

KINGDOM OF MOROCCO

HASSAN II ACADEMY OF SCIENCE AND TECHNOLOGY

**FOR A RELAUNCH OF SCIENTIFIC
AND TECHNOLOGICAL RESEARCH TO SERVE MOROCCO
DEVELOPMENT**

- MARCH 2009 -



**His Majesty the King Mohammed VI, God bless Him
Tutor of the Hassan II Academy
of Science and Technology**

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INTRODUCTION

By law, the Hassan II Academy of Science and Technology is asked to provide the stack holders and the government with analyses and advises on national policies related to scientific research and technology and propose, based on surveys and analytical studies of the various programs, the pertinent strategy for boosting and enhancing the national scientific research quality and productivity. In line with this mission, the Academy had taken during its solemn plenary session of February 2008, the decision to examine the current state of the national research and development (R&D) and technological innovation programs and make proposals with the aim of strengthening the efficiency of the various efforts already undertaken by the government, and give a new impetus to the national policy in this field.

This document represents the outcome of a first brainstorming carried out at the Academy after gathering with the help of various research actors reliable quantitative data on the national system of research and innovation and after collecting the opinions of the leading operators of research programs or projects.

This text is aimed at being an advocacy in favour of a resolved and lasting revival of scientific and technological research to serve the development of **the country, in accordance with the guidelines laid down by His Majesty the King in his speech of the Academy installation on the May 18th 2006, as in that of the August 20th, 2004, in which he recalled the challenge we need to take up “acquire advanced scientific and technological knowledge to overcome the underdevelopment and to be able to accompany the progress”**.

During the nineties, a growth dynamic of scientific research activities allowed Morocco to occupy, for its scientific production, the third place in the African continent. Unfortunately, some worrying signs, reflecting a slowdown of this dynamic appeared and are the result of dysfunction in scientific and technological research system. It becomes urgent to make necessary remedies and take appropriate actions in short and medium terms, otherwise, our country may lose a key leverage for its development in a regional and international environment, where the economic competition is increasingly fierce and where technological innovation, daughter of research and science, plays a crucial role in creating wealth, gain market share and create jobs.

It is in fact widely demonstrated that countries¹, which successfully manage their economic and social development or try to secure for their people a sustainable progress, have largely invested in education and in a strong scientific training at all levels including primary and secondary schools and university. Such countries have also created effective research centres, developed mutually beneficial collaborations between private and academic sectors, or established competitiveness clusters, privileged sites of partnership in R&D, technological innovation and wealth creation. In addition to good governance, to have a scientific and technological research system has become a must for any country wishing to ensure development and modernisation of its economy and its society and thereby preserve its future.

1 Of course this concerns countries the most efficient in research since decades (USA, Japan, Canada, E.U., etc.) but also, since few, countries such as South Korea, China, India, Brazil, Taiwan, etc.

This document, which is mainly a document of brainstorming and proposals, includes primarily a reminder of the relevance of scientific and technological research and of the crucial role of innovation in the development of the country. After addressing the state of research in Morocco and the main indicators that characterise it, it offers a series of strategic guidelines to put in place regarding the national system of scientific and technological research able to serve development. In parallel, it proposes a research program focused on areas considered as priorities, in terms of both basic research and requirements for economic development and social progress of the country.

In an appended document, “the national scientific research in figures” presents precise data and their trends over the last years regarding different indicators of scientific research in Morocco

RELEVANCE OF SCIENTIFIC AND TECHNOLOGICAL RESERACH FOR DEVELOPMENT OF MOROCCO

Questions here and there

While in several sectors of economic and social activity, Morocco is now showing unprecedented development, many people do not realise the importance of the relationship between this development and scientific and technological research. They express doubts and ask questions such as: Is scientific research a necessary activity or even useful? Are we able in Morocco to conduct relevant research and development activities? Should we simply acquire and purchase technologies, or try at least to adapt such technologies to our specific needs and then gradually produce technological innovation in a targeted way? Is it justified to give the R&D and technological innovation a particular priority among crucial leverages of national development? Can Morocco effectively contribute to the advancement of the world scientific and technological knowledge?

Such questions are legitimate! To provide them appropriate answers, we can of course refer to various and several examples across the world, but also examine the evolution of Moroccan reality itself, as it is

rich in lessons regarding the relevance of scientific and technological research for the development of the country.

The first elements of answer were given by the Noble Prize laureate in economics (1974), the Swedish Gunnar Myrdal, who described the development by the followings: “The development of a country consists of levelling up in a bottom-up way all sectors of society at the same time”, i.e. solve problems of education, health, housing, infrastructures, agriculture, technological development, communications, entertainment and environment. In other words, even if priorities exist, they should not prevent a sustained effort in all sectors and areas, including science and technology. In a globalised economy based on a fierce competition, each country uses its assets and strengths, but in many cases, weaknesses constitute the major obstacle to the competitiveness and development.

For example, some countries have abundant natural resources, generating important incomes, which enabled them to develop a modern infrastructure, but these countries do not dispose of sufficient human resources, or local expertise, and therefore their overall development level remains bellow that of countries with low natural resources but which are rich in terms of professionals, experts, researchers, engineers and technicians.

Usefulness of scientific research for many vital sectors

For instance can Morocco avoid conducting and completing the inventory of its various natural resources, if the country wishes to promote such natural resources and use them as a platform for it development? Is it possible to conduct this inventory and this promotion, without having experts and scientists in virtually all fields (geology, hydrology, agronomy, biology, oceanography, mineral resources, etc.)? Can such work be of quality if it is not based on knowledge and data obtained from demographic, sociological and historical studies and research, and by taking into account the social and cultural evolution of the Moroccan population?

In terms on public health, can we protect the population through prevention policy, without carrying out research on diseases that affect them, especially some endemic diseases, on their diagnosis and on vaccines and appropriate treatments? Is the result of such works that has enabled Moroccans to increase, in average, their life expectancy of 30 years within a half century period of time.

With regards to civil engineering, the Moroccan expertise is widely recognised, for both design and construction of hydraulic dams that remain essential for the production of drinking water and for partially responding to the Morocco needs in energy, irrigation and industry. Could Morocco secure the irrigation of a million hectares without such a policy of dams building?

In the critical field of meteorology and climatology, the Moroccan engineers and technicians rise to the forefront by carrying out advanced studies on climate change and its consequences for our country, and by participating actively in the discussions at international level regarding these matters, within intergovernmental group of experts established by the United Nations

In the strategic sector of agriculture, research works are needed to develop national production and provide protection to both Moroccan plantation and national livestock. Thanks to works performed by the specialised national scientific institutions, a strategic program has been established to conserve genetic resources of plants, preserve biological diversity and improve genetics of varieties of barley, wheat, legumes and forage. Thanks also to Moroccan researchers efforts that we could improve productivity and technological quality of sugar beet by successfully increasing the levels of performance and improve concentration of sugar (This allowed for example the area of Doukkala to obtain the equivalent of an additional 40 millions DH for each landscape).

Concerning protection of the livestock, Morocco currently disposes of national competencies and expertises playing a key role in the service of animal health and production of vaccines adapted to local diseases. The selection in 1998 of a new bred of sheep DS (50% D'man and 50% Sardi) allowed obtaining a race with interesting

maternal skills: 150% for prolificacy, early puberty, high frequency of double bearings, sufficient milk production and good adaptation for ride and the sheepfold.

Regarding fishery resources, Morocco has an important processing industry of fishery products; the efforts of Moroccan researchers allowed not only the inventory of various natural resources, but also use of this richness in the medical, food and cosmetics areas.

The scientific method: A necessary tool to make the right decisions

These remarkable results have required many years, even decades of efforts and perseverance, stressing the requirement and the usefulness of the scientific research. The role of science and research in the gradual development of a national expertise should be recalled, especially when it comes to think about choices for development and optimal use of capacity of the country. How to negotiate agreements for cooperation or partnership, and take decisions on major infrastructure programs, or direct economic and social policies over a long term without crucial involvement of national experts whose training must often include a portion of research? As it is also true that major infrastructure works should most often be based on research works carried out upstream in areas such as geology, seismological engineering, climatology and environment, along with socio-economic impact of such infrastructure.

In Morocco, the fight against poverty, the protection and promotion of its natural resources and its rich biodiversity, the democratisation of its institutions and the consolidation of the state of law and rights rely heavily on the contribution of geographers, sociologists, lawyers, economists, political scientists and scientists who often work in close cooperation with renowned international teams.

Scientific research, whether performed in Universities or implemented within companies is required for training of our executives/professionals to develop their sense of rigor, the exercise of reasoning and right interpretation of data, to comply with the requirement of the scientific

method (hypothesis, experiments, results and back to experiments, analysis and conclusions), and to transfer the knowledge and the know-how.

The first requirement for the development of science and technology is the disposal of highly qualified human resources

Can we just use the results of research made abroad, or simply buy licenses of patents produced elsewhere to exploit them on national territory?

If this was true, such a strategy would have allowed countries with important natural resources, and hence with large incomes, to be currently among the most developed, which is evidently not the case. In fact, it is not the financial and natural resources which are crucial elements for the development, but rather the human resources including professionals, highly qualified personnel open to economic intelligence and good governance.

In a world, where the progress of science is accelerating, where the global competition becomes increasingly fierce, where the time required to translate discoveries into technical innovations becomes shorter, proactive actions to ensure technological development have to be undertaken in conjunction with training, research works so that the trilogy “training-research-industrial marketing” becomes reality.

Such a vision involves training of researchers whose expertise would enable them to understand and master existing technologies and develop new ones. In addition there are areas specific to our country, where there are no products available on the market, simply because there is little interest for developed countries to carry out research in these fields. It concerns, in particular, specific diseases or promotion and adding value to some specific resources that are rare or do not exist elsewhere (phosphates, clays, argan, etc.). To limit the effects of these diseases and to add value and promote our natural resources, it is our duty to conduct in house the required research!

As an illustration, let's take the example the Argan (*Argania spinosa*) which is endemic in Morocco: various research works have been conducted on its nutritional and cosmetic benefits, but not yet extensive research regarding its genetics and its use in high-tech biotechnological niches. Should we wait till such research works will be conducted abroad resulting in added value production while Morocco keeps simply the role of supplier of the raw material, or should we make the required efforts to take the benefit for the potential applications offered by this rare and unique natural resource.

Furthermore, if Morocco invests heavily in research, have we the needed researchers and the required expertise? The past experience teaches us that while Morocco was almost absent in the 1980 international statistics regarding scientific research, permanent efforts Morocco has made allowed it to enter in the concert of nations that generate knowledge. Morocco now has competencies and expertise in different and various fields of science and technology, including engineers and technicians able to control and to modify existing technologies, researchers able to innovate, Morocco has talents both inside and outside the country. The number of these technicians, engineers and researchers remains however insufficient and has to be increased and the competencies the expertises need to be diversified. For instance, Morocco disposes of well recognised expertise in agriculture and in use of water resources, and also experts in construction and technical management of dams, in maintenance of aircraft, in information and communication technology with companies that hold important market share worldwide (for example, in the development of software for magnetic cards). It does not involve always research is strict term, but often concerns adaptation and development of existing technological processes. Morocco has also well recognised research teams in mathematics, physics, chemistry, biology and medicine. It is therefore necessary to rely on these competencies and provide them with appropriate infrastructure and resources comparable to international standards. Such strategy will likely lead to the development of our country and will reduce its dependence on foreign technology in the context of many challenges that the country should face and solve such as water and energy management and supply, food safety and public health issues.

Some people suggest focusing our efforts only on the applied research and innovation, believing that this will facilitate marketing of products, and consequently fund only research conducted in partnership with industrial sector.

Scientific and technological research is ruled by international rigorous standards

In fact, technological innovation and invention can only be developed in a stimulating, multidisciplinary and multi institutional scientific and technological environment, including academic research, research in industry and academic-industry partnership in open way on the global science and knowledge. We can ask to a system which was too long under-funded, to do and quickly only technological innovation. It is our believe that among essential steps to be is the upgrading of the national research infrastructure, which will allow Moroccan researchers to work within a stimulating environment that can lead not only to the production of knowledge and know-how but also lead to innovation and new products "made in Morocco".

It is easy to notice that Morocco, as the most developing countries, acquires technologies as objects or consumer goods such as cars, aircrafts or drugs protected by patents, etc.. The national engineers, technicians and scientists trying then to adapt many of these technologies to the Moroccan consumers needs, as in the food industry, electronics and micro-electronics or mobile telephony. These efforts gradually open the way to innovation and technological ownership.

Scientific research and technological innovation : leverage for economic development

So it makes sense to quickly give the right place to the scientific research and technological innovation among priority leverages of economic and social development of Morocco. The aim is neither to absolutely claim the highest priority, neither to ask for substantial and heavy financial resources, but rather to have political recognition of the research function and hence to seek appropriate and targeted resources for its development. This is because a technological improvement resulting from research is a competitive advantage and an element of added value. Morocco has also to improve the quality of all its products for local markets or export through technological innovation, and it can not rely forever its competitiveness on low costs production, for example in textile or food industry; that is why without technological innovation, there a serious risk to loss competitiveness and jeopardize the national development. .

In conclusion, the few quoted examples illustrate the relevance of scientific and technological research for economic, social and cultural development. Should we add that the most important economic and social added value in research activities is upstream and not downstream in the chain of production values: Research and development-design-industrialisation-manufacturing? Regarding training of professionals, the role of research is essential because it enables acquiring rigor, scientific method, development of initiative and critic spirit. While any investment carries some uncertainty, it remains an indisputable fact: Not investing in human capital and knowledge can only exacerbate underdevelopment and dependence.

And if the Hassan II Academy of Science and Technology recommends a relaunch of the scientific system to serve development of the country, this is because it raises some legitimate concerns today.

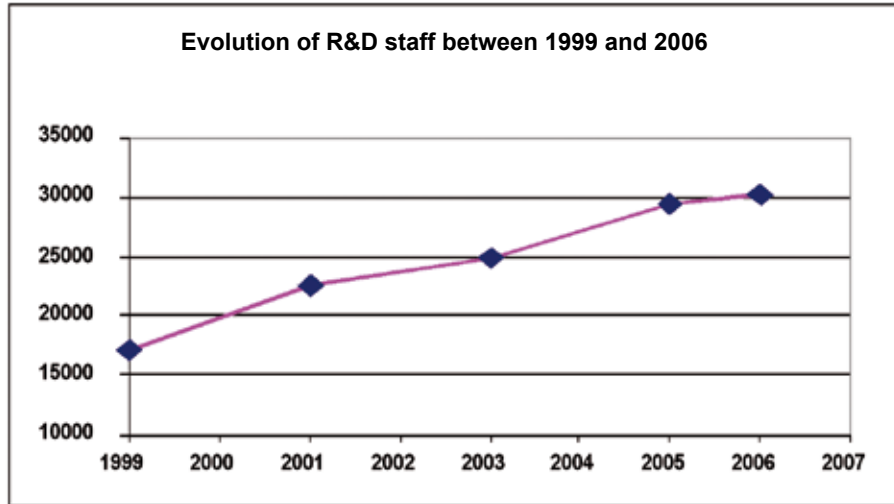
THE NATIONAL SCIENTIFIC SYSTEM: UNDENIABLE PROGRESS BUT ALSO WORRYING WEAKNESSES AND TRENDS

Morocco has today, regarding scientific research, a regulatory framework, structures for orientation and planning and operators of research expected to provide strong support to national development and contribute to booming of science. However, a deficiency in coordination and rationalisation of resources do not allow greater efficiency and better visibility of the research activity.

Research staff

With a workforce of more than 30 000 individuals (2006 data), the entire staff of scientific research (educators/lecturers-researchers, doctoral/PhD students, engineers, technicians and auxiliary personnel) conduct R&D activities in 487 institutions (higher education, public and private, public organisations and private companies). 80 % are in higher education, 13% in applied public research (public organisations of research) and 7% in the private sector.

Among the R&D personnel, 44% are educators/lecturers-researchers, 35% doctoral candidates and 10% engineers. The full-time researchers represent no more than 1%.

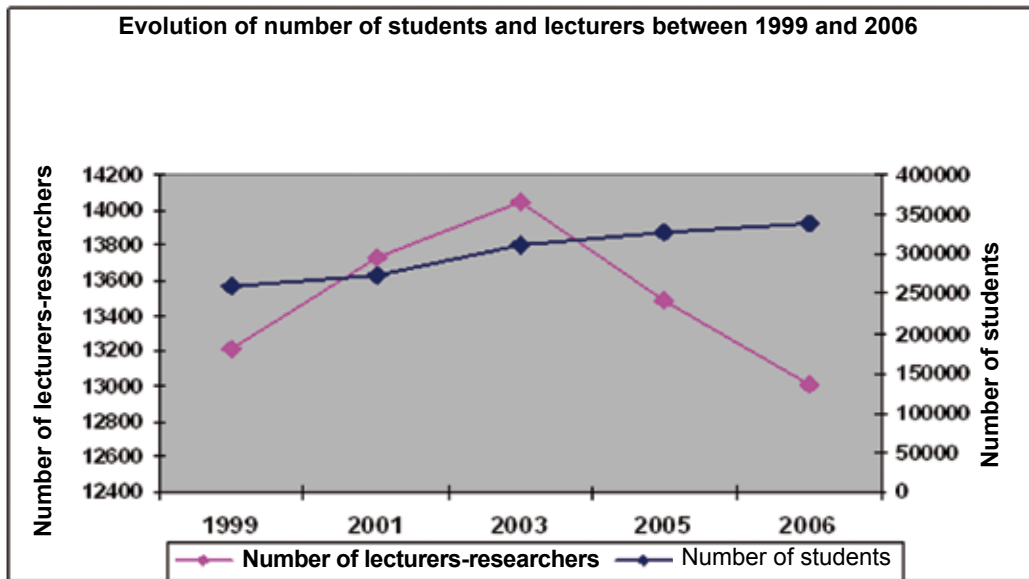


Regarding the gender, the presence of women remains low; in 2006 women represent 24% of the total R&D personnel.

In terms of the distribution by discipline, 37% of R&D personnel are active in Human and Social Science (HSS), 32% in Exact and Natural Sciences (ENS), 22% in Engineering Science (ES) and 9% in Medical Science (MS).

Situation of students (post-Baccalaureate)

In 2006, the total number of students enrolled in post-baccalaureate, all cycles combined, is almost 400 000, including professional education, the certificate of higher technician (BTS), preparatory classes and teachers training.



The evolution on number of students and educators/lecturers-researchers shows a discrepancy; we notice, although it is slow, an increase in students enrolment and alarming decline in the number of educators/lecturers-researchers. If this situation is not corrected soon, this may lead to unbalance that may result in fatal consequences for the quality of our students training.

Doctoral students (3rd cycle)

In 2007, nearly 28 000 students were enrolled in the 3rd cycle, 43% in Matter and Life Science (MLS) and 57 % in Human and Social Science (HSS)

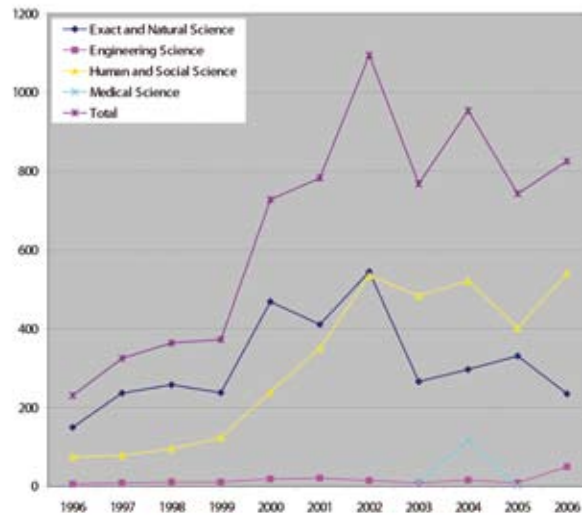
In 2006, while 12 643 students were registered in doctoral studies (45% in MLS and 56% in HSS), only 785 thesis have been defended (31% in MLS and 69% in HSS).

The introduction of BMD (Bachelor, Master- Doctorate) resulted in putting in place from this year 2008-2009 doctorate studies centres that will allow better supervision and follow up of doctoral students.

Evolution of number of obtained doctorates by disciplinary area

Disciplinary Area	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Evolution 1996-2006
Exact and Natural Science	150	237	258	238	469	411	545	266	297	331	235	56,67
Engineering Science	6	9	11	11	19	21	15	9	16	9	50	733,33
Human and Social Science	75	79	95	124	240	351	535	483	523	402	541	621,33
Medical Science								10	118	1		
Total	231	325	364	373	728	783	1095	768	954	743	826	257,58

Source: DEP (Direction de l'évaluation et de la prospective) - MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)



Even if the quality of the theses remains good in overall, since it results in almost all cases in publications in renowned international journals, the number of defended theses each year remains low as compared to the number of registered doctorate students or to the needs of the country, especially for the renewal of educators/lecturers. With more than 12 000 registered in doctorate thesis, whose period of preparation should not in principle exceed 4 years, and taking into account the retirements (more numerous in MLS) and the needs of scientific system (Universities, institutes, high schools, private sector), our needs for doctors per year should be few thousands (2 to 3 thousands), instead of few hundreds.

Moroccans in abroad

According to the generally agreed on criteria, Moroccans performing scientific activities outside of Morocco should not be included in

statistics about national scientific human resources. Additionally and in the best of our knowledge the complete statistics about this peculiar part of our Diaspora is not available. Nevertheless, it is legitimate to take into account the Moroccan students who are completing their higher education abroad.

In 2005, France welcomed nearly 30 000 Moroccan students, while in 2000 this number was 21 048, with a growth of 42%. Germany 8 227 (5 882 in 2000), Spain 4 547 (3 144 in 2000), Moroccan students represent 13.5% of total foreign students in France.

For doctoral studies, the number of Moroccan students in France in 2004 was 2 081 (1 443 in 2001), which represents 10% of foreign students enrolled in Doctorate program in France, (Foreign doctoral students represent 21 392 out of a total of 66 806). They are distributed as follows: 37.5% in Matter and Life Science and 62.5% in Human and Social Science (Year 2004). Thus, we find the same proportion between MLS and HSS than that found in Morocco.

Morocco undeniably made, since its independence, significant efforts in the field of training of human resources dedicated to science and education.

He was able quickly to acquire Moroccan professionals for higher education and research and build national competencies trained in Morocco or abroad.

However, we notice now a deficit in at least three levels:

- The total number of students remains insufficient for a population of over 30 millions persons; this is of course to be linked to the near stagnation in the number or new baccalaureate graduates per year;**
- The number of educators/lecturers-researchers is also in stagnation;**
- The Number of students registered in doctorate and the number of new doctors per year, especially in Matter and Life Sciences; which is alarming given the needs to relaunch scientific research in Morocco, renew competencies and secure the scientific and technological future of the country.**

Financial resources

The level of these resources is determined by calculating the GERD (Gross domestic Expenditure on Research and Development) including the total expenditures for R&D works performed on the national territory during a given period of time (one year).

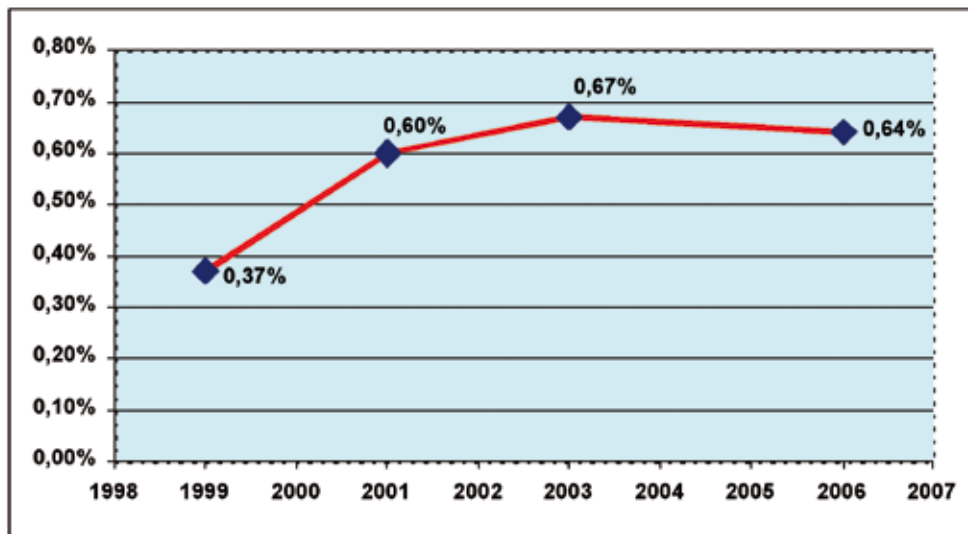
Value in millions DH (MDH)	1999	2001	2003	2006	Evolution 2006/1999 %
GERD	1 456,46	2 367,68	3 116,02	3 693,98	153,63
Financing by the Public Sector	1 335,46	1 905,48	2 578,81	2 819,77	111,15
Public Sector %	91,69	80,48	82,76	76,33	-16,75
Financing by the Private Sector	101,00	443,20	455,90	792,59	684,74
Private Sector %	6,93	18,72	14,63	21,46	209,41
International Cooperation	20,00	19	81,31	81,62	308,10
International Cooperation %	1,37	0,80	2,61	2,21	60,91
The GDP presented here is calculated using the 1998 as the base year and not 1980 as was the case before.					
GDP (1988 as the base year) in MDH	389 786	426 871	476 987	575 271	47,59
Share of GERD in GDP in %	0,37	0,55	0,65	0,64	71,85
Share of the public GERD in GDP in %	0,34	0,45	0,54	0,49	43,07
Share of the private GERD in GDP in %	0,03	0,10	0,10	0,14	431,72
Share of the international cooperation in GDP in %	0,005	0,004	0,017	0,014	176,52

Data from MENESFCRS – Technological Ministries¹ – Haut Commissariat au Plan – R&D Morocco Association

MDH : Millions of Dirhams, GDP : Gross Domestic Product, GERD : Gross Domestic Expenditures on Research and Development

¹ . These are the Ministries with research institutes or schools of professional training (agriculture, equipment, mineral resources, energy, etc.).

Structure and evolution of the share of the GERD in the GDP between 1999 and 2006



Evolution of the national GERD share in GDP between 1999 and 2006 (1998 is used as the base year to calculate the GDP)

Although Morocco is still far from the target set by the charter for the education and training developed by the COSEF (Special Committee of Education and Training), i.e. devote to scientific research 1% of GDP by 2010, the Moroccan GERD increased significantly over the last decade with a stagnation over the past three years. However, it should be noted that the increase trend will resume, given the new financial resources available to the sector in the context of the Emergency plan (additional 250 MDH for 2009 and recruitment of more than a thousand of new educators/lecturers-researchers); We need also to highlight the significant progress of the private sector effort that increased by 8 folds between 1999 and 2006, although its contribution (22%) as compared to the public effort is still below that in the developed or emerging countries. With regards to the public sector, the higher education remains predominant (64%).

Scientific production

If, during the years (1960-1980), where the priority was to establish the Moroccan universities and to train professionals in sufficient numbers, the Moroccan scientific production was quite absent in the international statistics and was limited to few dozens of papers or even few units. From the late 80 Moroccan scientific production has grown significantly to occupy during the years 1995-2003 the third place in Africa after South Africa and Egypt, and to appear in the international statistics.

However, since 2003, there has been a stagnation in production. This situation brought back Morocco from the third position to the sixth place in 2006, although the quality of publications is better, given the number of citation and impact factor of these publications.

In the Scopus database, the Moroccan production, for the exact science, life science and engineering science is about 1 200 articles per year (in attendance record), while that of South Africa is 7 600 and that of Egypt is 5 300.

Domaine	Maroc : nombre de publications					
	en compte de présence			en compte fractionnaire		
	2001	2003	2006	2001	2003	2006
Sciences de la vie *	378	403	367	277	296	249
Sciences de la matière	556	543	506	312	300	275
Sciences pour l'ingénieur et Mathématiques	209	229	233	130	146	140
Specialités multidisciplinaires	10	8	12	6	4	6
Tous domaines	1 054	1 073	993	725	746	670

données Thomson Scientific, traitements OST OST - 2008

Number of scientific publications of Morocco, by scientific field, using attendance and fractional record (2001, 2003, 2006)

Global share

The global share of publications of a given country is the ratio between the number of publications of this country and the number of publications worldwide, the global share of the Moroccan scientific production helps to determine the position of Morocco in relation to the world production.

Pays	Part/Monde (%) de publications toutes disciplines							
	1993	1995	1997	1999	2001	2003	2005	2006
Maroc	0,37	0,44	0,59	0,78	0,97	0,96	0,79	0,75
Algérie	0,24	0,25	0,27	0,30	0,36	0,44	0,56	0,62
Tunisie	0,37	0,36	0,40	0,49	0,59	0,75	0,90	1,03
France	52,0	53,6	54,0	53,7	51,4	48,4	45,0	43,8

données Thomson Scientific, traitements OST OST - 2008

Global share (‰) of Moroccan scientific publications, over a long period, in all disciplines, using fractional record (1993 to 2006)

- The global share of publications is here expressed per thousand and not in percent.

The Moroccan scientific production, as determined by publications, represents a contribution of 0.75 ‰ to the world production.

Discipline	Part/Monde (‰) de publications							
	Maroc				Evolution 2006/2001 (%)	2006		
	1993	1999	2001	2006		Algérie	Tunisie	France
Biologie fondamentale	0,20	0,31	0,29	0,27	- 7	0,14	0,64	44,5
Recherche médicale	0,30	0,72	0,85	0,65	- 24	0,09	1,10	42,4
Biologie appliquée-écologie	0,53	0,70	0,93	0,74	- 20	0,33	1,04	33,6
Chimie	0,54	1,16	1,43	0,99	- 31	1,18	1,30	41,0
Physique	0,32	1,00	1,29	0,88	- 31	1,26	0,78	50,2
Sciences de l'univers	0,47	0,89	1,09	1,00	- 8	0,62	0,81	48,9
Sciences pour l'ingénieur	0,34	0,58	0,82	0,64	- 21	1,22	1,07	41,9
Mathématiques	0,80	2,11	2,91	2,48	- 15	1,36	2,39	69,0
Toutes disciplines	0,37	0,78	0,97	0,75	- 22	0,62	1,03	43,8

données Thomson Scientific, traitements OST OST - 2008

Global share (‰) of Moroccan scientific publications, by scientific discipline, using fractional record (1993, 1999, 2001 and 2006 and evolution 2001 to 2006)

We note with interest that Moroccan mathematics represents 2.5 ‰ of world production.

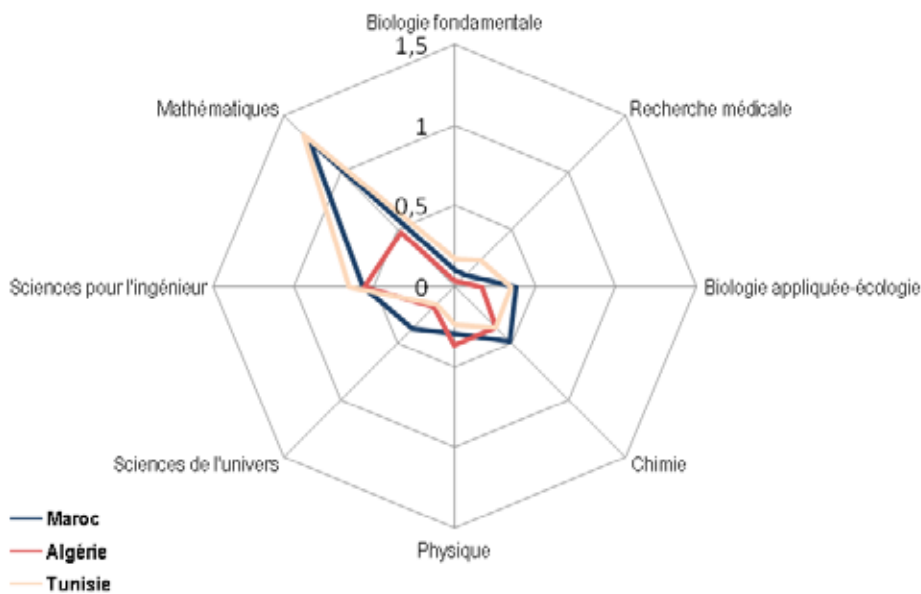
Discipline	Indice de spécialisation en référence mondiale							
	Maroc				Evolution 2006/2001 (%)	2006		
	1993	1999	2001	2006		Algérie	Tunisie	France
Biologie fondamentale	0,54	0,40	0,30	0,36	+ 20	0,22	0,62	1,02
Recherche médicale	0,81	0,92	0,88	0,86	- 2	0,14	1,07	0,97
Biologie appliquée-écologie	1,43	0,90	0,96	0,99	+ 3	0,53	1,01	0,77
Chimie	1,46	1,50	1,47	1,31	- 11	1,89	1,25	0,94
Physique	0,86	1,28	1,33	1,18	- 12	2,02	0,76	1,14
Sciences de l'univers	1,27	1,15	1,13	1,33	+ 18	1,00	0,78	1,11
Sciences pour l'ingénieur	0,92	0,74	0,84	0,85	+ 1	1,95	1,03	0,96
Mathématiques	2,16	2,71	3,01	3,29	+ 9	2,19	2,32	1,57
Toutes disciplines	1,00	1,00	1,00	1,00	-	1,00	1,00	1,00

données Thomson Scientific, traitements OST OST - 2008

Moroccan specialisation index worldwide, by discipline, using fractional record (1993, 1999, 2001 and 2006 and evolution 2001 to 2006), comparison with Algeria, Tunisia and France (2006)

(1) The specialisation index measures the disciplinary profile of Morocco in comparison to that of global publications. It is the ratio between the global share of Moroccan publications in a given discipline and its global share in all disciplines.

In 2006 at the global level, Morocco is considered a specialised country in mathematics, with a specialisation index in this discipline that has continued to increase to almost 3.3 in 2006; the specialisation index for universe science, physics, chemistry and medical research shows that Morocco has also a quite productive potential in these disciplines.



Global share of Moroccan citation (regional comparison)

Co-publications share by country

The share of Moroccan co-publications with another country in the total of Morocco international co-publications is presented for the first ten partners.

Part (%) des co-publications du Maroc				
Rang	2001		2006	
	Pays	Part (%)	Pays	Part (%)
1	France	71,1	France	63,9
2	Espagne	7,8	Espagne	13,0
3	Etats-Unis	7,3	Etats-Unis	7,2
4	Italie	6,3	Italie	6,4
5	Allemagne	4,7	Allemagne	5,5
6	Belgique	4,3	Canada	5,2
7	Canada	3,4	Belgique	3,5
8	Japon	2,1	Royaume-Uni	3,1
9	Royaume-Uni	1,8	Suisse	2,3
10	Tunisie	1,6	Portugal	2,2
Nombre de co-publications internationales		605	585	
données Thomson Scientific, traitements OST			OST - 2008	

Share (%) of Moroccan co-publications in the total of its international co-publications for the first ten partners, all disciplines included, using attendance record (2001, 2006)

• *The shares in this table can not be consolidated, as a Moroccan co-publication with a given country can be co-signed by teams from other countries*

For international co-publications of Morocco, 63.9% of them are co-signed with at least one French team; France remains by far the first scientific partner of Morocco in 2006.

Spain, the second partner with a share of 13% in 2006, reinforced this position significantly over the past five years.

In conclusion, between 1990 and 2003, the Moroccan scientific production has grown significantly; since 2002-2003 this production is experiencing a stagnation and even a slight decrease.

We need to understand the causes of this stagnation and loss of impetus; one explanation undoubtedly lies in the fact that since 1997, professors-researchers could only be hired if they hold a PhD diploma, whereas before (1975 Status), holders of DES¹ or even a CEA² could be hired as lecturers or assistants, and they were required to publish and to continue their research works to obtain the State-Doctorate diploma and to be qualified for promotion to the position of Professor of higher education, and benefit from advancement in their careers and a significant improvement in their salaries. Regarding the recruitment of educators/lecturers-researchers, there is another disturbing dimension; they are increasingly being recruited at a very advanced age and often several years after their thesis defence, therefore after an interruption of their research activities. An adequate recruitment policy of researchers and educators/lecturers-researchers should target young and bright elements who are still able to produce.

Moreover, the current criteria for career promotion of the lecturers-researchers (evaluation grid) include aberrations that not encourage professors/lecturers to develop their research skills particularly since research activities are insufficiently recognised in their overall activities. The research activity appears almost subsidiary, while it is essential not only for the quality of education but it also contributes to the economic and social development of the country.

Finally, it's worth to notice the deficiency in resources dedicated to research, and the difficulties experienced by researchers in the management of research grants.

These are some reasons that might explain the stagnation noted in scientific production, despite its quality

¹. Diploma of higher studies

². Certificate of advanced studies (equivalent to the French "Diplôme d'Etudes Approfondies (DEA)")

Technological development

The level of technological development of Morocco needs first to be assessed regarding its equipments and infrastructures, which constitute the basis of modernisation of the country. With regards to this aspect, undoubtedly Morocco, under the leadership of His Majesty the king Mohammed VI, is now catching up in the fields of basic infrastructures, as the entire country is now a huge construction site (roads and highways, ports and airports, facilities in drinking water and electricity, communications, housing, etc.); of course the modernisation of the country passes also through the development of its industrial structure and innovation share that characterises such a structure; major progresses have been recorded in the last period.

Patents

In 2007, nearly one thousand patents regarding industrial models or industrial designs have been filed at the Moroccan Industrial and Commercial Property Office (MICPO), when at the same time, China produced 200 000 patents, USA and Japan over 400 000, France some 20 000 and Turkey one thousand (filed by the Turkish companies). Regarding innovating companies, the R&D Morocco association has identified one hundred businesses working in different sectors, civil engineering, fuel transportation, pharmaceuticals, New Technologies of Information and Communication (NTIC), waste treatment, agro-food, chemistry, packaging and mechanics.

Evolution of the number of patents filed by type of applicant

	2000	2001	2002	2003	2004
personnes physiques	108	122	154	141	140
%	43.37	36.64	43.37	43.37	24.96
personnes morales	141	211	374	342	421
%	56.63	63.36	56.63	56.63	75.04
Total général	249	333	528	483	561

(source : Direction de la technologie et Département de la recherche, MENESFCRS)

As for the software development, according to the R&D Morocco association, there are twenty companies that produce software, some of them, particularly successful, have important share of the global market (magnetic cards)

In terms of equipments in NTIC, the number of Internet subscribers increased from 170 000 in 2005 to almost 700 000 in 2007, when the number of Internet users has almost doubled between 2005 and 2007 going from 3.7 millions to 6.6 millions, which represents a penetration rate of 20%; with respect to mobile telephony, the park consisted of 364 000 subscribers in 1999 and reached 23.3 million subscribers today (this corresponds to 65.5 mobiles per 100 inhabitants when this rate was 1.3 in 1999). For regular telephony, the overall park has increased by 25% between 2007 and today.

An interesting indication regarding the partnership between private sector and public organisations (Universities, public institutions of research, professionals training schools), lays on the financial resources concerned by research and development agreements signed between them; it stands in 2006 for approximately 20 MDH for universities, 2.6 MDH for public institutions of research and 1.1 MDH for schools of professionals training.

International partnership

Morocco has developed since post-independence an active scientific and technological cooperation policy. While the target of this policy during the early years of independence focused more on training of executives/professionals and technical support, especially since the 1980s, scientific programs on clear research topics has been put in place with most major European and American countries. Scientific cooperation agreements have been signed with France, Spain, Italy, USA, Canada, Germany, Belgium and Portugal. In 2003, an agreement on scientific and technological cooperation has been signed between the European Union and the Kingdom of Morocco. There are also agreements with some developing countries (Tunisia). Morocco participates to the European programs (Framework Programme of R&D (PCRD)). It participated to the 5th

and 6th PCRD with 61 and 111 projects respectively, while Algeria participated with 24 and 54 projects and Tunisia with 75 and 100 projects.

Over the past twenty years, Morocco has built a scientific and technological system that has undoubtedly helped to make progress and even to establish traditions in terms of scientific research and innovation; However, this system experiences today a lack of impetus. The proposals and recommendations that follow are likely to give it a new impetus that may revive Moroccan science and enable it to provide a crucial support to economic and social development of the country.

PROVIDE A NEW IMPETUS TO THE MOROCCAN RESEARCH SYSTEM : RECOMMENDATIONS OF GENERAL POLICY

In light of the arguments presented above, in particular in the part II, ten recommendations of general policy are proposed to clarify the objectives of scientific research development in Morocco and to secure a required efficiency and competitiveness

1) Make of scientific and technological research a national strategic choice, expressing a political will at the highest level of government and considering the financial effort as an investment that can be highly profitable, more important than number of other traditional economic activities. Scientific research, development of knowledge and skills training contribute indeed to the decisive improvement of the competitiveness, job creation and the emergence of new companies.

2) Consider research as a powerful tool to improve the quality of higher training. This is a sine qua nun condition for quality of the higher education, which can be conducted at the highest level only through regular upgrading integrating new knowledge and arising innovations; it will be thus possible to train highly qualified professionals/executives competent and useful for the production system of Morocco, in factories, country and services.

3) Basing research on the quality of works or encompassing activities, and on its opening to the environment and competitiveness, in all disciplines, particularly in science and technology. This choice should contribute to promoting culture of quality and excellence. It should take into account the following guidelines:

- allocate the adequate human and financial resources to the better structured teams and the most performing ones;
- encourage the less structured research groups to become involved in this requirement of quality by committing themselves to greater openness, to collaborative work and to multidisciplinary;
- respect the values of transparency and adopt performances indicators that contribute to an objective and reliable assessment of research activities, both in terms of production and the utilisation of results, in the context of real synergy between cognitive research and research & development activities.

4) Refine the priority areas of research based on the needs and imperatives of the country development and the guidelines set by the governmental authorities. In this context, a developing and a mobilising strategic plan with precise milestones, for each of the six priorities identified in the part V below, will enable to define medium and long terms programs and to establish processes of follow up and evaluation of these plans.

5) Support, through incentive actions and a proactive encouragement policy, research and development activities and technological innovation. In a globalised world, wealth creation and competitiveness can be measured by the capacities of individuals and societies to innovate. The development and promotion of innovation are based on three fundamental pillars:

- Talents that constitute the human dimension;
- The ecosystem that reflects the announced political commitments, the strategies put in place and the set priorities;
- The financial aspects which remain a key parameter.

6) Put the Moroccan research structures in regional and international environments, by strengthening cooperation between institutions, scientific communities and by participating to networks of excellence.

7) Include the Moroccan scientific community living outside of Morocco in the system of scientific research relaunch, especially by encouraging and facilitating participation of this community to national projects, and by taking appropriate measures to welcome in good scientific and material conditions those who wish to return to Morocco.

8) Promote dynamic and fruitful partnerships between academic and private sectors

9) Make the evaluation of research works a tool of orientation and improvement of quality and efficiency in all steps of research, from the preparation of projects and their support to the assessment of their results and their impact on research promotion and scientific and technological development of the country. Giving more autonomy to structures of education and research involves the concept of accountability and strengthening of internal and external evaluation of structures, projects and researchers on the basis on international criteria and standards, only evaluation allows identifying the strengths but also and especially the dysfunctions to correct and weaknesses to overcome.

10) Promote a strong and visible scientific community, in which Moroccan researchers recognise themselves, by encouraging them to become aware of their adherence to this community, by recognising their specific role in society, by supporting Scholar Associations, by encouraging national scientific edition of high-level and with scientific committees composed of scientists from inside and outside of the country.

PRIORITY AREAS AND THEMES

The objectives and priorities in terms of scientific research have been identified and agreed on during the national meetings of 2001 and 2006, and refined in the context of the major national programs of development, such as: the National Initiative of Human Development (NIHD) to fight against poverty and vulnerability, the Emergence plan in the sector of industry, the new IMPACT plan in the field of information technologies, the Emergency plan for education, the Morocco Green plan in the sector of agriculture, the program adopted for energy, the Azur plan for tourism and the many projects related to social housing and the creation of new cities. One can thus identify a number of priority axes or fields, among which the Academy recommends the selection of the themes that deserve more important investment because of their great potential in the future:

1- Improve food security

- selection of cereals and legumes varieties resistant to drought (use of biotechnologies);
- selection of fruit varieties (olive, citrus, date palm) more resistant to stress and better adapted to market requirements;
- control of irrigation and physiology of cultivated species;
- reduction in chemical inputs (biofertilisers and biopesticides);
- enhancing nutritional and sanitary quality of food;
- development of aquaculture.

2. Reduce diseases incidence

- improvement of immunological and genetic diagnostics;
- improvement of vaccines and expansion of immunisation programs;
 - support of clinical and biomedical research using appropriate legislation;
 - encouragement of research on health systems.

3. Reduce dependence on fossil energy

- development of renewable energies : solar energy (production of electricity, improvement of efficiency of photovoltaic cells, concentration of solar energy, use of solar energy to desalinate salty water or sea water), wind energy;
- development of processes to market oil shale.

4- Better know, preserve and market natural resources

- establishment of databases regarding the national natural heritage;
- soil revegetation and restoration of vegetation cover (genetic and physiological studies of major forest species - cedar, cork oak, argan, etc. to accelerate their growth and regeneration);
- marketing of marine and subsoil resources;
- development of geoscience, oceanography and hydrogeology.

5. Develop science, technology of information and mathematics

- electronics and microelectronics;
- production of software, marketing of products and services and society of information;
- development of numerical models and methods to solve problems of interdisciplinary, environment, energy, sustainable development and health.

6. Better understand the demographic and socio-economic issues to promote sustainable development

- Sociological studies;
- Studies of growth and employment issues;
- Research on demography, rural depopulation and emigration phenomena.

Moroccan scientific research is required to get much involved in the various development programs of the country, and to serve them. To this end, Morocco should strengthen its scientific and technological system. Such a commitment is not conflicting with academic freedom, essential for any scientific activity, which helps to feed and

even encourage a less applied research and very useful to training of University competencies and experts of all kinds.

The Identification of areas or niches that deserve significant investments in the context of pragmatic research programs, regularly evaluated, also aims to consolidate partners from public and private sectors and to use, wittingly, international cooperation. Such choices must take into account competitive advantages of Morocco, and to be operated with a prospective vision.

To take up these challenges and carry out these research programs requires organisation and suitable system, clearly stated political will and more perseverance and continuity in the effort.

PUTTING RESEARCH FOR SERVICE OF DEVELOPMENT: STRATEGY TO 2020

The analysis of all indicators of science and technology in Morocco and the results of studies show clearly that, despite its progress, the national scientific and technological research suffers from few weaknesses. Correct them to translate our assets to many opportunities, this should be the goal of reviving our research system; and can thus contribute to wealth creation generating stable jobs and integration of Morocco in knowledge economy. As part of a strategy to 2020, five major axes are identified.

Axis No. 1 - The research staff: strengthening and mobilisation

Train a new generation of researchers

Training of 15 000 researchers (educators/lecturers–researchers or full time researchers) over the next decade, to compensate for retirements, meet the quality requirements of research, deal with the desirable and predictable increase in number of students which is currently relatively low.

This ambitious policy will benefit from the creation of new centres of doctoral studies whose design, organisation and missions are established for better meeting quality criteria than the old units for training and research (UFR).

This policy of training should also take into account priority areas and themes, as well as disciplines to be promoted.

↳ **Establish an incentive system**

To attract the best students and engineers to doctoral studies and prepare them to conduct high quality research, it will be necessary:

- **To offer, in sufficient numbers of scholarships with a increased amount**, and improve the rate of young people between 18 and 24 years enrolled in higher education (increase in rate of scholarships, especially at level of Master and doctoral studies, studies-loans, for those who choose scientific and other promising careers);
- **To establish a system of research grants** which will allow the best doctoral students registered in Morocco or abroad to pursue their studies in suitable conditions;
- **To offer short-term contracts for post doctoral fellows (PDF)**, with the possibility to take into account the years spent as PDF when hired in universities and research centers as educator/lecturer-researcher. This measure was put in place by other countries and it is a good career incentive for strengthening our human potential;
- **To give more value to training through research** and to promote recruitment of doctors in industry and administration.

↳ **Better define the missions of education and research** of professors-investigators and ensure a balance between the two missions during their career. For this purpose, it is necessary to:

- **Implement an evaluation and promotion system** for the professor-researcher which will promote the research activities;

- **Encourage greater internal and external mobility of researchers** (between universities, between universities and companies and between national and international research structures);

- **Create a well managed system for a sabbatical year** spent either in industry or in university most often abroad.

- **Welcoming foreign researchers** during their sabbatical year and put in place appropriate mechanisms for the recruitment, on contract basis, of foreign visitor researchers and post-doctoral researchers for short periods of time (one to two years);

- **Create the status of professor emeritus** with the goal of keeping in activity the interested experienced professors, reaching the age of retirement. Such action does not require any additional investment and will strengthen the supervision of the doctoral students and young researchers;

- **Put in place a contract system** for educators/lecturers-researchers, particularly those involved in networks and expertise centres, regarding well defined research projects and including performance indicators.

↳ **Mobilise the scientific Moroccan diaspora** in more a methodical way, to strengthen national research activities and their assessment; the expatriate researchers, recognised for their works, could be hired as educators/lecturers-researchers, taking into account their seniority to determine their salaries and adopting fair procedures to this kind of recruitment.

↳ **Reward and encourage researchers with high productivity** by increasing their work resources as well as through honours, prizes or special awards.

↳ **Create research chairs on priority and promising research themes** involving both universities, technological ministries and productive sector.

Axis No. 2 - Funding and management of research activities

↳ **Increasing the share of Gross Domestic Product (GDP) devoted to research** to reach 1% in 2010, at least 1.5 % by 2015 and 3% in 2020; that is why the Hassan II Academy of Science and Technology recommends particularly:

- To accurately identify the budgets allocated to research by the different ministry departments;
- To significantly increase the special fund dedicated to scientific research and technological development;
- To raise private funds, especially through the tax incentive (Research tax credit, restoration of the Provision for R&D (PRD), etc.).

↳ **Participate more actively to international programs**
Additional resources can be raised by inviting Moroccan researchers to participate to international programs and to develop bilateral and multilateral scientific cooperation.

↳ **Greatly simplifying the procedures of managing** funds allocated to universities and other research centres or facilities in the context of real autonomy of the university, by performing management based on the post control principle.

Axis No. 3 - Priorities, coherence and coordination of the national research system, partnership with companies

↳ **The Priority fields and themes of scientific and technological research** referred in the part V of this document need to be **refined in a proactive and pragmatic spirit**; according to its mission, the Academy plans to participate to this initiative by encouraging development:

- **of research & development and innovation in sectors where Morocco has assets and advantages** (Mineral natural resources, fisheries, agriculture, solar energy, tourism, biodiversity) or which constitute a strategic interest (climatology, energy, rural development, oceanography and fisheries, hydrology, pharmaceutical industry and geosciences);

- **of appropriate technologies** enabling improvement of living conditions of the Moroccan population;

- **of the international businesses of Morocco** “MMM” defined in the “Emergence” plan, such as information and communication technology, offshoring, aeronautics, automobiles, aerospace, electronics, microelectronics, materials, parachemistry, textiles, etc.;

↳ **The Academy recommends four series of measures to ensure greater consistency, better coordination and efficient evaluation of the national research system:**

- **Take off existing boundaries between educators/lecturers-researchers teams** and regroup, going past faculty or university limits, competencies around an ambitious and internationally competitive projects;

- **Establish or strengthen regional centres of scientific research** which, being more coherent and regrouping human and material resources would decentralise research and implement technological platforms;

- **Promote the creation in the medium term of research structures with quality** in two or three strategic areas where Morocco may hold an honorable position at international level, such as biotechnology, materials and nanomaterials, information and communication technology.

↳ **Bring closer research units and companies,** in that context the national scientific system must:

- **Stimulate and encourage the mobility of researchers between university and industry** by strengthening the partnerships, that will sensitise business to the importance of innovation for its own development;

- **Focus on partnership projects between university and business** in the invitation to tender presented in the context of the promotion of research & development, **and encourage, in terms of tax credits**, companies which incorporate in their strategic choices innovation and investment thereof;
- **Make sure that research & development and innovation projects are based on the strategic choices** in terms of development and thus support the main projects of national development.;
- **Encourage the creation of venture capital funds** to support technological innovation and companies to invest in the R&D through fiscal measures, such as research credits;
- **Organise and revitalise incubators** of existing innovative companies, to join them to centres of doctoral studies, and provide them with sufficient resources to contribute to the innovation and the research promotion effort;
- **Strengthen information** and sensitisation of researchers regarding the **protection of intellectual and industrial property rights**.

Axis No. 4 - Evaluation of research and promotion of researchers

The evaluation consists of monitoring and assessing with the objective of improving the research programs quality, the expected outcomes and their promotion, the research structures and their efficiency, the researchers and their scientific productivity. Such evaluation must be guided by the principles of competence, independence, objectivity, dialogue and confidentiality.

Put in place an external evaluation body to :

- Evaluate organisations specialised in higher training and research based on their missions and activities, as well as the diplomas and training they offer;

- Evaluate the research activities conducted by research units and institutions; develop criteria and standards for the evaluation of researchers and their scientific productivity;
- Approve external evaluations put in place by operators using strict rules

Such independent evaluation body would be similar to that introduced within the Higher Council of Education for scholar education. With a small administrative structure and working with **Moroccan or foreign confirmed experts**, it will ensure a regular and rigorous assessment of the efforts accomplished by the researchers in organisations of higher education and research.

↳ **Establish a system of internal evaluation**, in all institutions and organisations of higher education and research to ensure the monitoring of expected outcomes of programs and projects of research and technological innovation and to prepare for the external evaluation exercise.

Axis No. 5 - Science education and development of scientific culture

Research requires for its development a favourable social environment and scientific culture broadly shared within the society. It is not the prerogative of intellectuals and scientists; it is in fact at the heart of the functioning and evolution of societies.

↳ **Create a favourable cultural environment through :**

- **the renovation of science didactic at school**, right from the elementary classes, to develop scientific curiosity and reasoning and to involve students. The experimental methods should be favoured as for the experience “main à la pâte”, implemented in several countries;

- **the strong involvement of the mass media**, especially audiovisual, in connection with the fourth channel ARRABIAA, dedicated to culture and under the responsibility of the Ministry of the National Education

(it is suggested to dedicate at least one hour over the eight hours of broadcasting, to scientific and documentary films and to lectures for the general public on science in the society of the 21st century);

- **amplification of activities such as “Youth and Science for Development” or “Science Week”** organised on annual basis by the Hassan II Academy of Science and Technology and by all universities (since almost ten years for the latter), involving more regional academies for education and training, teachers and their secondary schools and especially pupils and students;

- **creation of science museums** (it is a higher priority easier to achieve), and scientific clubs in schools;

- **promotion of scientific publishing**, allowing researchers to communicate their works to a wider audience and to the citizens, especially young people, and to have access to scientific books and articles.

↳ **Put in place a coherent linguistic policy that facilitates access to science and technology.** through mastering, in addition of the national language, at least two foreign languages, English and French.

The issue of language is indeed crucial for the future of our country and its handling should be based on logic and pragmatism. In a global economy, mastering foreign languages is indeed important both for the professional insertion of laureates and for their preparation to scientific research and creation of knowledge and innovation. The development of Arabic translation of scientific books especially for school and college students will contribute to spread the scientific spirit and culture.

GENERAL CONCLUSION

In the “battle” that Morocco leads decisively for its sustainable development, its modernisation and its overall upgrade, science and technology have a strategic role; this “fight” could not be won if the scientific and business worlds are not involved and if they are not engaged in it with determination. Ensure scientific and technological development is a sine qua non condition for the success at economic and social levels.

At the heart of this strategy, it should be stressed one more time the importance of research and innovation highly qualified human resources, which should be strengthened by increasing their numbers, enhancing their qualifications and diversifying their expertises. Indeed, the noticed slow-down in the national research system is due to a certain extent to the lack of financial resources available to research and which is relatively easy to correct¹, its revival and development are however much more dependent on human resources, researchers and research professionals, likely to be mobilised. This shortage is exacerbated by a deficit in the

¹ As proof, the budget of 2009 of the scientific research (depending of the unique department of higher education) has been increased of 250 MDH and additional 700 MDH are planed in the context of the Emergency plan (2009-2012).

recognition of the research function and its contribution to the development. The University must play a leading role in this process and become a productive structure of science, innovation and competent and qualified personnel, the goal being to quickly commit the research sector in the production of added value and innovation for all fields of the economy. That is why it is urgent to train sufficient number of researchers in some priority areas and themes with an important potential for the future.

If development is to provide quickly solutions to problems of populations living in urban and rural areas, and to improve their living conditions, sustainable modernisation of the country and its progress depend also on a research & development and innovation policy :

↳ In fields where Morocco has natural and human assets and holds strong positions at the international level (mineral resources, fisheries resources, chemistry, agro-food, new technologies),

↳ In sectors considered as strategic (energy, water, nutrition, health, environment and geosciences).

In a world moving forwards to knowledge-based and technology-based economies, strengthening national capacities in these fields is not a luxury but a necessity.

That is why the actions and the recommendations proposed in this document focus on the relaunch of Moroccan science and technology, through an audacious and visionary policy to increase the number and the quality of researchers, to enhance national funding effort, to expand and strengthen partnerships between the university and the business world, and finally to ensure determined and sustainable improvement of science education and scientific culture; the success of such a policy depends to a large extend on the recognition of the research function and on the full awareness, particularly among decision-makers, of its role as essential leverage for economic and social development of the country.

The Hassan II Academy of Science and Technology intends, after conducting this brainstorming and producing this document,

performing a detailed review of the recommendation or actions thereof, together with the national scientific community and responsible institutions, it is committed to progress, in accordance with its missions, to the goal that has been set by **His Majesty the King Mohammed VI, “Serve the country and contribute to development of the global science”**.

Appendices

scientific research in Morocco in figures

1. 1- Human Resources

1-1- Research and development (R&D) personnel

Research and Development personnel in 2006

Institutions		Number	R&D Personnel in 2006
Universities	Faculties	65	20 120 including 9 395 lecturers-researchers and 10 725 PhD students
	Schools	25	
	Research Institutes	5	
Non University public institutions for higher education		23	3 616 lecturers-researchers
Private institutions of higher education		117	3 061 including 331 permanents
Public institutions of research		13	4 122 (researchers, engineers, technicians and auxiliary staff)
Private companies		239	2 123 (Engineers, technicians)
TOTAL		487	30 312

Source: MENESFCRS - DEP- DFC - Ministères Techniques - EPR - R&D Maroc

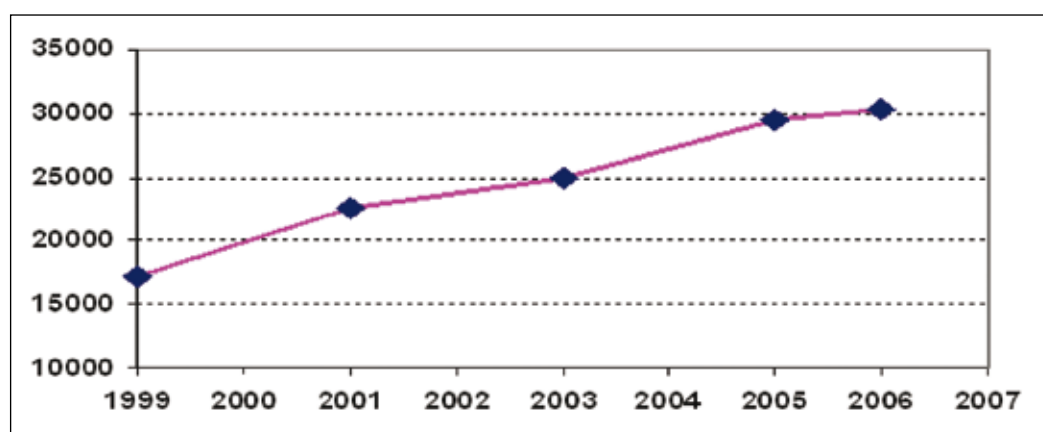
MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres, EPR: Etablissements publics de recherche, R&D Maroc: Association R&D Maroc

Evolution of number of R&D staff between 1999 and 2006

Personnel	1999	2001	2003	2005	2006	Evolution 1999-2006
Research personnel of public sector	16 629	21 788	24 093	27 662	27 858	67,53
Percentage (public sector) (%)	96,24	96,67	96,56	94,12	91,90	-4,50
Research personnel of private sector	650	750	858	1 728	2 454	277,54
Percentage (private sector) (%)	3,76	3,33	3,44	5,88	8,10	115,21
Total Research and Development personnel	17 279	22 538	24 951	29 390	30 312	75,43

Source: MENESFCRS - DEP- DFC-Ministères Techniques - EPR - R&D Maroc

MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres, EPR: Etablissements publics de recherche, R&D Maroc: Association R&D Maroc



Distribution of R&D personnel by category and by disciplinary area in 2006

Disciplinary Area	Category of Research and Development Personnel (number)						Total
	Lecturers- Researchers	Researchers	Engineers	PhD Students	Technicians	Auxiliary Personnel	
Exact and Natural Science	4 188	67	402	3 658	302	1 001	9 618
Percentage (%)	13,82	0,22	1,33	12,07	1,00	3,30	31,73
Engineering Science	2 717	97	2 531	189	689	510	6 733
Percentage (%)	8,96	0,32	8,35	0,62	2,27	1,68	22,21
Medical Science	1 088	119	171	1 102	62	178	2 720
Percentage (%)	3,59	0,39	0,56	3,64	0,20	0,59	8,97
Human and Social Science	5 406	33	14	5 776		12	11 241
Percentage (%)	17,83	0,11	0,05	19,04		0,04	37,08
Total	13 399	316	3 118	10 725	1 053	1 701	30 312
Percentage (%)	44,20	1,04	10,29	35,38	3,47	5,61	100

Source: MENESFCRS - DEP- DFC-Ministères Techniques - EPR - R&D Maroc

MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres, EPR: Etablissements publics de recherche, R&D Maroc : Association R&D Maroc

Distribution of R&D personnel and quota of Women by category and disciplinary field in 2006

Disciplinary Area	Category of Research and Development Personnel (number)														
	Lecturers- Researchers		Researchers		Engineers		PhD Students		Technicians		Auxiliary Personnel		Total		
	T	W	T	W	T	W	T	W	T	W	T	W	T	W	%
ENS	4 188	986	67	11	402	122	3 658	242	302	42	1 001	229	9 618	1 632	16,97
EGS	2 717	322	97	24	2 531	573	189	51	689	35	510	115	6 733	1 120	16,63
MS	1 088	402	119	56	171	117	1 102	547	62	31	178	83	2 720	1 236	45,44
HSS	5 406	1 268	33	3	14	2	5 776	1 942		0	12	5	11 241	3 220	28,65
Total	13 399	2 978	316	94	3 118	814	10 725	2 782	1 053	108	1 701	432	30 312	7 208	23,78
Percentage	100	22,23	100	29,75	100	26,11	100	25,94	100	10,26	100	25,40	100	24	

Source: MENESFCRS - DEP- DFC-Ministères Techniques - EPR - R&D Maroc

MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres, EPR: Etablissements publics de recherche, R&D Maroc: Association R&D Maroc

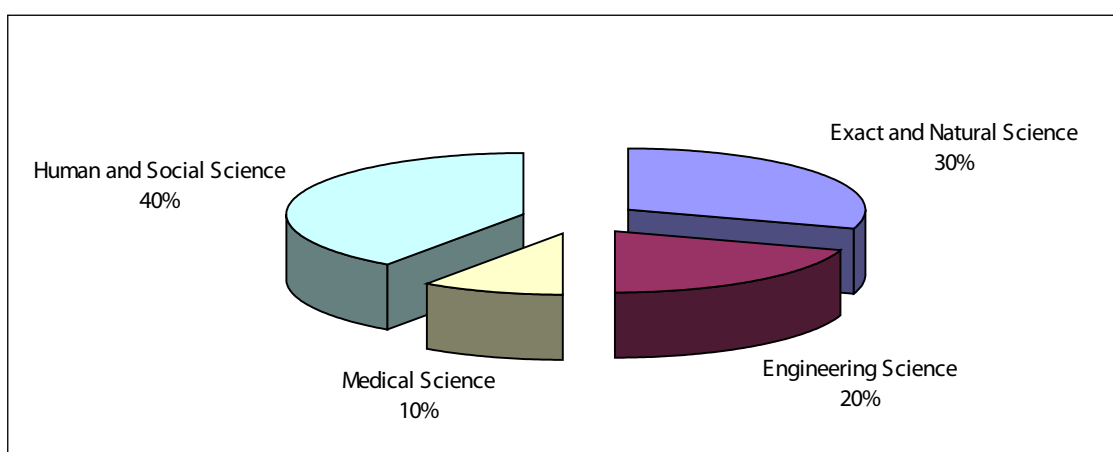
ENS : Exact and Natural Science, EGS : Engineering Science, MS : Medical Science, HSS : Human and Social Science

Distribution of public R&D staff by disciplinary area (2006)

Disciplinary Area	Number		Percentage	
	Total	Women	Total	Women
Matter and Life Science	16 628	3 988	59,69	14,32
Exact and Natural Science	8 329	1 632	29,90	5,86
Engineering Science	5 581	1 120	20,03	4,02
Medical Science	2 718	1 236	9,76	4,44
Human and Social Science	11 230	3 210	40,31	11,52
Total	27 858	7 198	100	25,84

Source: MENESFCRS – DEP – DFC - Ministères Techniques

MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC : Direction de la formation des cadres



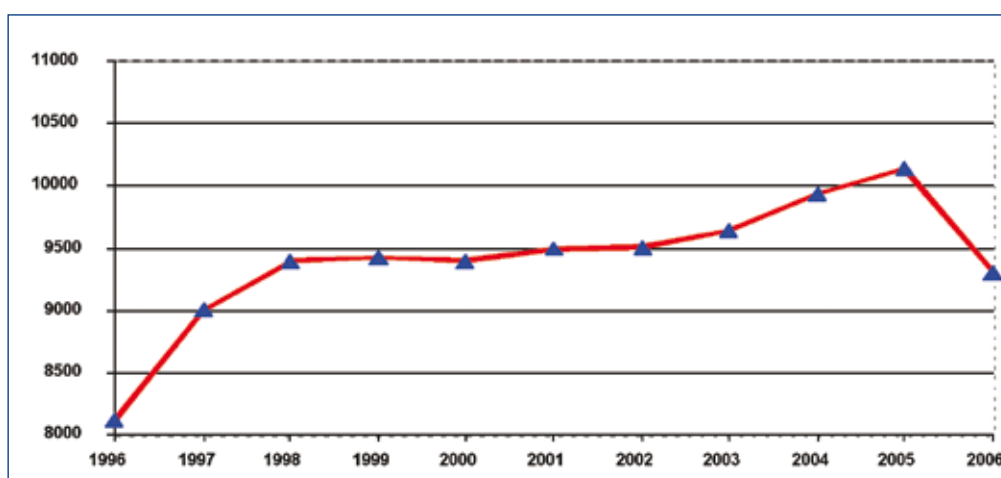
Evolution of number of University lecturers-researchers by position

Position	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Evolution 1996-2006 (%)
PES	1 513	1 569	1 671	1 980	2 185	2 439	2 788	3 298	3 502	3 631	3 494	+131
PH			715	884	966	956	925	1 083	1 170	1 188	999	
MC	947	1 164	456	279	269							
Pr. Agrégé						249	234	253	280	314	284	
PA			1 804	2 613	3 476	3 991	4 183	4 173	4 478	4 673	4 390	
MA	5 317	5 968	4 517	3 472	2 347	1 707	1 247	702	384	231	65	-99
Assistant	248	311	242	197	157	149	135	134	122	98	73	-71
Total	8 025	9 012	9 405	9 425	9 400	9 491	9 512	9 643	9 936	10 135	9 305	+16

Source: DEP (Direction de l'évaluation et de la prospection) – MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)

PES: Professeur de l'Enseignement Supérieur, PH: Professeur Habilité, MC: Maître de Conférences, Pr. Agrégé: Professeur Agrégé, PA: Professeur Assistant, MA: Maître Assistant

Evolution of number of University lecturers-researchers from 1996 to 2006



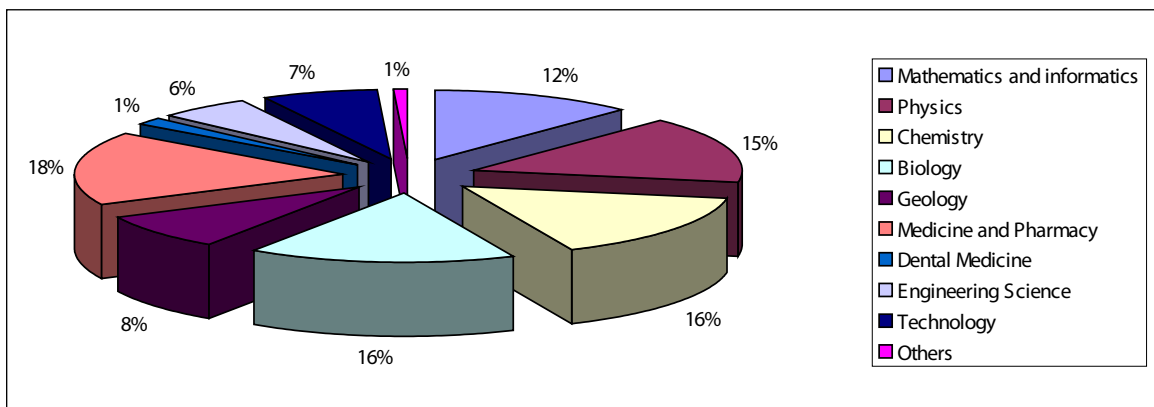
Distribution of University lecturers-researchers in Matter and Life Science in 2006

Matter and Life Science	Total	Percentage
Mathematics and Informatics	706	12,19
Physics	896	15,47
Chemistry	913	15,77
Biology	922	15,92
Geology	490	8,46
Medicine and Pharmacy	999	17,25
Dental Medicine	86	1,49
Engineering Science	334	5,77
Technology	402	6,94
Others	42	0,73
TOTAL	5 790	100

Source: DEP (Direction de l'évaluation de la prospective), MENESFCRS

MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)

Distribution of University lecturers-researchers by discipline in 2006



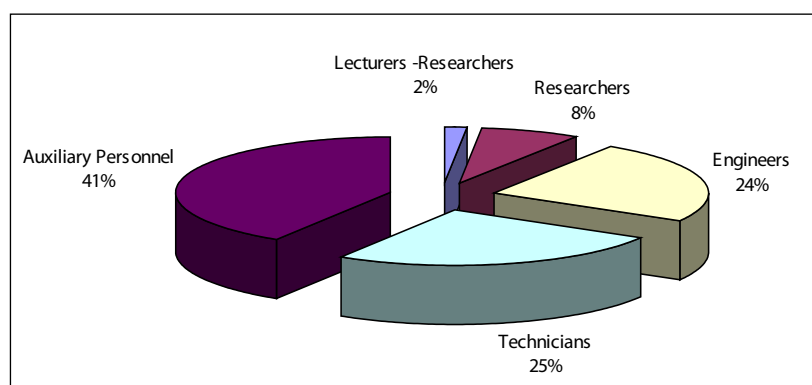
Distribution of R&D personnel of public institutions for research by category in 2006

Institutions	Lecturer - Researcher	Researcher	Engineer	Technician	Auxiliary Personnel	Total
CNRST	30		69	11	33	143
CNESTEN		50	60	65	53	228
CDER		10	32			42
LPEE		10	254	524	182	970
ONHYM		27	60	100	275	462
INH		81	85	29	91	286
IPM		38	86	33	85	242
INRA		57	169	218	851	1 295
INRH		36	124	64		224
CREF		3	42	9	128	182
CERED		5	7			12
IRCAM	29		7			36
Total	59	317	995	1 053	1 698	4 122
Percentage (%)	1,43	7,69	24,14	25,55	41,19	100

Source: Ministères Techniques – EPR (Etablissements publics de recherche)

- CNRST : Centre national pour la recherche scientifique et technique
- CNESTEN : Centre National de l’Energie, des Sciences et des Techniques Nucléaires
- CDER : Centre de Développement des Energies Renouvelables
- LPEE : Laboratoire Public d’Essais et d’Etudes
- ONHYM : Office National des Hydrocarbures et des Mines
- INH : Institut National d’Hygiène
- IPM : Institut Pasteur du Maroc
- INRA : Institut National de la Recherche Agronomique
- INRH : Institut National de Recherche Halieutique
- CREF : Centre de Recherche et d’Expérimentation Forestière
- CERED : Centre d’Etudes et de Recherches Démographiques
- IRCAM : Institut Royal de la Culture Amazighe

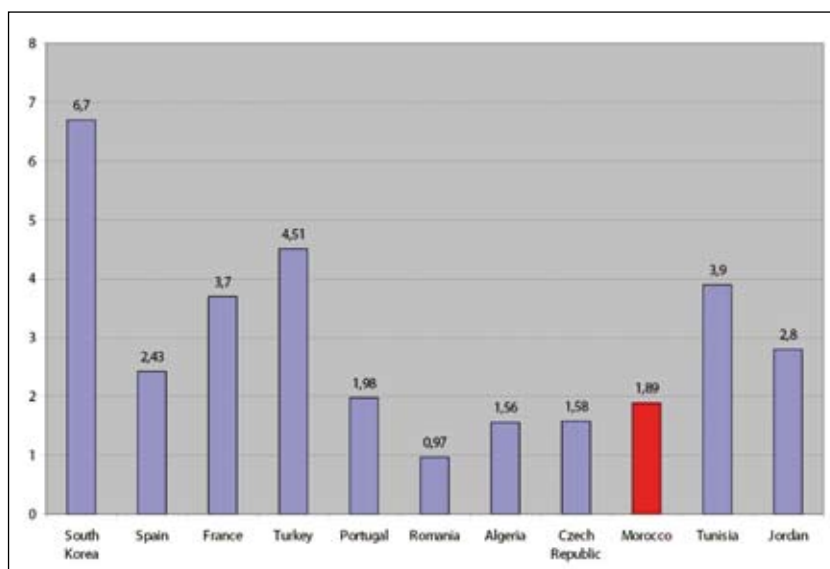
Distribution of personnel of public institutions for research by category in 2006



Number of researchers by active population (per thousand) (2005)

Country	Global Population	Researcher Number	Researchers per thousand active inhabitants
South Korea	48 000 000	321 600	6,7 (SHS excluded)
Spain	45 000 000	109 753	2,43
France	61 000 000	200 064	3,7
Turkey	73 000 000	33 876	4,51
Portugal	10 000 000	21 003	1,98
Romania	21 000 000	20 955	0,97
Algeria	33 000 000	27 497	1,56
Czech Republic	10 000 000	15 809	1,58
Morocco	31 000 000	29 390	1,89
Tunisia	10 000 000	25 445	3,9
Jordan	5 500 000	42 151	2,8

Source: UNESCO (United Nations Educational Scientific and Cultural Organisation)
 OECD (Organisation for Economic Co-operation and Development) – EUROSTAT (European Statistical Office)



1-2- Students

Students registered in graduate programs : Overview

Institutions	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Evolution 1996-2006 (%)
University education	246 042	250 763	242 926	249 253	250 111	261 629	266 621	280 599	277 632	293 866	301 638	22,60
Professional Training	13 882	14 580	13 265	12 329	10 889	11 189	12 303	13 972	16 336	14 816	16 549	19,21
Private higher education	8 195	8 169	8 500	9 266	10 146	11 519	13 425	15 483	17 558	19 215	21 537	162,81
Total 1	268 119	273 512	264 691	270 848	271 146	284 337	292 349	310 054	311 526	327 897	339 724	26,71
Professional education (high schools)	4 548	5 709	6 718	7 720	9 004	10 619	12 825	16 776	23 966	31 663	40 090	781,49
BTS					818	961	1 287	1 726	1 747	1 944	2 038	149,14 *
CPGE	12 572	11 975	12 932	14 766	1 978	2 281	2 689	3 036	3 211	3 340	2 661	34,53 *
CFI					12 688	13 142	10 159	5 096	3 885	2 712	1 140	-91,02 *
Total 2	17 120	17 684	19 650	22 486	24 488	27 003	26 960	26 634	32 809	39 659	45 929	168,28
TOTAL	285 239	291 196	284 341	293 334	295 634	311 340	319 309	336 688	344 335	367 556	385 653	35,20

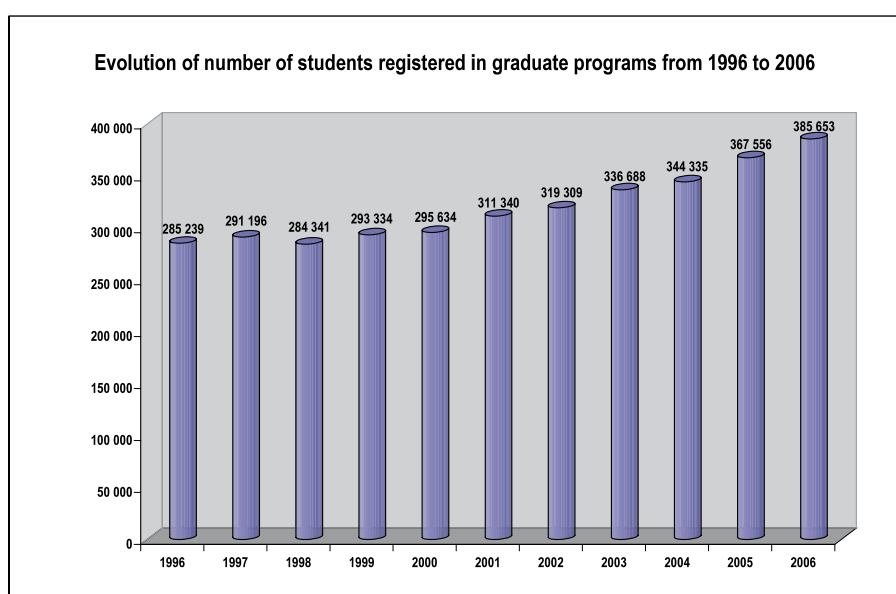
Source: DEP - DFC - MENESFCRS - CSE

DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres, MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, CSE : Conseil supérieur de l'enseignement

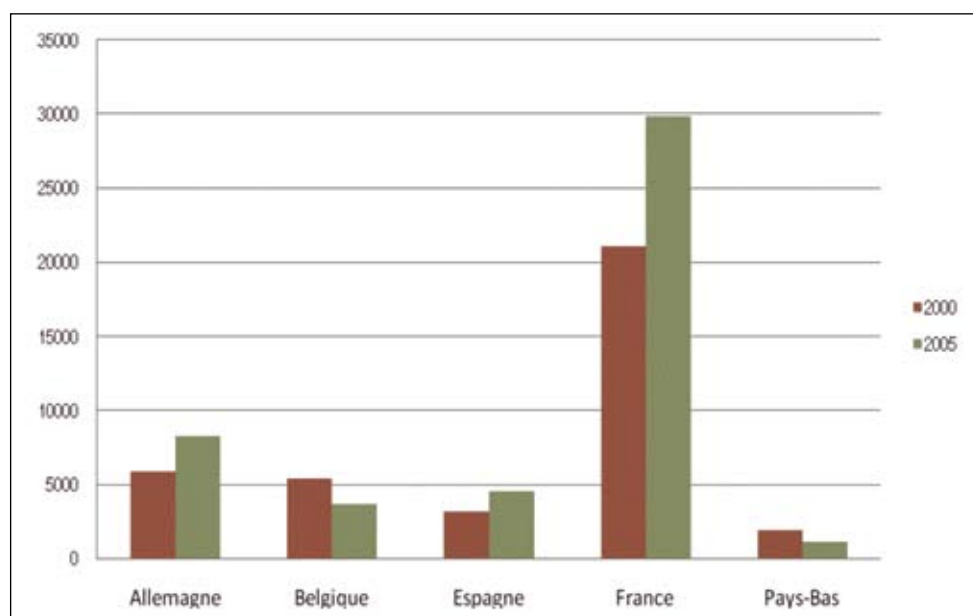
* Evolution 2000-2006

BTS: Brevet de Technicien Supérieur, CPGE: Classes Préparatoires aux Grandes Ecoles, CFI: Centre de Formation des Instituteurs

Evolution of number of students registered in graduate programs from 1996 to 2006



Number of Moroccan students in some European countries



Number of students and lecturers and supervision rate per University in 2006

Universities	Number of students	Number of lecturers	Supervision rate
Quaraouyine, Fes	4 641	105	44
Mohammed V- Agdal, Rabat	24 953	965	26
Mohammed V- Souissi, Rabat	18 981	947	20
Hassan II - Ain Chock, Casablanca	25 149	985	26
Hassan II - Mohammedia	22 762	714	32
Sidi Mohamed Ben Abdellah, Fes	40 210	991	41
Cadi Ayyad, Marrakech	41 402	1 292	32
Mohammed Premier, Oujda	26 279	592	44
Abdelmalek Essâadi, Tetouan	20 304	588	35
Chouaïb Doukkali, El Jadida	7 711	424	18
Hassan I, Settat	6 148	217	28
Moulay Ismail, Meknes	24 680	624	40
Ibn Tofaïl, Kenitra	11 591	376	31
Ibnou Zohr, Agadir	26 827	473	57
Al Akhawayn, Ifrane	1074	102	11
Total	302 712	9 395	32

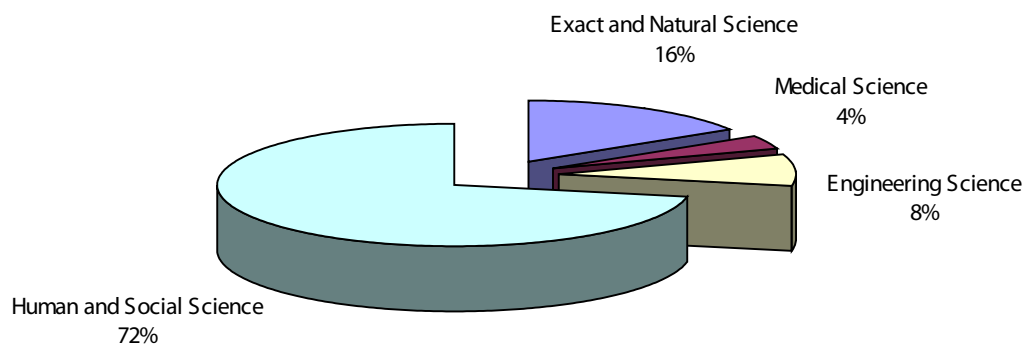
Source: MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique) – DEP (Direction de l'évaluation et de la prospective)

Distribution of students by disciplinary field and evolution

Disciplinary Area	1999	2001	2004	2006	Evolution 1999-2006 (%)
1- Matter and Life Science	61 084	62 576	87 126	94 821	55,23
%	23,48	22,94	27,97	27,99	19,21
1-1- Exact and Natural Science	49 435	37 734	45 869	54 872	11,00
1-2- Medical Science	7 480	7 802	12 865	11 928	59,47
1-3- Engineering Science	4 169	17 040	28 392	28 021	572,13
2- Human and Social Science	199 040	210 251	224 400	243 892	22,53
%	76,52	77,06	72,03	72,01	-5,90
Total	260 124	272 827	311 526	338 713	30,21

Source: DEP - DFC – MENESFCRS

DEP: Direction de l'évaluation et de la prospective, DFC: Direction de la formation des cadres,
 MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique



Evolution of number of students registered in the third cycle and distribution by disciplinary area

Disciplinary Area		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Evolution 1996-2007 (%)
MLS	ENS	4 496	4 776	4 763	5 422	5 266	5 450	4 936	5 182	5 865	6 524	7 444	10 286	128,78
	MS				38	144	163	189	219	191	254	1 140	1 052	2668,42*
	EGS	277	307	416	609	606	588	571	517	703	590	782	801	189,17
Total 1		4 773	5 083	5 179	6 069	6 016	6 201	5 696	5 918	6 759	7 368	9 366	12 139	154,33
HSS	LHS	4 305	5 632	4 664	5 202	4 509	4 494	4 845	4 892	5 209	5 193	5 722	6 625	53,89
	LES	8 254	8 590	2 734	3 019	3 090	3 227	3 202	3 831	4 834	5 802	6 324	8 525	3,28
	ES	534	717	448	760	718	802	783	800	826	847	611	660	23,60
Total 2		13 093	14 939	7 846	8 981	8 317	8 523	8 830	9 523	10 869	11 842	12 657	15 810	20,75
TOTAL		17 866	20 022	13 025	15 050	14 333	14 724	14 526	15 441	17 628	19 210	22 023	27 949	56,44

Source: DEP (Direction de l'évaluation et de la prospective) - MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)

MLS: Matter and Life Science, ENS: Exact and Natural Science, MS: Medical Science, EGS: Engineering Science

HSS: Human and Social Science, LHS: Literature and Human Science, LES: Legal and Economic Sciences, ES: Education Science

* Evolution 1999-2007

The third cycle leads to Master, DESA, PhD or Doctorate of State degrees

Evolution of number of students registered in the third cycle by scientific field

Discipline	Number of students registered in the third cycle by scientific disciplines					Evolution 1997-2006 (%)
	1997	2000	2003	2005	2006	
Matter and Life Science						
Mathematics	756	720	665	677	845	11,77
Physics	1 268	1 401	1 519	1 902	1 873	47,71
Chemistry	1 025	1 240	1 068	1 364	1 686	64,49
Biology	1 104	1 197	1 161	1 470	1 913	73,28
Universe Science	501	482	439	477	681	35,93
Medical Science	-	144	219	254	1 140	691,67 *
Engineering Science	429	831	847	1 224	782	82,28
Other specialities					485	
Total 1	5 083	6 015	5 918	7 368	9 405	85,03
Human and Social Science						
Law studies	5 284	2 123	2 459	3 751	4 165	-21,18
Business and Management	-	-	-	56	156	
Economic Science	3 137	967	1 372	1 995	2 029	-35,32
Original Education	558	424	397	330	257	-53,94
Islamic Studies	778	766	1 036	1 292	1 356	74,29
Language	3 348	2 533	2 624	2 628	2 849	-14,90
Geography	430	291	348	440	466	8,37
History	642	505	494	495	622	-3,12
Philosophy, Sociology	495	414	390	338	364	-26,46
Education Science	267	294	403	517	354	32,58
Total 2	14 939	8 317	9 523	11 842	12 618	-15,54
TOTAL	20 022	14 332	15 441	19 210	22 023	9,99

Source: DEP (Direction de l'évaluation et de la prospective) - (MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)

* Evolution 2000-2006

Number of students registered in the third cycle by degree and by field in 2007

Discipline	Master	DESA	DESS	National Doctorate	Doctorate of State	Total
Original Education	83	26		118	4	231
Legal, Economic and Social Science	2 939	1 755	344	2 727	553	8 318
Literature and Human Science	1 362	1 573	83	2 861	646	6 525
Science and Technology	2 964	2 109	327	4 277	609	10 286
Medicine et Pharmacy	-	845	-	157	-	1 002
Dental Medicine	-	-	-	50	-	50
Engineering Science	199	228	96	232	55	810
Business and Management	82	35	72	11	-	200
Technology	24	30	16	-	-	70
Education Science	189	118	-	190	41	538
Total	7 842	6 719	938	10 623	1 908	28 030

Source: DEP (Direction de l'évaluation et de la prospective) – MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)

DESA: Diplôme d'Etudes Supérieures Approfondies, DESS: Diplôme d'Etudes Supérieures Spécialisées

Evolution of number of graduates from the higher education

Disciplinary Area		Year											Evol 06/96
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
ENS	Licence	6055	5618	5947	5459	3989	3692	3233	3275	3289	3525	7160	18,25
	DESA, DESS					522	362	258	277	568	845	1233	-
	DES	277	132	197	68	49							-
	PhD, Doctorate of State	150	237	258	238	469	411	545	266	297	331	235	56,67
Total 1		6482	5987	6402	5765	5029	4465	4036	3818	4154	4701	8628	33,11
HSS	Licence	15594	16895	17896	17925	18957	17707	17857	17061	18845	21501	47555	204,96
	DESA, DESS					648	811	689	873	832	766	1222	-
	DES	330	347	243	386	262	12	1					-
	PhD, Doctorate of State	75	79	95	124	240	351	535	483	523	402	541	621,33
Total 2		15999	17321	18234	18435	20107	18881	19082	18417	20200	22669	49318	208,26
MS	MD	871	886	840	995	849	986	930	874	958	1134	995	14,24
	DESA, DESS, DSM						55	11	12	31	47	850	-
	PhD, Doctorate of State								10	118	1	-	
Total 3		871	886	840	995	849	1041	941	896	1107	1182	1845	111,83
EGS	Engineer of State	327	316	350	370	349	419	410	457	561	671	723	121,10
	DESA, DESS	17	9	14			93	37	21	22	86	110	547,06
	PhD, Doctorate of State	6	9	11	11	19	21	15	9	16	9	50	733,33
	DUT	675	631	695	824	955	1002	1054	1184	1193	1273	1367	102,52
Total 4		1025	965	1070	1205	1323	1535	1516	1671	1792	2039	2250	119,51
University Degrees	DUT	675	631	695	824	955	1002	1054	1184	1193	1273	1367	102,52
	Licence	21649	22513	23843	23384	22946	21399	21090	20336	22134	25026	54715	152,74
	MD	871	886	840	995	849	986	930	874	958	1134	995	14,24
	Engineer of State	327	316	350	370	349	419	410	457	561	671	723	121,10
	DESA, DESS, DSA, DES	624	488	454	454	1481	1333	996	1183	1453	1744	3415	447,28
	PhD, Doctorate of State	231	325	364	373	728	783	1095	768	954	743	826	257,58
Total 5		24377	25159	26546	26400	27308	25922	25575	24802	27253	30591	62041	154,51
Total of graduates from FDC		4779	5500	5788	5371	4190	3813	4115	5149	7004	5552	6540	36,85
TOTAL		29156	30659	32334	31771	31498	29735	29690	29951	34257	36143	68581	135,22

Source: MENESFCRS - DEP - DFC

MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, DFC : Direction de la formation des cadres

DESA: Diplôme d'Etudes Supérieures Approfondies, DESS: Diplôme d'Etudes Supérieures Spécialisées, DSM: Diplôme de Spécialité Médicale,

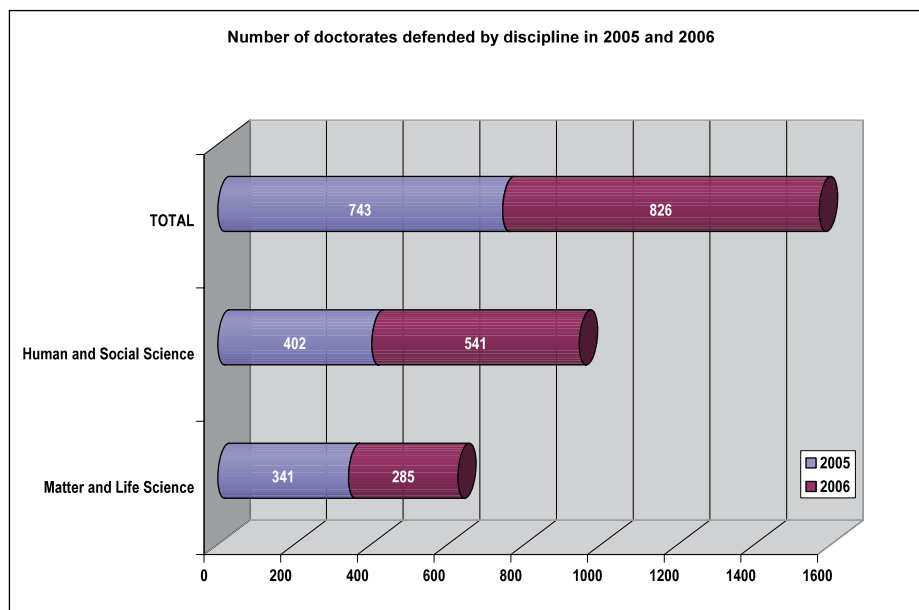
DUT: Diplôme Universitaire de Technologie, DES: Diplôme d'Etudes Supérieures, PhD : Doctorat, MD : Doctorat en Médecine, FDC : Ecoles de la Formation des Cadres

ENS: Exact and Natural Science, HSS: Human and Social Science, MS: Medical Science, EGS: Engineering Science

Number of doctorates defended by discipline in 2005 and 2006

Discipline		2005	2006
Exact and Natural Science	Mathematics and informatics	47	24
	Physics	78	63
	Chemistry	75	58
	Life Science	89	74
	Earth Science	42	16
Total 1		331	235
Engineering Science	Engineering Science	9	50
Total 2		9	50
Medical Science	Medical Science	1	0
Total 3		1	0
Human and Social Science	Law Studies	86	121
	Economic Science	18	47
	Original Education	22	13
	Islamic Studies	50	65
	Language	155	190
	Geography	13	36
	History	17	25
	Philosophy, Sociology	23	35
	Education Science	18	9
Total 4		402	541
TOTAL		743	826

Source: DEP (Direction de l'évaluation et de la prospective) - MENESFCRS (Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique)



**Rate of registration in graduate programs in 1999 and 2005
for the age group 18-25 years (compared to some countries)**

Country	Subscription rate in higher education (%)		
	1999	2005	Evolution 1999/2005 (%)
South Korea	66	91	37,88
Egypt	36	34	-5,56
France	52	56	7,69
Turkey	22	31	40,91
Spain	55	67	21,82
Romania	22	45	104,55
Malaysia	23	32	39,13
Algeria	14	20	42,86
Portugal	45	56	24,44
Morocco	9	11	22,22
Czech Republic	26	48	84,62
Tunisia	17	30	76,47
Jordan	28	39	39,29
Senegal	3	5	66,67

Source: UNESCO (United Nations Educational Scientific and Cultural Organisation) - 2006,
OECD (Organisation for Economic Co-operation and Development) - 2006

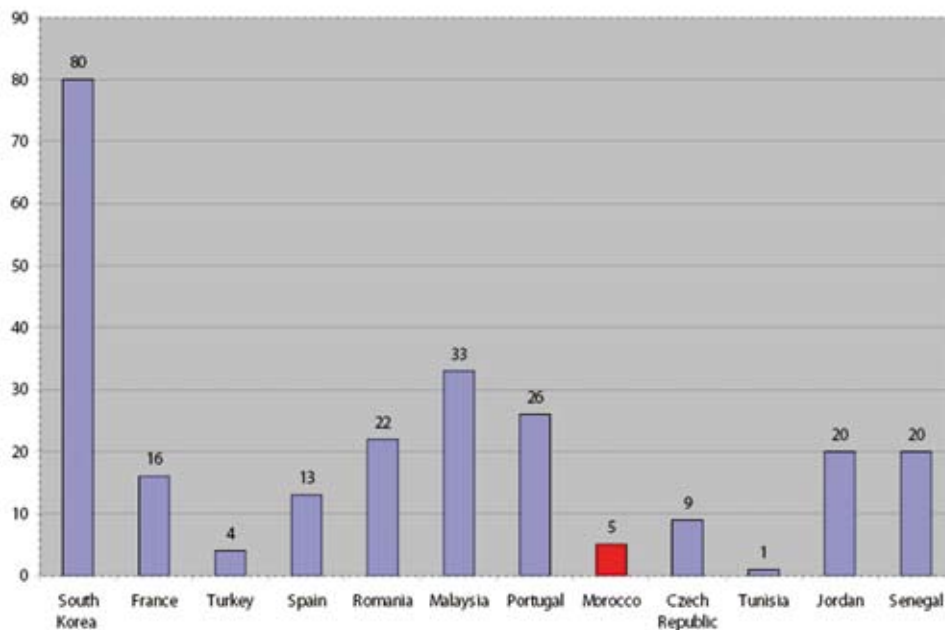
Rate of registration in the private graduate programs (2005)
(comparison with some countries)

Country	Private higher education (%)
South Korea	80
Egypt	UD
France	16
Turkey	4
Spain	13
Romania	22
Malaysia	33
Algeria	UD
Portugal	26
Morocco	5
Czech Republic	9
Tunisia	1
Jordan	20
Senegal	20

Source: UNESCO (United Nations Educational Scientific and Cultural Organisation), OECD (Organisation for Economic Co-operation and Development), EUROSTAT (European Statistical Office)

UD : Undefined

Rate of registration in the private graduate programs in 2005 (%)



Rate of supervision in graduate programs (2005) (comparison with some countries)

Country	Number of students	Number of Professors	Supervision rate
South Korea	3 210 184	190 521	17
Egypt	2 594 186	80 096	32
France	2 187 383	135 783	16
Turkey	2 106 351	82 096	26
Spain	1 809 353	144 973	12
Romania	738 806	30 875	24
Malaysia	731 077	41 871	17
Algeria	716 452	26 097	27
Portugal	380 937	36 773	10
Morocco	367 556	14 200	26
Czech Republic	336 307	24 298	14
Tunisia	314 569	16 671	19
Jordan	217 823	8 251	26
Senegal	59 127	1 099	54

Source: UNESCO (United Nations Educational Scientific and Cultural Organisation), OECD (Organisation for Economic Co-operation and Development), EUROSTAT(European Statistical Office)

Students having completed their higher education and graduated in 2005 (comparison with some countries)

Pays	Number of students	Number of graduates	Percentage
France	2 187 383	664 711	30,39
South Korea	3 210 184	607 982	18,94
Spain	1 809 353	298 448	16,49
Turkey	2 106 351	258 858	12,29
Malaysia	731 077	202 705	27,73
Romania	738 806	156 565	21,19
Portugal	380 937	70 023	18,38
Czech Republic	336 307	54 341	16,16
Morocco	327 897	36 143	14,69
Jordan	217 823	42 294	19,42
Tunisia	314 569	28 565	9,08

Source: UNESCO (United Nations Educational Scientific and Cultural Organisation), OECD (Organisation for Economic Co-operation and Development), EUROSTAT(European Statistical Office)

2. Financial Resources

Domestic expenditures on research and development

Domestic expenditures on R&D	Expenditures (MDH)			
	1999	2001	2003	2006
A- Public expenditures on R&D				
1. Expenditures in higher education sector				
1.1- Universities				
- Grant supports for R&D	45	45,28	45,10	40,33
- Master's and doctoral Scholarships	10	10	8,04	7,97
- Grant to Scholarly Associations	10	8,26	8,26	8,26
- Support to training and research units (UFR)		17,48		
- Grant for Science management				10,29
- Allowances to University lecturers-researchers	622,97	739,20	1 175,82	1 169,62
- Budget devoted to R&D by universities			19,07	153,34
- Investment Budget (Five-year plan)		48,20	93,15	54
1.2- Institutions for professional training (EFC)				
- Allowances to EFC lecturers-researchers	77,22	105,37	264,61	332,99
- Budget devoted to R&D by EFC				35,10
Total 1	765,19	973,79	1 614,05	1 811,90
2. Expenditures in public institution for research				
- Operation Budget	570,27	647,40	494,62	715,44
- Investment Budget		284,29	470,14	292,43
Total 2	570,27	931,69	964,76	1 007,87
Total public expenditures	1 335,46	1 905,48	2 578,81	2 819,77
Percentage of total GERD (%)	91,69	80,48	82,76	76,33
B- Private expenditures on R&D				
- Processing Industries	56	200	200	250
- Relocated Businesses				164,60
- Mining Companies	45	243,20	218,90	314,07
- 0,25 % Telecommunication Turnover			37	61,42
- Association R&D Maroc				2,50
Total private expenditures	101	443,20	455,90	792,59
Percentage of total GERD (%)	6,93	18,72	14,63	21,46
C- R&D Budget from international cooperation	20	19	81,31	81,62
Percentage of total GERD (%)	1,37	0,80	2,61	2,21
Total GERD	1 456,46	2 367,68	3 116,02	3 693,98
Evolution of total GERD (%)		62,56	31,61	18,55
<p>Source: MENESFCRS - DEP - Ministères Techniques - EPR - R&D Maroc MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, EPR : Etablissements publics de recherche, R&D Maroc : Association R&D Maroc</p>				

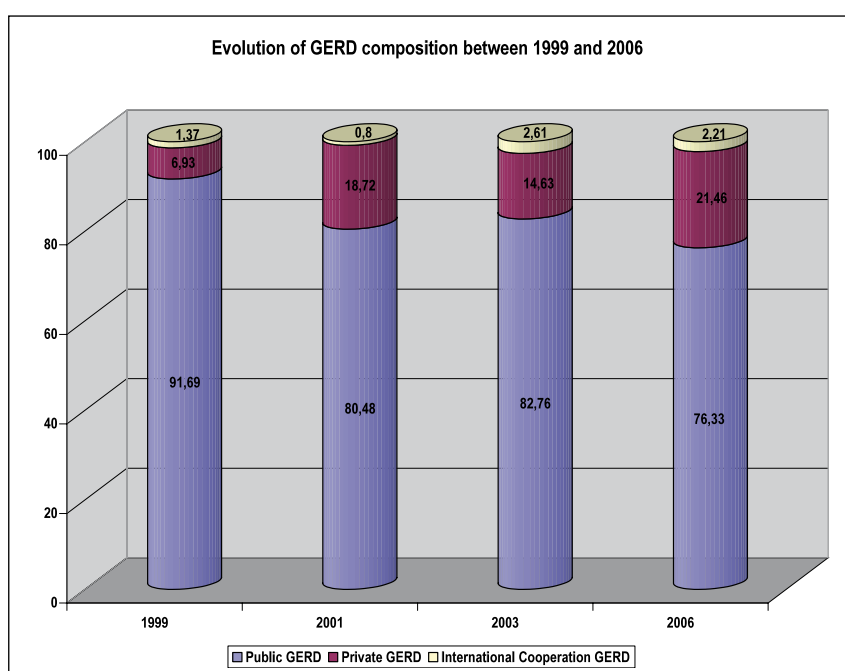
MDH: Millions of Dirhams, R&D: Recherche and Developpement, UFR: Unité de Formation et de Recherche, EFC: Etablissement de Formation des Cadres, GERD: Gross Domestic Expenditures on R&D

Structure and evolution of GERD share in GDP between 1999 and 2006

Amounts in MDH	1999	2001	2003	2006	Evolution 1999-2006 (%)
GERD	1 456,46	2 367,68	3 116,02	3 693,98	153,63
Financing from the public sector	1 335,46	1 905,48	2 578,81	2 819,77	111,15
Share of public sector (%)	91,69	80,48	82,76	76,33	-16,75
Financing from the private sector	101,00	443,20	455,90	792,59	684,74
Share of private sector (%)	6,93	18,72	14,63	21,46	209,41
International Cooperation	20	19	81,31	81,62	308,10
Share of International Cooperation (%)	1,37	0,80	2,61	2,21	60,91
The GDP presented here is calculated using the 1998 as the base year and not 1980 as was the case before. This has led to raising the national GDP					
GDP (Base year 1998)	389 786	426 871	476 987	575 271	47,59
Share of GERD in GDP (%)	0,37	0,55	0,65	0,64	71,85
Share of public GERD in GDP (%)	0,34	0,45	0,54	0,49	43,07
Share of private GERD in GDP (%)	0,03	0,10	0,10	0,14	431,72
Share of International Cooperation GERD in GDP (%)	0,005	0,004	0,017	0,014	176,52
<i>Source: MENESFCRS - Ministères Techniques - Haut commissariat au plan - R&D Maroc</i> <i>MENESFCRS: Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, R&D Maroc: Association R&D Maroc</i>					

MDH: Millions of Dirhams, GDP : Gross Domestic Product, GERD: Gross Domestic Expenditures on Research and Development

Evolution of GERD composition between 1999 and 2006



Distribution of the public GERD by type of expenditure in 2006

	Universities	EFC	EPR	Total
Public GERD (MDH)				
Staff GERD	1 169,62	332,99		
Operation GERD	220,19	35,10	715,44 *	2473,34 *
Investment GERD	54,00		292,43	346,43
Total 1 (MDH)	1 443,81	368,09	1 007,87	2 819,77
Percentage of public GERD (%)				
Staff GERD	81,01	90,46		
Operation GERD	15,25	9,54	70,99	87,71
Investment GERD	3,74		29,01	12,29
Total 2 (%)	100	100	100	100

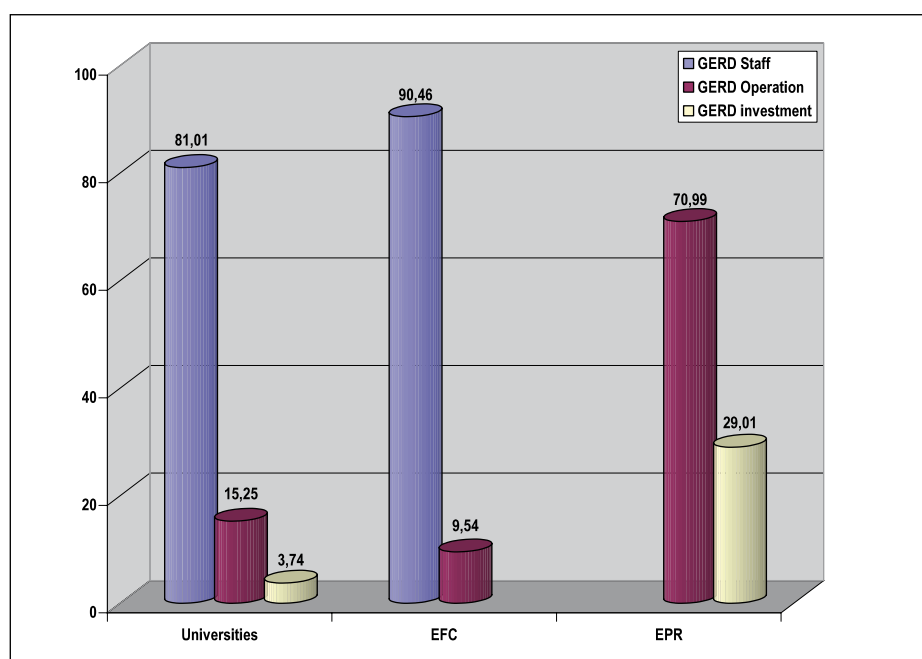
Source: MENESFCRS - DEP - Ministères Techniques – EPR

MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, EPR : Etablissements publics de recherche

* GERD Operation and Staff salaries

EFC: Etablissements de la Formation des Cadres, EPR: Etablissements Publics de Recherche, GERD: Gross Domestic Expenditures on Research and Development, MDH: Millions of Dirhams

Distribution of the public GERD by nature of expenses

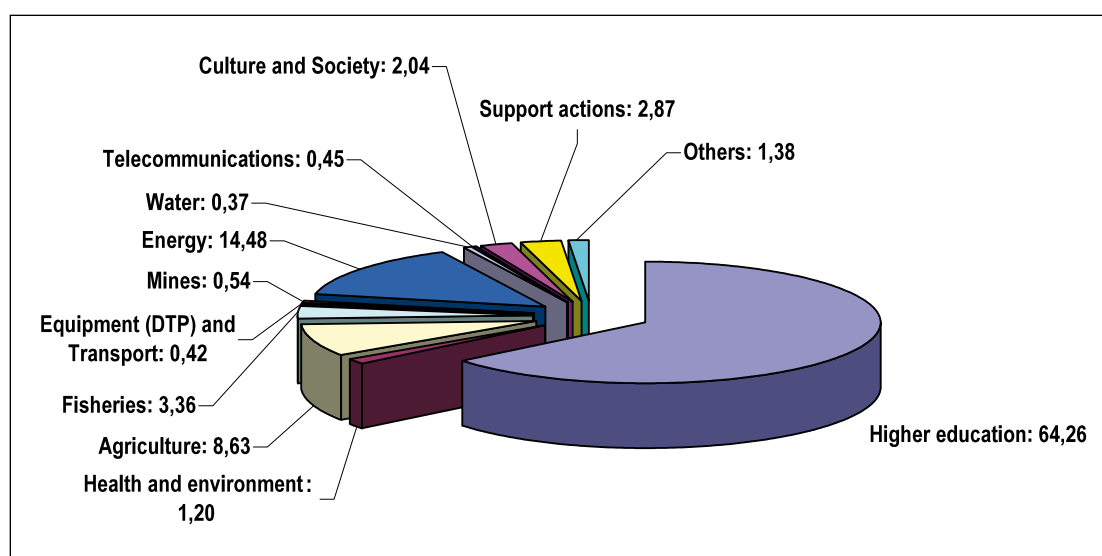


Distribution of the public GERD by activity sector in 2006

Activity Sector	Amount (MDH)	Share (%)
Higher Education	1811,90	64,25
Energy	408,17	14,47
Agriculture	243,24	8,62
Fisheries	94,83	3,36
Support Actions	80,79	2,86
Culture and Society	57,56	2,04
Health and Environment	33,88	1,20
Mines	15,26	0,54
Telecommunications	12,68	0,44
Equipment (DTP) and Transport	11,97	0,42
Water	10,44	0,37
Others	39,05	1,38
Total expenditures	2 819,77	100

*Source: MENESFCRS - DEP - Ministères Techniques - EPR - R&D Maroc
 MENESFCRS : Ministère de l'éducation nationale, de l'enseignement supérieur, de la formation des cadres et de la recherche scientifique, DEP: Direction de l'évaluation et de la prospective, EPR : Etablissements publics de recherche, R&D Maroc : Association R&D Maroc*

MDH: Millions of Dirhams



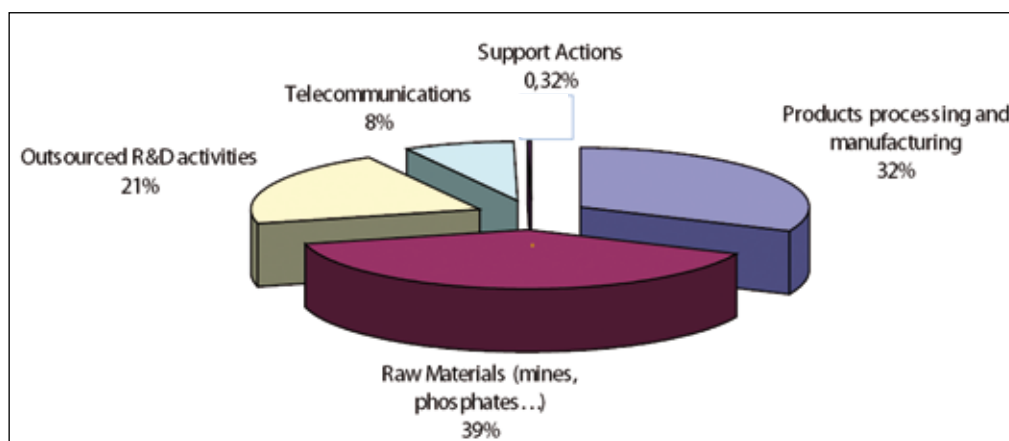
Distribution of the private GERD by activity sector in 2006

Activity Sector	Amount (MDH)	Share (%)
Products processing and manufacturing	250,00	31,54
Raw Materials (mines, phosphates...)	314,07	39,62
Outsourced R&D activities	164,60	20,76
Telecommunications	61,42	7,74
Support actions	2,50	0,31
Total expenditures	792,59	100

Source: Ministère de l'Industrie – Association R&D Maroc

R&D: Recherche and Développement, MDH: Millions of Dirhams

Distribution of the private GERD by economic sector in 2006



Share of GDP devoted to higher education in 2005 (comparison with some countries)

Country	Expenditures in % of GDP
South Korea	2,4
Spain	1,2
France	1,4
Turkey	1,2
Malaysia	1,7
Portugal	1
Romania	0,6
Czech Republic	1,1
Morocco	1,1
Tunisia	1,8
Senegal	1,4

GDP : Gross Domestic Product

3- Scientific Production

3. 3-1- Scientific Publications

Number of scientific publications of Morocco (2001, 2003, 2006)

Fields	Number of publications of Morocco					
	Presence record			Fractional record		
	2001	2003	2006	2001	2003	2006
Life Science	378	403	367	277	296	249
Matter Science	556	543	506	312	300	275
Engineering Science and Mathematics	209	229	233	130	146	140
Multidisciplinary Specialities	10	8	12	6	4	6
All fields	1 054	1 073	993	725	746	670

Source : OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

Number of scientific publications in 2006, regional comparison

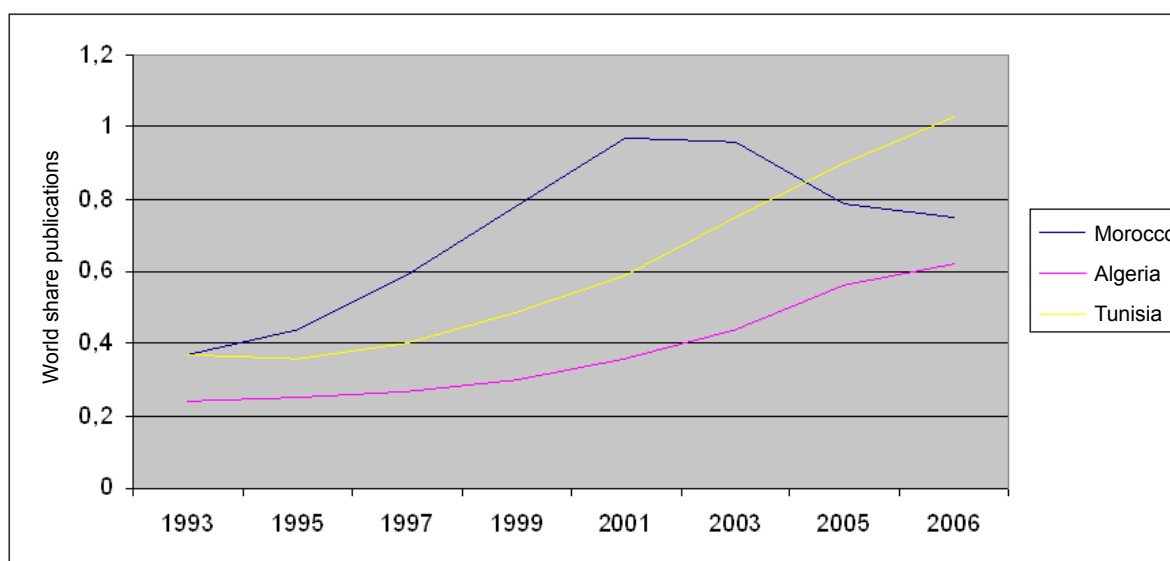
Fields	Number of publications: 2006					
	Presence record			Fractional record		
	Algeria	Tunisia	France	Algeria	Tunisia	France
Life Science	120	571	25 177	60	434	18 901
Matter Science	526	500	21 875	315	294	13 206
Engineering Science and Mathematics	302	305	10 140	172	185	6 544
Multidisciplinary Specialities	14	22	961	7	8	417
All fields	808	1 242	52 730	554	922	39 068

Source: OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

World share of Morocco publications by discipline, regional comparison

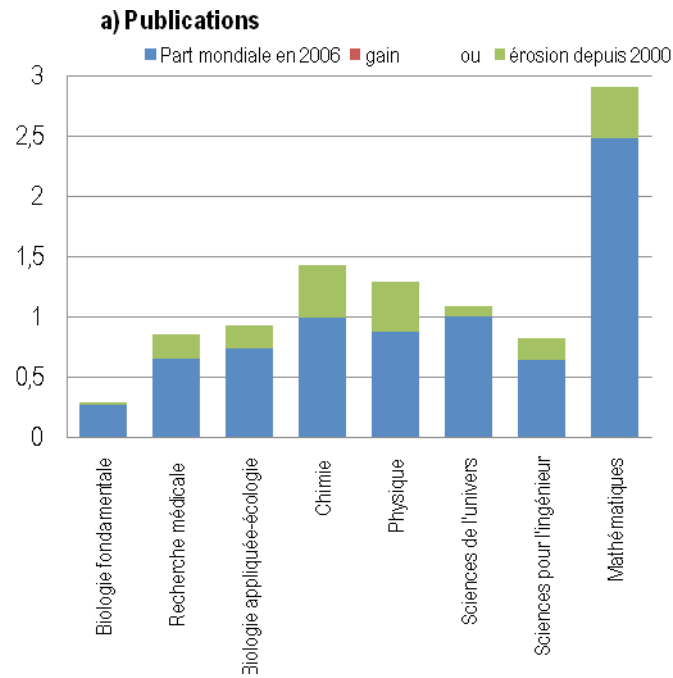
Discipline	Share per thousand World publications							
	Morocco					2006		
	1993	1999	2001	2006	Evolution 2001-2006 (%)	Algeria	Tunisia	France
Fundamental Biology	0,20	0,31	0,29	0,27	-6,90	0,14	0,64	44,50
Medical Research	0,30	0,72	0,85	0,65	-23,53	0,09	1,10	42,40
Applied Biology - Ecology	0,53	0,70	0,93	0,74	-20,43	0,33	1,04	33,60
Chemistry	0,54	1,16	1,43	0,99	-30,77	1,18	1,30	41,00
Physics	0,32	1,00	1,29	0,88	-31,78	1,26	0,78	50,20
Universe Science	0,47	0,89	1,09	1,00	-8,26	0,62	0,81	48,90
Engineering Science	0,34	0,58	0,82	0,64	-21,95	1,22	1,07	41,90
Mathematics	0,80	2,11	2,91	2,48	-14,78	1,36	2,39	69,00
All disciplines	0,37	0,78	0,97	0,75	-22,68	0,62	1,03	43,80

Source: OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

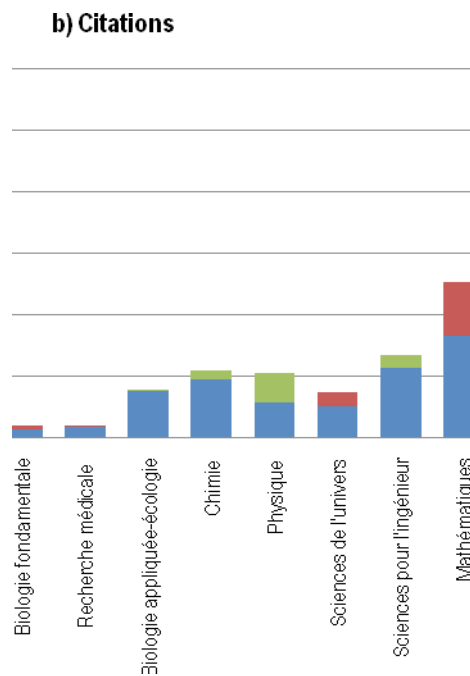


Source: Observatoire des Sciences et Techniques (OST), Paris, France

Global share of publications and citations of Morocco (2006 and evolution)



Source: Observatoire des Sciences et Techniques (OST), Paris, France

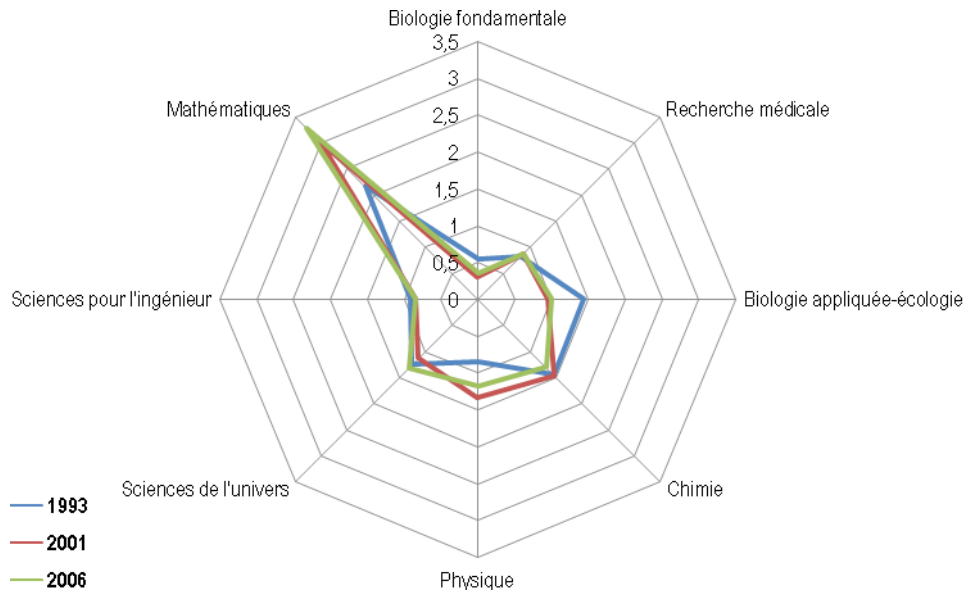


Source: Observatoire des Sciences et Techniques (OST), Paris, France

Scientific specialisation index for Morocco (1993, 2001, 2006)

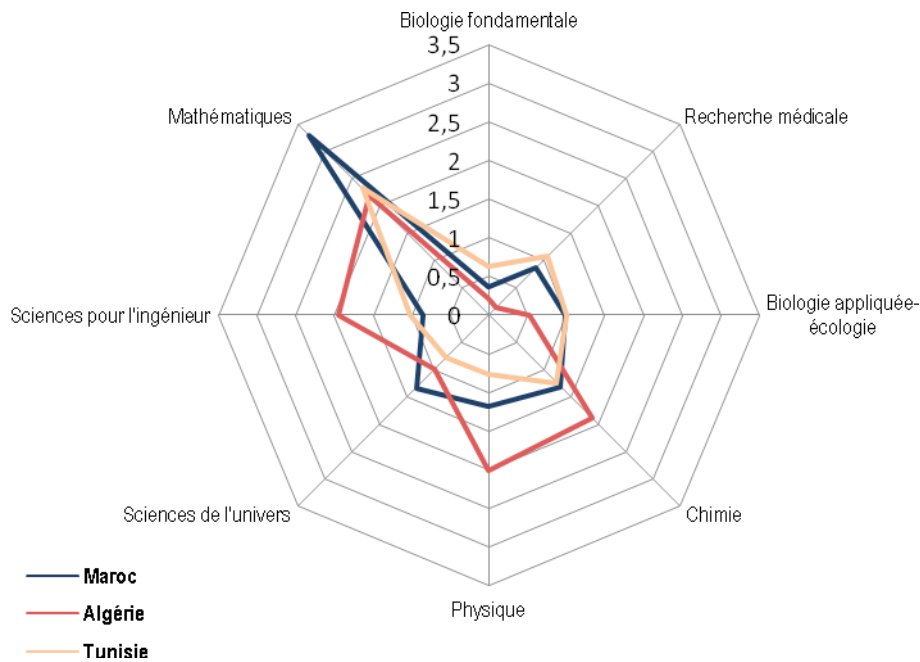
The specialisation index determines the disciplinary profile of Morocco as compared to that of global publications. This index is calculated as the ratio of the world share of Morocco publications in a given discipline and its world share in all disciplines.

The Figures bellow show the evolution of this index between 1993 and 2006, and its comparison with the corresponding index of other countries



Source: Observatoire des Sciences et Techniques (OST), Paris, France

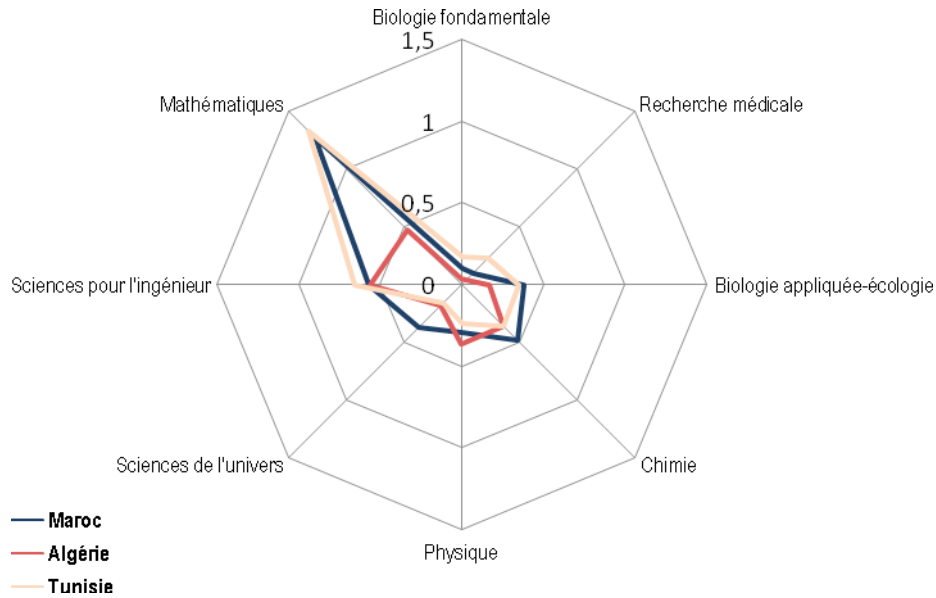
Specialisation index for Morocco (regional comparison)



Source: Observatoire des Sciences et Techniques (OST), Paris, France

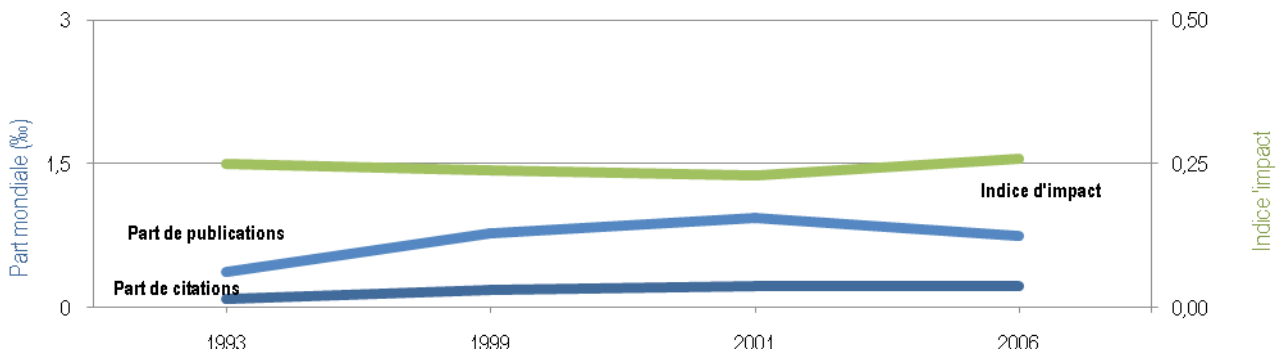
World share of Morocco citations (regional comparison)

The share of citations obtained during the years **N** and **N+1** for Morocco publications produced during the year **N** provides a first indication regarding Morocco visibility in the world.



Source: Observatoire des Sciences et Techniques (OST), Paris, France

Comparative evolution of publications, citations and impact index of Morocco



Source: Observatoire des Sciences et Techniques (OST), Paris, France

Distribution of single-address publications and co-publications

Publication status	Morocco : Share (%) in total publications			
	2001	2003	2006	Evolution 2001-2006 (%)
Single-address publication	30	28,6	24,1	-19,67
Co-publication	70	71,4	75,9	8,43
Total	100	100	100	
Number of publications	1 054	1 073	993	-5,79

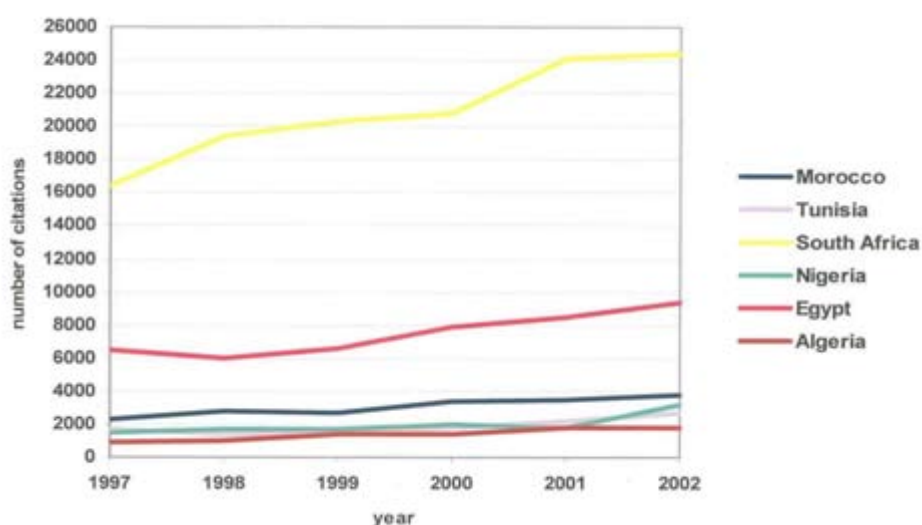
Source: OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

National and international co-publication share of Morocco

Publications status	Morocco : Share (%) in total publications			
	2001	2003	2006	Evolution 2001-2006 (%)
In co-publication with other Moroccan addresses	24,8	28,4	31,2	25,81
In international co-publication	57,4	56,3	58,9	2,61
Total publications	100	100	100	

Source: OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

Total number of citations : 1997-2006



Source: Direction de la technologie

3-2- Technological Production

Evolution of patenting by sector

Field	2000	2001	2002	2003	2004
Medicine – Hygiene	47	82	158	140	196
Chemical Industries	24	60	100	101	107
Various Industries and water treatment	40	56	63	49	73
Physics – Electricity	56	65	63	53	67
Mechanical Technology, Constructions and packaging - Handling	61	34	74	82	67
Food	19	24	48	39	40
Textile Industries		12	17	14	11
Solar Energy	2		5	5	
Total	249	333	528	483	561

Source: Direction de la technologie

Number of European patent applications for Morocco (1993-2006)

Field	Morocco : Number of European patent applications			
	1993	1999	2001	2006
Electronics – Electricity		1	1	3
Instrumentation			1	1
Chemistry – Materials	0	1	0	1
Pharmacy – Biotechnology	0	0	0	3
Industrial Processes	0	0	0	1
Machinery – Mechanical - Transport		0	0	1
Household consumption - BTP	0	1	0	
All fields	1	3	3	9

Source: OST 2008 (Data from Institut National de la Propriété industrielle/Office Européen des Brevets, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)

BTP : Bâtiment et Travaux Publics (Construction)

4. Scientific partners of Morocco in co-publications

The first scientific partners of Morocco (2001, 2006)

Rank	Share (%) of Morocco co-publications			
	2001		2006	
	Countries	Share (%)	Countries	Share (%)
1	France	71,1	France	63,9
2	Spain	7,8	Spain	13
3	United States	7,3	United States	7,2
4	Italy	6,3	Italy	6,4
5	Germany	4,7	Germany	5,5
6	Belgium	4,3	Canada	5,2
7	Canada	3,4	Belgium	3,5
8	Japan	2,1	United Kingdom	3,1
9	United Kingdom	1,8	Switzerland	2,3
10	Tunisia	1,6	Portugal	2,2
Number of international co-publications		605		585
<i>Source: OST 2008 (Data from Thomson Scientific, treatment by Observatoire des Sciences et Techniques (OST), Paris, France)</i>				

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