and NEPRA needs to enforce it in Pakistan, while licensing all new plants. There has been a blatant departure from this principle as for example most of the captive power plants are designed well below the economies of scale size and have a high cost of generation yet these have a higher priority for supply of natural gas. If that gas is provided to higher thermal efficiency CCGT power plants of larger size these would generate over 60 per cent more electricity and at much lower unit cost.

Hydroelectricity provides lower-cost power on a renewable basis, besides providing crucially needed water. Pakistan is facing electricity as well water crisis; therefore, building water reservoirs and constructing hydroelectricity power plants is a priority choice. Mega dams have now become even more critical for controlling floods that are occurring with greater intensity and frequency due to looming effects of the climate change.

As brought out earlier in the paper, there is a need to spread a revolution of user-end solar power and local power centers having solar-cum-wind-cum-biomass power plants with micro-grids in remote areas presently not connected with the main grid.

Back in 1998, Pakistan faced a serious energy crisis. It had little foreign exchange to import oil in the wake of economic sanctions linked with the nuclear tests conducted in May 1998. The Ministry of Petroleum & Natural Resource took far-reaching steps and introduced the use of indigenous natural gas in the transport sector to substitute for the imported motor spirit. This led to an unprecedented restructuring of the primary energy mix within 12 years as the share of oil reduced from 44 per cent to 31 per cent and that of natural gas went up from 37 per cent to 49 per cent in the year 2009/2010. This resulted in substitution of over 2.5 million tons of imported gasoline saving over 2.5 billion dollars in 2010. This case reference provides a useful guide of articulating fuel polices for optimal gains. Even now it is crucial for the country to reduce import of oil, increase import of gas and supply required gas to the transport sector at appropriately matched price. It is pertinent to mention that the restructuring of the primary energy mix and introducing use of gas in the transport sector in 1998 was predicated on early import of natural gas.

The Ministry of Petroleum & Natural Resources is the only administrative entity for fossil fuels. In the normal course of events, the officials stay busy in routine firefighting. They have very little time, resources and even the background to undertake and maintain active research following the breakthroughs in knowledge and technology for finding creative solutions to our energy challenges. This calls for a need to develop associations with resource institutions like the universities and

other research bodies on the lines that happens in the developed countries. We should initiate the system of welcoming renowned Pakistani experts in various fields of energy to work with the Ministry on sabbatical leave from jobs a

CHAPTER 7

The Use of Foresight in Formulating and Implementing a National Policy

Umar Sheraz

Introduction

Over the past three decades, foresight has emerged as a prominent tool to support anticipatory opinion and action in decision-making, both for public policies and commercial entities. The purpose of the emerging discipline of foresight is to better understand the processes of change so that individuals and organisations can create wiser and preferred futures. All nations of the world are faced with a number of social, technological, economic, political and ecological issues in the backdrop of a globalised world, which inadvertently influence policy-making, resulting in the need for a new culture of future-oriented thinking.

Therefore, foresight can influence policy formulation and implementation in many ways. By stressing the possibility of different future states, as opposed to the assumption that there is a pre-determined future, and hence foresight creates the opportunity of shaping futures. Moreover, the possibility of different future states enables flexibility in policy making and its implementation, helps to broaden perspectives, and encourages thinking-outside-the-box (Schartinger and Weber, 2007)

In an era of globalisation, radical innovation and sweeping technological change, the role of policy makers is evolving. The policy makers in the 21st century have added responsibilities which require flexibility of approach and thinking in response to growing complexity and uncertainty.

The policy makers have begun to realise that there is a yawning gap between the pace of technological change and the responding ability to formulate suitable policies. By incorporating the views and insights of experts, who have an understanding of the underlying systems and mechanisms, policy response can be strengthened.

Foresight is crucial as an early warning system as it can assist in detecting weak signals i.e**.** unclear events/trends which warn us about the possibility of future events. The identification of such weak signals can assist in re-assessment and re-alignment of existing policies.

The political ownership and public support of policies can be achieved by foresight methods like Delphi. A classical recent example is the

Vision 2023- Turkey's National Technology Foresight Program, which was proposed as a useful tool to overcome lack of participation, isolation and fragmentation in the policy arena (Saritas etal, 2007). The impact of the program has been mixed but it was instrumental in getting political ownership and caught the attention of the general public and media.

In terms of policy implementation and policy response, foresight tools like patent analysis can be quite useful. Patent repositories represent a treasure trove which has not yet been properly exploited in the developing world. For developing countries like Pakistan, patent analysis can be useful in:

1. Focused R&D and funding for critical and selected technologies
2. Planning of future direction and mapping the trajectory of a particular technology
3. Avoiding duplication and disputes, given that the budget for science and technology is meager in the developing countries like Pakistan. Intellectual Property Offices could act as a coordination mechanism between R&D organisations and universities

Foresight to avoid Blind Spots in Policy Making

Used Futures

A Used Future, a term coined by Sohail Inayatullah in 2008, highlights the way a community/organisation's sense of the possible, probable, and preferable is occupied unthinkingly, inappropriately, and in all likelihood damagingly, by concepts developed in another context (and pursuing other interests) altogether (Sheraz etal, 2013). The particularly concerning aspect of this decolonisation of the future is the disempowering of thought, by accepting the futures of others as our own. Other postcolonial scholars from the subcontinent have referred to "the theft of distinctive futures" (Nandy, 1996). Others have even warned of colonial/Western tendencies in the discipline of futures studies itself (Sardar, 1993) (Kapoor, 2001).

An important question in this regard is have we borrowed a used future? Is the image of a desired future, is it unconsciously purchased from somebody else? While discussing used futures, a brief discussion about images is important. Images often provide us with what we think, we know about the world. For example, our notions about the problems of the poorest countries are flooded with images of starving children, cold-blooded multinationals and crooked politicians. Uprising and disruptive change is often synonymous with the image of Che Guevara, ever-present as a poster on student t-shirts and revolutionary graffiti on walls. The problem arises when the image does our thinking for us and we are held prisoner by these images. For instance, the Asian cities have tended to follow the same

pattern of urban development that western cities did generations ago (Inayatullah, 2004). The image of the future, of unbridled growth without concern for nature or livability has led to the "concrete jungle model" of the Asian cities. Public administrators in such cities are now questioning their own assumptions and asking if instead of spending unwisely on unplanned growth, they should have instead focused on creating livable communities. They should have planned green public spaces as dividers of developed regions. By unconsciously following this pattern, Asian cities are now facing a crisis of overpopulation, equity, fresh water depletion, climate change and loss of human dignity. In the process they have also disowned their own traditions where living with nature was important and community was central.

Here it needs to be clarified that throughout history, societies and organisations have forged ahead by learning through emulation. However the point of difference is that the method of best practice lesson-drawing must be examined with context-specific analysis and policy formulation. Otherwise history is replete with examples of failed interventions and costly experiments.

Disowned Futures

Another important aspect of the futures' thinking process is the concept of the disowned future. This refers to the stakeholders, segments of society or even issues which we choose to disown or ignore, while formulating a particular policy and then the disowned come back to haunt us and disrupt well-laid plans. Plans go astray not because of lack of effective strategy but because the act of creating a particular direction ignores other personal and organisational entities (Inayatullah, 2007). Michael Porter (1996) observed that "*the essence of strategy is choosing what not to do"* and while using foresight, the challenge is to integrate the disowned. A classical case can be given of both developed as well as developing countries which provide subsidies and assistance to farmers to cultivate tobacco, then provide assistance and tax rebates to the tobacco factories to grow tobacco related products. On the other hand, department of health of the same government puts in millions of dollars every year for "No Smoking" campaigns and treating victims of smoking and second hand smoke. So while a Grand National Health Strategy, assisted with the help of International consultants and experts might exist, the act of disowning, threatens to undo all the hard work. This is not an isolated example. In countries where the consumption of alcohol is legal, the Ministry of agriculture and Ministry of industries assist farmers of grape vines and the alcohol industry but at the same time millions will be spent annually on billboards and advertising about

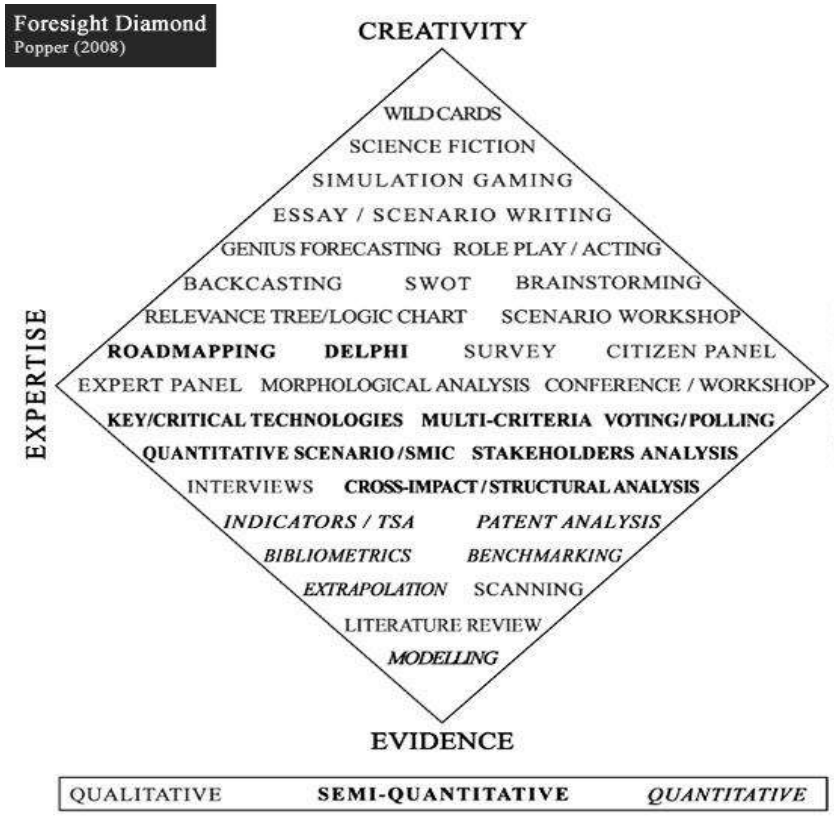
moderation in drinking and avoiding drunk driving by the Ministry of Health. Also there will be policing and litigation costs over drunk driving and violence related to drunkenness. So again, while grand National Policies might exist, the act of disowning puts various departments and organisations in conflict with each other.

In the above examples, each involved ministry represents a sector-specific knowledge infrastructure. However, due to the act of disowning, innovation and dynamism are hindered by seriously flawed policy interventions. In the practical world, this has resulted in tension between the two camps of "technical ministries" like trade and industry, agriculture and "welfare ministries" like health (Research Council of Norway, 2005). These two camps have quite different traditions and cultures, and as a result, they take widely different, un-coordinated positions, pulling in different directions vis-à-vis the National Health Policy. The challenge then is to integrate the disowned and the proper alignment of strategy. Other instances of disowned futures include, disowning the environment in the name of development and short-term gain; disowning communities and the disadvantaged in national plans of education; to name a few.

Selection of Foresight Methods

There are many methods of conducting foresight. Popper (2008) after assessing nearly 2,000 country case studies of foresight devised a foresight diamond of 34 different methods of foresight (figure 1). These different methods of foresight are put together according to their relationship with creativity and evidence versus interaction and expertise.

Figure-1
Popper's Diamond (Popper, R. (2008)



According to the Popper's Diamond

Creativity-based methods refer to a mixture of original and imaginative thinking. This is usually done by subject "gurus", using genius forecasting, back casting or scenario-based essays.

Expertise-based methods are reliant on the skill and knowledge of experts or gurus in a particular subject.

Interaction-based methods assume that expertise can contribute to policy making, if different world views are brought together and then the collective wisdom is used to strengthen policy making and plug any gaps in the process.

Evidence-based methods are based on data, statistics and reliable documentation and attempt to forecast about a particular occurrence.

According to this study, there is no "ideal" methodological framework providing the "best" combination of methods. In fact, there is no "ideal" number of methods to be used in a project. Popper *et al.* (2005) took a sample of 130 cases from 15 countries—Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Turkey, UK and the US—and found an average of five to six methods per exercise. It is important to incorporate different tools and methodological frameworks during foresight exercises, so that the gaps and lacunae in one method can be compensated with the strengths of other methods, resulting in more robust and broader policy frameworks.

Moving Forward

An initial step in the use of foresight in our policy formulation process would be to change our thinking of "futures as predicted and fixed", to future space existing between alternates. Unlike astrology where, the future is not contested, questioning and divergent views are not only incorporated in modern futures studies; they are essential for robustness and resilience (Inayatullah, 2013). From mapping alternative futures, the process then moves on towards shaping desired futures and then filling in the space between today and the desired future.

The present was once a future and will become past immediately. So what really matters is the present. What we do today will resonate with our future generations, just as we are reaping the actions—good or bad, wise or unwise—of our ancestors. So it is important that we think about our future wisely and carefully.■

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CHAPTER 8

Learning from Best Practices: Chinese Economy

Zhao Lijian

The following is the gist of Mr Zhao Lijian's talk transcribed from the audio recording.

Over the years, in the light of its own national conditions and drawing on the successes of other countries, China has made tremendous efforts to explore a road towards development.

Due to the reforms and opening-up, China has scored remarkable achievements in economic and social development. China's per capita GDP was about 149 US dollars in 1978, and it increased to over 7,589 US dollars last year — an increase of more than 50 times. The Chinese economy not only continues to grow at the fastest speed among major economies in the world, but also keeps presenting the world with miracles for development. It is estimated that in 2014, the contribution of China's economy to the world economy almost accounts for 30 per cent, making China a remarkable driving force for the world economic growth.

It is worth mentioning that despite such achievements, China's position as the world's largest developing country has not changed. By per capita, it ranks 80th in the world. China's per capita GDP is 65 per cent of the global average, one-seventh of the US and one-fifth of the European Union. Development is uneven between China's urban and rural areas and between its various regions. There are modern metropolises like Beijing and Shanghai. However, the central and western parts of the country, especially the far-flung villages, are generally poor. By China's own standard, over 70 million people in rural areas are living in poverty, and by World Bank's standard, China still has a poor population of 200 million.

However, China has found a Chinese road to development in line with its national conditions and the world situation. China has balanced the relations among reform, development and stability. It promotes social harmony and stability while maintaining a clean and efficient government.

The major achievements of China's economic growth may be attributed to its current development model, namely the New Normal. The New Normal is centers upon knowledge-based economy, innovation, reforms, market-driving, among others. For further explanation, following

thoughts are considered valuable.

First, it is important to step up innovation and structural reform. China's economy gradually shifts from factor-driven and investment-driven growth to the innovation-driven growth. "Made in China" can be changed into "Created in China."

Second, it is important to draw on further opening-up to boost development. We have expanded the Shanghai Pilot Free Trade Zone and established similar zones in Guangdong, Tianjin, and Fujian. We have worked to keep exports stable and increase imports, and China's international market share in exports continues to increase. Foreign direct investment actually made in China reached 119.6 billion US dollars, making the country the world's top destination for foreign direct investment.

Third, it is important to exercise targeted regulation on the basis of range-based macro regulation. Instead of using short-term stimulus measures, we continue to develop new ideas and methods for macro regulation. We have been effectively implementing proactive fiscal policy and prudent monetary policy.

Furthermore, it is important to carry out global cooperation on production capacity. The size of China makes it the largest producer of more than 200 industrial products in the world. Chinese equipment, being at the middle-end of the global industrial chain, is competitive given their high quality and low prices. China calls for open global cooperation on production capacity. Such a cooperation model will provide the global market with cost effective equipment, production capacity and solid financial services.

Recently, some international media has blamed China's stock market and Chinese Yuan exchange rate fluctuations for the latest global stock market plunge, painting a bleak picture of China's economy, which could trigger a new round of global economic crisis. They even suggest that China's economy may collapse. I think such assertion is apparently unfair.

Actually, the recent global stock market plunge is the result of combined action of multiple market factors rather than the China factor. The recovery of the world economy is sluggish and the aftermath of the financial crisis still lingers on. As for the fundamental causes, the recent volatility in the global stock markets reflects a changing pattern of global economic growth and has helped release risks of the international financial market.

Besides, China's reform of the mechanism to determine the central parity rate of the yuan is a further step to improve the country's market-based formation regime of the yuan exchange rates. There is no basis for sustained devaluation of the yuan. The yuan exchange rates will remain basically stable at a reasonable and balanced level. This is because the

Chinese economy has maintained a steady and relatively rapid growth and China has large foreign-exchange reserves and adequate economic regulatory tools.

It should be pointed out that China's sustainable economic growth is the country's biggest contribution to the economy of its neighbouring countries and the entire world. In the first half of this year, China's GDP has registered a 7 per cent growth, the best of the world's major economies. According to IMF estimates, China's contribution to global economic growth in GDP is 27.8 per cent. China is now the largest trading partner of more than 120 countries and regions in the world. China's role as an important engine of global economic growth will become more prominent, especially with the full implementation of the Belt and Road Initiative and other development strategies.

China's overall economic performance is within a reasonable range and its economic fundamentals remain sound as a whole. China's economic structure is improving, the quality of growth is strengthening and its internal impetus to growth is gaining strength. We will continue to move forward with the structural reform, implement a proactive fiscal policy and prudent monetary policy, so as to keep up the momentum of steady economic growth and make greater contribution to the world economy.■

CHAPTER 9

Learning from Best Practices: Economy of Japan

Mr. Takashi Harada

The following is the gist of Mr Takashi Harada's presentation transcribed from the audio recording.

The World War II ended 70 years ago in 1945 while causing a great damage to the economy of Japan. Japan was devastated towards the end of the World War II. The industry was damaged. The infrastructure collapsed. The inflation rate had risen to 300 per cent. However, since 1955 Japan maintained continuous growth rate of 9 per cent for twenty years.

Although it was difficult to capture the entire economic bloom, the infrastructure development of Japan would be focused.

The presentation is divided into three parts:

1. Infrastructure
2. Lessons Learnt from the History of Infrastructure Development in Japan
3. Current Development of Japan's Infrastructure Investment in Asia

Brief outlook of Japan's Infrastructure

Japan is a country of archipelagoes; it is a mountainous country as well. To unify the nation, the geographic perspective of Japan is the basic motivation for infrastructure development. Roads, tunnels and bridges are indispensible for connecting cities. Ports are also important to connect islands by maritime transport. As Japan has been hit by frequent natural disasters like earthquakes and tsunamis, a robust infrastructure has been its chief requirement. Japan has some major economic centers — Tokyo, Osaka, Nagoya, Fukuoka cities — but they are dispersed; connectivity between these cities is the main goal of the government.

Japan has accumulated huge infrastructure stocks and road networks. These networks provide an alternative. For instance, if a road is congested, we can find another way to go. The same applies to all transport, including air transport and maritime transport.

Lessons can also be drawn from the long-lasting history of Japan's infrastructure development. First, the division of roles between the public and private is important. The public is responsible for entire nation. Market mechanism is not feasible for the public sector. On the contrary, private sector is effective; it works through market mechanism.

In the case of Japan, since 1950 to 1990, the government has played a leading role in infrastructure investment. Infrastructure investment does not fit in the market mechanism. Japan has utilised a wide variety of financial resource, namely taxes, bonds, national savings (pension fund and postal saving), foreign borrowing mainly from the World Bank. Japan has paid a large accumulation of national debt as a result of inefficient management under the government itself. Since then, Japan accelerated the privatisation of the major infrastructure operator of every economic sector. Currently, Japan is actively promoting the private finance in Asia in infrastructure development.

However, the quality infrastructure is essential. In the course of Japan's infrastructure development, Japan has realised that the quality infrastructure is the key. The quality infrastructure can be best summed up in two words: safety and robustness.

The quality infrastructure can endure many disasters. Tokyo Sky Tree i.e. a broadcasting tower, for instance, was hit by the earthquake of the magnitude 8.7, during its construction period and endured it. Although the construction is the most fragile period, yet due to quality construction, it withstood such a disastrous earthquake. Now it is known as the symbol of quality construction in the world.

In addition, placing emphasis on 'project life cost' instead of 'project construction cost' is imperative. Although quality infrastructure requires somewhat higher cost, the result is high quality and longstanding. On the other hand, the cheap infrastructure requires rehabilitation and more cost. Therefore, quality must be incorporated in the infrastructure. The most advanced technology should be used for construction, operation and maintenance of the infrastructure. Innovation in technology is the greatest driving force to accelerate economic growth.

In his speech, at the 21st, International Conference on the Future of Asia, the Japanese Premier Shinzo Abe was firmly determined to support the development of quality infrastructure in Asia. Further, he ensured all possible support to develop quality infrastructure. There is a limit to what public administration alone can achieve vis-à-vis quality and quantity. A breakthrough is still possible, however, by developing and enhancing the mechanism to attract private investment for infrastructure development in Asia. In doing so, Japan intends to support the Asian countries, including Pakistan in the pursuit of quality infrastructure investment. Financial

assistance for Asia and transfer of technical assistance by all possible resources of Japan's public and private sector has been ensured by the Japanese government. Japan will play a key role in further mobilising the financial resource from the public sector across Asia. Asia is a region, which is full of potential; we only need to promote infrastructure investment the region needs both in terms of quality and quantity. A case study of quality infrastructure is the 'Purple Line' in Bangkok, an urban railway project, built with financial assistance from Japan and Thailand.

Pakistan is a country which is at the very center of distribution: it is in the middle of world's two biggest markets i.e. China and India, oil rich gulf countries and promising Africa beyond the sea. Pakistan has abundant mineral resources, educated human resource as well as massive markets. If it gains peace and stability, investors would come from all directions as Pakistan would become a huge market for investment. For Japan, the relationship with Pakistan will surely become vital at an accelerated pace in future. Both Japan and Pakistan will not only benefit from this relationship, they will also prosper by collaborating particularly in the economic sector.■

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