THE SCIENCE AND TECHNOLOGY SYSTEM OF THE KINGDOM OF MOROCCO

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English translation of French terminology

(Alphabetically according to English translation)

English translation	**Original French**
Bureau for Minerals Research and Surveys	*Bureau de Recherche et de Prospection Minière (BRPM)*
Centre for Agro-food Industries	*Le Centre Technique pour l'Industrie Agro-alimentaire (CETIAA)*
Centre for Construction Technology and Materials	*Le Centre des Techniques et Matériaux de Construction (CETEMCO)*
Centre for Development of Renewal Energies	*Centre de Développement des Energies Renouvelables (CDER)*
Centre for Mechanic, Metallic, Electrical and Electronic Industries	*Le Centre d'Études et de Recherche des Industries Métallurgiques, Mécaniques et Électriques (CERIMME)*
Centre for Textile and Clothing	*Le Centre Technique du Textile et de L'Habillement (CTTH)*
Department of Higher Education, Professional Training and Scientific Research	*Département de l'Enseignement Supérieur, de la Formation des Cadres et de la Rechercher Scientifique*
Establishments of Professional Training	*Etablissements de Formation des Cadres*
Establishments of Teacher Training	*Etablissements de Formation Pédagogique*
Faculties of Arts and Humanities	*Facultés des Lettres et Sciences Humaines*
Faculties of Dentistry	*Facultés des Médecine Dentaire*
Faculties of Economic and Social Sciences	*Facultés des Sciences Économiques et Sociales*
Faculties of Legal Sciences	*Facultés des Sciences Juridiques*
Faculties of Medicine	*Facultés de Médecine*
Faculties of Original Education	*Facultés d'Enseignement Originel*
Faculties of Pharmacy	*Facultés de Pharmacie*
Faculties of Polydisciplines	*Facultés Polydisciplinaires*
Faculties of Science	*Facultés des Sciences*
Faculties of Science and Technology	*Facultés des Sciences et Techniques*
Faculties of Science of Education	*Facultés des Sciences de l'Education*
Forum of Moroccan Biologists in the World	*Forum des Biologists Marocains dans le Monde*

[1] [1] This country report was mainly produced by Nelius Boshoff. One of the main sources for the report was the original country study by Mina Kleiche produced for the *Science in Africa* project.

English translation	Original French
Government Authority in charge of Scientific Research	*Autorité Gouvernementale Chargée de la Recherche Scientifique*
Hassan II Academy of Science and Technology	*L'Académie Hassan II des Sciences et Techniques*
Higher School of Translation	*Ecole Supérieure de Traduction*
Higher Schools of Technology	*Ecoles Supérieures de Technologie*
Industrial Engineering Network	*Réseau de Génie Industriel (RGI)*
Institute for African Studies	*Institut des Etudes Africaines*
Institute for Studies and Research on Arabisation	*Institut des Etudes et de Recherche pour l'arabisation (IERA)*
Knowledge and Development	*Savoir et Développement*
Large School Preparation Centres	*Centres de Préparation aux Grandes Écoles*
Ministry of Industry, Trade and Mines	*Ministère de l'Industrie, du Commerce et des Mines au Maroc*
Ministry of National Education, Higher Education, Professional Training and Scientific Research	*Ministère de l'Education Nationale, de l'Enseignement Supérieur de la Formation des Cadres et de la Recherche Scientifique*
Mohammed VI Arabic Language Academy	*L'Académie Mohammed VI de la Langue Arabe*
Moroccan Association for Research and Development	*L'Association Marocaine pour la Recherche et le Développement (R&D Maroc)*
Moroccan Institute for Scientific and Technological Information	*Institut Marocain de l'Information Scientifique et Technique (IMIST)*
Moroccan Intellectual Property and Commercialisation Office	*Office Marocain de la Propriété Industrielle et Commerciale*
Moroccans in Large Schools	*Caravane – Marocains en Grandes Ecoles*
National Agronomic Research Institute	*Institut National de Recherche Agronomique*
National Centre for Coordination and Planning of Scientific and Technological Research	*Centre National de la Coordination et de la Planification de la Recherche Scientifique et Technique*
National Centre for Forestry Research	*Centre National de Recherche Forestière*
National Centre for Road Studies	*Centre National des Etudes Routières*
National Centre for Scientific and Technological Research	*Centre National de la Recherche Scientifique et Technique*
National Centre for Space Studies, Tele-detection and Nuclear Energy	*Centre National d'Etude Spatiale, de Télédétection et d'Energie Nucléaire*
National Centre of Energy and Nuclear Science and Technology	*Centre National de l'Énergie, des Sciences et des Techniques Nucléaires (CNESTEN)*
National Commission for Co-ordination of Higher Education	*La Commission Nationale de Coordination de l'Enseignement Supérieur*
National Fisheries Research Institute	*Institut National de la Recherche Halieutique (INRH)*
National Institute for Hygiene	*Institut National d'Hygiène*
National Office for Drinking Water	*Office National des Eaux Potables*
National Office for Petroleum Exploitation Research	*Office National de Recherche et D'exploitation Pétrolière*
Pasteur Institute	*Institut Pasteur*

English translation	Original French
Permanent Inter-ministerial Committee for Scientific Research and Technological Development	*Comité Permanent Interministériel de la Recherche Scientifique et du Développement Technologique*
Phosphate Control Board	*Office Chérifien des Phosphates (OCP)*
Provision for Research and Development	*Provision pour Recherche-Développement (PRD)*
Public Testing and Studies Laboratory	*Laboratoire Public des Essais et Etudes (LPEE)*
Regroupings of Moroccan Biologists in Canada	*Regroupements des Biologistes Marocains au Canada (RMBC)*
Research Centre for Demographical Studies	*Centre de Recherche et d'Etude Démographiques*
Research Centre for the Study of Phosphates	*Centre des Etudes et de la Recherche sur les Phosphates (CERPHOS)*
Research Conventions for Industrial Development and Formation	*Conventions de Recherche pour le Développement Industriel et la Formation (CREDIF)*
Research on Mines and Exploitation (REMINEX)	*Recherche Mines et Exploitation (REMINEX)*
Schools Engineering Sciences	*Ecoles des Sciences de l'Ingénieur*
Schools of Trade and Management	*Ecoles de Commerce et de Gestion*
Scientific Institute	*Institut Scientific*
Technical Support Units for Scientific Research	*Les Unités d'Appui Technique à la Recherche Scientifique (UATRS)*
Technology Dissemination Network	*Réseau de Diffusion Technologique (RDT)*
Thematic Scientific Research Support Programme	*Programme Thématique d'Appui à la Recherche Scientifique (PROTARS)*
University Institute for Scientific Research	*Institut Universitaire pour la Recherche Scientifique*

Introduction

This report looks at the science, technology and innovation system of Morocco and is structured in three main parts. Section 1 briefly deals with the national political environment. Section 2 presents the key country characteristics, specifically indicators pertaining to the country's economic, health, education, and information & communication technology (ICT) infrastructure. Section 3, which forms the main part of the report, gives an overview and analysis of the science and technology (S&T) system. This section is subdivided into seven thematic subsections covering the governance of S&T, the S&T landscape, human resources, funding, research outputs, technological innovation and lastly international co-operation and networks activities.

Section 1: The political environment

Morocco's location and resources led to early competition among European powers in Africa, beginning with successful Portuguese efforts to control the Atlantic coast in the 15th century. France showed a strong interest in Morocco as early as 1830. Following recognition by the United Kingdom in 1904 of France's "sphere of influence" in Morocco, the Algeciras Conference (1906) formalised France's "special position" and entrusted policing of Morocco to France and Spain jointly. The Treaty of Fes (1912) made Morocco a protectorate of France. By the same treaty, Spain assumed the role of protecting power over the northern and southern (Saharan) zones.

Nationalist political parties, which took shape under the French protectorate, began a strong campaign for independence after World War II. A manifesto of the Istiqlal (Independence) Party in 1944 was one of the earliest public demands for independence. That party subsequently provided most of the leadership for the nationalist movement and remains a dominant political force.

In 1953, France exiled the highly respected Sultan Mohammed V and replaced him with the unpopular Mohammed Ben Aarafa. Ben Aarafa's reign was widely perceived as illegitimate, and sparked active opposition to French rule. France allowed Mohammed V to return in 1955, and by 1956, Morocco had regained its independence.

During the 1990s, King Hassan made great strides toward economic and political liberalization. King Hassan died on July 23, 1999, and was succeeded by his son, Mohammed VI, who pledged to continue these reforms. Under Mohammed VI, the Moroccan Government has undertaken a number of economic, political, and social reforms, including the 2006 Equity and Reconciliation Commission, which investigated allegations of human rights abuse from 1956 to 1999.

In 2006, Morocco celebrated its 50th year of independence from France.

(www.state.gov/r/pa/ei/bgn/5431.htm)

Section 2: Country characteristics

2.1 Basic economic outlook

In Morocco, nearly half of the country's 30 million people and most of the poor live in rural areas. The agricultural sector, which employs half of the work force, remains a major component of the economy, contributing about 17 percent to the gross national product. As a result, agricultural performance has a critical impact on the socio-economic situation of rural households.

Morocco faces low growth and high unemployment. Indeed, since 2001, Morocco has been experiencing higher economic growth, but this is far from the needed higher rates to fight poverty reduction. In 2005, GDP growth was affected by weak demand for Moroccan exports in the European market, the end of trade preferences for textiles, and a severe drought. The good GDP growth in 2006 (almost 7 percent) is partly explained by an exceptional agricultural output, still reflecting high dependence of the economy to weather conditions. Globally, low growth translates into poor job creation, particularly in the urban areas where the unemployment rate remains stubbornly high dropping from 22 percent in 1999 to 18.5 percent in 2005. Urban unemployment may drop further in 2006, but still, to be able to reduce unemployment rates significantly in the coming years, the economy must sustain growth rates of at least 6 percent annually.

Another key challenge is Morocco's high incidence of poverty. Although poverty has declined from 19 to an estimated 15 percent over the period from 1999 to 2004, this rate remains high. Furthermore, poverty also remains linked to the volatility of agricultural growth. The recent improvement of poverty has been the result of a good performance of the agricultural sector over the 2001-2004 period, while the deterioration of poverty in the 1990s (from 13 % in 1991 to 19% in 1999) was the result of drought-stricken low economic output. Thus, poverty is subject to deterioration in the event of repeated drought and the ensuing low growth rates. Poverty continues to be typically a rural phenomenon, with more than 25 percent of the rural population living below the poverty line, compared to just 12 percent of the urban population. The depth and severity of poverty is also much higher in rural areas, and has increased significantly since 1991 (World Bank, 2006:1).

2.2 Demographic profile (including health, education and ICT indicators)

Table 1 summarises recent statistics for Morocco with regard to health, education, and information & communication technology (ICT) infrastructure.

Table 1: Summary of various demographic statistics for Morocco

Indicator	Statistic	Year	Source
General demographical			
Total population	30.2 mill	2005	World Bank [1]
Urban population (% of total population)	59%	2005	World Health Organization [2]
% of population 0-14 years	31%	2007 (est.)	CIA Factbook [3]
% of population 15-64 years	64%	2007 (est.)	CIA Factbook [3]
% of population 65+ years	5%	2007 (est.)	CIA Factbook [3]
Health			
HIV/AIDS adult prevalence rate	0.1%	2001	CIA Factbook [3]
Female life expectancy at birth	73 years	2005	World Health Organization [2]
Male life expectancy at birth	69 years	2005	World Health Organization [2]
Life expectancy at birth (years)	70 years	2005	World Bank [1]
Total fertility rate (children born per woman)	2.7	2005	World Health Organization [2]
Female adult mortality per 1 000	101	2005	World Health Organization [2]
Male adult mortality per 1 000	156	2005	World Health Organization [2]
Under 5 mortality per 1 000	40	2005	World Bank [1]
Infant mortality per 1 000 live births	36	2005	World Health Organization [2]
Total expenditure on health as % of GDP	5.1%	2004	World Health Organization [2]
Education			
Adult literacy rate (% of population age 15+)	52	2006	World Bank [1]
Primary school enrolment, % gross	105	2005	World Bank [1]
Primary completion rate, total (% of relevant age group)	80	2005	World Bank [1]
Secondary school enrolment, % gross	50	2005	World Bank [1]
Ratio of girls to boys in primary and secondary education (%)	88	2005	World Bank [1]

Table 1 Continued

Indicator	Statistic	Year	Source
Information & Communication Technology (ICT)			
Telephone main lines per 1 000 people	44	2005	World Bank , ICT at a Glance [4]
Mobile subscribers per 1 000 people	411	2005	World Bank , ICT at a Glance [4]
Population covered by mobile telephony (%)	98	2005	World Bank , ICT at a Glance
Internet users per 1 000 people	152	2005	World Bank [1]
Personal computers per 1 000 people	25	2005	World Bank , ICT at a Glance [4]
% of households with television	76	2005	World Bank , ICT at a Glance [4]
Broadband subscribers per 1 000 people	8.3	2005	World Bank , ICT at a Glance [4]
International Internet bandwidth (bits per person)	235	2005	World Bank , ICT at a Glance [4]

[1] http://devdata.worldbank.org/external/CPProfile.asp?PTYPE=CP&CCODE=MAR

[2] http://www.who.int/whosis/database/core/core_select.cfm

[3] https://www.cia.gov/library/publications/the-world-factbook/geos/mo.html

[4] http://devdata.worldbank.org/ict/mar_ict.pdf

Section 3: Science and technology system

3.1 Governance of S&T

The national system of scientific and technical research is guided by different elements, such as the pronouncements of His Majesty the King (see Text Box), reports of special commissions, year plans, and the creation of a special programme for the support of research (WHO, 2004:25). The Moroccan government's Five-Year Plan for 2000-2004 articulated the priority lines for research. The declared objectives of this plan were to align S&T research with socio-economic development priorities. Sectors declared as priority areas were: agriculture, health fisheries, drinking water, geology, mining, energy, environment, information and telecommunications technologies, and transport. This approach highlighted the need for effective institutional coordination, which enabled different parties to work together around common priority socio-economic objectives (Kleiche, 2003:303).

King underscores 'key role' of science in Morocco's development

Addressing the first meeting of the Hassan II Academy of Science and Technology, the monarch stressed that "scientific research, technological advancement, innovation and creativity must contribute to this crucial project," which, he said, is to upgrade the living conditions of Moroccans and promote their integration into the knowledge-based society.

The sovereign voiced persuasion the institution will manage "to discharge its mission and muster the means and resources needed to promote advanced scientific research," highlighting his own commitment to the fields of science.

"Through this inauguration we are showing how committed we are to science and learning, given the direct bearing they have on our country's development and progress," he said.

King Mohammed VI added that the ultimate objective of this "young institution" is to serve Morocco and "contribute to the advancement of global science."

Source: Portal National du Maroc, 2006

Morocco is currently in the process of developing a national R&D strategy for the next 20 years as well as an action plan for the next 4 years. A fundamental aspect of this future strategy is the reinforcement of the existing national science system (Belcadi, 2006:4).

3.1.1 Permanent Inter-ministerial Committee for Scientific Research and Technological Development

The Permanent Inter-ministerial Committee for Scientific Research and Technological Development was created in 2001 and is the most important S&T policy-making body in the country. The committee is composed of ministerial representatives with S&T responsibilities and is presided over by the prime minister. It suggests to government the directions needed for promoting scientific research and technological development, and provide guidelines with regard to coordinating and overseeing the research activities of the different government departments. It also suggests how resources should be allocated to research projects and programme areas, in line with national priorities (WHO, 2004:25; www.minrecherche.gov.ma/snrs/12.htm).

3.1.2 Government Authority in charge of Scientific Research

The Government Authority in charge of Scientific Research acts as the secretariat for the Permanent Inter-ministerial Committee for Scientific Research and Technological Development, and is responsible for developing and implementing government policy in the field of scientific research (WHO, 2004:26). It was established in 2002 and is located within the Ministry of National Education, Higher Education, Professional Training and Scientific Research (see Section 3.1.3).

Some of its responsibilities include: (http://www.minrecherche.gov.ma/snrs/attributions.htm)

- working out the strategy for scientific and technical research development;
- determining national research projects and priority programs;
- implementing the procedures and means required to co-ordinate, finance, evaluate and valorise scientific research;

- conducting studies, evaluations, and investigations with regard to scientific research and technological development;
- allocating government resources to various projects and research programs which are defined according to national priorities;
- publishing every two years an evaluation report of scientific research;
- nurturing and developing human resources in S&T; and
- supporting co-operation and partnerships between researchers and agents of technological innovation, as well developing international co-operation.

3.1.3 Ministry of National Education, Higher Education, Professional Training and Scientific Research

The Ministry of National Education, Higher Education, Professional Training and Scientific Research is the central government ministry in the country's S&T system. The key department within this ministry is the Department of Higher Education, Professional Training and Scientific Research, headed by a Secretary-General. Nine directorates fall under the jurisdiction of the Secretary-General.

Below we list the nine directorates, as well as the divisions of the two directorates that specifically deal with S&T matters (www.men.gov.ma):

- Higher Education
- Science
  - Exact & Natural Sciences
  - Humanities & Social Sciences
  - Research Studies, Programmes & Promotion
- Technology
  - Technology Development
  - Valorisation & Innovation
  - Forecasting & Expertise
- Professional Training
- Evaluation & Vision
- Legal Affairs & Private Higher Education
- Student Affairs
- Human Resources & Budgets
- Construction & Equipment

3.1.4 Other ministries with S&T responsibilities

Other relevant ministries are those responsible for Industry, Trade, Mines, Energy, Health and Agriculture.

3.2 S&T landscape

3.2.1 S&T supporting agencies

3.2.1.1 National Centre for Scientific and Technological Research

The National Centre for Scientific and Technological Research is a public institution that was created in 1976. Its original name was the National Centre for Coordination and Planning of Scientific and Technological Research. The Centre's functions include (Khrouz, Hajji & Bousetta, 2001:4-5):

- preparing and maintaining an inventory of the national scientific and technological potential, and of achievements in this area;
- conducting studies to identify priority options, based on development plan requirements, and to define avenues of research;
- defining the broad outline of research programmes, arranging for their implementation and monitoring their execution – all in conjunction with the various research institutions; and
- encouraging and facilitating research by providing grants, organising practicums and seminars, and publishing and circulating research documentation.

According to Khrouz, Hajji and Bousetta (2001:5) the centre only in theory plays a central role in the process of defining, planning and evaluating research activities in Morocco. They claim that the Centre – at the time of writing their paper – did not meet its responsibilities and that the results of its work were unimpressive. In contrast, and more recently, Belcadi (2006:4) regards the centre as the most important R&D actor at national level in Morocco because it structures research by directly participating in and leading research activities as well as by providing services through its own and associated laboratories. It should be noted that the centre was revitalised in 2001.

Moreover, the National Centre for Scientific and Technological Research is the parent organisation of the Moroccan Institute for Scientific and Technological Information, which was created in 2003-2004. The role of the institute is to collect, analyse and disseminate scientific and technological information in all its forms (scientific works, reviews, reports, data banks, etc.), and to provide information support to both the public research sector and industry (Belcadi, 2006:5).

3.2.1.2 Moroccan Association for Research and Development

The Moroccan Association for Research and Development is a professional association that was created in 1997 and recognised as a public utility in 2001. Its members are representatives of public and private companies, public research organisations and government departments responsible for the management of innovation and research. The objective of the association is to contribute to the promotion of innovation and research and development in the national productive sector. (www.rdmaroc.com)

3.2.1.3 Hassan II Academy of Science and Technology

The Hassan II Academy of Science and Technology is a non-governmental body under the authority of the King. It is responsible for promoting scientific research in areas of national priority and integrating scientific and technological research into the national and international socio-economic environment (WHO, 2004:26). It was created in 1993 but its first meeting only occurred in May 2006. (www.ucam.ac.ma/academie_hassan_II_des_sciences.htm)

3.2.1.4 Mohammed VI Arabic Language Academy

The Mohammed VI Arabic Language Academy was created in 2003, to promote the use of Arabic in different fields of science and daily life. For instance, it is responsible for the development of grammatical, lexical and generative system of the Arab language, and launched research and linguistic studies in this regard. (www.minrecherche.gov.ma/textes-juridiques/loi-10-02.htm)

3.2.1.5 National Commission for Co-ordination of Higher Education

The National Commission for Co-ordination of Higher Education was created in 2000. Its role is to advice on the creation of universities and/or any other higher public or private educational institution. It is also responsible for programme accreditation, the promotion of university scientific research and the encouragement of academic excellence (www.minrecherche.gov.ma/snrs/14.htm).

3.2.1.6 National Centre for Energy and Nuclear Science and Technology

The National Centre for Energy and Nuclear Science and Technology is a publicly owned organisation that was created in 1986. Its principal roles are to develop nuclear energy research and to promote its application in various socio-economic sectors. (wwwires.in2p3.fr/ires/publications/a99/maroc/cnesten.pdf).

3.2.2 R&D performing institutions

3.2.2.1 Higher education institutions

The higher education sector in Morocco comprises three broad categories of institutions (Khrouz, Hajji & Bousetta, 2001:6; Ouakrime, 2003:450-451; www.dfc.gov.ma/annuaries/index.htm).

- Firstly, there are the public universities with their associated faculties, schools and research institutes. The public universities are subject to the Ministry of National Education, Higher Education, Professional Training and Scientific Research.
- Secondly, there is a diversity of professional training schools and institutes that fall under the wing of various line ministries, depending on the technical or professional orientation of the institute (Agriculture, Energy and Mines, Trade and Industry, etc.). These schools and institutes were established mainly during the 1980s with the purpose of absorbing the growing number of students and to implement a policy of relative decentralisation. They comprise 31 large school preparation centres, 61 establishments of professional training and 23 establishments of teacher training. Their primary role is to train a particular kind of manager. As a result, research activities at these institutions (largely of the applied variety) are often relegated to the background.
- Lastly, there are a significant number of private higher education institutions, of which only one – Al Akhawayn University – is not-for-profit.

We will only discuss the public universities and their associated faculties, schools and research institutes because these institutions are the main R&D performers in the higher education sector.

3.2.2.1.1 Public universities and associated faculties, schools and research institutes

Fourteen public universities fall under the Ministry of National Education, Higher Education, Professional Training and Scientific Research. The faculties and schools of these universities are regarded as institutions themselves and often comprise the unit of reporting in official publications. Table 2 shows the headcount of students per university in 2002-2003 and 2003-2004, and Table 3 gives a breakdown of the total headcount in terms of the faculty and school groupings. As can be seen, in 2004 there were 80 faculties and schools in total.

The status of research and the nature of research activities vary according to the type of institution concerned. Research activities are largely concentrated in institutions of specialised higher education (i.e. higher schools, schools, and faculties of Medicine, Pharmacy and Dentistry), where relatively adequate funding has been made available through projects and research contracts with the private sector, international development agencies, and foreign universities. On the other hand, research in institutions of the traditional type (faculties of Science, Legal Sciences, Economics, Social Sciences and Humanities) has generally been of the degree-seeking type where individual researchers carry out research for postgraduate qualifications, in order to be promoted. It is only in recent years that academics in the latter group of institutions have become more motivated to carry out research other than the degree-seeking type (Ouakrime, 2003:456).

Table 2: Headcount of students by university, 2002-2003 & 2003-2004

University	2002-2003 Headcount	2003-2004		
		Headcount	% Women	% Foreign
Cadi Ayyad (Marrakech)	34849	35897	41%	1%
Sidi Mohammed Ben Abdellah (Fès)	32772	35203	45%	2%
Mohammed V Agdal (Rabat)	24970	24504	47%	3%
Hassan II Aïn Chock (Casablanca)	24779	23894	52%	2%
Mohammed Premier (Oujda)	22512	23863	46%	1%
Moulay Ismaïl (Meknès)	25120	23348	42%	1%
Ibnou Zohr (Agadir)	22302	22935	39%	1%
Hassan II (Mohammadia)	21926	21379	54%	1%
Mohammed V Souissi (Rabat)	21430	18422	49%	2%
Abdelmalek Essaâdi (Tétouan)	17607	18353	50%	1%
Ibn Tofaïl (Kenitra)	9254	9857	43%	2%
Chouaïb Eddoukali (El Jadida)	8931	7550	49%	1%
Hassan I (Settat)	6967	6148	48%	3%
Quaraouiyine (Fès)	7180	6075	36%	2%
Total	**280599**	**277428**	**46%**	**2%**

Source: Ministry of National Education, Higher Education, Professional Training and Scientific Research (www.enssup.gov.ma)

Table 3: Headcount of students by faculties and schools, 2002-2003 & 2003-2004

Faculties & schools	2002-2003		2003-2004	
	Number of institutions	Headcount of students	Number of institutions	Headcount of students
Faculties of Original Education *	4	7180	4	6075
Faculties of Legal Sciences	12	67925	14	65583
Faculties of Economic and Social Sciences		51393		49695
Faculties of Arts and Humanities	14	93249	14	92548
Faculties of Sciences	11	37440	11	38956
Faculties of Polydisciplines	0	0	3	
Faculties of Science and Technology	7	7229	7	7610
Faculties of Science of Education	1	501	1	499
Faculties of Medicine	4	6529	4	6492
Faculties of Pharmacy		461		450
Faculties of Dentistry	2	1024	2	1035
Schools of Engineering Sciences	8	2736	9	3357
Schools of Trade and Management	3	1968	3	2029
Higher Schools of Technology	7	2889	7	3026
Higher School of Translation	1	75	1	73
Total	**74**	**280599**	**80**	**277428**

Source: Ministry of National Education, Higher Education, Professional Training and Scientific Research (www.enssup.gov.ma)

* Religious and Arabic Studies

The four university-based research institutes are the Scientific Institute, the Institute for Studies and Research on Arabisation, the Institute for African Studies, and the University Institute for Scientific Research.

- The Scientific Institute is the oldest university research institute in Morocco. It was created in 1920, as the *Scientific Institut of the Sherifs*. The activities of the Institute, located at the Mohammed V University in Rabat, primarily concern fundamental research topics. The activities cover the majority of fields in the natural sciences and the aim is to supplement the inventory of natural resources of Morocco. (www.emi.ac.ma/univ-MdV/IS.html)
- The Institute for Studies and Research on Arabisation was established shortly after dependence in 1960. It is associated with the Mohammed V University in Rabat. Its objective is to develop Arabic as an official language in Morocco, as well as to develop Arabic internationally as one of the six main languages of the world. Furthermore, the Institute strives to equip the Arabic language with the necessary conceptual, terminological and computational tools in order to make Arabic a modern language of work, teaching and science and technology. The Institute conducts both fundamental and applied research and is adequately equipped with teaching and technological aids, all serving to strengthen the Institute in its mission. (www.enssup.gov.ma/etablissements/FicheIERA.html)
- The Institute for African Studies is based at the Mohammed V Souissi University in Rabat. It was created in 1987 but only started its scientific activities in 1990. It is a fundamental research institute doing research on the cultural heritage of Moroccan Africans and all fields concerning Africa (social sciences, economics, etc). (www.enssup.gov.ma/etablissements/nstafric.html)
- The University Institute for Scientific Research was created in 1961 and is attached to the Mohammed V Souissi University in Rabat. Its role is three-fold, namely (1) to develop research in the social sciences, particularly in anthropology, geography, history, linguistics and national environment; (2) to ensure that the research is aligned to the national socio-economic environment; and (3) to invite and house both national and foreigner researchers with an interest in doing research on Morocco. (www.enssup.gov.ma/etablissements/nstscient.htm)

Selected university faculties and schools also form the national focal points for thematic networks in specialised research fields. These are indicated in Table 4.

Table 4: Thematic Networks and Networks of Centres of Excellence

Network	National focal point
PCQ - Network of Competence Centres for Quality	Ecole Supérieures de Technologie (Casablanca)
REMER - National Network for Marine Science and Technologies	Faculté des Sciences (El Jadida)
RUPHE - National High Energy Physics Network	Faculté des Sciences Ain Chock (Casablanca)
RUSTE - University Network for Space Science and Technology	Ecole Mohammadia d'Ingenieurs (Rabat)
MisoBiop - Competence Centre for Soil Micro-Biology and Plant Biotechnology	Faculté des Sciences (Rabat)
STIC - Network of Competence in Information and Communication Sciences & Technologies	Faculté des Sciences (Rabat)
PCE - Network of Competence in Economics	Faculté de Droit (Rabat)
PCNG – Neuro-genetic Network of Competence	Faculté de Médecine et de Pharmacie (Rabat)
RUMEC – University Network in Mechanics	Faculté des Sciences Ain Chock (Casablanca)
MACOMS – Network of Competence in Condensed Matter and the Modelling of Systems	Faculté des Sciences (Rabat)
REMAT – National Network for the Physical-Chemistry of Materials	Faculté des Sciences Ain Chock (Casablanca)
PECCA – Network of Competence in Analytical Chemistry and Corrosion-Electrochemistry	Faculté des Sciences (Rabat)
RELOR – Research Network for Local and Regional Territorial Development	Faculté de Lettres (Rabat)
RENAPT – National Network for Theoretical Physics	Faculté des Sciences (Rabat)
PC2E – Competence Network for Water and the Environment	Faculté des Sciences Semlalia (Marrakech)

Source: Belcadi (2006:2)

3.2.2.2 Government and semi-public research institutes

Around the 1980s, most ministries and some large public companies established their own research and development centres, and those public R&D institutes remaining from the French colonial days were revitalised. The outcome was fifteen government and semi-public R&D institutes mainly in the fields of mining, phosphates, energy and nuclear technology. These institutes perform largely development activities, and employ high-level technicians and engineers with advanced qualifications (Kleiche, 2003:293)

The government institutes are directly subject to a particular ministry and conducts research that primarily addresses practical concerns. Some have a substantial national infrastructure, with local and regional branches and excellent scientific staff. Examples here are the National Agronomic Research Institute, Bureau for Minerals Research and Surveys, and the Public Testing and Studies Laboratory.

The semi-public institutes are public bodies with legal status and financial independence. Some have a substantial infrastructure and conduct research on a significant scale. Fairly well-equipped, and with a small but usually highly skilled staff, their research is mainly applied and often sectoral (mines, fisheries, etc) in character. The most important institute here is the Research Centre for the Study of Phosphates, which is part of the Phosphate Control Board (Khrouz, Hajji & Bousetta, 2001:6).

The fifteen government and semi-public research institutes, in alphabetical order, are as follows:

- Bureau for Minerals Research and Surveys
- Centre for Development of Renewal Energies
- National Agronomic Research Institute
- National Centre for Forestry Research
- National Centre for Road Studies
- National Centre for Scientific and Technological Research
- National Centre for Space Studies, Tele-detection and Nuclear Energy
- National Fisheries Research Institute
- National Institute for Hygiene
- National Office for Drinking Water
- National Office for Petroleum Exploitation Research
- Pasteur Institute
- Public Testing and Studies Laboratory
- Research Centre for Demographical Studies
- Research Centre for the Study of Phosphates

3.2.2.3 *Private sector research institutes*

The private sector is the least active player in research activity in Morocco. The REMINEX Corporation (Research on Mines and Exploitation) is the most prominent research performer in the private sector, and is a subsidiary of Omnium Nord Africain, the largest privately-owned mining group in Morocco (Khrouz, Hajji & Bousetta, 2001:6).

3.2.2.4 *New research institutes*

The government has recently made provision for several new institutions to be created in fields that are considered vital to socio-economic and national development. The first of these was created at the Sidi Mohammed Ben Abdellah University at Fès, namely the:

- National Institute of Aromatic and Medicinal Plants

Other institutions to be created are:

- Institute of Hispano-Portuguese Language Studies
- University Institute of Ground Microbiology and Plant Biotechnology
- Research Centre for the Study of Water and Energy
- Research Centre for Saharan Studies
- Network of Environment Sciences
- National Institute of Geophysics

[www.minrecherche.gov.ma/politique/33.htm]

3.3 *Human capital for S&T*

3.3.1 *Size and structure of the R&D workforce*

The most recent figures available on the number of research staff in Morocco are those provided by the Ministry of National Education, Higher Education, Professional Training and Scientific Research in its 2002-2003 annual report. According to this report, Morocco had 17 390 research staff[2] in 2002-2003 (see Table 5). The majority (58%) were employed in the university sector.

Table 5: Headcount of researchers in Morocco, 2002-2003

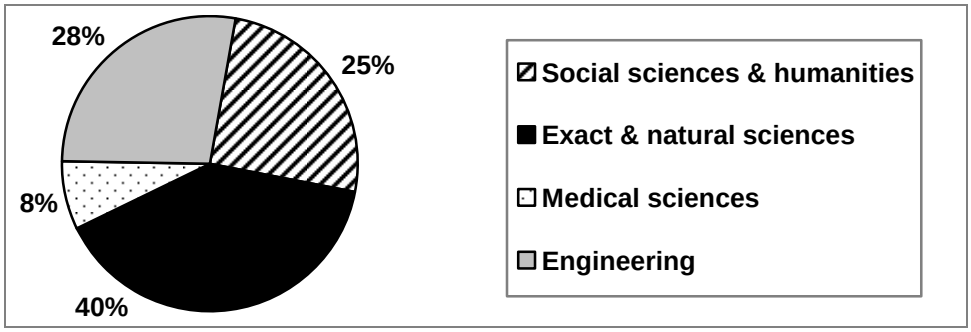
Sector	Headcount	Percent
Universities	10069	58%
Non-university educational establishments	2751	16%
Public research organisations	4012	23%
Private research organisations	558	3%
Total	**17390**	**100%**

Source: MESFCRS (2003:4).

[2] Strictly speaking, these are not all researchers. In public research organisations the more than 4 000 research staff is composed of researchers (349), engineers (651) and technicians (943), with the balance consisting of administrative and management staff (MESFCRS, 2003:7). Thus, if we estimate the number of researchers in the public research organisation sector to be 349, and not 4 012 as in Table 5, the total number of researchers in Morocco during 2002-2003 was about 13 727. Moreover, the researchers in the university and educational establishments are teacher-researchers, meaning that a significant component of their time is allocated to teaching activities.

Figure 1 shows the breakdown of the total number of research staff (17 390) by scientific field, and Table 6 shows the breakdown of the 10 069 researchers in the university sector by faculty/school.

Figure 1: Distribution of Moroccan researchers by scientific field, 2002-2003



Source: MESFCRS (2003:4).

Table 6: Headcount of permanent university teachers by faculty and school, 2002-03 & 2003-04

Faculties & schools	2002-2003 Headcount	2003-2004		
		Headcount	% Women	% Professor
Faculties of Original Education	128	129	12%	40%
Faculties of Legal Sciences	1099	1191	20%	41%
Faculties of Economic and Social Sciences				
Faculties of Arts and Humanities	2294	2383	23%	35%
Faculties of Sciences	3244	3313	23%	62%
Faculties of Science and Technology	1018	1026	23%	42%
Faculties of Science of Education	103	105	42%	33%
Faculties of Medicine	1090	1120	32%	65%
Faculties of Pharmacy				
Faculties of Dentistry	83	88	60%	53%
Schools of Engineering Sciences	377	406	23%	42%

Table 6 Continued

Faculties & schools	2002-2003 Headcount	2003-2004		
		Headcount	% Women	% Professor
Schools of Trade and Management	97	103	29%	5%
Higher Schools of Technology	366	369	26%	14%
Higher School of Translation	12	16	31%	31%
Total	**9911**	**10249**	**24%**	**48%**
Scientific research institutes	158	164	34%	34%
Grand total	**10069**	**10413**	**24%**	**48%**

Source: Ministry of National Education, Higher Education, Professional Training and Scientific Research (www.enssup.gov.ma)

'Original Education' = Religious and Arabic Studies

'Professor' includes the following ranks: = *Prof Agrégé*, *Prof Habilité*; & *Prof de l'Enseignement Supérieur*

3.3.2 *Trends in masters and doctoral enrolments*

In 2003-2004, 17 424 students enrolled for degrees that are equivalent to masters and doctoral degrees. The majority of these (7 678 and 2 457) were doctoral enrolments (see Table 7).

Table 7: Headcount of postgraduate students by degree type and by faculty/school, 2003-04

Faculties & schools	Total M&D		Masters degree equivalent				Doctoral degree equivalent			
			D.E.S.A.		D.E.S.S.		Doctorat		Doctorat d'Etat	
	HC	%W	HC	%W	HC	%W	HC	%W	HC	%W
Faculties of Original Education	427	20%	267	21%	21	19%	128	20%	11	0%
Faculties of Legal Sciences	3179	29%	1075	36%	156	32%	1653	26%	295	12%
Faculties of Economic & Social Sciences	1631	34%	661	40%	167	38%	624	32%	179	13%
Faculties of Arts & Humanities	5080	33%	1577	36%	71	58%	2519	35%	913	19%
Faculties of Sciences	5353	35%	1866	32%	263	39%	2264	38%	960	35%
Faculties of Science & Technology	431	35%	140	30%	40	48%	217	37%	34	24%
Faculties of Science of Education	399	33%	141	45%	70	39%	123	23%	65	17%
Faculties of Medicine	139	48%	124	45%	--	--	15	73%	--	--
Faculties of Pharmacy										
Faculties of Dentistry	58	74%	58	74%	--	--	--	--	--	--
Schools of Engineering Sciences	703	27%	492	26%	76	37%	135	24%	--	--
Schools of Trade & Management	24	46%	24	46%	--	--	--	--	--	--
Total	**17424**	**33%**	**6425**	**35%**	**864**	**39%**	**7678**	**33%**	**2457**	**24%**

Source: Ministry of National Education, Higher Education, Professional Training and Scientific Research (http://www.enssup.gov.ma)

'Original Education' = Religious and Arabic Studies

'D.E.S.A.' = Diplôme des Études Supérieures Approfondies; 'D.E.S.S.' = Diplôme des Études Supérieures Spécialisées

'HC' = Headcount; '%W' = % Women

3.3.3 *Masters and doctoral graduate output*

In 2002-2003 there were 1 095 theses in total, compared to 779 in 2001-2002. Of the 1 095 theses, 545 were in the exact sciences, 403 in the humanities, 132 in the legal, economic and social sciences, and 15 in engineering (MESFCRS, 2003:11). It is not clear whether these were masters or doctoral theses.

3.3.4 *Human and institutional capacity development strategies*

In order to produce doctorates in fields that are of priority for national development, a doctoral grant scheme was introduced in 2003. Two hundred doctoral candidates will each receive 2 300 Moroccan Dirham[3] per month for a period of three years. The National Centre for Scientific and Technological Research is responsible for administering these grants (MESFCRS, 2003:22).

A programme was set up to support scientific publication and dissemination activities. The publications can be of any type (specialised reviews, scientific work, doctoral theses, conference proceedings etc) and the scientific dissemination can be conferences, congresses, meetings, seminars and/or workshops (MESFCRS, 2003:22).

3.3.5 *Scientific mobility*

There is a growing number of Moroccan researchers living and working abroad. There are also significant numbers of Moroccans studying in other countries, particularly in France and Belgium (see Table 8).

Table 8: Moroccans enrolled as foreign students in selected countries, 2001

Host country	Number of Moroccan students enrolled as foreign students in host country		Moroccan students as percentage of total foreign students in host country	
	1998	2002	1998	2002
France	17518	29504	11.8%	17.8%
Germany	5120	6960	3.0%	3.3%
United Kingdom	144	132	0.1%	0.1%
Belgium	5044	5146	14.0%	12.8%
Italy	275	361	1.2%	1.3%
Spain	1968	3263	6.8%	7.3%
United States	1045	2102	0.2%	0.4%
Japan	25	45	0.1%	0.1%

Source: OST (2005)

[3] 2 300 Moroccan Dirham = 213.1 Euro and 243.7 US Dollar, as at 30 June 2003.

Many Moroccans in foreign countries are interested in contributing to research in Morocco and have organised themselves in a number of networks or associations. Belcadi (2006:10) lists the following:

- *Knowledge and Development*. This is a network of researchers based in France but coming from third countries of the Mediterranean basin. It consists of managers and engineers who are interested in economic growth and development in their countries of origin.
- *Regroupings of Moroccan Biologists in Canada*. This network brings together Moroccan and non-Moroccan researchers in Canada who are interested in biology and related disciplines. The objective is to encourage and promote scientific collaboration and exchange between Canada and Morocco.
- *Moroccans in Large Schools*. This network is based in France and brings Moroccan students in France in contact with companies.
- *Forum of Moroccan Biologists in the World*. This forum encourages networking and the exchange of information and mainly consists of discussion lists and information related to the life sciences.
- The *Moroccan-American Society for Life Sciences* (BIOMATEC) is a non-profit, non-government corporation that aims to respond to diverse needs of Moroccan institutions in sciences, by offering information support, technical expertise transfer, educational assistance, and other services that would improve the scientific standards and the level of biotechnological industries and businesses. BIOMATEC's mission is to gather scientists, particularly Moroccans with graduate school training, to work towards goals such as promoting scientific advances, and serving as a bridge between scientific communities and organisations in the United States and Morocco. (http://us.biomatec.org/constitution.htm).

Lastly, the National Centre for Scientific and Technological Research is responsible for engaging Moroccan researchers abroad in national research programmes (MESFCRS, 2003:9).

3.4 Financial resources

3.4.1 R&D expenditure

In 2002 R&D expenditure as a percentage of GDP was 0.6% (www.uis.unesco.org). At present about 0.7% of Morocco's national GDP is devoted to research, and the government's goal is to reach 1% of GDP by 2010 (Belcadi, 2006:5).

3.4.2 National financial resources

The National Research Fund was created in January 2001. Its role is to diversify and reinforce the resources already allocated to R&D by public authorities, and to provide the means for civil society to participate in research activities (Belcadi, 2006:4).

The national funding research programme is the Thematic Scientific Research Support Programme, known as PROTARS. It has six main priority themes, namely: (1) improving quality of life; (2) national resources – their understanding, conservation and exploitation; (3) socio-economic and cultural development; (4) information sciences and technologies; (5) agriculture and hardship; and (6) innovation and competitiveness (Belcadi, 2006:11).

3.4.3 International donor funding

UNESCO financially supported four chairs in S&T in Morocco (UNESCO, 2007:26). The details are as follows:

- 1994: UNESCO Chair for Training and Research in Marine Sciences (Ibn Tofaïl University and Chouaib Doukkali University)
- 1997: UNESCO–Natural Gas Chair in Environmental Management and Sustainable Development (Mohamed V University)
- 1998: MOROCCO UNESCO Interdisciplinary Chair in Sustainable Water Resources Management (Hassania School of Public Works)
- 2006: UNESCO Chair in Water, Women and Decision-making (Al Akhawayn University)

3.5 Research outputs

Table 9 summarises Morocco's article output in journals indexed by Thomson ISI in the USA for three 5-year periods between 1990 and 2004. As can be seen, Morocco's share of ISI articles in the world has increased from 0.06% in 1990-1994 to 0.13% in 2000-2004.

Table 9: Moroccan article output in ISI

	1990-1994	1995-1999	2000-2004
Total number of articles in ISI	1705	3643	5017
Social sciences & humanities	21	32	40
Science, engineering & medicine	1684	3611	4977
Percent of world articles in ISI	0.06%	0.11%	0.13%

Source: Pouris (2007)

Table 10 shows that Moroccan scientists specialise in the fields of mathematics and statistics but that their international visibility is largely in the fields of materials science, metallurgy and crystallography.

Table 10: Morocco specialisation index and impact index for top sub-disciplines, 2001 publications in ISI

Sub-disciplines	World specialisation index	Impact index
Mathematics, statistics	2.99	0.27
Applied physics	1.81	0.39
Chemistry	1.71	0.23
Plant science, agronomy	1.57	0.58
Medical chemistry, pharmacy	1.49	0.27
General & nuclear physics	1.46	0.32
Materials science, metallurgy, crystallography	1.41	0.70
Gastroenterology, cardiovascular system	1.39	0.06
Geosciences	1.38	0.29
Analytical chemistry	1.24	0.42
Ecology, environment	1.10	0.32

Source: OST (2005)

The 'world specialisation index', for any discipline, is the ratio of Morocco's share of publications in that discipline to Morocco's share of publications in all disciplines (i.e. its share of publications in the world). A value greater than 1 indicates specialisation in that discipline. A value less than 1 indicates a lack of specialisation in that discipline.

The 'impact index', for any discipline, is the ratio of the mean number of citations to Moroccan publications in that discipline, to the mean number of citations to Moroccan publications in all disciplines (i.e. in the world). It is a measure of international visibility.

3.6 Technological innovation

3.6.1 Technology balance of payments

No information

3.6.2 Patents

In 2002-2003 Moroccan residents filed 252 patents with the Moroccan Intellectual Property and Commercial Office. These were mainly in the fields of mechanical engineering, electronics, advanced electrics, agro-food and renewable energies (MESFCRS, 2003:11). Table 11 shows the annual number of patents filed between 1996 and 2000.

Table 11: Patents filed at the Moroccan Intellectual Property and Commercialisation Office, 1996-2000

Year	Patents filed	Patents filed by residents of Morocco	Patents filed by researchers at Moroccan universities
1996	325	89	4
1997	468	111	11
1998	498	96	4
1999	463	127	6
2000	249	104	7
Total	**2003**	**527**	**32**

Source: Belcadi (2006:14)

Table 12 summarises the annual number of patents filed with and granted by the European Patent Office and the United States Patent and Trademark Office, respectively. The reference period is the years 2000 to 2005.

Table 12: Number of patents filed and granted by the EPO and USPTO, 2000-2005

Country	European Patent Office (EPO)		United States Patent and Trademark Office (USPTO)	
	Filed	Granted	Filed	Granted
2000	1	1	7	9
2001	No info	No info	5	2
2002	No info	No info	3	3
2003	1	1	3	3
2004	2	1	0	3
2005	3	0	0	3

Sources: www.epo.org & www.uspto.gov

3.6.3 Manufacturing sector

The manufacturing sector in Morocco accounts for about 18% of GDP (OECD, 2006:373). Ownership in the manufacturing sector is largely private, but the government owns the phosphate-chemical fertiliser industry[4] and much of the sugar-milling capacity, through either partnership or joint financing. It is also a major participant in the car and truck assembly industry and in tire manufacturing.

The manufacturing sector produces light consumer goods, especially foodstuffs, beverages, textiles, matches, and metal and leather products. Heavy industry is largely limited to petroleum refining, chemical fertilisers, automobile and tractor assembly, foundry work, asphalt, and cement. Many of the processed agricultural products and consumer goods are primarily for local consumption, but Morocco exports canned fish and fruit, wine, leather goods, and textiles, as well as such traditional Moroccan handicrafts as carpets and brass, copper, silver, and wood implements. (http://nationsencyclopedia.com/Africa/Morocco-INDUSTRY.html)

[4] Morocco holds the world's largest phosphate reserves.

Table 13 contains some selected indicators of technological capability in manufacturing.

Table 13: Selected indicators of technological capability in manufacturing

Indicator	1990	2002
Manufacturing value added (MVA) per capita (1995 US$)	218.3 US$	250.4 US$
Manufactured exports per capita	113.1 US$	194.6 US$
Share of manufacturing in total output (GDP)	18.4%	17.5%
Share of manufacturing in total exports	65.8%	74.5%
Share of medium-or-high technology production in MVA	28.7%	24.1%
Share of medium-or-high technology products in manufactured exports	25.9%	25.7%

Source: UNIDO (2005:159)

3.6.4 Innovation strategies

Below are recent initiatives to strengthen the country's innovative capacity:

- As a result of new legislation related to the activities of higher education institutions it is now possible for universities to establish companies providing that:
  - The purpose of the company is to produce, apply or commercially exploit goods and services that are economic, scientific, technological or cultural in nature; and
  - The university retains at least 50% of the capital of these subsidiaries.

  Furthermore, universities may now participate as shareholders in public or private companies on condition that their ownership does not fall below 20% of the capital of the company. They are free to exploit patents and licences and to commercialise the results of their activities (Belcadi, 2006:4).
- A *university-enterprise interface system* has been introduced which is still in a pilot phase. The role of the university-enterprise interface structures is to:
  - Facilitate the development of collaboration between industry- and university-based partners for research, consulting, training and quality related activities; and
  - Enable universities to transfer technology and respond to the explicit needs of industry.

  Current examples of interface structures exist in the Higher Schools of Technology and Faculties of Science and Technology. The plan is to extend the system also to other institutions in Morocco (Belcadi, 2006:6).
- In 2003 a *Technology Dissemination Network* was established, as a joint initiative between the Ministry of National Education, Higher Education, Professional Training and Scientific Research, and the Ministry of Industry, Trade and Mines. It is a network of competence that brings together various experts who have experience of working with enterprises and who understand the needs and requirements of enterprise development, particularly the need to introduce new technologies and upgrade existing systems. The work is carried out through the execution of enterprise audits. The goal of the network is to:
  - Provide a link between industry and the research system with a view to the exploitation in industry of scientific and technological know-how;
  - Support the dissemination of new technologies; and

- Closely monitor the needs of individual companies and accompany them through each stage of the technology adoption process.

The Technology Dissemination Network is financially supported by the French FSP[5] and it is expected that it will support about 300 interventions with industrial partners over the coming years (Belcadi, 2006:7).

- The French FSP also supports an *Industrial Engineering Network* in Morocco, which is mainly about training experts in Industrial Engineering (how to conduct technological audits, training of trainers, etc.). The goal is to train 128 experts in Industrial Engineering and in the process assists 100 companies in their efforts to gain competitive advantage (Belcadi, 2006:7).
- An *incubator network* was also established with support by the French FSP. The network provides training to those involved in industrial projects in their incubation phase and to those involved in the running of incubators. The network also provides technology-watch services (Belcadi, 2006:7).
- The Ministry of Industry, Trade and Mines has established a network of *Industry Technical Centres* to improve technological productivity and quality, and to provide support for the adoption of technology and the development of technological sectors. There are currently four technical centres, according to Belcadi (2006:8):
  - Centre for Construction Technology and Materials
  - Centre for Textile and Clothing
  - Centre for Agro-food Industries; and
  - Centre for Mechanic, Metallic, Electrical and Electronic Industries
- University-industry links are also encouraged via financial incentives:
  - The *Research Conventions for Industrial Development and Formation* is available as an incentive when a company and a research laboratory collaborate because of a doctoral research student in a research project. The doctoral student works on the project at the company but is managed jointly by the company and the research laboratory.
  - The *Provision for Research Development* provides an incentive to industry in the form of a tax relief of between 2-20% of pre-tax profits, on condition that the company invests the amount in research activities.

  Furthermore, universities may now participate as shareholders in public or private companies on condition that their ownership does not fall below 20% of the capital of the company. They are free to exploit patents and licences and to commercialise the results of their activities (Belcadi, 2006:8)
- The *Technical Support Units for Scientific Research* are places where access to or services based on the use of heavy or expensive equipment can be provided to the scientific community as well as to industry. This optimises the use of resources and allows for a large number of researchers to have access to such equipment. The Technical Support Units for Scientific Research have been established to address needs in five sectors: Chemistry; Materials cience; Marine Sciences; Biosciences; and Informatics and Computing (Belcadi, 2006:8-9).

[5] The *Fonds de Solidarité Prioritaire* (FSP) in France.

3.7 International co-operation and networks

Table 14 shows the top five research partners of Morocco, as evidenced in co-authorship patterns in ISI journals. Undoubtedly, France is the single most important research partner of Morocco.

Table 14: Top five international research partners of Morocco, per scientific field, as reflected in ISI co-publications (2001)

Scientific field	France	Spain	United States	Italy	Germany	Belgium	Canada
Fundamental biology (68 co-publications)	75.4% [1]	7.9% [2]	5.9% [4]	5.4% [5]		6.9% [3]	
Medical research (63 co-publications)	72.3% [1]	6.4% [3]	8.5% [2]			5.3% [4]	3.2% [5]
Applied biology-ecology (60 co-publications)	52.2% [1]	11.7% [3]	16.7% [2]			8.3% [4]	5.6% [5]
Chemistry (226 co-publications)	82.3% [1]	6.9% [2]	2.8% [5]	2.9% [4]	3.8% [3]		
Physics (136 co-publications)	65.4% [1]	7.6% [3]	6.1% [4]	14.0% [2]	5.9% [5]		
Astro- and geo-sciences (68 co-publications)	74.0% [1]	7.4% [4]	11.3% [2]	7.8% [3]	5.4% [5]		
Engineering (75 co-publications)	72.0% [1]	5.3% [4]	4.4% [5]		6.2% [3]		7.1% [2]
Mathematics (41 co-publications)	55.3% [1]	7.3% [4]	10.6% [2]		8.1% [3]		5.7% [5]
All disciplines (593 co-publications)	**72.0% [1]**	**7.5% [2]**	**7.0% [3]**	**5.8% [4]**	**4.8% [5]**		

Source: OST (2005)

The various research institutes and universities also have their own collaborative partners. For instance, the National Centre for Scientific and Technological Research signed in 1999 a collaborative agreement with the Portuguese International Scientific and Technical Cooperation Institute.

Montana State University in the USA and Al Akhawayn University in Ifrane, Morocco, have collaborated on a variety of projects over the past 10 years. In a new collaborative project, an attempt is made to increase the number of PhD's in Computer Science in Morocco and to make Morocco more competitive in the ITC industry. The project aims to do so by offering the Montana State University Computer Science Programme in partnership with Al Akhawayn University (Oudshoorn & Bensaid, 2005).

3.7.1 Bilateral co-operation

Table 15 summarises Morocco's most important bilateral agreements over the last two decades.

Table 15: Morocco's bilateral agreements

Country	Nature	Number or type of projects	Effective date
France	Integrated actions	121	1983
Spain	Integrated actions	68	1996
Tunisia	Integrated actions	22	1997
Belgium	Specific programme of co-operation in applied research	7	1996
Community of French women in Belgium	Exchange programme for 2000-2002	11	
France Informatics	Specific programme of co-operation in informatics	Support for establishing an inter-academic set of thematic networks	2000
France REMER	Specific programme of co-operation in marine science	Support for establishing an inter-academic set of thematic networks	1997
USA	Cultural and scientific exchange	USA grants Exchanges of lecturers Research training courses in the USA and Morocco	2006

Sources: Belcadi (2006:12) and MESFCRS (2003:45)

An important agreement of co-operation was also signed with France in December 2001. The purpose of the agreement was to support initiatives within Morocco's national framework plan for 2000-2004. It supported the establishment of the Moroccan Institute of Scientific and Technological Information, and the creation of the Technical Support Units for Scientific Research.

A programme of exchange with regard to science and technology was initiated with Korea in 1999. In 2002, a Korean expert on energies helped to set up a research programme in this field in Morocco (MESFCRS, 2003:45). The Morocco-US S&T co-operation plan promotes the exchange of innovative scientific ideas, information and knowledge, skills and techniques and the training of technical experts. It also allows for joint scientific and technological projects, conferences and workshops (SciDevNet, 2006).

3.7.2 Multilateral co-operation

A scientific co-operation agreement was signed with the European Union in Salonique (Greece) in June 2003. The agreement enables Moroccan researchers to participate in the European research programmes. It also supports young Moroccan doctoral graduates to work in European research laboratories (MESFCRS, 2003:44; SciDevNet, 2003).

A memorandum of agreement was signed with the European Network EUREKA[6] in 2003, giving Morocco the status of associate member within this European network. The objective of the agreement is to support collaboration between Morocco and the various companies, research institutes and technological centres that are involved in the projects and programs of the EUREKA Network. Since June 2003, Morocco also takes part in high-level meetings of EUREKA (MESFCRS, 2003:44).

[6] EUREKA is a pan-European network for market-oriented, industrial R&D. Created as an inter-governmental initiative in 1985, EUREKA aims to enhance European competitiveness through its support to businesses, research centres and universities who carry out pan-European projects to develop innovative products, processes and services. (http://www.eureka.be/about.do)

3.9 Conclusion

Morocco's own evaluation of its national research system – carried out in 2003 – revealed that the country has a good supply of well trained high quality human resources and that some laboratories are of very high quality. However, the greatest gap at that point of time lied in the link between research and innovation (Belcadi, 2006:13).

Since then, the Moroccan government has introduced a number of structures to bridge the gap between universities and enterprises and to contribute to the country's innovative capacity. However, it appears that the private sector in Morocco is not a significant R&D performer, which is a potential weakness in the system. As a result, industry may lack the capacity to absorb the R&D results from universities and public sector research organisations and to translate it into technological processes and products.

Moreover, apart from the recent S&T agreement with the USA, Morocco has no S&T agreements with any country that is not its regional neighbour (Tunisia) or related to its colonial heritage (French, Belgium and Spain). This provides a space for South Africa to pursue closer bilateral collaborations, as South African scientists can only benefit from Morocco's research activity in especially nuclear and laser technology and minerals research. The added advantage of closer collaboration with Morocco for South Africa would be the opportunity to reap the fruit of R&D developments in France, given that many Moroccan scientists received training in France or are performing research in collaboration with French scientists.

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