

# *From Generation to Cultivation by the State: Progress of Moroccan Scientific Research*

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*Scientific activity in any country takes on styles of organisation and overall directions depending greatly on the twists and turns of its history. In Morocco scientific research has never been central to development policies. Nevertheless, the government has in the recent past shown more interest in that area. The aim of this paper is to trace the history of 'modern science' in Morocco in order to capture the essence of the background to a science policy that is currently emerging.*

THE WESTERN PART of North Africa, the Maghreb, has never been the hub of Arabian science. Some universities founded long ago were science's finest creations: Kairouan in Tunisia; Tlemcen in Algeria; and the Quaraouiyyine of Fès in Morocco. The only traces of that golden era are some popular, rosy images of the typical 'scholar' in literature. The revival of science in North Africa, in its modern form, came with the advance of the European empires in the nineteenth century. Such regeneration was sometimes promoted by a country's own government (as in Egypt and Tunisia), anxious to harness the powers of medicine and military sciences from the perspective of ruling regimes. More often, it was imported by the colonisers, who gained hold of the region in stages (Algeria from 1830; Tunisia in 1896; Egypt in 1879; and Morocco as late as 1912). The scientific activity that became established was therefore cast in the mould of a specific type of production, attached to human and natural sciences directed by the colonising country's institutions.

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### The Era of Colonial Science in Morocco

'Modern science' was introduced in the first decade of the twentieth century when France set up the protectorate.<sup>1</sup> Scientific research was then conceived and organised to serve colonisation, being regarded as a means of making the most of the newly acquired territory. In Algeria, occupied early on and destined for a substantial influx of colonisers, then annexed completely as a *département* of France, the phase of exploration was a long one. It required all types of research (including fundamental science). Establishments were founded in Algeria to that end. A university even saw light of day in 1905.

For Morocco the reverse was the case. The imperial takeover came late in 1912 and that country was not considered to be 'uncharted' territory. The country's 'development', the pragmatic watchword of the day, did not induce the governors dispatched from France to call for either erecting grand institutions or conducting basic research. A system of colonial research did exist, but became very rapidly oriented to applied research of utility for colonial policy or for the colonists themselves. The character of local science was above all data collection. Subjects of science-based development for the country's interest hardly featured in such exercises (Gaillard et al. 1997: 23–29). This colonial style of scientific production nevertheless was not monolithic. It did leave room for considerable variations. It was devoted above all to two fields: health and agriculture. The system was essentially based on research centres (Table 1), which were placed under the responsibility of the protectorate's technical services department. These establishments employed full-time civil-service researchers from France where they had received their training.

The Institut Pasteur of Tangier and then Casablanca conducted some fundamental research (especially on rabies [Kleiche 1994]), but the tasks of vaccine production and epidemiological surveillance quickly gained priority over all their other activities. In agriculture the colonial administration organised its research services around a 'new' discipline, genetics. The first trial gardens, field trial stations and experimental farms were soon grouped together within the agricultural experimentation centre, which was assigned the task of cereal selection, that is, on wheat (Kleiche 2000: 15–16).

Twenty years later there was a change in approach. In France in the late 1930s this was expressed by a prime concern for the planning and coordination of scientific investigations in the whole empire. The movement was driven by the newly formed Centre National de la Recherche

TABLE I  
Research Institutions in Morocco under the Protectorate

Year <i>founded</i>	Name	Location	Field				
			Agri*	Med*	NS*	ES*	HSS*
1914	Cherifian Scientific Institute	Rabat				+	
1914	Trial gardens	Rabat	+				
1914	Hygiene laboratory	Rabat		+			
1914	Institut Pasteur			+			
1915	Trial gardens	Marrakech	+				
1916	Experimental farm	Fès	+				
1919	Centre for Agricultural Experimentation	Rabat	+				
1920	Centre for Higher Scientific Studies	Rabat					+
1924	Genetics and seed testing station	Rabat	+				
1928	Centre for Law Studies	Rabat, Casablanca					+
1932	Pasteur Institute	Casablanca		+			
1940-45	Centre for Higher Scientific Studies	Rabat					+
1945	Institute of Oceanography	Casablanca				+	
1946	Public Laboratory for Research and Testing	Casablanca					+
1945	Agronomic Research and Agricul- tural Experimentation Services	Rabat	+				
1946	Marine Fisheries Institute	Casablanca	+				

Source: Compiled by author.

Notes: \*Agri: agricultural sciences; Med: medical sciences; NS: natural sciences; ES: engineering sciences; HSS: human social sciences.

\* Indicates the promotion of the discipline.

Scientifique (National Centre for Scientific Research) (CNRS) in France. The new organisation and the ethos it embodied promised a broadening of the scope of research, and to make room for fundamental studies and new disciplines. World War II put the project on the back burner, but it returned to the fore after the end of the conflict (Bonneuil and Petitjean 1996: 119-45). In Morocco a Franco-Moroccan Scientific Committee was established at Rabat. However, its impetus was curbed by a colonial administration fixed on the short-term gains and which in any case jealously guarded its authority (BIM 1947: 26-27; DIP 1950: 9-10]. The Franco-Moroccan Scientific Committee subsequently had only about five plenary meetings between 1947 and 1955. The wishes of the committee's sections were never put into practice. In 1955, on the eve of independence

in the face of so much bad grace, some of them stopped holding meetings (BEPM 1955: 10–48).

The updating of research envisaged by France after World War II went no further than the foundation of a new institute of oceanography in 1945, and in the applied sector to the creation in 1946 of a fisheries institute and a public research and testing laboratory to serve industry and civil engineering. Local science remained deprived of means, extremely isolated and either subjugated to the administration or highly dependent on the science of the colonial power. The policy of coordination on an empire-wide scale and the scheme to build up a network devised by proponents of centralised planning in Paris (under the responsibility of the CNRS) failed. The newly independent Morocco nevertheless was left with a significant legacy, in terms of accumulated, stored and usable knowledge. But in terms of institutions it was slim. Research centres were fewer, less diverse and less well endowed than in other Maghreb countries.<sup>2</sup> Only in agriculture were they strong enough to form a true system, and this under the close eye of the corresponding government department. That system did indeed generate lasting models of research development and even of rural 'scientific development' (Kleiche 2000: 19). However, in this field as in others (medicine included), practically no Moroccan researcher had been trained to take over and sometimes not even as assistants.

### **Little or No Training for Research**

Colonisation turned out to bring very little for higher education and training. Whereas in Algeria there was a fully operational university (albeit largely closed to the local people, referred to at the time as 'the Muslims') and in Tunisia the creation of one had been mooted (even if the project fell apart in the end), the protectorate of Morocco came to initiate higher studies only in 1928 when it created the Centre d'Etudes Juridiques (Centre for Law Studies) (CEJ), with establishments at Rabat and Casablanca to produce graduates qualified in law. In 1940 a centre for higher scientific studies was being planned. It was not operational until after the liberation. In 1945 a school of agriculture was founded at Meknès, with the objective of training agricultural technicians.<sup>3</sup> Then the beginning of the 1950s saw the establishment of the Ecole Marocaine d'Administration (Moroccan School of Administration) (EMA) in Rabat,<sup>4</sup> as well as three secondary-level schools of agriculture that produced 'monitors' whose task was to explain and popularise farming information (see Table 2 for higher education institutions).

TABLE 2  
Higher Education Institutions in Morocco at the Time of the Protectorate

Year founded	Name	Location	Field				
			Agri*	Med*	NS*	ES*	HSS*
1923	Secular Sciences Institute	Fès			+		+
1928	Centre for Law Studies	Rabat,					+
		Casablanca					
1940-45	Centre for Higher Scientific Studies	Rabat					+
1945	School of Agriculture	Meknès	+				
1945	Xavier Bernard School of Agriculture	Rabat	+				
1945	School of Horticulture	Meknès	+				
1945	School of Agriculture	Soueilah (near Marrakech)	+				
1950	Moroccan School of Administration	Rabat					+

Source: Compiled by author.

Notes: \*Agri: agricultural sciences; Med: medical sciences; NS: natural sciences; ES: engineering sciences; HSS: human social sciences.

\* Indicates the promotion of the discipline.

These establishments were not intended for training to higher degrees or qualifications, although they could give the preparatory grounding for higher studies to be carried out in France. Principally, they trained the technical assistants needed for colonisation. They were in any case effectively closed to Moroccans, at least in the beginning. When local people gained wider access to them (from 1950 onwards), they aimed largely for humanities, law and non-scientific disciplines because of the associated job prospects. Such dispositions were to have an influence on the way higher education turned out after independence (1956).

Morocco had anyway not been devoid of higher education before French power gained a hold. It was a Muslim system and colonisation did not suppress it. However, it did remain enclosed in its own methods of recruitment and was detached from any form of training for employment and from any teaching of 'modern' sciences. Claims by students and initiatives by progressive intellectuals from the higher echelons of Moroccan society brought attempts to bring in courses in mathematics, cosmography, applied astronomy, history and geography (Quaraouiyyine: Institut des Sciences Profanes 1923-33). But they were short-lived for lack of suitable teachers and equipment (Paye 1957: 395). Scientific education seemed then to offer no career prospects for young Moroccans, who found it

better to become interpreters or lawyers in the framework of the protectorate.

Under the protectorate no medical or paramedical teaching institution was ever set up. It was the same story for engineering and technical training (except agriculture). The higher education establishments were merely at an embryonic stage and had no great culture of research. Moreover, the training of students in the specialist ecoles or universities of the colonial country (or in other countries abroad), which provided a positive educational contribution in other countries of the Maghreb, was for Morocco no more than a trickle. At independence Morocco had barely 100 engineers or technical professionals (half of whom were in agriculture), about twenty doctors and six pharmacists (Laberge 1987: 194).<sup>5</sup>

#### **A Shift of Balance: The Rise of Higher Education after Independence, 1956–86**

When independence came (1956) most colonial technicians left the country. The Moroccan government therefore found itself in charge of a range of infrastructure whose functioning was jeopardised by the absence of qualified or managerial-level personnel. Administrative, scientific and technical services all had the same problem. The great issue was to organise an effective system of accelerated training of a high standard. The task was first assigned to a rapidly founded university system. The national government built one up (first at Rabat) from the embryonic higher education structure they inherited and which it extended prodigiously. In a second phase a specific national system termed 'Formation des Cadres' (professional and management training) undertook to serve the different professional spheres (business schools and engineering colleges). At the same time the university system grew even further, with establishments setting up in many Moroccan towns. During this period the services of the pre-existing research centres and institutes were either maintained (to a large extent by French development aid) or transferred to the university sector (the case of natural sciences, law and social sciences). Those establishments anyway gradually lost their monopoly on scientific production as higher education gained strength and became more professional.

#### **The University System**

The high points in the organisation of education in Morocco in the period just after independence were the Royal Commission of Reform set up in

1957, followed by the Maâmora Symposium in April 1964.<sup>6</sup> The policy enunciated was embodied in a Charter for Education of April 1966. The question of higher education was approached from the angle of the need for Moroccanisation at managerial and professional levels, and not at all from a concern for research. At the time the Moroccan government, like most states in the African continent, showed little interest in scientific creativity. It did not set up any new infrastructure for this sphere, but maintained the research establishments in place with the aid of France, which delegated qualified aid workers to run them.

In 1957 the Institut des Hautes Etudes Marocaines, the Centre d'Etudes Supérieures Scientifiques (Centre for Higher Scientific Studies) and the Centre d'Etudes Juridiques (Centre for Law Studies) were amalgamated in a single Faculty of Letters. As for the establishment concerned with research in the natural sciences, the Institut Scientifique Chérifien, it was incorporated in the Faculty of Sciences. The two faculties made up the Mohamed V University (in 1962 a Faculty of Medicine was added), which was cast in the mould of its French counterparts.<sup>7</sup> It employed a substantial number of aid workers from France among its teaching staff until such time as Moroccans could take over.

In 1957 the organisation of elementary education (a handful of engineers who had qualified in France) pressed for the creation of high-level specialist schools (*écoles supérieures*) along the lines they had come to know in France. Two years later this preparatory organisation itself became, the first of Morocco's high-level engineering *écoles*, with the aid of UNESCO's financial backing: the Ecole 'Mohammedia' d'Ingénieurs for mining, industry and public works (Vermeren 2000: 303). In 1966 the Hassan II National Institute (a school for agriculture and veterinary studies) was created. Although at the time they were not very visible, these *écoles* were to become highly prestigious. They soon stood as a model to show the way for higher education policy. (See Appendix 1 for the founding of Moroccan higher education. The first structures were established between 1956 and 1970.)

### **The *Grandes Ecoles***

The situation changed during the 1970s. The economic and political situation had seriously deteriorated. Morocco was reeling from a fall in the price of phosphates (its main export), and suffered the full shock of the oil crisis. The country soon had to submit to the constraints of the

structural adjustment plans imposed by the International Monetary Fund, which limited state expenditure.

The universities had at the same time turned into an immense hotbed of unrest. Education as a whole area became a very sensitive issue and highly political. At the Oaks Symposium devoted to this issue in 1964, a tendency formed that was in favour of a process of Arabisation and Islamisation, which opposed the government's bilingual policy (El Masslout 1999). A national front was formed, which seized the opportunity to form a coalition, calling on students to boycott national elections. From 1965 to 1974 arrests became more and more frequent and students' unions were disbanded (Squali and Merrouni 1981: 143–46).

Faced with this situation, the government opted for a large increase in the number of faculties in the provinces, but which were dotted with only meagre resources.<sup>8</sup> It devoted most of its efforts to creating new professional and managerial schools (*ecoles de cadres*), outside the university sphere. The idea was to get round the drawbacks inherent in universities. Admission to the *grandes ecoles* was selective and students were much more tightly supervised, but they were less politicised. From the 1970s the more specialised sectors (business, various types of engineering, rural and environmental specialities) began to find their place under the different ministries (bar education). Assistance coming from bilateral or international aid funds was channelled preferentially towards this new means of education and training. The Five-Year Plan for 1973–77 encouraged private investment and sought to modernise those sectors that could earn foreign currency. It banked on the *grandes ecoles* system to produce the managers and professionals necessary for bringing new development, agriculture and tourism projects to fruition.

It was therefore for political reasons to separate these establishments from the centres of unrest in the universities that the government chose the '*grande ecole*'. This new sector soon strengthened with the addition of many institutes of tertiary-level schools, avoiding the dual risk of succumbing to mass intake and Arabisation (see Appendix 1). The dual nature thus built into the higher education system presaged another: that which was to come into play between the 'academic' and 'technological' sectors, as soon as the *grandes ecoles* started to develop work within their own style of science.

**University Expansion and Mass Intake, 1980–90:  
Dynamics of the Academic World**

The universities and the *grandes ecoles* are the two main players in the theatre of Moroccan research that gave rise to two professional bodies: that of university teachers and that of ‘technologists’. This distinction is important as it will enable us to explore the expansion of these two sectors. The new universities’ main mission was teaching. The government gave no stimulation at all to research within them. However, the strong growth in student numbers led also to an increase in teaching staff. The situation was not easy for the new recruits. The growth of the universities in the 1980s was marked with the rapid rise of the student numbers, which increased dramatically from 25,000 in 1975 to 50,000 in 1980, 100,000 in 1985 and 200,000 in 1990. The university network in Morocco expanded (Appendix 1) and the universities recruited substantially (Table 3).

**Table 3**  
**Growth in Student Numbers and Teaching Staff in University**  
**Establishments in Morocco, 1995–2000**

<i>Academic years</i>	<i>Number of students</i>	<i>Number of student-researchers</i>
1955–56	1,687	0
1960–61	5,117	172
1970–71	14,808	488
1980–81	86,844	2,490
1990–91	206,725	6,437
1998–99	249,253	9,867

**Source:** Ministry of Higher Education web site (<http://www.dfc.gov.ma>)

In 1975 the first laws were introduced that were entirely devoted to university organisation.<sup>9</sup> They conferred a status on teacher-researchers. A specific salary scale was introduced that led to an increase in their salaries. The university system matured. With full ‘Moroccanisation’ during the 1980s and the arrival on the scene of many young teachers, fresh from experience with research during recent doctoral or postdoctoral studies, production becomes highly visible. Development aid from abroad had an essential role in the ‘upsurge in research’ observed. The research groups formed generally owed their existence to the personal or individual action of researchers or professors and were sometimes associated with a small team. Their project cannot easily be dovetailed with others. They

have limited means. Often they survive due to international aid obtained through informal interactions (because of past Ph.D. training) of their heads with colleagues in the host university in Europe or with partners in bilateral scientific aid schemes when working on joint projects.

### **Growth of the Technological Sector**

Two types of establishments that are outside the university system contribute to the research potential. They are the specialist research centres (active mainly in agriculture and health) and the newly created high-level *grandes ecoles*. At the beginning of the 1970s the research centre world had stagnated. The Pasteur Institute, which had developed some organisational problems, seemed to be in complete decline in the 1980s (Laberge 1987). The Institute of Marine Fisheries became more involved in commercial affairs than in scientific activities from 1970 onwards. The Institut National Agronomique (National Agronomics Institute) (INRA), one of the paramount institutes of the colonial era that had fallen into decay and dissolved, was reborn in 1982, but it no longer had the mission of planning and coordinating agricultural research. It was in its revised form a modest executive agency, which performed applied and development research work on the demand of its own Division of Agricultural Education, Research and Development.

Revival of research came from elsewhere. It was first the Hassan II Agriculture and Veterinary Institute that demonstrated initiative. It built bridges between basic research and action research. Its teachers were recruited from among its own students (the best), sent for Ph.D. training in the USA. There they benefited from research experience (of the 'research by doing' type) and the institute insisted that they continue to devote themselves to it on their return. That institute was decentralised and had branches in nine regions of the country. Original research was conducted there, which soon was to make the institute the principal producer of scientific results in agriculture. In the experimental zones it maintained permanent contact with the field, the farmers and the professional workers in agricultural development. It attracted a substantial influx of money locally. The research it did was a mark of the prestige and high standard of the establishment, at the same time a source of funding.

This original model inspired some imitators. Its arrival on the scene heralded the construction of a new 'technological' field. Not what would be considered 'academic' (even though the institute that promoted it here devoted itself to teaching), in the sense that the research performed had

no crucial significance for career promotions. It was done on a larger scale than the applied research of the old specialist institutes because it included work effected 'upstream', and involved at the same time a direct link with the development services that were beginning to be built up in government departments and industry (industrial companies).

The major novelty was that most ministries and some large public companies founded their own research development centres around the 1980s. Fifteen public or quasi-public research establishments rose mainly in the fields of mining, phosphates, energy and nuclear technology (see Appendix 2). This system, intended for training of administrative middle management, has left some room for a strong research dynamics to develop at its margins (Appendix 3). On the other hand the state backed technological research in public institutes set up for that purpose. Clearly, research as an activity is defined differently in the two cases. The research centre sector conducts mainly work for development; it mostly employs engineers with advanced qualifications and high-level technicians. The university sector does research in an exploratory vein or for educational purposes. Can a new situation bring a convergence of the two styles? It is not a rhetorical question, but one which we are bound to consider given recent developments. It is the new paradox of research that has developed spontaneously and becomes abruptly an object of interest and regulation.

### **The Current State of the Research Sector**

Most Moroccan scientific research currently falls within the public sector. The most productive establishments depend at present on the major ministry, which groups together (under separate divisions) universities, professional and management training, several *ecoles* and fifteen research institutes under government. The Centre National de Coordination et de Planification de la Recherche Scientifique et Technique (National Centre for Coordination and Planning of Scientific and Technical Research) (CNCPRST),<sup>10</sup> set up at the end of the 1970s in order to stimulate and coordinate research in all the various parts of the Moroccan system, has never really been able to exercise its role. The setting up of a wide-reaching Ministry of Higher Education, Management Training and Research in 1976 was one of the significant steps. This new ministry was active as a secondary supervisory body in establishments governed for budget purposes by other ministries. The very recent advance towards a national policy for science has brought the question of a coordinating body back

on the agenda, one that could generate a consensus and become accepted as the authority. The right formula is yet to be found and proved. We will come back to this in later sections.

### **Scientific Productivity and Main Sites**

The PASCAL database recorded 2,798 'publications' with Moroccans as authors between 1991 and 1997.<sup>11</sup> These work out to 2,559 articles, and include books and monographs and communications to symposia, and represent an average 360 articles or 400 'publications' per year. During this same period production rose by more than 60 per cent, over 100 per cent of which were in medical sciences and more than 50 per cent in exact and engineering sciences. It stayed constant (as an absolute value) in agricultural sciences. This strong, regular expansion runs counter to the great tendency elsewhere in Africa where the usual research 'giants' fell back. Egypt receded a little, South Africa quite noticeably and Nigeria dramatically, and other countries relatively stagnated, the Maghreb countries remaining an exception and Morocco actually recorded growth.<sup>12</sup>

A more recent check brought into relief a further leap forward for the years 1997–2000 with the proportions between the disciplines noticeably maintained.<sup>13</sup> The medical sciences in particular are very strong (41 per cent) with regard to the theoretical 'potential' in this area. Although not exceptional for North Africa (Morocco, Algeria, Tunisia and Egypt), the score of 50 per cent reached by publications in fundamental or engineering sciences is so by comparison with the normal performances of the rest of French-speaking Africa. The basic sciences (mathematics is extremely strong subject in Morocco) such as physics and chemistry are particularly active and are progressing markedly.

The progress can be attributed to 1,000 research teams or laboratories and to 7,000 authors ('active' researchers). However, half of them were involved in only one publication in four years, and 10 per cent of them produce 25 per cent of contributions. About 100 teams produce more than two articles per year in influential international journals. This figure can reach as high as ten (such as urology at Rabat, mathematics from Marrakech). It is the universities that recorded by far the greatest contribution, working out to 83 per cent of articles indexed. Another feature is that the contributions of different institutions are highly unequal. The first-generation universities are those where the research culture is the most deeply embedded (Rabat and Casablanca: 60 per cent of contributions).<sup>14</sup>

### **Human Resources in R&D**

One way of measuring research capacity is from the number of people in terms of 'full-time equivalent' work in research institutions. Many precautions must be taken in order to make such estimates representative of a real situation.<sup>15</sup> These figures are valuable mainly for making international comparisons. Universities possess the greatest human resources potential from the point of view of sheer numbers. The number of teacher-researchers increased four-fold over two decades toward the end of 1990s. There are about 2,000 teacher-researchers employed in professional and management training and 3,000 researchers in what may be called R&D institutions.<sup>16</sup> In 1996–97, the department in charge of this estimated the number of teacher-researchers who performed both teaching duties and research at 595 out of more than 2,000. For the sake of simplification, we have taken the full-time equivalent to be one-sixth in universities, one-sixth in management training and two-thirds in the 'dedicated' sector existing away from the teaching sphere.<sup>17</sup> A revised distribution can be calculated, provided some corrections are made to account for certain establishments whose exceptionally intense research activity is documented (such as the Hassan II Institute of the Casablanca Faculty of Medicine). The research strength can therefore be estimated at a little over 5,000 persons full-time equivalent, as categorised above. A large number of researchers belong to schools of agriculture (22.1 per cent of the total are highly active in applied research). Finally, the bulk of personnel outside teaching in semi-public industrial companies (mining, phosphates, telecommunications and so on) are mainly made up of engineers and technicians who perform development research on request from their employers (see Tables 4 and 5).

### **Financing of Research**

In 2000 public expenditure (salaries excepted) devoted to scientific research (investments and running costs) represented officially 0.14 per cent of the GDP (381.7 million dirham). The supplementary funding contributed by the private sector is difficult to quantify. The budget assignment for higher education establishments is 39.8 million dirham. The Ministry of Research and Higher Education now supports a programme to fund basic research through tenders called *Programme d'Appui à la Recherche Scientifique* (Financial Programme for Scientific Research) (PARS). This was launched in 1998 and a budget of 37 million dirham was allocated to

**TABLE 4**  
**Number of People Involved in Research**

	<i>Humanities &amp; social sciences</i>	<i>Exact &amp; natural sciences</i>	<i>Medical sciences</i>	<i>Engineering</i>	<i>Agricultural sciences</i>	<i>Total</i>	<i>Potential (%)</i>
University	3,700	4,100	1,200	700	300	10,000	66.0
Professional & management training	200	700	–	750	450	2,100	14.0
Outside teaching	–	–	200	2,300	400	2,900	20.0
<b>Total</b>	<b>3,900</b>	<b>4,800</b>	<b>1,400</b>	<b>3,750</b>	<b>1,150</b>	<b>15,000</b>	<b>100.0</b>

Source: Kleiche (2000).

**TABLE 5**  
**Number of Researchers Expressed as Full-time Equivalent**

	<i>Humanities &amp; social sciences</i>	<i>Exact &amp; natural sciences</i>	<i>Medical sciences</i>	<i>Engineering</i>	<i>Agricultural sciences</i>	<i>Total (rounded)</i>	<i>Active researchers (%)</i>
University	950	1,050	350	175	100	2,600	52.0
Professional & management training	50	150	—	125	80	400	8.0
Outside teaching	—	—	100	1,600	270	2,000	40.0
Total	1,000	1,200	450	1,900	450	5,000	100.0

it for three years. It financed 227 projects out of 713 submitted.<sup>18</sup> It was a means of learning where subjects were declared of interest spontaneously by the scientific community and of identifying young teams and of planning for future theme-based programmes in the certitude that research capacity was strong enough to tackle them.

In reality higher education establishments have less means at their disposal for research. In 1995 a CNPRST survey estimated that most universities earmarked 12 to 15 per cent of their operating budget to 'research', a sum of 23.1 million dirham. But once bonuses and grants are deducted, this leaves 2 million dirham (\$200,000) for programme support. There is no doubt that the state, more interested in 'technological' research, makes a relatively greater effort in endowments to the research centres, and the specialist engineering and technical *ecoles*. Given such financial constraints, scientific production, especially in the universities, seems quite remarkable.

### **Aid Partnerships**

Scientific aid no doubt partly explains the steady progress achieved in Moroccan scientific production. About 75 per cent of the references recorded by the American bibliographic database, the Science Citation Index, in the case of Morocco are co-authored by Moroccans with authors from a variety of countries. This proportion falls to 50 per cent according to the PASCAL database, which covers Moroccan journals.<sup>19</sup> Publication in international periodicals, which unveils partnership aid involvement, represents a sizeable volume and is increasing. Schemes run with French teams predominate (a constant figure of 80 per cent of co-authored articles).<sup>20</sup> Partnership aid has helped update the theoretical bases. It has brought transfer of modern methods and training of young generations with state-of-the-art knowledge. Schemes have concerned especially basic sciences adopting an academic style. This is certainly the case of French scientific aid, highly active since 1970. In the 1980s new French programmes consisted of joint research projects with strong training and method of transfer elements.

Morocco is trying to diversify both the kinds of regime of liaison and partner countries. French aid effort is contributing to this change of tactic. However, the adjustment is being approached cautiously and in no way disrupts existing established programmes.<sup>21</sup> They receive less finance (between 1996 and 2001 French funding decreased by 17 per cent). But it still provided the bulk of scientific production. The leap forward seen

in Moroccan scientific production therefore results in large measure from international aid partnerships.

### **Research and Development: The Weak Link of the Moroccan System?**

Even if basic science is by far the main focus of research, some applied research laboratories exist (often outside the university sphere) that produce results. A market economy framework began to impose itself in the 1990s, which required to be more competitive to be able to link up with the European economic zone. A requirement for innovation came to the centre stage, essentially for realising high-quality products and improved processes. Research was expected to turn its effort towards these concerns, and research establishments had to show a spirit of enterprise. Technological research had increased during 1980s and 1990s. Some *grandes écoles* (and some university centres) followed in their footsteps. Some of them succeeded in raising substantial funds of their own and revenue from selling their expertise.

This was the case in the agriculture and food sector, hydrocarbons, chemistry, energy and mining resources. Groups of institutions were formed incorporating the specialist *écoles*, the institutes of applied research, and centres of research and development with the potential for evolving into hubs of technology-based activity. They developed in any case a new research culture, different from academic science by its ethos for realising applications. Their work was not an integral part of an overall plan but oriented in an autonomous way according to the needs expressed by the companies. This was significant trend.

Small and medium-sized businesses dominated the industrial fabric. They used somewhat 'mature' technologies, and relied on a cheap and scarcely qualified workforce. The sector had little concern for renewing techniques and know-how. A survey conducted in 1997 by the Ministry for Industry showed that out of 500 large companies, 100 had carried out R&D or used subcontracting locally. The local engineering sector was insignificant. Quite logically, there was proportionally little call for its services. In 1977 468 patents were filed at the Moroccan Patent Office, 25 per cent of which came from nationals, ten of these (one in fifty) by academics (often filed on a personal basis). Water treatment was the subject of 115 of them (MESFCRS 1999). Inter-university partnerships with countries of the North rarely focused on development.<sup>22</sup> Their results were seldom applied and hardly any patents were filed. The interaction between researchers, laboratories and the world of production was not

very effective. Reliance on technology transfer was justified by the need to set up an operational industrial base in the shortest time possible. Promotion of technological research was only of secondary importance. However, the situation was further compounded due to the debt burden, the energy crisis, the constraints imposed by structural adjustment programmes in the 1990s.

### **University Research: Locked in its Ivory Tower or Neglected by the State?**

Moroccan academic research is by and large oriented towards industrialised countries at the cost of topics related to immediate, local or national importance. University teachers are seen to be oriented away from their economic and social environment. There is also a problem of institutionalisation in the sense that if the head of the operation leaves then the research group finds it difficult to continue and progress. Researchers, however, complain about the indifference of industrial leaders and the government. There has also been the problem of brain drain in recent years with the departure of researchers from universities to countries of the North. Those who stay say they are not motivated seeing talented students and teachers going abroad.

The fact is that meagre finances and inadequate infrastructures push universities towards research without equipment. In mathematics, physics and biology it is especially *theoretical* research that is developing because it does not depend on heavy equipment. Not much experimental research is conducted. Moroccan researchers, moreover, find access to new information they need difficult. Low budgets put regular subscriptions to the major journals out of reach. They often have to ask acquaintances from abroad to select and send articles to them. The dispersion of the scientific community, the absence of any overriding plan and of assessment of research activities show up a failing of national policy. These factors have marginalised academic research, keeping it outside the development processes taking place in the country. It is this situation, however, that has begun to change for the better in recent years.

### **Initiatives and New Challenges**

The idea of linking up academic research with development began from the early 1990s, but it needed a political storm before it could take

substance. A new government, arriving with a whirl of changed mentalities and balance of power from 1998, started laying the foundations of a national-scale scientific research policy. For the first time a ministerial office for research was created at the 'secretary of state' level. It was placed under a large ministry, which had the mandate of unifying a scattered field of higher education, research, and professional and management training. Secretary of State Zerouali stated recently that

At the end of the past decade...there was research in Morocco, but it was research based essentially on individual initiative. Because of this it was completely fragmented and dispersed, and furthermore its results were not transformed in the field. The result: it was not applied and was not applicable.<sup>23</sup>

Several measures have been taken to set up an institutional framework:

1. A law came into effect to recognise higher education.<sup>24</sup> It included several measures to encourage teaching staff and establishments to do research (such as career incentives, sharing the fruits of results and grants to universities partly linked to the extent of doctoral programmes).
2. A Higher Council for Scientific Research was set up, responsible both for proposing national policy and for research commercialisation.
3. A National Research Foundation was to finance priority projects and programmes, and was also responsible for managing the National Research Fund, another new body which was to be expanded in the future.
4. A new culture began to take shape, with the formation of assessment committees by discipline to prioritise national programmes.

These new overseeing bodies were first set up within the auspices of the Ministry of Higher Education, Professional and Management Training and Research. They dealt with the establishments primarily under its wing. But their mission was much broader. The government's goal was 'integrated' scientific research.<sup>25</sup> It created an Inter-Ministerial Committee on Scientific Research and Technological Development for this purpose. Institutions such as Hassan II Academy of Sciences and Technology, created by DAHIR in 1993 and the CNRST might overlap with these new agencies.<sup>26</sup> Another major step taken was the forging of a link with

those involved in research under the aegis of different ministries (agriculture, health, mining, etc.).

### **The Strategy of Creating Incentives**

The Secretary of State Office for Research had the task of implementing the overall policy. It set to work actively, following a three-strand strategy: create incentives, build a structure, then direct research activities. The government's first job was to make research more attractive. To stimulate interest among teacher-researchers after the reform of the doctoral-level programmes (1997),<sup>27</sup> their promotion assessments (including for changing grade) would take greater account of their publications. A two-tier system of career advancement was introduced for the first time. The law on higher education from now on allowed universities to use some of their own revenues from research work and services sold. They are channelled into supplementary allowances for those who had contributed to them as encouragement or element of competition. The government intended to reward researchers' activity through this reform and hoped to give research a strong impetus.<sup>28</sup>

The endowment of each university was now supplemented by a 'scientific research promotion' budget allocation based on postgraduate, doctorate-level students and of teacher-researchers who worked there.<sup>29</sup> It provided operation costs proportionate to the number of people working on the programmes and went towards supporting scientific publication. The financing of research (particularly academic) was clarified and made more stable. Now scientific research featured officially as a budgetary item within the endowment for each university. The endowment rose from 20 million dirham in 1995 (about \$2 million) to 45 million dirhams since 1998.<sup>30</sup> The National Research Fund has in particular been planned since 1998 drawn from state subsidies, by public or private sector companies, and by international partnership aid.

### **Research Link-up to Local Industry**

The new research policy is being elaborated from elements with different rhythms and from centres of activity widely different in character. The approach was pragmatic and care was taken not to immediately impose new national-level bodies to direct the course of research.

The Five-Year Plan for 2000–2004 was concerned with indicating the priority lines of research. It provided for a significant investment of

567.8 million dirham over five years for scientific research. The declared objectives for this period were to bring scientific and technological research to meet the concerns of those active in the social and economic spheres. Companies were encouraged to set up research-based subsidiaries or to take shares in other companies of that type. Sectors declared as priority areas were: agriculture, health, fisheries, forestry, drinking water, geology, mining, energy, environment, information and telecommunications technologies, and transport. This approach highlighted the need for effective institutional coordination, which enabled different parties to work together around common priority socio-economic objectives. Such joint research undertakings usually required the involvement of several disciplines and institutes. Nevertheless, some universities, like the *grandes ecoles*, are taking the initiative. The Marrakech Faculty of Sciences is a good example. It has been set up to develop the applications and market potential of academic research work and an incubator has also been established. This is a service to help young enterprises, built on new technical ideas whose profitability (and even translation into marketable product) is not yet assured, to fully develop their business plan. The company formed can remain linked to the laboratory, which invented the idea by way of R&D contracts.

The industrial and academic spheres are separate worlds and such initiatives come up against this division. Projects are also faced with the weakness of private industry, which is unenthusiastic for innovation by taking on board the fruits of local research. The coupling between public research and the economic sphere cannot do without institutions that occupy the interface. These are starting to appear in one or other of the 'two worlds'. Research and industry clubs are an expression of this approach, an example being the original Association R&D Maroc. It was founded in 1997 on the initiative of large Moroccan industrial groups. The club's aim is to initiate, promote and dynamise innovation by way of R&D. It supports the diffusion of the results of research, the strengthening of ties with Moroccan experts living abroad, the promotion of research and development, and the setting up of innovating companies.

### Conclusion

In Morocco development of scientific research and the harnessing of technology are recurring themes of the political discourse. With the strengthening of links with European markets and the noticeable exposure

of local industry to world markets, the government began to pay rather more attention to the status of the science and technology sector, including higher education. It has invested considerably in the creation of a country-wide higher education system. It has preserved (and what is more, recently set up) a network of technologically-oriented research centres, employing full-time researchers, some with entrepreneurial spirit. It is true that these efforts have not always had any visible effects for social or material improvement. Nor has it increased the technological capability of an industry that today is fairly obsolete. Also true is the fact that several sectors have developed separately, with quite different scientific styles (academic in universities, technological in the specialist technical and engineering *ecoles* and the research centres).

Can we legitimately talk of a scientific community in Morocco, given the context described? The processes by which colonial structures were transformed and taken over created a dual system, bringing basic science into confrontation with applied science, a quite classical situation. Since the end of the 1980s, though, a new heterogenous mode of operation emerged where different approaches coexist, up to a certain point maintaining somewhat disconnected communities. In the current situation too main research types can be distinguished:

1. An 'academic' style of research, based mainly at the universities. It is practised by teacher-researchers, conducting their work within their discipline, on subjects of their own choice. The constraints they have are financial (state funding has up to now been meagre). Mainstream science (or its local offshoots) is their field of competition and career promotion is the paramount motivation.
2. A 'useful' style of science, prevalent in some disciplines such as medical research, agriculture, natural sciences (investigating the flora, fauna, and rocks and minerals). The supporters of this approach are either teacher-researchers in such areas (working in the universities or *grandes ecoles*) or a good number of engineers serving in various national research institutes (some inherited from French colonial days: INRA [agriculture]; INRH [fisheries], Institut Pasteur and so on; others founded more recently). Those promoting this style display a concern for problems considered to be of special local relevance.

These two styles are at opposite ends of a spectrum the 'universal' and the 'local', the pure and the useful. The whole scientific sector is divided

by their contrasting natures and all indications are that there is not one single scientific community in Morocco, but two. The problems considered as solvable, the subjects which deserve to be tackled, the methods for approaching them, the solutions judged to be viable and the publics aimed for are fundamentally different. There are apparently two distinct epistemological stances, conceptions of what science is and what sort of science is worthwhile.

Conditions in the science field are naturally modified by the world of development knowledge and also by the processes of globalisation and change in the scientific profession. Some scientific disciplines are, for instance, eagerly taking on subjects that are highly fashionable (and internationally financed), like the environment or renewable energy. It remains to be seen whether these are being tackled for practical objectives—for locally feasible applications. Another sign of development is that only relatively recently old journals and societies (based on specific disciplines: Geographer's Association, Economists' Association, *Revue Marocaine des Sciences Physiques*; Chemists' Association and so on) are multiplying. These also generate groupings according to sub-discipline, even subject area (Moroccan Mechanical Sciences Society, for example). This tendency, which appeared in the mid-1990s, is borne up on the changes science is undergoing worldwide. It expresses the vigour of the local scientific sphere, and how far it has increased in power and specialised. The resulting differentiation creates new compartments, a prelude maybe to a reorganisation of the academic community, in line with different approaches rather than disciplines. It could herald joint projects, cutting across traditional demarcation lines, with the community of technicians.

The institutional sphere is also highly dynamic. Recent launches or reinforcement of journals of various establishments testify to this (such as *Les Cahiers de la Recherche de l'Université Hassan II Aïn Chok* [Hassan II Aïn Chok University's Journal of Research] in Casablanca published since April 1999). Such an enterprise is an instrument for generating a structure in research circles and the proof that the establishment has the will to make research an integral element of its identity. It is also a sign that an institution is once again taking the initiative, while the attractions of the global market for science are enticing researchers away by offering them opportunities to practise their talents in return for good pay and to use the facilities at their disposal, in the framework of international projects piloted from outside the institution.

Finally, there is a change that may turn out to be a major one. A third style of science is appearing, this time in the 'technological' sector. The

energy crisis at the end of the 1970s and the implementation of structural adjustment plans during the 1980s have given impulse to a new ideology. The hope that the nation could restart its economy by stint of innovation was firmly held by many different managerial circles. Since then it has spread. Centres of research for development sprang up, in the 1980s and 1990s, in the large industries. New public sector research institutes were formed. Engineers and high-level technicians (but also teacher-researchers as at the Institute for Agriculture and Veterinary Studies or the Mohammadia School of Engineers) are developing both initial stage applied research, and research and development, mainly in food and agriculture, hydrocarbons, chemistry, energy and mining. In these cases it is the engineering departments rather than the discipline-oriented departments that are organising the scientific field.

The government is endeavouring to bring the whole of the community to move in this direction by launching theme-based research programmes (such as the PROTARS), and by bringing the various specialities and skills (whether academic or otherwise) together within especially concentrated centres. It is perhaps opening the way to the reunification of the scientific community and to a continuum of research (going from fundamental research work by way of development to 'demonstration' operations), which would function in a hybrid style actively involving researchers from different disciplines with problem solving as the prime objective. Moroccan research is rising in strength. Its growth rate (in terms of publications in the best international journals) is the highest in Africa. Morocco is now the third-highest science producer in this continent. The government has recently provided itself with the means to encourage and place this vigorous, fully determined, potential on a sound framework. For the first time a flexible yet sustained policy for research is taking shape, modelled by a succession of strokes of initiative. It could effectively give added impetus and a direction to the dynamism already in motion.

### Appendix 1: Universities, 1956–96

Year founded	Name	Location	No. of students	No. of researchers	Field			No. of publications (1997–2001)**
					Med*	NS*	ES*	
1956	Mohamed V University	Rabat	43,721	2,271	+	+	+	446
1974	University Hassan II	Casablanca, Mohammedia	46,349	1,916	+	+	+	317
1975	University Sidi Md Ben Abdellah	Fès	34,788	1,078	+	+	+	261
1978	University Cadi Ayad	Marrakech, safi, Beni-Mellal, Errachidia	32,684	1,269	+	+	+	620
1978	University Mohamed Ist	Oujda	19,535	587		+	+	152
1978	University Ibn Tofail	Kénitra	8,707	405		+	+	217
1978	University Chouaib Doukkali	El Jadida	8,374	438		+	+	226
1978	University Moulay Ismaïl	Mcknès	24,879	663		+	+	233
1980	University Abdelmalek Saadi	Tétouan, Tanger	13,133	548 + 27		+	+	114
1980	University Ibn Zohr	Agadir	12,590	455 + 21			+	216
1980	Other Universities	Settat, Errachidia	4,491	189			+	164
Total number (1999)	11		249,251	9,867				2,966

Source: Waast and Rossi (2002).

Notes: \*Med: medical sciences; NS: natural sciences; ES: engineering sciences; HSS: human social sciences.

\*\*Total for 1997–2001 except for Med and HSS.

\*Indicates the promotion of the discipline.

## Appendix 2: Research Institutes in Morocco

Year founded	Name	Location	No. of researchers	Field			No. of publications (1997–2001)
				Agriculture forestry; agriculture, etc.	Civil engineering, chemistry, electrical, minerals, industry, etc.	Medical research	
1914	Institut National d'Hygiène	Rabat				+	12
1914, 1932	Institut Pasteur	Casablanca, Tanger	136			+	25
1982	Institut National de Recherche Agronomique	Rabat	135	+			56
1945	Institut National de Recherche Halieutique	Casablanca		+			16
1946	Laboratoire Public d'Essais	Casablanca	435			+	32
1985	Centre National d'Etude Spatiale, de Télédétection et d'Energie Nucléaire	Rabat				+	8
NA	Centre de Recherche et d'Etude Démographiques	Rabat	90				?
Années 1990	Centre de Développement et d'Energie Renouvelables	Rabat	90			+	5
Années 1990	Centre National de Recherche Forestière	Rabat	21	+			3
Années 1990	Dir. Des mines et de la géologie Bureau de Recherche et de Prospection Minière	Rabat	17			+	9

*(Appendix 2 contd)*

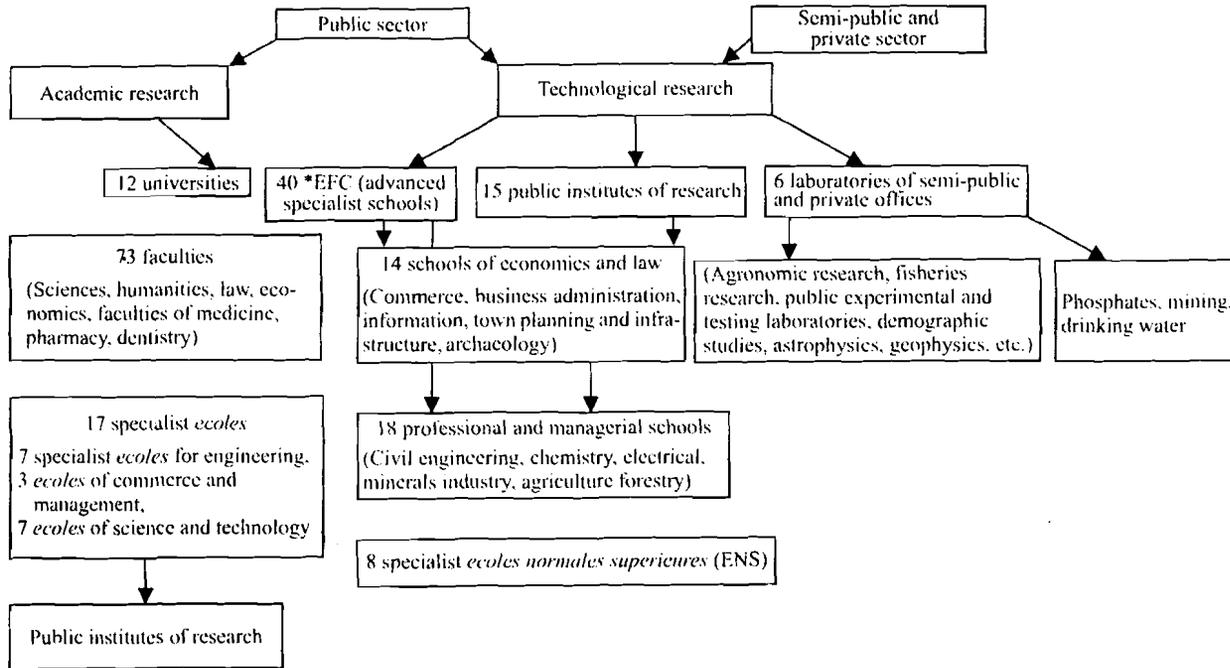
(Appendix 2 contd)

<i>Year founded</i>	<i>Name</i>	<i>Location</i>	<i>No. of researchers</i>	<i>Field</i>			<i>No. of publications (1997-2001)</i>
				<i>Agriculture forestry, agriculture, etc.</i>	<i>Civil engineering, chemistry, electrical, minerals, industry, etc.</i>	<i>Medical research</i>	
NA	CNER	Rabat	17?		+	6	
1975	Groupe OCP	Casablanca, Marrakech	817		+	9	
1981	CNRST	Rabat			+	12	
Années 1990	Office National des Eaux Potables		220		+	6	
Années 1990	Office National de Recherche et D'exploitation Pétrolière				+	15	
Total			2,500*			227**	

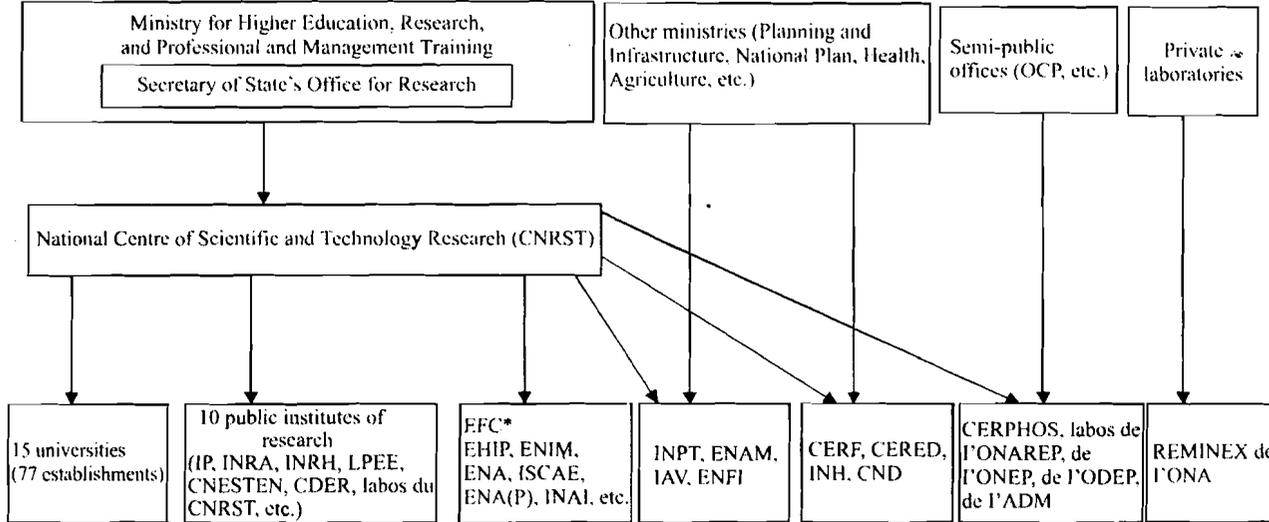
Notes: \*Figures for 1998.

\*\*Figures for 1997-2001.

### Appendix 3: Scientific Styles and Supervising Bodies of the Main Scientific Producers in Morocco



### Appendix 4: Organisation of Scientific and Technological Research in Morocco



**Note:** \*'Ecoles de la Formation des Cadres': Advanced specialist schools created outside the university system (they belong to the sector termed 'Management and Professional Training').

### Appendix 5: Moroccan Scientific Production, 1991–97

<i>As % of articles published</i>	<i>Morocco 1991–97</i>	<i>Morocco 1997</i>	<i>Morocco 1997–2001</i>	<i>Total number of articles (1997–2001)</i>	<i>North Africa</i>	<i>Africa 1997</i>
Agricultural sciences	12.0	8.0 ↓	8.0	355	9.0	12.0
Biomedical sciences	14.0	16.0 ↑	11.0	484	14.5	21.0
Clinical medicine	24.0	25.0 =	21.0	899	14.5	18.0
Other biological sciences	9.0	6.0 ↓	5.0	228	8.0	13.0
Earth and planetary sciences	9.0	6.0 ↓	7.0	318	6.5	10.0
Physics	14.0	18.0 ↑	20.0	866	13.5	7.5
Chemistry	5.0	6.0 ↑	5.0	209	11.5	5.0
Maths and computer sciences	3.0	3.0 =	5.0	227	2.5	1.5
Engineering science	10.0	10.0 =	18.0	769	20.0	12.0
Mean annual number of references	400	600	870	4,355		8,000

Source: Waast and Rossi (2002), after the PASCAL database.

NOTES

1. See the report 'Forme de domination coloniale où, en théorie, l'autorité des souverains traditionnels est maintenue et où l'administration est indirecte', in Aouad-Badoul and Tamer (2000).
2. It was Algeria that was left with the most substantial scientific legacy in areas of 'discovery' (astronomy, geosciences, ecology, etc.) and some research in nuclear studies, haematology, cancer research, etc. These were sustained by French assistance over ten years (see also Khelifaoui 2000a, 2000b).
3. This was mainly reserved for children of colonial settlers. Its annual intake was about thirty students who were trained over three years.
4. After independence this school became the Ecole Nationale d'Administration Publique (National School of Public Administration) (ENAP).
5. According to one commentator, Paule Laberge (1987), at independence there were just nineteen Moroccan nationals who were doctors (out of 587 practitioners) and six pharmacists (out of 348) available.
6. The conclusion was made that the various systems had to be united under the same structure; also, the programme content should be converted to Arabic, the managerial levels to be Moroccanised and education made universal (during independence only 12 per cent of children aged 7–14 years received schooling). In summary: 'The objectives was to provide education, in Arabic, to as many children as possible, administered by Moroccan teachers, with common nationwide curricula and schooling hours.' These provisions concerned especially primary education (see Moatassime, 1978: 22–34).
7. Its degrees and the quality of its courses and teaching are guaranteed by the University of Bordeaux.
8. The government order of 16 October 1975 upgraded all advanced establishments in any given town to universities.
9. The universities were at the time gathered under the wing of the Ministry of Higher Education and Research, created in 1976, whereas the specialist *ecoles d'ingénieurs* (schools of engineering) continued to depend on the technical ministries. The establishments were given autonomy over budget and elected advisory councils were envisaged. These instructions were hardly at all acted upon.
10. This subsequently became the Centre National de La Recherche (CNR) now the Centre National de la Recherche Scientifique et Technique (CNRST)
11. The American Science Citation Index records 2,788 articles in the same time.
12. Tunisia is making progress, but more modestly than Morocco.
13. A change in methods used for PASCAL–French database (recording of all the authors of a reference instead of only the first author completed) in 1998 led to expectation of an automatic rise in annual production of 30 per cent. The real figure is about 50 per cent.
14. Distinctions must still be made. At Casablanca there is a strong research culture in medicine, but mediocre in general science and technology. It is rather the opposite at Rabat.
15. They do not say anything about the productivity of each one, nor of the style of science that it represents. This is another subject that the paper takes up further on when discussing productivity.

16. If full-time equivalent is the yardstick, proportions are different. The changeover to use of full-time equivalents evidently is made on the basis of certain hypotheses. It is clear that a teacher does not do research full time. In developing countries the norm is to consider that a teacher spends a third of his work time on research. This approximation has to be revised case by case. In Morocco many university teachers do not undertake any research at all. That is particularly true in the professional and management training sector.
17. This ratio is debatable because many of the people listed as being involved in 'research' within the production boards, the mining companies or the Public Works Research and Testing Laboratory no doubt perform more tasks to do with service (routine analyses) than for development.
18. Expert committees organised around the main broad disciplines assessed these projects according to criteria of scientific quality and feasibility, but also on aspects that might contribute to structure building: multidisciplinary aspect, planning in the perspective of several years, group effort in UFRs or in networks, linkages within international partnership schemes, partnership with industry, and sectors of production and joint financing.
19. Where local journals exist, Moroccans usually publish on their own. If they want to publish in international journals, they team up with foreign scientists in partnership schemes. There is no doubt that, symmetrically, these foreign teams occasionally publish on their own in journals of their own country.
20. An enquiry conducted by the National Centre for Coordination and Planning of Scientific and Technical Research in 1996 found that out of 1,071 joint projects with foreign research teams declared by Moroccan groups, over 80 per cent were being carried out with French partners (50 per cent of them in agriculture) (Secrétariat d'Etat Chargé de la Recherche Scientifique 1998).
21. The total grants France has made available for the Integrated Action Programme (PAI), research programmes in partnership with French academic establishment, since 1983 has been estimated at 115 million francs. This item (with 16 million dirham annually) currently represents 24 per cent of the funds assigned by French overseas aid to Morocco in spite of a decrease.
22. A 1996 survey by the Scientific Research Department of the Ministry of Higher Education, Management Training and Research showed ninety-six PAIs, but very few had led to patents. Only four were filed in this context, mostly in chemistry.
23. Interview given to a journalist of the Moroccan newspaper *Libération* (1999).
24. Law number 01-00, enacted by the Dahir number 1-00-199 of 15 safar 1421: 19 May 2000.
25. Contribution by Prime Minister Abderrahman Youssoufi in Actes de la Rencontre Nationale: Recherche Scientifique et Développement (2001) Rabat (government publication).
26. Both of them have the vocation of coordinating and planning research, with the academy having perhaps a more consultative role and the CNRST a more active, operational one.
27. See decree number 2-96-796 of 11 Chaoual 1417 (19 February 1997) establishing the regulations for studies and examinations for the doctorate, the Diplôme d'Etudes Supérieures Approfondies (DESA) and the Diplôme d'Etudes Supérieures Spécialisées (DESS) as well as the terms and conditions for certification of university establishments authorised to provide preparation and delivery of these qualifications.

28. See interview given by Driss Khalil, Minister for Higher Education and Management and Professional Training. See *L'Economiste* (no date).
29. For the academic year 1998–99, this financial contribution was about 3.5 million dirham and for 1999–2000 it was around 13.5 million dirham.
30. Other items are entered in the national budget and contribute to direct support for research activities: 10 million dirham for 'subsidy to scientific organisations'; 20 million was for Morocco's contribution to partnership actions (financed moreover by the partner countries); 10 million corresponding to postgraduate-level grants (the recipients of which were at the laboratories' disposal).

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