United Nations
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UNESCO Forum on Higher Education,
Research and Knowledge

OCCASIONAL PAPER No. 17

Mapping scientific research in member states of the Organization of Islamic Conference (OIC)

Research summary

S. Tanveer Naim and Atta-ur-Rahman
COMSTECH Secretariat, Islamabad,
Pakistan

Division of Higher Education • UNESCO Forum on Higher Education, Research and Knowledge
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CONTENTS

Foreword

The UNESCO Forum on Higher Education, Knowledge and Research is pleased to publish this Occasional Paper N° 17 entitled *Mapping Scientific Research in Member States of the Organization of Islamic Conference (OIC).* This study develops a research summary presented by Professor S. Tanveer Naim and Professor Atta-ur-Rahman of the OIC Standing Committee on Scientific and Technological Cooperation, at the Global Research Seminar held in Paris, 28 to 29 November 2008, on the theme of *Sharing Research Agendas on Knowledge Systems*. This Seminar gathered together some 100 researchers from over 50 Member States as well as experts from UNESCO's IGO and NGO partner organizations such as OECD, WHO, FAO and NEPAD, which carry out work in this important area.

It is appropriate to situate this publication in relation to the aims of UNESCO Forum and, thus, to contextualize current issues related to systems of higher education, research and innovation research (known as HERI). The UNESCO Forum focuses on the role and status of research systems (whether national, regional or global) and international trends in this domain in relation to the challenges posed by the Knowledge Society of the twenty-first century. Located at UNESCO and supported by the Swedish International Development Agency (Sida), the UNESCO Forum provides a platform for researchers, policy-makers and relevant stakeholders to engage critically with the key elements underpinning research systems*: (i) policy trend; (ii) infrastructure; (ii) human capacity; and (iv) investment.* This project has assured follow-up action for two major UNESCO conferences, the 1998 World Conference on Higher Education, "*Higher Education in the twenty-first century*" and the 1999 World Conference on Science, "*Science for the twenty-first century*", and links closely to the intergovernmental programme for the *Management of Social Transformation* (MOST), located in the Sector of Social and Human Sciences (SHS), UNESCO.

Today, unprecedented emphasis is being placed on research as key motor for advancing the knowledge society and its offspring, the knowledge economy. Consequently, "*research on the state of research"* has moved high on the priority agendas for governments, for their specialized agencies and bodies devoted to this area, and for higher education institutions. Thus, mapping and analyzing their systems has become essential in order to acquire an understanding of their functioning and, therefore, future requirements.

This systemic approach necessitates the study of specific issues arising from the various areas involved.

- Comparing methodologies for the study of knowledge systems.
- Case studies related to higher education (notably universities), to the mapping and analysis of research systems.
- Specific dimensions of knowledge systems (inter alia, policies, governance, infrastructure, human resources, research output, cooperation agreements and emerging tensions and dynamics).

This Occasional Paper provides an opportunity for an in-depth study of the research challenges faced by the fifty-seven countries of the Organization of Islamic Conference (OIC) which is a body spanning several regions. These challenges are historical, political, economic and social in character and they affect some 25 per cent of the world's population which reside mainly in low-income countries (LICs). It is thus essential to find ways and means to promote higher investment in research capacity in these states and to draw on the rich scientific heritage that they already possess.

The UNESCO Forum expresses its gratitude to the authors for their valuable contribution to this global debate.

Mary-Louise Kearney, Director,

Forum Secretariat,
UNESCO Forum on Higher Education,
Research and Knowledge

Biography of Professor S. Tanveer Naim

Professor Tanveer Kausar Naim is a consultant with the Organization of Islamic Conference's Standing Committee on Scientific and Technological Cooperation (COMSTECH). She is a member of the UNESCO International Advisory Board on Reform of Higher Education and Science and Technology in Nigeria, Member of the Gender Advisory Board of UNESCO, and Member of the Advisory Committee of the International Science Development Network. In addition, she has been hired to perform a Technology Audit for Turkey and Serbia under the 6th Framework program of the European Union. Previously, Tanveer Kausar Naim worked for the Pakistan Council for Science and Technology (PCST), and later served as the first female Secretary of the National Commission on Science and Technology, the highest decision-making body headed by the President of Pakistan. She obtained her Ph.D. in Organic Chemistry from the University of Sussex in 1971.

Biography of Professor Atta-ur-Rahman

Atta-ur-Rahman is the Coordinator General of COMSTECH, an OIC Ministerial Committee, and is Federal Minister/Chairman of the Higher Education Commission and Adviser to the Prime Minister on Science and Technology. Atta-ur-Rahman is also the President of the Pakistan Academy of Sciences and the Network of Academies of Sciences of Islamic Countries (NASIC). Previously, Atta-ur-Rahman was the Federal Minister for Science and Technology (2000-2002). Atta-ur-Rahman obtained his Ph.D. from Cambridge University (1968) and was later honoured as a Doctor of Science (Sc.D.). He has been widely published in several fields of organic chemistry, including 480 research publications, 15 patents, 93 books and 59 chapters in books published by major US and European presses

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Mapping Scientific Research in Member States of the Organization of Islamic Conference (OIC)

S. Tanveer Naim and Atta-ur-Rahman, *Pakistan*

The 57 states of the Organization of Islamic Conference (OIC) are located in different subcontinents. They are endowed differently in terms of natural resources, environment and culture. There are also large differences among OIC countries in the historical, political, economic and social challenges that they face. Together OIC states possess about 70 per cent of the world's energy and 40 per cent of the world's mineral resources. They constitute about one quarter (1.5 billion) of the world's population, almost half of which comprises young people. Some OIC countries have also had a glorious past of scientific achievements. Despite this rich natural endowment almost 40 per cent of OIC member states are classified by the UNCTAD as low-income developing countries (LICs).[1]

The potential contribution of scientific and technological knowledge towards development has yet to be recognized in most OIC countries. This factor is particularly evident in the general under-investment in education and scientific research in these countries, a factor which results in the unequal distribution of resources and significant inequalities within their societies. In situations where knowledge does exist, it is seldom integrated into systems that can actually support development and decision-making that may lead to the development of indigenous technology capability building. Technological expertise lies at the core of economic development. To acquire comparative advantage in this era of globalization, regular innovations in products, processes and services are essential which in turn are to a large extent dependent on the scientific and technological capabilities of nations.

Rand Corporation[2] has developed a composite index for measuring a country's technological capacity covering input and output indicators. Countries are classified in four groups *(i) scientifically advanced, (ii) scientifically proficient, (iii) scientifically developing* and *(iv) scientifically lagging*. The 22 *scientifically advanced* countries include Japan, South Korea, Taiwan, Russia, Australia, Israel and countries of Western Europe and North America. The *scientifically proficient* countries include some countries in Asia, Europe and Latin America. They perform slightly above the international average in some areas and in other areas fall below the mean international value. The *scientifically developing* countries include 24 countries which operate at lower scientific capability. These countries have invested substantial amounts in science and technology but their scientific capacity still remains below the international average. Nine OIC countries placed in this group are: Turkey, Egypt, Iran, Pakistan, Uzbekistan, Benin, Kuwait, Turkmenistan and Indonesia. The remaining 49 OIC countries are grouped among the world's 80 *scientifically lagging* countries.

UNDP Technological Achievement Index (TAI)[3] classifies countries as *leaders, potential leaders, dynamic adopters* and *marginalized* countries. Not a single OIC member state is ranked among the 18 countries termed as *technology leaders*. Just two OIC member countries,

Malaysia and Turkey, are included in the group of 19 countries classified as *potential leaders*. Iran, Egypt, Indonesia, Tunisia, Algeria and Syrian Arab Republic are grouped among countries known as *dynamic adopters*. The rest of the OIC countries are classified as either *marginalized* or *others* for which complete data was not available. Availability of reliable data is a severe constraint in measuring the scientific capability of most OIC countries.

The higher income oil exporting OIC countries are also lagging behind in scientific and technological development due to their indifference and neglect of this sector for decades. Their under-investment in building human capital (HC) and quality institutions for scientific research has relegated them to a state of perpetual dependence on the developed countries for most of their technological needs. While international technology transfer is important for economic development, sustained social and economic development cannot be achieved without creating the requisite level of absorptive capacity by training and retaining a critical number of scientists and engineers within OIC countries. Misconceived priorities and traditional supply focused S&T policy approaches have not resulted in building systems or institutions which can transfer technical knowledge to economic advantage. Consequently even the low investments that these countries make to train their brightest are often lost due to the migration of much needed talent to developed countries. In USA 40 per cent of Ph.D. research and 50 per cent of postdoctoral research is conducted by immigrants.

There appears to be a growing realization in some OIC countries that scientific and technological capability is essential for national development. Following the economic and trade liberalization policies since late 90s, some OIC countries including Turkey, Egypt, Iran, Malaysia and Pakistan have invested substantially in higher education and building infrastructure for science and technology. These countries have developed a reasonable science base to attract international partners. (Turkish, Pakistani, Jordanian, Iranian, Egyptian scientists have participated in the recently launched project of Hedron Collidor. CERN has signed formal cooperation agreement with the governments of Algeria, Egypt, Iran, Jordon, Morocco, Pakistan, Saudi Arabia and UAE). Some oil rich countries such as Saudi Arabia, Qatar, Oman and UAE have also invested in attracting world class universities to establish their subsidiary campuses in their countries. Some experts have commented that planning has been faulty with funds being largely spent on building luxurious campuses and attracting foreign faculty with little investment in training and retaining high quality local scientist and engineers and investment directed at unleashing the creative potential of young population.

Sami Mahroum[4], has discussed the case of Dubai, ranked by Instead Global Innovation Index as the 14th innovation city of the world, and argues that there are different routes to innovation-driven economic prosperity. Dubai's innovation system has not emerged from its scientific or technological accomplishments or from world class universities but from its capacity to access foreign knowledge and through a mixture of financial, legal and infrastructure related incentives to attract the best brains from abroad. The Dubai Internet City and Knowledge Village houses 550 national and international media companies. This innovative initiative has created employment opportunities for 7,000 knowledge workers.[5]

This paper compares the relative scientific capabilities of OIC member states and those located within a geographic region. Input indicators such as higher education enrolments, R&D expenditure and number of researchers per million populations are compared with output indicators such as research papers published in international journals and USTPO patents granted to each country during a certain period. Research trends and collaboration of OIC countries is mapped in terms of coauthored papers published with scientists of developed countries, among scientists of OIC countries and between scientists of OIC countries located within a geographic region. OIC countries are benchmarked as "Scientifically Developing" to include countries which have developed infrastructure for scientific research in a few areas but in most others areas they still lag behind the international average. These countries have gradually increased their R&D expenditures in the past ten years they have a minimum of 300 researchers involved in R&D per million population and show a positive trend in research publications and filing of resident and international patents. "Scientifically Aspiring" countries are those that have in recent years increased their R&D expenditures and have attracted world class universities to establish their campuses. They have also attracted foreign talent including scientists, engineers and managers to work in their universities and research establishments. "Scientifically Lagging" countries are those that have not yet invested in building a scientific infrastructure for research.

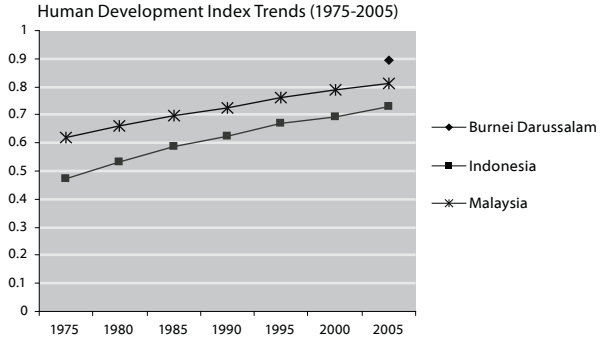
We are aware of the limitations of the indicators used for Mapping Scientific Knowledge of OIC countries in this paper. It would be wrong to presume that research papers published in Science Citation Index database of International Scientific Institution (ISI) or patents registered in the USA or other international patent offices accurately reflect the scientific knowledge produced in these countries. A large number of research papers in OIC countries are published in local journals written in local languages which are not covered by the ISI database as it primarily covers journals published in THE English language. These indicators cannot be applied to measure other knowledge systems such as traditional knowledge or knowledge related to local production systems which may be of great economic value to these countries.

I. Education – the prerequisite for scientific development

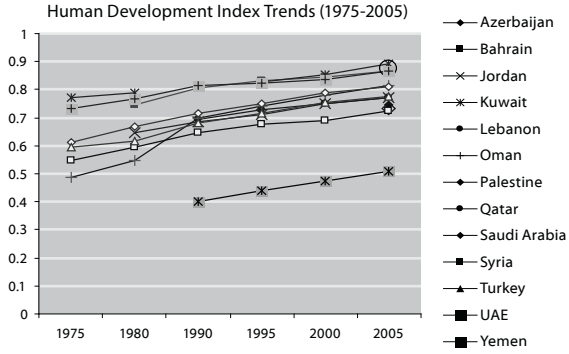
The average expenditure on education in OIC countries is about 4.0 per cent of GDP. The expenditure for the most highly populated OIC countries (Indonesia, Pakistan and Bangladesh) is half of the OIC average (2.1 per cent of GDP).[6] Only 11 OIC states have achieved above 90 per cent literacy. Among these 6 are the former Central Asian Soviet republics (Kazakhstan, Azerbaijan, Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan). 2 are oil rich countries (Kuwait and Brunei Darussalam) and the remaining 3 countries are with relatively small populations (Surinam, Palestine and Albania). 6 countries (Malaysia, Jordan, Indonesia, Bahrain, Lebanon, Qatar) have achieved above 80 per cent literacy. In 14 countries (mostly in North Africa and the oil rich Gulf region) the literacy rate is above 60.0 per cent. About 22 OIC countries (mostly in Africa and South Asia) have below 50 per cent literacy rates. Most of these countries are also classified by the UN as least-developing countries (LDCs). The UNDP Human Development Index (HDI) for OIC countries depicts sharp contrasts with Kuwait and Brunei ranked at 33rd and 34th from the top and Mali third-last at 175 and Niger ranked at the bottom at 177. The ten year trend of HDI (1975-2005) shows moderate progress for all OIC member states.[7]

Figures 1.1 to 1.9

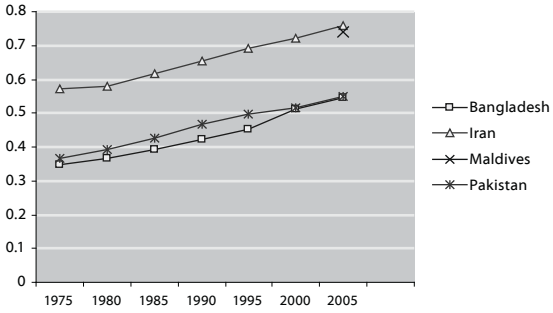
South East Asia
Human Development Index Trends (1975-2005)



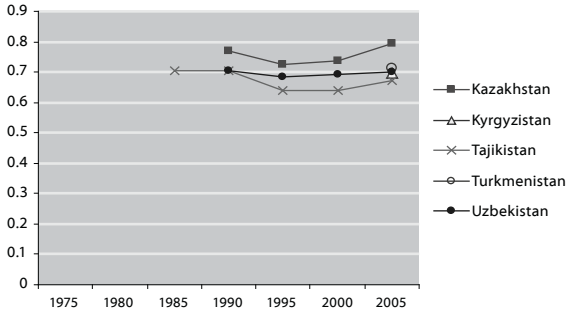
Western Asia
Human Development Index Trends (1975-2005)



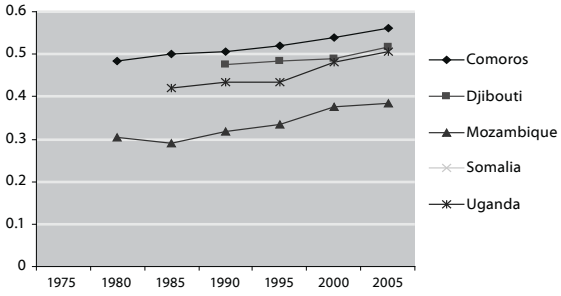
Southern Asia
Human Development Index Trends (1975-2005)



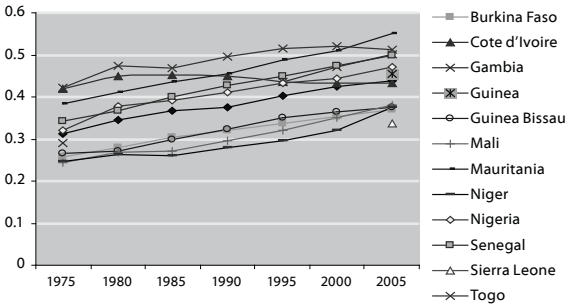
Central Asia
Human Development Index Trends (1975-2005)



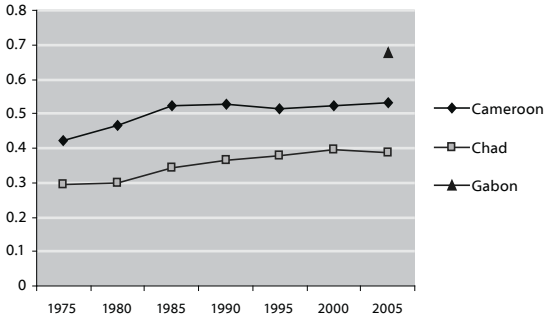
Eastern Africa
Human Development Index Trends (1975-2005)



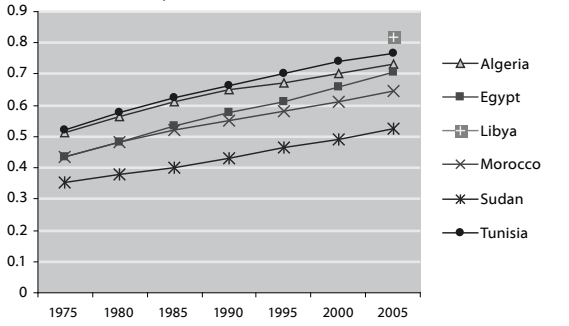
Western Africa
Human Development Index Trends (1975-2005)



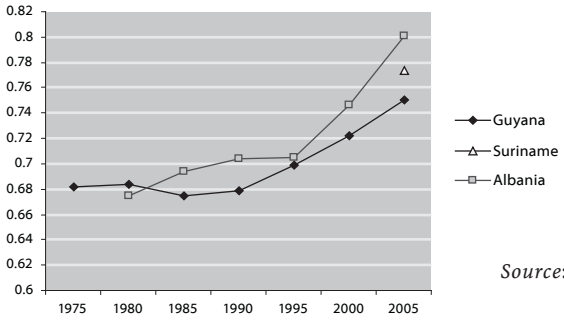
Middle Africa
Human Development Index Trends (1975-2005)



Northern Africa
Human Development Index Trends (1975-2005)



South America & European Region
Human Development Index Trends (1975-2005)



Source: Human Development Report 2007/08.

II. Higher Education

Several studies have been undertaken linking higher education attainments of nations to their achievements in economic development. A critical number of highly educated people are required by nations not only to manage their natural resources productively but also to absorb external knowledge for achieving national competitiveness. Several studies by UNCTAD and OECD have recommended that countries need to train their own economic managers, doctors, engineers, scientists and other specialists because almost all development related activities require specialized expertise in diverse fields of knowledge. Higher Education is therefore considered an imperative for development.

There are large disparities among OIC countries in terms of enrolments in higher education. The highest higher education enrolments for the relevant age group are reported from OIC countries located in West Asia, Central Asia and North Africa. (average 25 per cent for relevant age group), with Libya, Kazakhstan and Turkey leading at 53, 56 and 36 per cent respectively. The lowest enrolments (2-4 per cent of age group) are reported for the countries in West, East, and Middle African regions as well as South Asia with the exception of Iran where the higher education enrolments have risen substantially in the last decade to reach 24 per cent of the age group in 2005. Region-wise higher education enrolments and number of scientists, engineers per million population is presented in **Table 1**.

Table 1.
Researchers in R&D (per million people), Expenditure for R&D (as percentage of GDP) and Tertiary Gross Enrolments Ratio (percentage of relevant age group)

Name of Country	Researchers in R&D (per million population)	Expenditure on R&D (% of GDP)	Tertiary Gross Enrolments ratio (% of relevant age group)
West Asia			
Azerbaijan	1203 (2006)	0.25 (2005)	15.0 (2005)
Bahrain	N/A	N/A	33.1 (2005)
Iraq	N/A	0.5 (2004)	15.0 (2005)
Jordan	1927 (1990-05)	0.43 (2002)	39.0 (2005)
Kuwait	242 (1996-05)	0.2 (2006)	18.0 (2005)
Lebanon	N/A	N/A	51.0 (2005)
Oman	3.43 (2006)	N/A	15.0 (2005)
Palestine	N/A	N/A	41.1 (2005)
Qatar	N/A	N/A	18.6 (2005)
Saudi Arabia	140 (1996-04)	N/A	28.0 (2005)
Syria	29 (2006)	0.2 (2006)	14.8 (1997)
Turkey	476 (2006)	0.79 (2006)	31.0 (2005)
UAE	N/A	N/A	22.0 (2005)
Yemen	N/A	0.28 (2005)	9.0 (2005)

South East Asia			
Brunei Darussalam	274 (1990-05)	0.01 (2003)	15 (2005)
Indonesia	207 (1990-05)	0.1 (2006)	17 (2005)
Malaysia	509 (2006)	0.63 (2006)	32 (2005)
South Asia			
Afghanistan	N/A	N/A	1 (2005)
Bangladesh	77 (1996-04)	0.62 (2000-04)	6 (2005)
Iran	1279 (2006)	0.59 (2006)	24 (2005)
Maldives	N/A	N/A	0.2 (2004)
Pakistan	350 (2007**)	0.9 (2007**)	5 (2005)
Central Asia			
Kazakhstan	786 (2006)	0.28 (2006)	53 (2005)
Kyrgyzstan	397 (2007)	0.22 (2005)	41 (2005)
Tajikistan	N/A	0.10 (2006)	17 (2005)
Turkmenistan	N/A	0.6 (2006)	19.5 (1997)
Uzbekistan	1754 (1990-05)	0.3 (2006)	15 (2005)
West Africa			
Benin	N/A	0.7 (2006)	3 (2001)
Burkina Faso	19 (2006)	0.20 (2006)	2 (2005)
Cote d'Ivoire	N/A	N/A	6.5 (1999)
Gambia	N/A	N/A	1 (2005)
Guinea	342 (1996-04)	N/A	3 (2001)
Guinea Bissau	N/A	N/A	0.4 (2005)
Mali	N/A	N/A	3 (2005)
Mauritania	N/A	N/A	3 (2005)
Niger	N/A	N/A	1 (2005)
Nigeria	800 (2007)	1 (2004)	10 (2005)
Senegal	1.34 (2006)	0.11 (2005)	5 (2005)
Sierra Leone	N/A	N/A	2 (2005)
Togo	102 (1990-05)	N/A	3.6 (2001)
East Africa			
Comoros	N/A	N/A	2.3 (2004)
Djibouti	N/A	N/A	2.2 (2005)
Mozambique	132 (1996-04)	0.52 (2006)	1 (2005)
Somalia	N/A	N/A	2.5 (1997)
Uganda	37 (1996-04)	1.25 (2006)	3 (2005)
North Africa			
Algeria	N/A	0.19 (2004)	20 (2005)
Egypt	493 (1990-05)	0.49 (1995)	33 (2005)
Libya	361 (1990-05)	N/A	56 (2005)
Morocco	782 (1996-04)	0.75 (2006)	11 (2005)
Sudan	252 (2006)	0.4 (2006)	6.2 (2000)
Tunisia	1460 (2006)	1.35 (2006)	29 (2005)
Middle Africa			
Cameroon	28.31	N/A	6 (2005)
Chad	N/A	N/A	1 (2005)
Gabon	109 (1996-04)	N/A	7.10 (2005)

South America & Europe			
Albania	N/A	N/A	20 (2005)
Guyana	N/A	N/A	10.8 (2005)
Suriname	N/A	N/A	12.4 (2002)

Source: (a) Institut de la statistique du Quebec (http://www.stat.gouv.qc.ca/donstat/econm_finnc/ conjn_econm/compr_ inter/pdf/rechdev-ang.pdf), (b) UNDP, Human Development Report 2007/ 2008, (c) World Bank, World Development Indicators – 2007, (d) SESRIC (http://www.sesrtcic.org/stat_ database.php) (e) http://www.uis.unesco.org/ev.php?ID=2867_ 201&ID2= DO_TOPIC.

The quality of higher education can be judged by the number of research papers originating from institutions of higher learning and their impact in terms of citations and international patents. These are given in **Figures 2.1** to **10.1**.

III. OIC Research Universities

Information on world-wide ranking of universities is regularly published by several institutions: the two better known are Jiao Tong and Times Higher.[8, 9] Jiao Tong gives greater weightage to Nobel prizes won by scientists and citations of research papers whereas the Times Higher ranking places greater emphasis on capability of universities to attract international students. Although indicators used by both methods are different and have several limitations largely related to the verification and statistical analysis of data, what emerges from these studies is a set of good institutions occupying the top 100 ranking in the world, irrespective of the type of indicators or methods used for evaluation. None of the OIC universities are included in the ranking of top 100 universities by Jiao Tong or Times Higher.

The OIC organization of Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) has reported the existence of 1900 universities in OIC countries. SESRIC has analyzed data of 85 OIC universities using similar methodology to Shanghai Jiao Tong. The total number of research papers published by a university during 2005-07 was given a score of 65 per cent and a 17.5 per cent score was given to citations that those papers received. The weighted average of the score received from papers and citations was divided by the number of academic staff. This figure is also given a weightage of 17.5 per cent. Based on these indicators the ranking of top 30 OIC universities includes 17 from Turkey, 7 from Iran, 2 from Malaysia and one university each from Egypt, Pakistan, Kuwait and UAE **(Table 2)**. Regional distribution of the top 30 OIC universities show concentration in the region of West Asia (83 per cent), thus reflecting disproportional distribution of these knowledge centres among OIC countries.

Table 2.
University Ranking by Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC)

Rank	Country	University
1	Turkey	Hacettepe University
2	Turkey	Istanbul University
3	Turkey	Ankara University
4	Iran	University of Tehran
5	Turkey	Gazi University
6	Turkey	Middle East Technical University
7	Turkey	Ege University
8	Egypt	Cairo University
9	Turkey	Istanbul Technical University
10	Iran	Sharif University of Technology
11	Turkey	Dokuz Eylul University
12	Iran	Tarbiat Modares University
13	Turkey	Ondokuz Mayis University
14	Turkey	Erciyes University
15	Turkey	Ataturk Univeristy
16	Turkey	Inonu University
17	Iran	Shahid Beheshti University
18	Malaysia	Univeristy of Malaya (UM)
19	Iran	Tehran University of Medical Sciences and Health Services
20	Turkey	Marmara University
21	Malaysia	Universiti Sains Malaysia (USM)
22	Kuwait	Kuwait University
23	Turkey	Firat University
24	Turkey	Cukurova University
25	Iran	Institute for Studies in Theoretical Physics and Mathematics (IPM)
26	Turkey	Baskent University
27	Pakistan	Quaid-i-Azam University, Islamabad
28	Turkey	Selcuk University
29	UAE	United Arab Emirates University
30	Iran	Shiraz University

Source: Esat Bakimli, Ranking of Universities in OIC Member Countries: Progress and Challenges, Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

IV. OIC Centres of Excellence

The ISI database selects institutions world-wide on the basis of citations of research papers contributed by them. Institution counts are based on author affiliation given on the published paper. Only those institutions are considered for which a cumulative citation count of 10 or more years is available. Just 45 OIC institutions are included in the list of 3788 highly cited institutions world-wide, (**Table 3**). Among these, 17 institutions are from

Turkey, 11 are from Iran, 4 are from Egypt, 3 are from Saudi Arabia and 2 each are from Pakistan, Malaysia and Uganda. Also included in this list are institutions, one each from Kuwait, Lebanon, Oman and UAE respectively.

Table 3.
OIC Research Institutes (Highly Cited)

Sr. No.	Name of Institutes	Country
	East Africa	
1	Makerere University	Uganda
2	Uganda Virus Research Institute	Uganda
	North Africa	
1	Ain Shams University	Egypt
2	Cairo University	Egypt
3	Mansoura University	Egypt
4	University of Alexandria	Egypt
	West Asia	
1	Kuwait University	Kuwait
2	American University of Beirut	Lebanon
3	Sultan Qaboos University	Oman
4	King Fahd University of Petroleum and Minerals	Saudi Arabia
5	King Faisal Specialist Hospital & Research Centre	Saudi Arabia
6	King Saud University	Saudi Arabia
7	Akdeniz University	Turkey
8	Ankara University	Turkey
9	Ataturk University	Turkey
10	Başkent University	Turkey
11	Bilkent University	Turkey
12	Bogazici University	Turkey
13	Ege University	Turkey
14	Gazi University	Turkey
15	Gaziantep University	Turkey
16	Hacettepe University	Turkey
17	Inonu University	Turkey
18	Istanbul Technical University	Turkey
19	University of Istanbul	Turkey
20	Karadeniz Technical University	Turkey
21	Marmara University	Turkey
22	Nigde University	Turkey
23	Uludag University	Turkey
24	United Arab Emirates University	UAE

Sr. No.	Name of Institutes	Country
	South-East Asia	
1	University of Malaysia	Malaysia
2	Universiti Sains Malaysia	Malaysia
	South Asia	
1	Amirkabir University of Technology	Iran
2	Bu-Ali Sina University	Iran
3	Iran University of Science & Technology	Iran
4	Isfahan University of Technology	Iran
5	Islamic Azad University	Iran
6	Razi University	Iran
7	Sharif University of Technology	Iran
8	Shiraz University	Iran
9	Tarbiat Modarres University	Iran
10	Tehran University of Medical Science	Iran
11	Tehran University	Iran
12	Aga Khan University	Pakistan
13	Quaid-i-Azam University	Pakistan

Source: Essential Science Indicators (http://esi.isiknowledge.com/allmenus.cgi?option=I).

V. R&D Expenditure and Research Manpower in OIC Countries

Available statistics for R&D expenditure and R&D manpower for most OIC countries is sketchy. It is estimated that OIC countries, on average, spend less than 0.42 of their GDP on research and development. This compares poorly with the average of 2.8-3.5 per cent of the much higher GDPs of the developed countries of the world. More recently (2006-07) some oil rich countries such as Saudi Arabia, Qatar, Oman and UAE have made notable investments in order to attract world class universities to establish their subsidiary campuses in their countries. Dubai announced the creation of a US$10 billion fund to establish research centers in Arab universities and offer research grants to Arab scientists. Qatar Education City has attracted campuses of seven of the world's top universities. Saudi Arabia has laid the foundation of a new university city to be built with an estimated cost of US$2.6 billion dedicated to science and technology. Turkey, Pakistan, Egypt, Malaysia and Mozambique have also increased their R&D expenditure during the past decade.

Private sector R&D is linked to the achievement of innovation and international competitiveness. In this regard the relevant data is not available for most OIC countries. A World Bank study has reported the estimated average private R&D expenditure of 33 OIC countries between 10-30 per cent of their relatively smaller share of R&D expenditure as percentage of GDP compared to the 70 per cent share of average R&D expenditures of 2.6-4.0 per cent of the much larger GDP of OECD countries and 84 and 87 per cent share of the R&D expenditure of 3.0-3.6 per cent of GDP respectively of South Korea and Japan. [10]

Statistics on R&D manpower per million population for OIC countries (average 525) also compares poorly with developed countries (average 3780).[6] The average number for OIC Asia region (527) is higher than the African region (131 per million).

VI. OIC Scientists and Engineers

A recent COMSTECH study has assessed the life long research contributions of the leading scientists in OIC member states based on a set of quantitative and qualitative bibliometric indicators.[11] Scientists are ranked in their fields of study through the collective scores assigned on the basis of research related contributions. These contributions were assessed on the basis of the number of research papers published in international journals as single author, two, three or multiple authors, their citations and respective impact factors, students trained for Masters, M.Phil and Ph.D. training programmes, post graduate level research books authored or edited and published by international publishers, competitive international grants obtained, patents filed (USPTO, EPO or Triadic), research collaboration with international institutions and participation in international projects. 381 OIC scientists who have published a minimum of 40 research papers in ISI abstracted journals were selected for this study.

The maximum number of scientists who qualified for this study were from Turkey (81), followed by Pakistan (62), Iran (55), Egypt (45), Malaysia (27) and Saudi Arabia (17). Discipline-wise distribution of scientists shows research concentration in the fields of chemistry, physics, biology and medicine. Mathematics, engineering, earth sciences and environmental sciences are relatively weaker areas of research. The top 100 scientists who received higher citations, above the world average, in their respective fields of study (for five best research papers) were from Malaysia, Pakistan, Iran, Egypt and Turkey.

The majority of the leading research scientists in the OIC member states working in the rich oil producing countries such as Saudi Arabia, Qatar, Oman, Kuwait and UAE were not of local origin but were visiting foreign scientists. It is alarming that these countries have very few scientists of native origin working in their institutions, indicating their failure to attract local talented students to adopt careers in science or engineering, resulting in the lack of an intrinsic long-term national commitment for the indigenous development of these disciplines.

VII. Most Cited Researchers of OIC Countries

Thomson ISI has carried out an analysis of 19 million papers published during 1981-1999, authored by five million scientists. Out of these 5,000 researchers are selected world wide for the maximum number of citations that they receive on their research papers published in 21 scientific fields. This represents approximately 250 researchers selected in each field which are a very small number (0.1 per cent) that are involved in top quality research. Most of the highly cited scientists are working in US institutions (4034), followed by Western Europe (978). Just three scientists, one each from Turkey, Iran, Pakistan and Algeria are included in the list of the most cited scientists. Further studies on the affiliation of most cited scientists has reported the clustering of these scientists in the world's top ranking universities and research establishments.[12]

Table 4.
Field strengths of some OIC countries based on citations of research papers 1998-2008

Sr. No.	Country	Field strengths
1	Egypt	Chemistry
2	Iran	Chemistry
3	Morocco	Chemistry
4	Algeria	Chemistry
5	Malaysia	Chemistry
6	Turkey	Clinical Medicine
7	Pakistan	Clinical Medicine
8	Tunisia	Clinical Medicine
9	Saudi Arabia	Clinical Medicine
10	Jordan	Clinical Medicine
11	United Arab Emirates	Clinical Medicine
12	Kuwait	Clinical Medicine
13	Oman	Clinical Medicine
14	Nigeria	Clinical Medicine
15	Lebanon	Clinical Medicine
16	Indonesia	Clinical Medicine
17	Bangladesh	Clinical Medicine
18	Qatar	Engineering
23	Kazakhstan	Physics
24	Uzbekistan	Physics
25	Syria	Plant & Animal Science
26	Benin	Plant & Animal Science

Source: Essential Science Indicators
http://esi.isiknowledge.com/rankdatapage.cgi?thvalue=0&thvalue=0&thresholdon=1&sortby=1&option=C&search=%28All%20Fields%29&searchby=F&displayalphabet=&x=46&y=8&currpage=4

VIII. OIC Rising Stars

ScienceWatch.com is a bimonthly online Newsletter of Thomson Reuter and provides information on ranking of scientists, institutions, countries and journals in 22 broad fields of Sciences using the Essential Science Indicators database. Ten year citations data plus some number of consecutive bimonthly periods are used to determine the rankings. Since the database is updated every two months, it is possible to track improvements. In September 2008 and in January 2009 Issues of ScienceWatch.com Pakistan and Iran are selected as Rising Stars on the basis of having received maximum citations in multiple fields. (**Table 5**). Other OIC countries included in the list of Rising Stars are: Tunisia, Nigeria and UAE.

Table 5. Rising Stars

Sr. No.	Country	Field
1	Tunisia	Agricultural Sciences
2	Nigeria	Biology & Biochemistry
3	Iran	Clinical Medicine
4	Pakistan	Computer Sciences
5	U Arab Emirates	Economic & Business
6	Pakistan	Engineering
7	Iran	Environment / Ecology
8	Nigeria	Immunology
9	Pakistan	Material Sciences
10	Pakistan	Mathematics
11	Tunisia	Microbiology
12	U Arab Emirates	Pharmacology & Toxicology
13	Pakistan	Plant & Animal Sciences

Source: Science Watch.Com
sciencewatch.com/dr/rs/08sep-rs.

IX. Publication Trends and Impact (Regional Comparisons)

OIC countries contribute only 4.18 per cent of the total research papers in world scientific publications. Among the top 25 countries ranked by their share of papers in science, medicine and engineering published in ISI abstracted international journals only one OIC country, Turkey, is included with its share of 1.22 per cent. A ten year (1998-2007) analysis of research papers contributed by scientists of OIC countries shows great disparities among countries as well as countries within a certain geographic region.

The impact of research may be measured from citations as well as patents filed or granted by national and international patent institutions. Citations depend on the circulations of the journals and vary greatly from one field to another. Research papers published in the fields of medicine and biology tend to receive higher citations than those published in the field of mathematics or physics. Citations also differ for sub-fields and for specific areas of research. Citation per paper is often used as a measure of quality of research. However it appears that citations per paper cannot be used as a reliable indicator to compare impact of research papers contributed from different OIC countries as higher citations per paper for a small number of papers can provide an unrealistic picture for comparing their relative scientific capability. This study has therefore relied on using cumulative citations and patents (international only) as a measure of the quality of research.

Patent statistics are often used as a measure of commercial output generated by research. The OIC countries contributed just 0.05 per cent to the share of patents granted in the United States of America during 1963-2007. Patent statistics from the World Intellectual Property Organization (WIPO) for applications filed by residents and non-residents during 1997 -2006 world wide show just 0.56 per cent contribution in the patent applications filed by residents and 2.12 per cent from non-residents of OIC countries.[13,14]

X. Scientific Collaboration among OIC Countries

This study has used internationally coauthored publications for analysis of the pattern of collaboration. This provides quantitative measurement but does not give a full picture of collaboration as relative contributions from individual authors can not be judged. The time scale (1998-2007) of coauthored papers measurements is the same as that used for counting research papers published from these countries in international journals. The source is ISI web of science database. Two visible trends of research collaboration are observed. When one considers the collaboration of Scientists in OIC member states with scientists in other countries one finds that scientist in OIC countries on average publish 80-90 per cent of all such papers in collaboration with scientists in developed countries. Only about 10-20 per cent of research papers are published in collaboration with scientists in other OIC countries. Within this wide matrix, research collaboration is governed by the level of scientific development of member states. First, scientists of countries with relatively better scientific capabilities such as Turkey, Iran, Malaysia and Pakistan tend to collaborate not only with scientists of developed countries but also with scientists of OIC countries, second, countries with limited scientific capabilities tend to publish primarily with scientists in developed countries. Third, OIC countries with scant scientific infrastructure and very low level of scientific capabilities tend to publish exclusively with scientists in the developed countries. The reason for this could be the individual initiatives of few scientists and researchers who received their postgraduate training in the western countries and their reliance on their networks of research which they forged while studying abroad. Regional research collaboration among OIC countries is insignificant.

West Asia

This region hosts a group of 14 OIC member states: Turkey, Saudi Arabia, Jordan, Azerbaijan, Palestine, Yemen, Qatar, Iraq, Bahrain, Syria, Oman, UAE, Lebanon and Kuwait. OIC countries in this region have collectively published 141,520 research papers during 1998-2007 with 70 per cent contribution from Turkish institutions. Next is the group Saudi Arabia, Jordan, Kuwait and Lebanon which published 23 per cent of the research papers. The remaining 11 countries including Azerbaijan, Palestine, Yemen, Qatar, Iraq, Bahrain, Syria, UAE, Palestine, Iraq and Oman collectively contributed just 7.0 per cent of the total papers published from this region.

Ten-year trends of research papers for this region are promising with Turkey

Fig 2.1 **Annual Output in Science & Social Science**

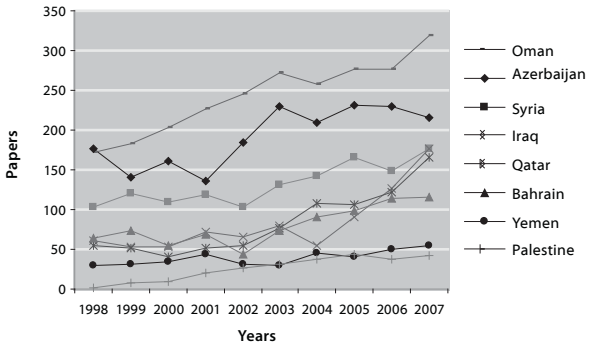
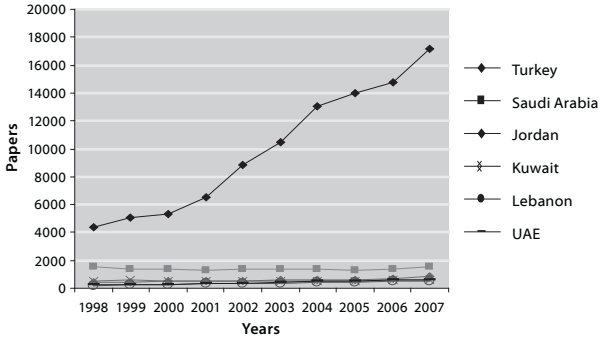


Fig 2.2 **Annual Output in Science & Social Science**



showing a rapid increase in the number of papers from 1998 till today. A relatively slower increase is seen in the number of papers published by Saudi Arabia, Jordan, Kuwait, Lebanon and UAE. The remaining countries in the region have published less than 300 papers each in the ten year period (1998-2007).

Only four countries from this region have filed national and international patents. Resident applications by Turkey are much higher than from Saudi Arabia, Uzbekistan and Jordan, (figure 2.5). The maximum number of USPTO patents during 1963-2007 were granted to Saudi Arabia (280) and Turkey (191).

This region can be termed as the most prolific OIC region in terms of research papers published in international journals and for filing national and international patents.

The region hosts 24 out of 45 of the most cited research institutions of the member states, of which 17 are from Turkey 3 from Saudi Arabia and remaining 4 from UAE, Kuwait, Lebanon and Oman.

Figure 2.6, represents the percentage of research papers coauthored by scientists in OIC countries within the region, with other OIC countries and with scientists of non OIC countries.

On average about 60-70 per cent of research collaboration for all countries in this region is reported with non-OIC countries with a relatively higher number of papers published in collaboration with US scientists. Research collaboration with other

OIC countries for Turkey, Kuwait, Lebanon and UAE ranges from a minimum of 3 per cent for Lebanon to 15 per cent for Kuwait. Higher collaboration between 20-26 per cent with other OIC countries is observed for Qatar and Saudi Arabia.

Fig 2.3 **Relative Impact**

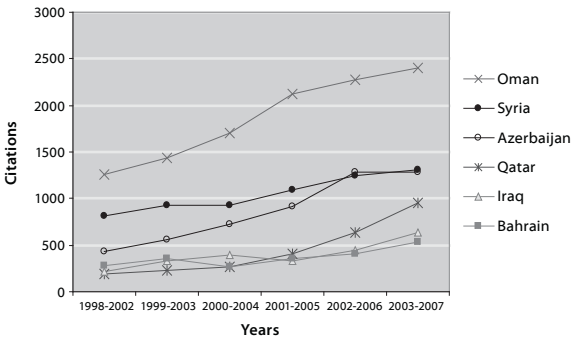


Fig 2.4 **Relative Impact**

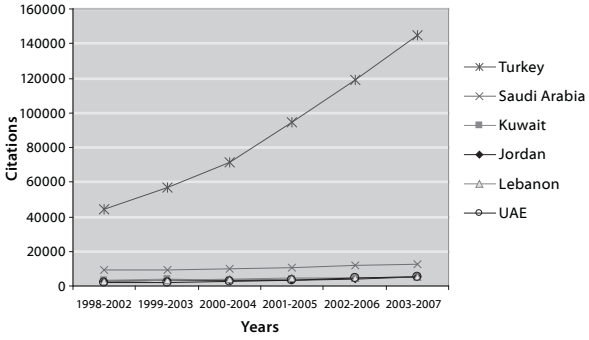


Fig 2.5 **Patent applications by office, breakdown by resident & non-resident (1997-2006) & USPTO by country of origin (1963-2007)**

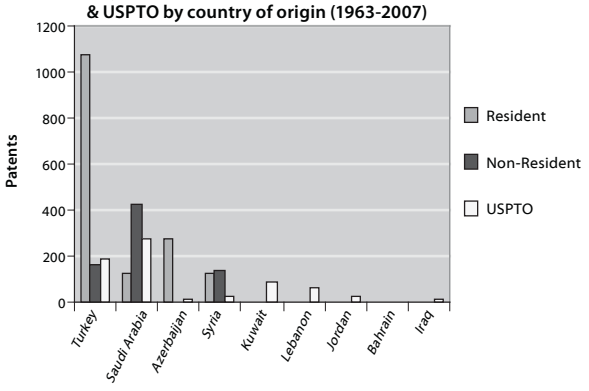
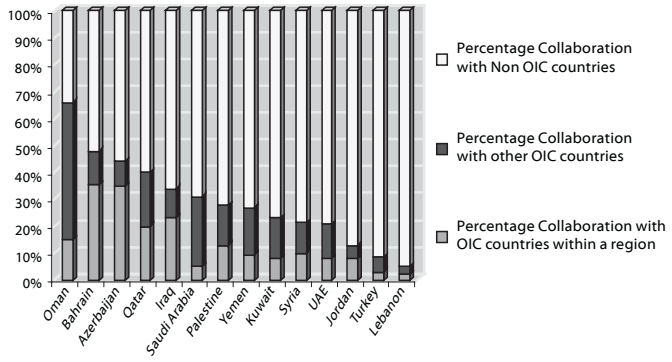


Fig 2.6 **Percentage Collaboration with OIC & Non OIC Countries**



South Asia

The five OIC countries in this region, Iran, Pakistan, Bangladesh, Afghanistan, Maldives have contributed 47,325 research papers during 1998-2007. Iran has contributed 69.6 per cent papers of the regions total published papers while Pakistan and Bangladesh together have 30 per cent of the region's share. There is insignificant contribution by Afghanistan and Maldives.

Publication trends show a sharp rise in the number of research papers published by Iran in past five years. A steady increase in research papers published by Pakistan has also been observed since 2002. For Bangladesh, Maldives and Afghanistan there is no significant increase.

Relatively higher number of resident patent applications (691) were filed by Iran compared with Pakistan (58) and Bangladesh (22) during the period (1997-2006). During 1963-2007 Iran was granted 73, Pakistan 38 and Bangladesh 2 USPTO patents only.

Regarding collaborative research with scientists of other countries, the scientists of all four countries in the region published 90.5 per cent of papers in collaboration with scientists working in the developed countries. Only 1.2 per cent of research papers were published in collaboration with OIC scientists.

Fig 3.1 **Annual Output in Science & Social Science**

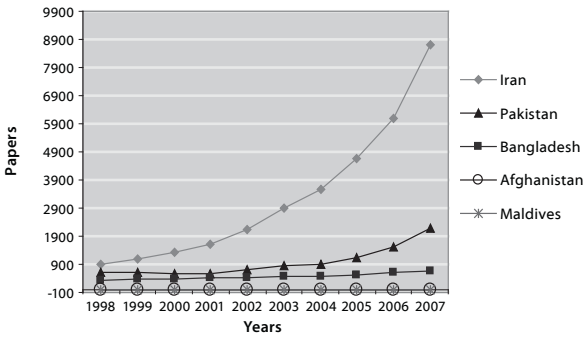


Fig 3.2 **Relative Impact**

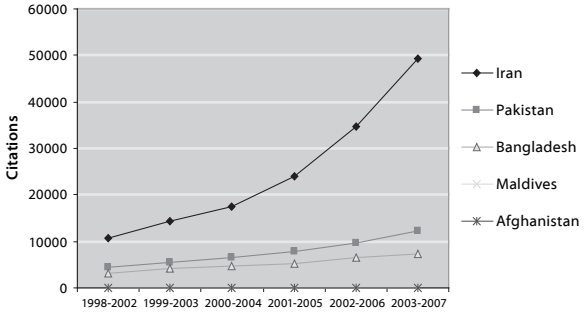


Fig 3.3 **Patent applications by office, breakdown by resident & non-resident (1997-2006) & USPTO by country of origin (1963-2007)**

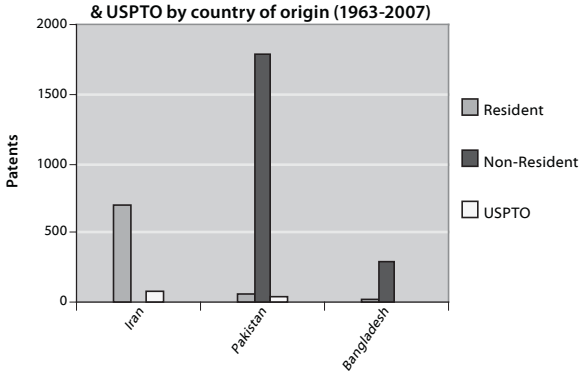
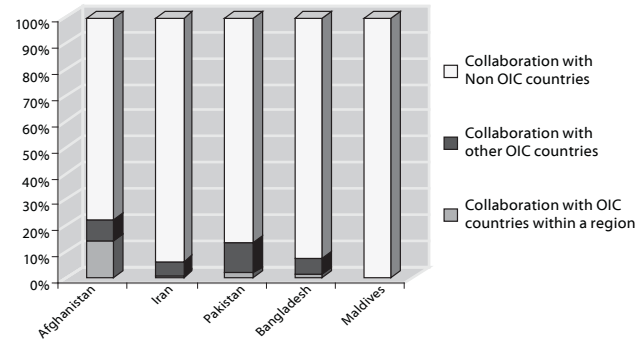


Fig 3.4 **Percentage Collaboration with OIC & Non OIC Countries**



South East Asia

In this region a total of 17,921 research papers were contributed by the three OIC countries, Malaysia, Brunei Darussalam and Indonesia. Malaysia leads with 70 per cent of the total number followed by Indonesia (28 per cent) and an insignificant contribution by Brunei Darussalam.

Malaysia was granted 795 USPTO patents and is considered the innovation leader of the OIC. Indonesia was granted 173 patents during the same period (1963-2007). WIPO data (1997-2006) on patent applications filed by residents and non-residents for Malaysia reveals only 179 patent applications by residents compared to 6272 by non-residents. No patent application, either nationally or internationally has been reported for Brunei Darussalam.

The pattern of research collaboration is similar to that observed for OIC states in the South Asia region with majority of inter-institutional collaborative papers published with scientists in developed countries. Only 1.3 to 5.4 per cent of the total papers were published in collaboration with scientists in OIC countries.

Fig 4.1 **Annual Output in Science & Social Science**

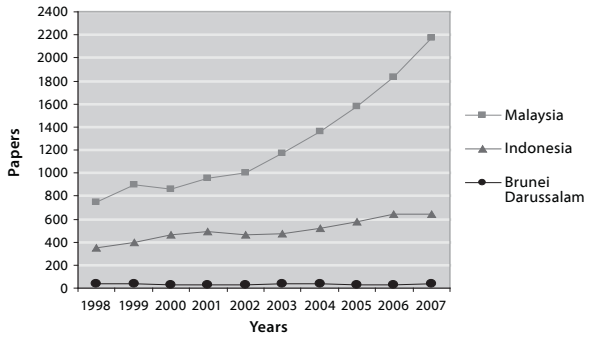


Fig 4.2 **Relative Impact**

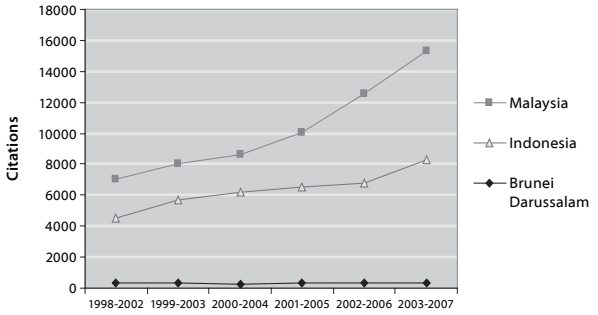


Fig 4.3 **Percentage Collaboration with OIC & Non OIC Countries**

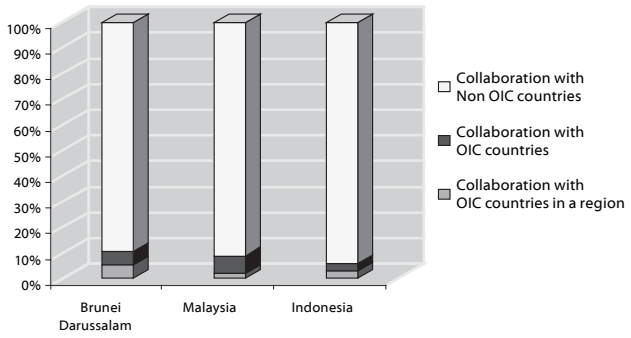
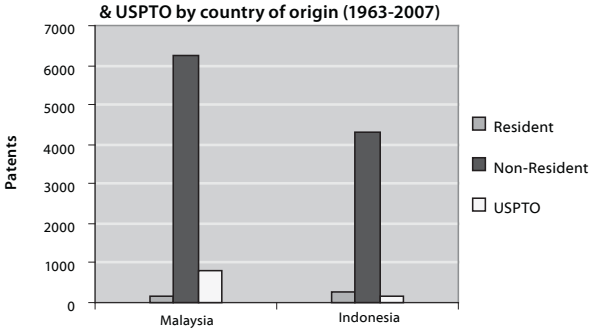


Fig 4.4 **Patent applications by office, breakdown by resident & non-resident (1997-2006) & USPTO by country of origin (1963-2007)**



Central Asia

The five Central Asian OIC states, Uzbekistan, Kyrgyzstan, Kazakhstan, Turkmenistan and Tajikistan have published 5966 research papers during 1998-2007 with 86.6 per cent of papers originating from Uzbekistan and Kazakhstan only. About 12 per cent papers are contributed by Tajikistan and Kyrgyzstan and just 1 per cent by Turkmenistan.

From this region Kazakhstan has filed the maximum number of resident patent applications (1,433) followed by Uzbekistan, Kyrgyzstan, Turkmenistan and Tajikistan in descending order (figure 5.3). Only three states Kazakhstan, Uzbekistan and Kyrgyzstan have been granted USPTO patents (21, 12 and 3 respectively) during 1963-2007.

As observed in general for most OIC countries the five Central Asian states have published 83.6 per cent papers mostly in collaboration with Russia, Eastern Europe, Western Europe and USA. Only 9 per cent papers were published through regional collaboration and 7.3 per cent through collaboration with other OIC countries.

Fig 5.1 **Annual Output in Science & Social Science**

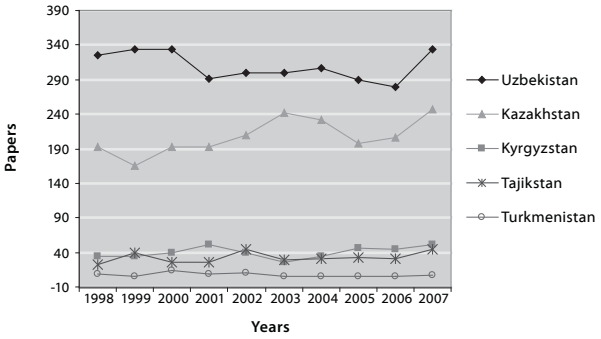


Fig 5.2 **Relative Impact**

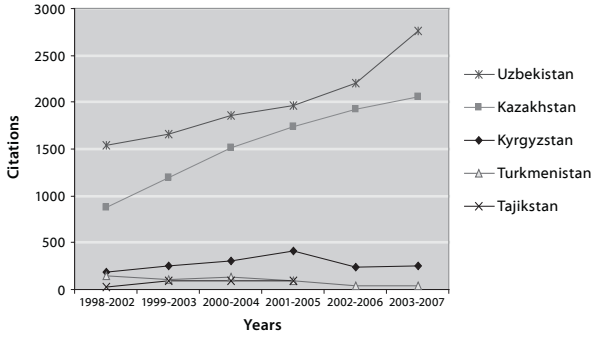


Fig 5.3 **Patent applications by office, breakdown by resident & non-resident (1997-2006) & USPTO by country of origin (1963-2007)**

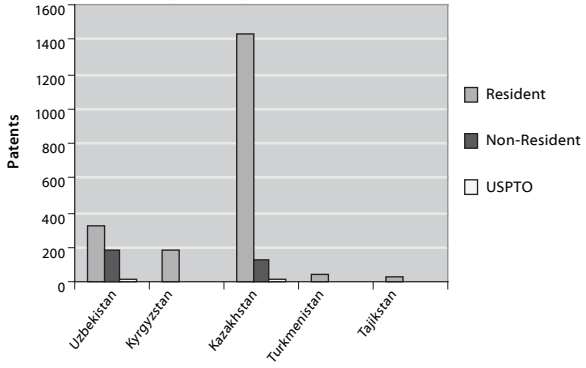
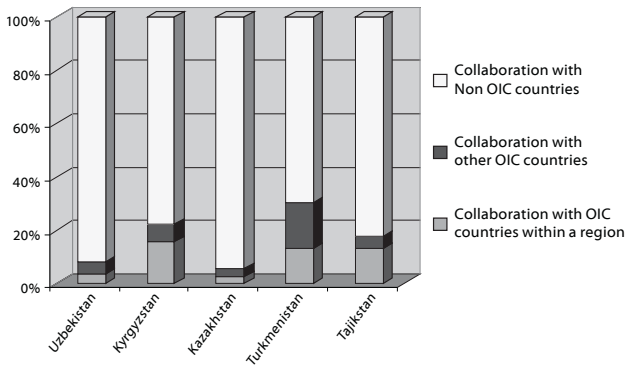


Fig 5.4 **Percentage Collaboration with OIC & Non OIC Countries**



East Africa

Five OIC countries from this region, Uganda, Mozambique, Somalia, Comoros and Djibouti have published just 2704 papers in international journals during 1998-2007.

Most of the research papers (81 per cent) were published from Uganda. Mozambique has contributed 16 per cent of the total research papers published by OIC countries in this region. There was insignificant contributions from Somalia, Comoros and Djibouti.

Trends show a significant rise in research papers from Uganda since 2002. No noticeable increase in published research papers was seen from other countries in the region.

Inter-institutional research collaboration patterns indicate 90 per cent of coauthored papers published with developed countries and just 10 per cent with other OIC countries. There are negligible number of papers (0.8 per cent) published in collaboration with scientists working in the OIC countries of this region.

Fig 6.1 **Annual Output in Science & Social Science**

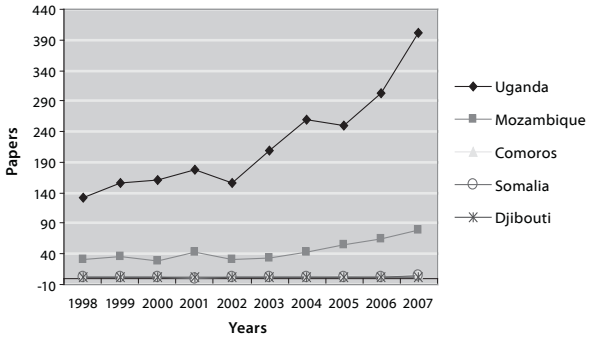


Fig 6.2 **Relative Impact**

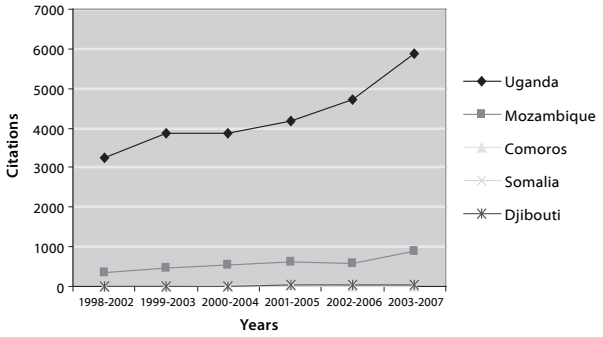
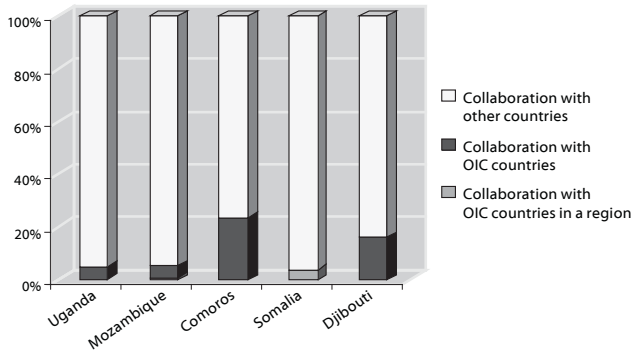


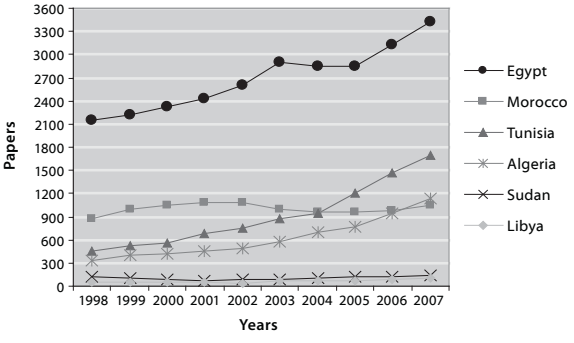
Fig 6.3 **Percentage Collaboration with OIC & Non OIC Countries**



North Africa

Six OIC member states located in this region contributed 53,942 research papers in the ten-year period (1998-2007) with 50.0 per cent of the papers being published by Egypt. The rest (47.0 per cent) were published by Morocco, Tunisia and Algeria combined and just 3.0 per cent were published by Sudan and Libya.

Fig 7.1 **Annual Output in Science & Social Science**



Trends in research publications during 1998-2007 show a gradual increase in papers published from Egypt, Morocco and Tunisia (figure 7.1). For Sudan, Libya and Algeria no noticeable increase in research papers has been observed in the ten year period studied.

There is insignificant research collaboration between scientists working in this region.

Just 3.3 per cent of papers are published with regional collaboration as compared to 85 per cent published in collaboration with scientists in West Europe and USA.

Fig 7.2 **Relative Impact**

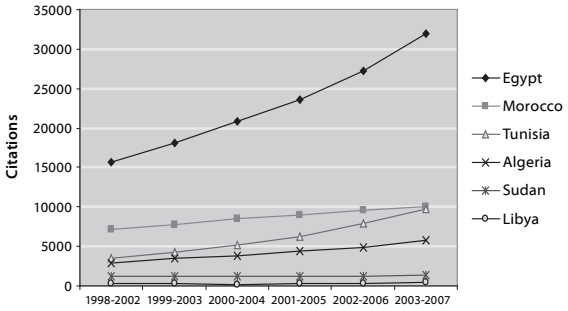
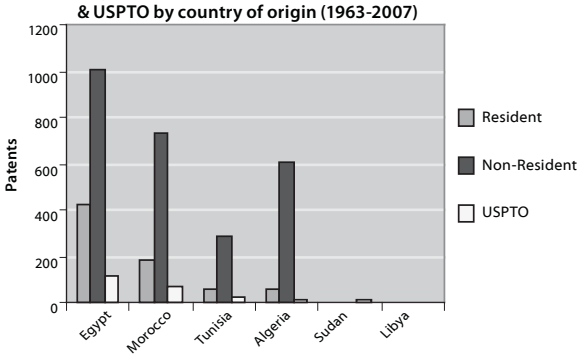


Fig 7.3 **Patent applications by office, breakdown by resident & non-resident (1997-2006) & USPTO by country of origin (1963-2007)**



West Africa

Fig 8.1 **Annual Output in Science & Social Science**

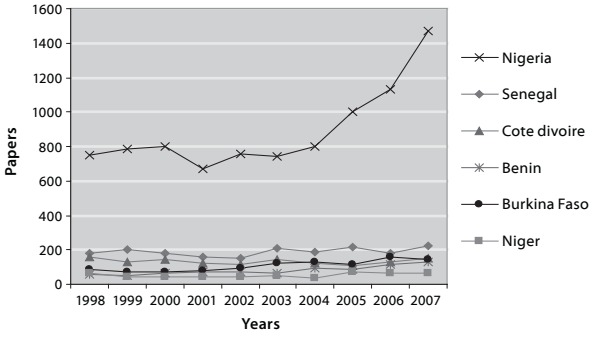


Fig 8.2 **Annual Output in Science & Social Science**

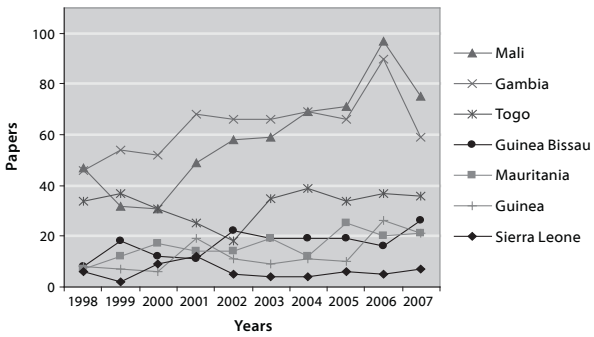
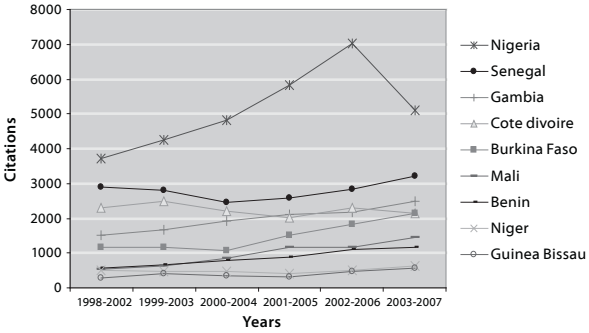


Fig 8.3 **Relative Impact**



Fourteen OIC member states from this region published 14,518 research papers during 1998-2007 with more than half of the papers (61 per cent) being published from Nigeria. Three other member states located in this region, Senegal, Cote d'Ivoire and Burkina Faso together published 30 per cent of the region's research

papers. The average number of papers published from these countries is about 10 per year. The remaining 9 countries (Sierra Leone, Gambia, Burkina Faso, Mauritania, Guinea Bissau, Togo, Mali, Niger and Guinea) have made insignificant contributions.

Ten-year trends show positive growth for Nigeria. For the remaining 13 countries no significant increase in research papers is observed during the period under study.

In this region only Burkina Faso, Guinea, Guinea Bissau and Mali have published between 15-20 per cent of the total papers published in collaboration within the regional OIC countries. The average collaboration pattern in this region for all countries shows that almost 80 per cent of the papers published in collaboration with foreign countries were with France, USA and other developed countries, while only 5.5 per cent of the papers were published with other OIC countries outside the region.

Fig 8.4 **USPTO by country of origin (1963-2007)**

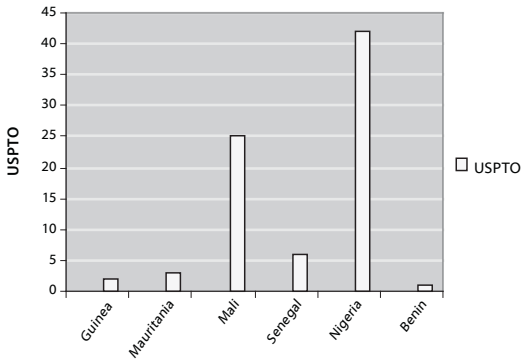
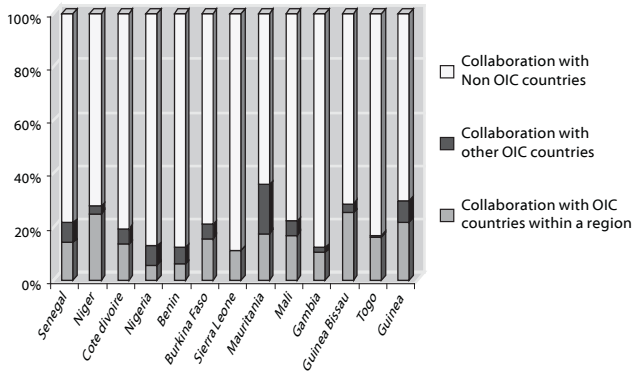


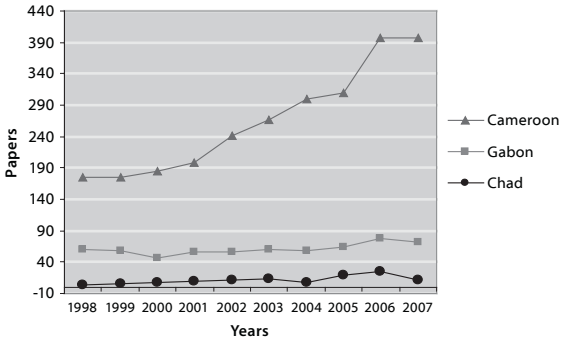
Fig 8.5 **Percentage Collaboration with OIC & Non OIC Countries**



Middle Africa

The three OIC countries located in this region, Chad, Gabon and Cameroon, contributed 3373 research papers with Cameroon contributing 78 per cent of the total.

Fig 9.1 **Annual Output in Science & Social Science**



Ten-year publication trends show relatively positive increase for Cameroon. There is no increase in research papers from Chad or Gabon.

Research collaboration between the regional OIC countries is just 3.3 per cent of the total inter-institutional coauthored papers published. These three OIC countries also collaborate preferably with scientists of Western Europe and USA with 85 per cent coauthorship with scientists of these countries. Collaboration with OIC countries outside the region is just 11.7 per cent of the total coauthored papers published.

Fig 9.2 **Relative Impact**

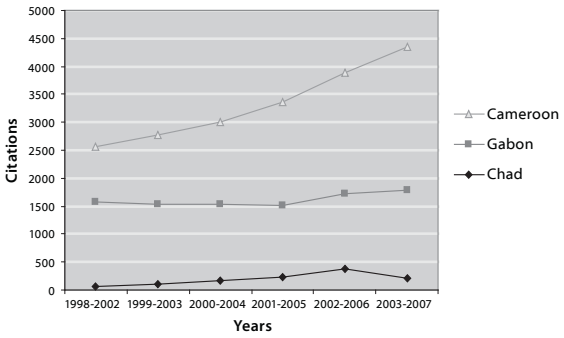
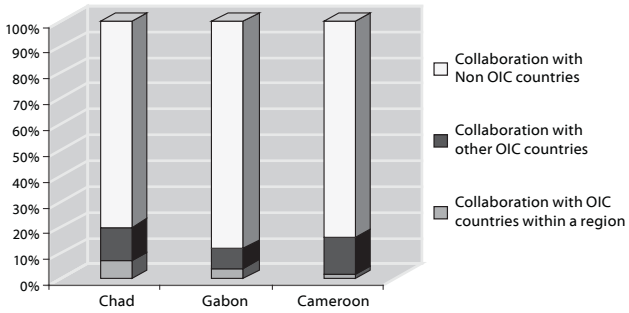


Fig 9.3 **Percentage Collaboration with OIC & Non OIC Countries**



South America

There are just two OIC Member states located in this region, Guyana and Suriname. Guyana has contributed 127 research papers and Suriname 37 papers only during 1998-2007.

Research collaboration with foreign countries show 98 per cent papers published in collaboration with scientists of USA and western European countries. Only 0.2 per cent of the papers were published in collaboration with the other OIC countries in the region and 1.9 per cent with other OIC countries.

Suriname was granted 4 and Guyana 7 USPTO patents between 1963-1994.

Fig 10.1 **Annual Output in Science & Social Science**

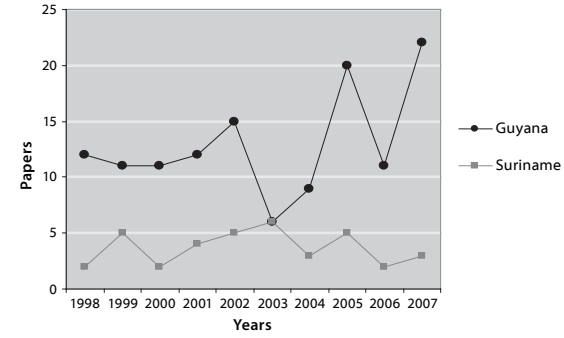
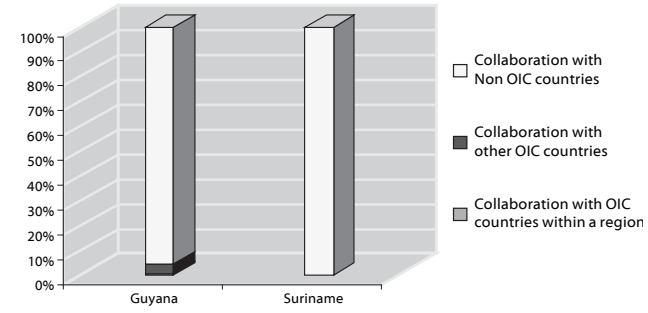


Fig 10.2 **Percentage Collaboration with OIC & Non OIC Countries**



Figures 2.1, 2.2, 2.3, 2.4, 2.6, 3.1, 3.2, 3.4, 4.1, 4.2, 4.3, 5.1, 5.2, 5.4, 6.1, 6.2, 6.3, 7.1, 7.2, 8.1, 8.2, 8.3, 8.4, 8.5, 9.1, 9.2, 9.3, 10.1, 10.2
Source: Thomson ISI Web of Knowledge

Figures 2.5, 3.3, 4.4, 5.3, 7.3
Source: U.S. Patent and Trademark office (1963-07); World Intellectual Property Organization; 1997-06 (data refers to most recent year available during the period specified)

Europe

Only one OIC country, Albania, located in this region has published 332 research papers during 1998-2007. The co-authorship pattern of papers with foreign countries shows 98 per cent collaboration within Europe and USA and just two per cent of papers coauthored with scientists in other OIC countries. Only one USTPO patent was granted to Albania during 1963-2007.

XI. Conclusions

The analysis of research related indicators of OIC countries presented above highlights serious knowledge, information and research gaps between OIC countries and the developed countries. While these gaps are widening and while it appears difficult to bridge these gaps, there are examples of countries such as Turkey which have made tremendous progress in training high quality scientists and engineers and developing a sound scientific research infrastructure in the past decade. This is evidenced by a rapid increase in the number of international publications by Turkish researchers. Since 1997 Turkey has risen from 27th to 19th in world ranking based on the number of scientific publications as well as a substantial increase in filing of patents. 17 of its universities are listed among the most cited institutions in the world. In recent years Turkey has also increased its expenditure on research and development from 0.6 per cent to 1.0 per cent of GDP.

There are large disparities in the scientific capacities of OIC countries located in different geographic regions of the world and between countries located within the same region. West Asia can be termed as the most productive of the OIC regions as almost half of the total of 289,836 research papers from OIC countries published in international journals during the period 1988-2007 were from West Asia. Turkey with 70 per cent of the total publications from the region remains the most prolific country. Others include Saudi Arabia, Qatar, UAE, Kuwait and Oman. These countries have in recent years increased their investment in developing a world class infrastructure for higher education, science and technology. *The Economist* magazine has recently ranked Saudi Arabia in the seventh position in the world with respect to developing a world class infrastructure for higher education although it lags far behind developed countries in training of high quality indigenous research manpower or output of international publications and patents.

The second productive region of OIC in terms of research publications is North Africa. With its glorious history of scientific achievements, it is not surprising that Egypt leads the region in contributing 50 per cent of the region's total. The remaining contributions are by Morocco, Tunisia and Algeria. Tunisia with a population of only 10 million published more research papers than Indonesia that has the largest population of 220 million among the OIC countries.

In South Asian region a sharp rise in the number of research publications has been achieved by Iran which contributed 70 per cent of the total published from this region. Pakistan also increased its output substantially since 2003 due to a quantum jump in investment in higher education and R&D. Science Watch in its September 2008 issue has ranked Pakistan on top of the list of countries termed as Rising Stars based on achieving

the highest percentage increase in total citations of research publications in multiple fields. (Other OIC countries listed as Rising Stars are Iran, Nigeria, Tunisia and the United Arab Emirates).

In the East Asia region Malaysia leads not only in the number of research papers but also in the number of patents filed. Malaysia is relatively new to fostering scientific research. It began investing in higher education in the 1970s but this investment has demonstrably paid off as evidenced by its development achievements. Malaysia has been granted the highest number of USPTO patents 579 during 1964-2007 and its share of high technology exports (58 per cent of the total exports) is also much higher than other OIC countries. On the other hand Indonesia is the most populated OIC country but its 10 year research output is half that of Malaysia. Brunei Darussalam, despite its immense oil wealth, has not invested in any notable manner in science and technology.

In other OIC regions, countries such as Nigeria in West Africa, Cameroon in East Africa and Uzbekistan and Kazakhstan in central Asia have made investments in developing an infrastructure for science and technology. In the year 2006 the President of Nigeria announced an allocation of US$5 billion to establish a national science foundation. Nigeria is also the largest contributor of research papers from the region of West Africa. The scientific output of Cameroon and Uzbekistan is relatively low. The remaining OIC countries, mostly located in Africa, show very limited scientific capabilities.

Based on the assessment of research related indicators mentioned above, OIC countries have been placed in three categories:

1. **Scientifically Developing** which include Turkey, Iran, Egypt, Malaysia, Pakistan, Tunisia, Nigeria, Saudi Arabia, and Morocco.
2. **Scientifically Aspiring** which include Jordan, Qatar, Kuwait, Lebanon, Oman, United Arab Emirates (UAE), Uganda, Algeria, Cameroon, Uzbekistan, Kazakhstan, Bangladesh and Indonesia.
3. **Scientifically Lagging**: Afghanistan, Albania, Azerbaijan, Bahrain, Benin, Brunei, Burkina Faso, Chad, Comoros, Cote d'Ivoire, Djibouti, Gabon, Gambia, Guinea, Guinea Bissau, Guyana, Iraq, Kyrgyzstan, Libya, Mali, Maldives, Mauritania, Mozambique, Niger, Palestine, Senegal, Sierra Leone, Sudan, Suriname, Somalia, Syria, Tajikistan, Togo, Turkmenistan, Yemen.

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References

1. UNCTAD, The Least Developed Countries Report 2007, **http://www.unctad.org**

2. Caroline S. Wagner, Irene Brahmakulam, Brian Jackson, Amy Wong, Tatsuro Yoda, Science and Technology Collaboration: Building Capacity in Developing Countries? Rand Science and Technology Report. (2001)

3. Meghnad Desai, Sakio Fukuda-Parr, Claes Johansson and Fransisco Sagasti. Measuring the Technology Achievement of Nations and the Capacity to Participate in the Network Age, Journal of Human Development, vol. 3, No.1, (2002)

4. Sami Mahroum, Different routes to innovation, Financial Times (2008) **http://www.ft.com/cms/s/0/b8fe105a-5f40-11dd-91c0-000077b07658.html**

5. Kristin M. Lord, A new Millennium of Knowledge, The Arab Human Development Report on Building a Knowledge Society, Five Years On. Analysis Paper, Saban Centre, Brookings (2008).

6. Science and Technology in the OIC Member Countries, Executive Summery, Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), **www.sesrtcic.org**

7. UNDP. Human Development Report 2007/ 08

8. Shanghai Jiao Tong University, **http://www.arwu.org/rank**

9. Times Higher Education, **http://www.topuniversities.com/worlduniversityrankings/results**

10. Knowledge Assessment Methodology (KAM), World Bank, **http://info.worldbank.org/etools/kam2/KAM_page3.asp**

11. S.T.K Naim, Leading Scientists and Engineers of OIC Member States, 2008 **www.comstech.org**

12. ISI Highly Cited.Com **http://hcr3.isiknowledge.com/formBrowse.cgi?error=1&&page=0&link1=Browse&valueCategory= &valueCountry=96&submitCountry.x=12&submitCountry.y=7**

13. U.S. Patent and Trademark office, http://www.uspto.gov/go/taf/cst_utl.htm

14. World Intellectual Property Organization (WIPO), **http://www.wipo.int/ipstats/en/statistics/patents**

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