

2.2

THE MOROCCAN RESEARCH SYSTEM: ORGANISATION AND NEW INITIATIVES

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Here, we examine the organisation and present dynamics of Moroccan research.

2.2.1 THE RESEARCH SYSTEM

2.2.1.1 Organisation of the overall system and coordination

Most Moroccan scientific research currently falls within the public sector domain. The most productive establishments operate at present under the same major ministry, which groups together (under separate divisions) the universities, professional and management training schools (called *écoles*), and research institutes (15 specialised government institutes). Other establishments exist that depend on it only for recruitment and personnel management, while their budget and programmes are under the authority of another ministry (which is the case in important fields, such as agriculture and health). Finally, various services and laboratories are in the quasi-public sphere, created by offices and companies devoted to development and industrialisation, whose research needs they serve (see Appendix 1).

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))¹ was set up in the late 1970s to stimulate and coordinate research throughout the Moroccan system. It has, however, never really been able to exercise its role. It seemed the diverse supervisory organisations were anxious to keep their grip on the programmes, and working terms and conditions of personnel in the establishments within their competence. Fragmentation was considerably lessened in 1976 with the establishment of a wide-reaching Ministry of Higher Education, Management Training and Research. This new ministry was also active, as a secondary supervisory body, in establishments governed for budget purposes by other ministries. The very recent advance

¹ This subsequently became the Centre National de la Recherche (CNR), and now the Centre National de la Recherche Scientifique et Technique (CNRST).

towards a national policy for science has brought back to the agenda the question of a coordinating body, one that could generate consensus and be accepted as the authority. The right formula remains to be found and proven.

2.2.1.2 Main sites of production

The absence of a more central system has not held back the dynamism of Morocco's research (active in many different centres), which has been progressing for 20 years or so. However, bibliographic databases indicate certain significant achievements. And a CNCPRST's larger-scale survey gave a census of active research groups and their members was published in 1995 ⁽²⁾.

Outside the humanities and social sciences, output indexed by an international database (PASCAL, 1997–2000) amounts to 900 annual references on average, which confirms continuous strides for over 15 years now. This output can be ascribed to 700 different laboratories. Even if some of these laboratories are especially active, scores for individual laboratories range from 1 reference to 35 references over 4 years. The universities make up by far the greatest contribution: 83 % of articles itemised (although such bases tend to reveal the more academic research without ignoring the 'technological' kind). Another feature is that the contributions of different institutions are highly unequal. The first-generation universities are those where the research culture is deeply embedded (Rabat and Casablanca amount to 60 % of contributions) ⁽³⁾. In the 'young' universities, output figures are fed by particular fields, built around prominent scientists who have gone there to get established. Some engineering schools show high productivity (in particular those *écoles* that train agricultural specialists: Institut Agronomique et Vétérinaire Hassan II (IAV), Rabat, Ecole Nationale d'Agriculture de Meknès (ENA), Meknes).

Our own survey (Gérard & Kleiche, 2002) brings in additional data concerning the humanities and social sciences. The formation of these sciences appears less structured around laboratories than the exact and natural sciences. Output here is often the work of individual researchers (some of whom are brilliant, although not really seeking to create a research following or group). The 'focal points' are bound to a small number of subject areas, tackled in an exclusive way by a specific discipline (e.g. studies on the state, the political system, work, and development). Nevertheless, substantial research is conducted, unobtrusively and rather in isolation, around a whole range of topics studied from a variety of disciplinary angles (therefore less as 'specialities', for example, women, science, and so on). Our assessment is that output of the humanities and social sciences is similar to that of the natural sciences (about 20 % of the country's total output).

These results are quite consistent with those of the CNCPRST survey, which was devised around a different methodology. The census lists 910 research 'units and/or teams', most of which had no official status at the time (1995). Most (79 %) of these de facto groups were teams of people at universities (CNR, 1997). Humanities and social sciences work accounted for 20 % ⁽⁴⁾ (here, we come across the 700 or so units attached to the other sciences); if they still exist, their composition will surely have changed since then.

² This directory, updated as far as possible, remains an important reference.

³ Distinctions must still be made. At Casablanca, for example, the research culture is strong in medicine but mediocre in S&T. It is the opposite at Rabat.

⁴ Forty percent of teachers employed are in these disciplines. It is evident, therefore, that they devote themselves less to research than their colleagues working in other fields (the CNCPRST census has identified groups, even ephemeral ones, consisting of a professor and his doctoral students). It is true that in the humanities and social sciences there is a particularly heavy load of teaching duties, with a staff: student ratio twice as high as in the other disciplines (72 % of the students for 40 % of the teaching staff).

2.2.1.3 Numbers

Research capacity can be measured by the number of people who, by their professional status, could be assumed to devote themselves to this activity (theoretical potential) or, in terms of 'full-time equivalent', the amount of work time they dedicate to research. Many precautions must be taken so as to make such estimates representative of the real situation ⁽⁵⁾. These figures are valuable mainly for making international comparisons.

From the point of view of sheer numbers, universities possess the greatest human resource potential. The number of teacher-researchers has increased by 4 times over two decades (and by 20 times in three decades!). They amount to about 10 000 individuals (over 65 % of the total potential) ⁽⁶⁾. There are also thought to be about 2 000 teacher-researchers employed in professional and management training, and 3 000 researchers not involved in teaching (e.g. government institutes, industrial firms, and agencies).

If the full-time equivalent is the yardstick, the proportions are different. The switch to the use of full-time equivalents is evidently made on the basis of certain hypotheses. It is clear that a teacher does not do research full-time. In developed countries, the norm is to consider that a teacher spends one-third of their work time on research. This approximation has to be revised case by case.

In Morocco, many university teachers do not conduct research at all, and this is particularly true of the professional and management training sector. In 1996–1997, the department in charge of this sector estimated the number of teacher-researchers who performed both teaching duties and research at 595 out of more than 2 000 individuals. For the sake of simplification, we have taken the full-time equivalent to be one-sixth in the universities, one-sixth in management training, and two-thirds in the 'dedicated' sector (other than the teaching sphere) ⁽⁷⁾. 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 IAV.

Table 1. Number of persons theoretically involved in research

	Humanities & Soc. Sci.	Exact & Natural Sci.	Medical Sci.	Engineering	Agric. Sci.	Total	% of potential
University	3 700	4 100	1 200	700	300	10 000	66
Professional & Mgmt Training	200	700	-	750	450	2 100	14
Outside Teaching	-	-	200	2 300	400	2 900	20
TOTAL	3 900	4 800	1 400	3 750	1 150	15 000	100%

Source: Kleiche (2000).

⁵ Nothing is mentioned about the productivity of each one or of the style of science that it represents. This is another subject, which the paper takes up further on (section 2.2.1.5: Output).

⁶ In June 2000, the CNCPRST counted 14 522 researchers, which comes down to 0.5/1 000 inhabitants (compare: 3.7 in the US, 3.8 in Israel, and 2 in the European Union).

⁷ 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 with development.

Table 2. Number of researchers expressed as full-time equivalent

	Humanities & Soc. Sci.	Exact & Natural Sci.	Medical Sci.	Engineering	Agric. Sci.	Total (rounded)	% of active researchers
University	950	1 050	350	175	100	2 600	52
Professional & Mgmt Training	50	150	-	125	80	400	8
Non-Teaching	-	-	100	1 600	270	2 000	40
TOTAL	1 000	1 200	450	2 000	450	5 000	100

The research strength can, therefore, be estimated at a little over 5 000 full-time equivalents, half of whom are university academics, about 400 are in management training, and 2 000 are scientific workers outside the teaching realm. Work in human sciences (possibly applied) involves 20 % of them. A further 25 % are devoted to natural or experimental sciences, 8 % work in medical sciences, and about the same in agriculture. Engineering takes the lion's share: 40 % of the work time available.

Universities conduct research mainly in exact sciences and social sciences and humanities; very little work is devoted to engineering sciences⁽⁸⁾. The teachers practising in professional and management training establishments do a type of research that lies somewhere in-between, partly (let us say, half) in basic research and the other half in engineering. The greatest number of them (943 or 45 %) belongs to the eight *écoles normales supérieures*. They excel specifically in physics, chemistry, and the corresponding branches of engineering.

A large number of researchers belong to schools of agriculture (22.13 % of the total, highly active in applied research). Finally, the bulk of non-teaching personnel are mainly made up of engineers and technicians, who perform development research on request by their employer (e.g. semi-public industrial companies in mining, phosphates, telecommunications, and so on). In 1997, MESFCRS statistics show that 2 900 people had such research occupations, which is equivalent to our estimation of 2 000 full-time researchers⁽⁹⁾.

The figure for researchers who are more-or-less active fall between the two estimates. In universities, the number is exacerbated by doctoral students (and in medicine, by residents) who, although they do not have the status of researchers, are no less productive (when they belong to structures that have a strong research culture). Besides, even if they devote a limited amount of time, many teachers (not all, but more than the full-time equivalent score might suggest) do show their interest and produce work at their own pace. In any case, this number, which the bibliographic databases confirm, is still smaller than the theoretical potential. An encouraging sign, perhaps, is that there is still a reserve of researchers that could be mobilised. It could also, nevertheless, be an alarm signal, and prompt the question of what holds people back from committing themselves to research. This might be answered in part by the financial means available.

⁸ They are also the great producers of results in health-related fields (bio-medical or clinical research).

⁹ In Morocco, 8.6 engineers out of 10 000 habitants have been counted (64 in France, 540 in Japan, 8.9 in Tunisia), 40% of whom work in administration.

2.2.1.4. Financing of research

In 2000, public expenditure (salaries not included) devoted to scientific research (investments and running costs) represented officially 0.14 % of the gross domestic product (MAD 381.7 million). The supplementary funding contributed by the private sector is difficult to quantify. It is likely to be confined to internal expenses and engineering purchases from abroad, much more than it is to feeding national public research contracts.

The budget allocation for higher education establishments (MAD 398 million) covers expenditure that has no direct link with research activity. It has to provide a salary supplement paid to all teachers (to compensate for pay freezes), which has nothing to do with any research conducted (although this allowance is called a 'research bonus'). It also covers the payment to grant-holders studying for higher degrees (who certainly contribute as an additional workforce, but do not bring in any material means to their host laboratory).

Seven percent of the visible funding assigned, therefore, is put towards the actual programmes; in other words, for purchasing consumable materials, equipment maintenance, travel for conferences, and obtaining documents (in short, everything needed to conduct research work instead of staying effectively laid off). In reality, higher education establishments have less means at their disposal for research. In 1995, the CNCPRST's survey estimated that most universities earmarked 12 to 15 % of their operating budget for 'research', a sum of MAD 23.05 million. However, once bonuses and grants are deducted, this leaves MAD 2 million (USD 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 *écoles*).

Given such financial constraints, scientific output (especially in the universities) seems quite remarkable — even more so given that it has been continually growing for two decades now. This strong rise can in no way be attributed to just the increase in numbers, which has practically stopped.

2.2.1.5 Output

Between 1991 and 1997, the PASCAL database recorded 2 798 'publications' with Moroccans as authors⁽¹⁰⁾. These come down to 2 559 papers (including books, monographs and communications to symposia), and represent an average of 360 papers or 400 'publications' per year. During this same period, output rose by more than 66 %, growing over 100 % in medical sciences and more than 50 % in exact and engineering sciences, and remaining constant (as an absolute value) in agricultural sciences. This strong, regular expansion runs counter to the major trend observed elsewhere in Africa, where the usual research 'giants' fell back; Egypt receded a little, South Africa quite noticeably, and Nigeria dramatically. Other countries on the continent, with very few exceptions, hung on with various degrees of difficulty⁽¹¹⁾. The Maghreb countries were an exception, and Morocco achieved the strongest advance.

¹⁰ 2 788 papers were recorded at the same time by the American SCI (Source: Narvaez 1999).

¹¹ Tunisia is making progress, but more modestly than Morocco: + 15 % in 7 years.

Table 3. Moroccan scientific output (1991–1997)

As % of papers published	Morocco 1991–1997	Morocco 1997	Morocco 1997–2001	Total number of articles (1997–2001)	North Africa	Africa 1997
Agric. sci.	12 %	8% ↓	8 %	355	9 %	12 %
Biomedical	14 %	16 % ↑	11 %	484	14.5 %	21 %
Clin. medicine	24 %	25 % =	21 %	899	14.5 %	18 %
Other biological sci.	9 %	6 % ↓	5 %	228	8 %	13 %
Earth and Planet. sci.	9 %	6 % ↓	7 %	318	6.5 %	10 %
Physics	14 %	18 % ↑	20 %	866	13.5 %	7.5 %
Chemistry	5 %	6 % ↑	5 %	209	11.5 %	5 %
Maths-Computer sci.	3 %	3 % =	5 %	227	2.5 %	1.5 %
Engineering sci.	10 %	10 % =	18 %	769	20 %	12 %
Mean annual no of references	400	600	870	4 355		8 000

Source: Waast (2000 b), and Rossi & Waast (2002), after PASCAL database.

A more recent check highlighted a further leap forward for the years 1997–2000 ¹², with the proportions of each discipline maintained more or less. The medical sciences, in particular, are very strong (41 %), with regard to the theoretical ‘potential’ in this area. Although not exceptional for North Africa (i.e. Morocco, Algeria, Tunisia and Egypt), the 50 % score reached by publications in fundamental or engineering sciences is indeed the case when compared with the normal performance of the rest of French-speaking Africa. The basic sciences (mathematics — an extremely strong point in Morocco — physics and chemistry) are particularly active and are progressing markedly.

The progress can be attributed to 1 000 research teams or laboratories and 7 000 authors (‘active’ researchers). However, half of them are involved in only 1 publication every 4 years, and 10 % of them produce 25 % of contributions. About 100 teams produce more than 2 articles per year in influential international journals (those covered by the large bibliographic databases). This figure can reach as high as 10 (this is the case for urology at Rabat, and mathematics at Marrakech).

2.2.1.6 Aid partnerships

There is no doubt that scientific aid partly explains the steady progress achieved for Morocco’s scientific output. About 75 % of references recorded by the American bibliographic

¹² A change in methods used for PASCAL (the recording of all the authors in a reference instead of only the first author) in 1998, raised the expectation of an automatic rise in annual output of 30 %. The real figure is 50%.

database, SCI, are co-authored by Moroccans alongside authors from a variety of countries. According to the PASCAL database, which covers Moroccan journals, this statistic falls to 50 % (13).

Publication in international periodicals, which shows partnership aid involvement, represents a sizeable volume, and is increasing. Schemes run with French teams predominate (a constant figure of 80 % of co-authored articles) (14). In contrast, American aid has declined in the past 10 years, whereas new European projects are diversifying the scene. Morocco has achieved remarkable successes, through work with various laboratories, in the context of Europe's INCO (international cooperation) programmes. These are designed to support joint research projects between European countries and countries of the south, mainly in agriculture, health and the environment and, more recently, in town planning, biotechnology and advanced technology.

Partnership aid has helped update the theoretical bases. It has combined the modern methods and training of younger generations with state-of-the-art knowledge. Schemes have concentrated on trying to generate an academic style for the basic sciences. This is certainly the case of French scientific aid, highly active since 1970. Such programmes first focused on training of teacher-researchers (the same as American aid efforts, active at the time in agriculture and engineering). In the 1980s, new French programmes consisted of joint research projects, with strong training and method transfer elements. These were 'PICS', Programme International Communautaire Scientifique (International Community Scientific Programme), managed and financed from 1982 by France's Centre National de la Recherche Scientifique (National Centre for Research (CNRS)). From 1983, they would become 'PAI', Programme d'Action Intégrée (Integrated Action Programme), financed by the ministries of the both countries. The calls for tenders target the laboratories, which must join together in 'twinning' arrangements to respond. An evenly balanced Franco-Moroccan scientific committee determines selection and assessment (during the project and at the end). The areas covered are the basic sciences (PICS and (PAI)), and sometimes applied sciences (PRAD, Programme d'Aide à la Recherche et au Développement (Aid for Research and Development Programme) which derived from PAI for agriculture, and health).

Other aid programmes have recently begun along the same lines, this time with Spain and Portugal (Ministerial Office for Scientific Research, 2000). Morocco is trying to diversify both kinds of regimes: liaison and partner countries, twinning with 'European scientific regions', such as the Languedoc; and schemes based more on 'technological' research, organised around 'Moroccan spheres of competence' rather than around laboratories.

The French aid effort is contributing to this change in tactic. However, the adjustment is being approached cautiously, and in no way cancels older established programmes (15). They receive less finance (in 1996–2001, French funding decreased by 17 %) but still provide the bulk of scientific output (measured by co-authorship of articles; in 1995–2000, French scientific partnership grew in Morocco more rapidly than anywhere in Africa).

The leap forward seen in Moroccan scientific output, therefore, results largely from international aid partnerships. These schemes, initially built around a few individuals or

¹³ 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 these foreign teams occasionally publish on their own in journals in their own country.

¹⁴ A survey conducted by CNCPRST in 1996 found that out of 1 071 joint projects with foreign research teams declared by Moroccan groups, over 80 % were being carried out with French partners (50 % of them in agriculture), Secretary of State's Office for Scientific Research (Secrétariat d'Etat Chargé de la Recherche Scientifique), 1998.

¹⁵ The total grants France has made available for PAI since 1983 has been estimated at FRF 115 million. In spite of a decrease, this item (with MAD 16 million annually) currently represents 24 % of the funds assigned by French overseas aid to Morocco.

laboratories, are on sound footing. The new element is that now the government is endeavouring to increase their size and scope. It intends to make them an integral part of its new science and technology policy.

2.2.1.7 Research and development: the weak link in the Moroccan system?

Even if basic science is by far the main focus of research, there are some applied research laboratories (often outside the university sphere) that produce results. A market-economy framework began to take hold in the 1990s, which had to be more competitive to link up with the European economic zone. The need for innovation came to the forefront, essential for delivering high-quality products and improved processes.

Research was expected to shift its efforts towards these concerns, and research establishments had to show an entrepreneurial spirit. Technological research had increased during the 1980s and 1990s; centres of research and development had sprung up and grown in the bigger industries, and applied research centres in the public sector. Some *grandes écoles* (and some university centres) followed in their footsteps. Some of them succeeded in raising substantial funds of their own, selling their expertise as revenue.

This was the case in the agriculture and food, hydrocarbons, chemistry, energy and mining resources sectors. Large institutions formed, embracing the specialist *écoles* (Institutes of Applied Research and Centres of Research and Development), with potential for evolving into hubs of technology-based activity. They developed a new research culture, differentiated from academic science by the ethos of producing 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, the branch or the sector it concerned.

This was a significant trend but it was far from the case generally. Small and medium-sized enterprises dominated the industrial fabric. They used somewhat 'mature' technologies and relied on a cheap and scarcely qualified workforce. The sector has 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. Three types of activity made up the bulk of this R&D: experimental development (55 %), applied research (42 %), and basic research (3 %). The overall total expenditure was MAD 56 million (MESFCRS, 1999: 16).

It is experimental development that is under-represented here, in comparison with international norms (a ratio of 100:10:1 for development, applied research and basic research. Above all, for the moment, industrial companies rely to a very large extent on external organisations to meet their engineering needs. Investors call most often on ready-to-use technologies, manufacturing under licence or foreign experts to fill in gaps.

These practices preclude any recourse to local services judged to be slow or not reliable, whether concerned with national research or engineering.

The local engineering sector was insignificant and, quite logically, there was proportionally little call for its services. In 1997, 468 patents were filed at the Moroccan Patent Office, 25 % of which came from nationals, 10 of these (1 in 50) from academics (often filed on a personal basis). Water treatment was the subject of 115 of them (MESFCRS, 1999: 19). Inter-university partnerships with countries in the north rarely focused on development, with particular exceptions (such as the Franco-Moroccan PRAD in agriculture and the European MEDA programmes) ⁽¹⁶⁾. Their results were seldom applied and hardly any patents were filed. Much remained to be done to initiate, stimulate and organise effective joint action between researchers, laboratories and the world of production.

Reliance on technology transfer was justified by the need to set up an operational industrial base in the shortest time possible. Promotion of national technology was only of secondary importance. However, the situation changed. The debt burden, the energy crisis, and the constraints imposed by structural adjustment brought out the huge cost of engineering-related imports (swelled further by the need to remain competitive). Such expenditure amounted to MAD 4 billion, half the bill for oil. Moroccan engineering covered only 15 % of total needs. This rate did, however, vary with the sector. It was nearly 100 % in the building industry, about 90 % in large-scale water engineering, and hardly anything in industrial engineering. In total, 1.6 % of GNP was spent externally in foreign currency, part of which could be saved.

The need for research specifically directed and geared to modernising the national production complex, which was antiquated in some quarters ⁽¹⁷⁾, was now recognised in several government circles. Innovative industrial circles had similar concerns. A new demand for technological research rose up, primarily for the 'non-academic' sector.

2.2.1.8 University research: locked in its ivory tower?

Some would like to associate technical research with the universities because they offer greater potential in terms of researchers. Universities, under fire in this respect and in others, were first expected to produce administrative managers and renew the teacher supply. This was accomplished, but the state has practically stopped all recruitment.

The ever increasing number of unemployed graduates shows that the profiles developed by education and training no longer fit the jobs on offer. Is there a need to remodel the curricula? Do teachers have the knowledge and skills to handle this? Since 1990, other means for gaining professionally-oriented qualifications have developed: bachelor degrees in applied subjects, science and technology faculties, specialised *écoles supérieures* in the field of technology, and high-level national *écoles* included within faculties (commerce and management, applied sciences, industrial arts and trades). All of these forms of training only accommodate 4 % of students. Much is, however, expected of the experiment in terms of a closer association with the production sector.

¹⁶ A 1996 survey by the Scientific Research Department of the MESFCRS showed that 96 Integrated Action Programmes (PAI) had been carried out in partnership with French academic establishments but very few had led to patents. Only four were filed in this context, mostly in chemistry (cf. Belcadi, 1996: 148).

¹⁷ Moroccan industry specialised either in commonplace products (e.g. textiles, leather, food and agricultural produce for export), construction materials and consumer goods of low added value or mining and associated products (phosphate).

This overhaul of the universities' tasks raises the question of whether the research done can and should, in its turn, be given a new direction. Are they developing (and how?) within the new forms of training? What advantage can be drawn from academic work, actively pursued in the more classical set-ups? All this is the subject of lively debate.

Some arguments claim that the research world is cloistered, distant from society, and produces no useful applications. Reformists and neo-free market proponents agree on this theme. Moroccan academic research is, thereby, considered completely oriented towards the industrialised countries and not very interested in topics related to immediate, local or national preoccupations (except in medicine). University teachers are perceived as cut off from their economic and social environment. Their status exempts them from any accountability to the administration concerning their research work, which has little to do with the life of the establishments. Their research activity has a poor structural framework, meaning that if the head of the operation left the institution, for whatever reason, the work could not continue.

Researchers, on their part, express their goodwill. However, they complain about the indifference of industrial leaders and the government. The quite recent halt to teaching staff recruitment is now compounded by the departure of some of them to northern countries. Those who stay, say they have lost their motivation, realising that when they have devoted four or five years to training a talented student, they often see them go abroad or (in the worst cases) participate in sit-ins organised by unemployed graduates protesting in front of the Parliament or the Ministry of Higher Education.

The fact is that meagre finances and inadequate infrastructures push the universities towards research without equipment. In mathematics, physics and biology, theoretical research is preferred over experimental research, due to the lack of heavy and specialised equipment. Moreover, Moroccan researchers find access to recent information difficult since low budgets place regular subscriptions to major journals out of reach. They often have to ask acquaintances from abroad to select and send papers to them. Adding to this problem, local sources that hold results of national research are scattered. The direct benefit of this type of activity is perhaps to keep teachers up-to-date in their discipline and speciality. It is, therefore, the quality of their teaching that will mainly be improved. They also maintain their participation in international Networks of Excellence, representing a substantial potential that remains to be tapped into.

The dispersion of the scientific community, and the absence of both any overriding plan and research assessment activities shows a weakness in national policy. These factors have marginalised academic research, keeping it outside the development processes taking place in the country. This situation is changing and will now be examined.

2.2.2 INITIATIVES AND NEW CHALLENGES

The idea of linking up academic research with development began to emerge in the early 1990s but it needed a political storm before it could gain substance. A new government, arriving with a whirl of changing mentalities and balance of power, started laying the foundations in 1998 of a nationwide scientific research policy.

2.2.2.1 Government initiative revived

For the first time ever, a ministerial office for research was created at Secretary of State level. It was placed under a large ministry, which had the brief of unifying the scattered fields of higher education, research and professional and management training.

The Minister of the time, Mr Zerouali stated, ‘[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’⁽¹⁸⁾. This summed up how a new authority, which was concerned for the first time about the state of research and wanting to govern it, saw the situation. The task is complicated, owing to the extreme divisions between institutions with different histories and under different parent organisations, and because of the two divergent research traditions: academic and development-oriented.

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

A law came into effect to reorganise higher education⁽¹⁹⁾. It includes several measures to encourage teaching staff and establishments to conduct research (such as career incentives, sharing results, and grants to universities partly linked to doctoral programmes). A Higher Council for Scientific Research was set up, responsible for both proposing national policy and showing concern for research markets.

A National Research Foundation was established to finance priority projects and programmes and responsible for managing the National Research Fund, another new body that will be enlarged on further. A new culture began to take shape with the formation of assessment committees per discipline, linked to priority national programmes being set in place. They had good opportunities to ‘break in’ their systems, and try and impose their legitimacy: first by choosing the areas of university training most fit to offer PhD programmes⁽²⁰⁾, then by meeting to evaluate the proposals received in response to ministerial calls for tender (Scientific Research Support Programme (PARS) and Thematic Scientific Research Support Programme (PROTARS)).

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

¹⁸ Interview given to a journalist of the Moroccan newspaper, *Libération*, 7 December 1999.

¹⁹ Law No 01-00, enacted by Dahir No 1-00-199 of 15 Safar 1421 (19 May 2000).

²⁰ Special Training and Research Units (Unités de Formation et de Recherche (UFR)), which exist only in small numbers since the specialist diploma and doctoral level programmes reform of 1997.

the establishments primarily or secondarily under its wing but their mission was much broader. In order to 'integrate' scientific research ⁽²¹⁾, the government recently created an Interministerial Committee on Scientific Research and Technological Development in order to initiate and to plan it.

Nevertheless, it stayed on to clarify the functions of structures set up previously with similar remits, which had not been abolished. The establishments concerned were the Hassan II Academy of Sciences and Technology, created by *Dahir* in 1993, and the CNRST ⁽²²⁾ (whose roles might overlap). Their orientation functions were in disuse and their operational bodies were dormant. In any case, updating would eventually be necessary.

Another major step to be taken was the forging of a link with those involved in research under the aegis of different ministries (e.g. agriculture, health, and mining).

The powerful Ministry of Agriculture (followed by others) re-evaluated its entire system. Wide-ranging conferences on agricultural research were held in 2001. The Department of Education, Research and Agricultural Development consulted with its establishments: the National Institute for Agronomic Research, a specialist agency employing full-time researchers; Hassan II Institute, which has university status; and other engineering schools and scientific communication services. What was at stake was to draw up a conclusive reorganisation plan, integrating training, research and spreading, in line with the new government policy and coordinated with the Ministry of Higher Education's system.

2.2.2.2 The strategy

The Secretary of State's Office for Research had the task of implementing the overall policy. It set to work actively, following a three-pronged strategy: creating incentives, building a structure, and then directing research activities.

■ Creating incentives

The government's first job was to make research more attractive among teacher-researchers after the reform of the doctoral-level programmes (1997) ⁽²³⁾. Today their promotion assessments (including for changing grade) is based on their publications (even if this existed partially in the texts of 1975). For the first time, a two-speed system of career advancement began to be possible.

From now on, the law on higher education allows universities to use some of their own revenues from research work and services sold. They are channelled into supplementary allowances for those who have contributed to generating those revenues as an encouragement or to stimulate competition. The government intended to reward researchers' activity through this reform and hoped to give it a strong boost ⁽²⁴⁾.

Establishments were also encouraged to embark on research. The endowment of each university is now supplemented by a 'scientific research promotion' budget allocation ⁽²⁵⁾. This

²¹ Contribution by the Prime Minister, Abdelrahman Youssoufi, in *Actes de la Rencontre Nationale, Recherche Scientifique et Développement*, Rabat, 13-14 April 2001, p. 11.

²² Both of them have the mission of coordinating and planning research, with the Academy having perhaps a more consultative role, and the CNRST a more active, operational function.

²³ See Decree No 2-96-796 of 11 Chaoual 1417 (19 February 1997), establishing the regulations for studies and examinations for the doctorate, 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 prepare students, and to confer these qualifications.

²⁴ See interview given by Driss Khalil, Minister for Higher Education and Management and Professional Training: The universities: a reform under consideration for efficiency', *l'Economiste*, No 195.

²⁵ For the academic year 1998-1999, this financial contribution was about MAD 3.5 million and for 1999-2000, it was around MAD 13.5 million.

is granted to approved doctoral programmes (UFRs) depending on the number of post-graduate, doctorate-level students and teacher-researchers who work there. It provides operating costs in proportion to the number of people working on the programmes and supports scientific publication.

The research centres are now also able to recruit, under contract, young researchers who can aspire to greater freedom in their own initiatives and better career prospects than at the universities, where recruitment is rare and the higher grades or greater means are appropriated by their seniors (and will be for a long time to come).

The financing of research (particularly academic) has been clarified and made more stable. Officially, scientific research features as a budgetary item within the endowment for each university and cannot be converted into any other type of expenditure⁽²⁶⁾. This provision avoids the loss of direct programme support in a sea of subsidies, grants, teaching expenses and building maintenance.

The endowment rose from MAD 20 million in 1995 (about USD 2 million) to MAD 45 million in 1998. In addition, other items have been entered into the national budget and contribute to direct support for research activities: MAD 10 million as a 'subsidy to scientific organisations'; MAD 20 million for Morocco's contribution to partnership actions (financed moreover by the partner countries); and MAD 10 million in postgraduate-level grants (the recipients of which were at the laboratories' disposal).

This new mechanism should be topped up by other resources whose institutional basis has been delayed but whose should shortly be set in motion. State subsidies, public or private sector companies, and international partnership aid should support a National Research Fund planned since 1998. The government contribution has been written into the 2002 finance act. If the competitive funds are taken into account, the university teams will have access to a programme support budget, which has unquestionably doubled in three years. These funds, however, are not specifically earmarked for them even though the research teams are allotted considerable assistance from them. However, such financial support has the virtue of being explicitly assigned to the teams that won the tenders.

■ Building a research structure

Formation of units for training and research

The doctoral-level reform of the higher education system⁽²⁷⁾ instigated a single doctorate qualification, and Unités de Formation et de Recherche (Units for Training and Research (UFR)) appointed to prepare for it. Their authorisation is for a two-year period, renewable after assessment. They have the task of devising and conducting research work, with which candidates for the doctorate or for the Diplôme d'Etudes Supérieures Approfondies (DESA) becomes involved in to develop their theses.

²⁶ See the operational budget for academic establishments and research centres for 1995.

²⁷ See Decree No 2-96-796 of 11 Chaoual 1417 (19 February 1997) establishing the regulations for studies and examinations for DESA and DESS as well as the terms and conditions for certification of university establishments authorised to prepare students for and confer these qualifications.

Organising centres of subject-area expertise

Centres of specialist expertise have been built up as subject-focused networks. These initiatives have the objective of providing a sound framework that facilitates collaboration between researchers working on the same subjects in solidly set-up research units. Five subject-area networks (i.e. particle physics, marine science and technology, space science and technology, biotechnology, and product and process quality improvement) are today identified as centres of expertise.

■ Research support bodies

The Moroccan Academic and Research Wide Area *Network* (MARWAN) should enable those involved in economic issues and researchers to communicate with one another. It provides access to scientific and technological information sorted according to their needs.

The Moroccan Institute for Scientific and Technical Information will have the task of collecting from national stakeholders (researchers and institutions) the fruits of their labour (e.g. books, articles, theses, conference proceedings and seminars). It will also have the responsibility of making available to the scientific community the works and publications necessary for them to carry out their work (by buying them or through exchanges).

■ Direct research

The Ministry of Research and Higher Education now organises calls for tender. Its first operation in support of research (known as PARS) was launched in 1998 to aid basic research. A budget of MAD 37 million (USD 3.7 million) was allocated to it for 3 years. It financed 227 projects out of 713 proposals submitted ⁽²⁸⁾. PARS was a means of learning which subjects were spontaneously declared to be of interest by the scientific community, identifying young teams and planning for future theme-based programmes, in the certainty that research capacity was strong enough to tackle them.

Six more tightly focused PROTARS were set up based on this information. Their budget allocation was MAD 55 million (USD 5.5 million), which financed 516 new projects. PROTARS financed proposals as much from researchers belonging to university establishments as from other public research institutes or laboratories. The first true call for proposals addressing the scientific community at large (1999–2000) gave priority to industrial product quality, water science and technology, space studies, and biotechnology and particle physics. In 2001, six new, theme-based programmes were launched, concerning standard of living, natural resources, economic and social development, information science and technology, agriculture in harsh conditions, and innovation and competitiveness of industrial companies.

By way of these programmes, the Secretary of State's Office sought to diversify and multiply joint ventures between establishments — and between different scientific styles and worlds (enterprise and research), ventures that can generate a new momentum. One of the special

²⁸ Expert committees (organised around the main broad disciplines) assessed these projects according to the criteria of scientific quality and feasibility but also on aspects that might contribute to structure building: for example, multidisciplinary nature, planning over a timescale 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.

features is that the support systems are not exclusively earmarked for one or other of the sectors (academic or 'technological' specialised *écoles* and research centres), making either eligible under the variety of programmes. Some institutions (such as the Hassan II Agronomic and Veterinary Institute, and Ecole Mohammadia) have already built bridges between basic research and applied research, the productive sector, and various research sectors. Points of resistance, nevertheless, strongly persist and sectional interests still assert themselves.

2.2.2.3 Linking research with local industry

Forces with different rhythms and centres of activity that vary widely in character are elaborating the new research policy on. The approach was pragmatic and care was taken to avoid immediately imposing new national-level bodies to direct the course of research. Such organisations are in an embryonic stage, and gradual development can only give them opportunities for becoming more effective. However, when directions of research and subjects for study are considered, the options of the different umbrella organisations can diverge.

The Five Year Plan for 2000–2004 was concerned with indicating priority lines of research. Providing for a significant investment of MAD 567.8 million over 5 years for scientific research, the declared objectives for this period are to make scientific and technological research meet the concerns of those active in the social and economic spheres. Companies are encouraged to set up research-based subsidiaries or to take shares in other companies of that type. They have the option of putting 20 % of their tax-exempt profits into research and development, and for some this has even been made compulsory. For example, in certain cases, 1 % of turnover must be devoted to research (e.g. in telecommunications).

Sectors declared as priority areas include agriculture, health, fisheries, forestry, drinking water, geology, mining, energy, the environment, information and telecommunications technologies, and transport. This approach highlights the need for effective institutional coordination, which enables different parties to work together around common priority socio-economic objectives. Such joint research undertakings usually require the involvement of several disciplines and institutes. For example, the concern for a healthy diet (with aspects involving agriculture, industry, disciplines of nutrition and health) translates into research subjects that need to call on expertise scattered over many universities, and institutes (the National Institute for Research in Agronomy (INRA), National Institute for Fisheries Research (INRH), Pasteur Institute (IP), and the National Institute of Hygiene (INH)). All these fall under different ministerial departments.

The Secretary of State's Office is the hub of the activity. The broad subjects chosen for its PROTARS are as close as can be to the priorities laid out in the plan. Many ministries are prepared to adopt a common programme policy but the real challenge comes from the high fragmentation of the research scene. This instils a heavy inertia between supervising bodies (still nowhere near the convergence envisaged), between institutions, and even between disciplines. One example comes from within the aegis of a single authority (the Ministry of Health). A scheme has been afoot since 1995 to bring the institutes and

laboratories within its scope together into the single Institute of Health Sciences Research and Expertise. This has still not materialised.

Nevertheless, some universities, like the *grandes écoles*, are taking the initiative. The Marrakech Faculty of Sciences is an example. It has set up a structure to develop applications and market the potential of academic research work and an incubator. This is a service to help young enterprises, built on new technical ideas whose profitability (and even translation into marketable products) is not yet assured, to fully develop their business plan. The company formed can remain linked to the laboratory that invented the idea by way of R&D contracts.

The industrial and academic spheres are separate worlds, and such initiatives come up against this divide. Projects have also to face the weakness of private industry, which is unenthusiastic for innovation by taking on board the fruits of local research. The linkage between public research and the economic sphere cannot do without interface's institutions. 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. Founded in 1997 on the initiative of large Moroccan industrial groups (e.g. Office Chérifien des Phosphates (OCP) and Omnium Nord Africain (ONA)), it aims to 'initiate, promote and activate innovation by way of R&D', support the dissemination of research results, strengthen ties with Moroccan experts living abroad, promote research and development, and set up innovating companies. It has just issued its own calls for tender ⁽²⁹⁾.

The semi-public sector, whose top managers have a Saint-Simonian frame of mind, is the leader in this kind of project. In any case, nothing could be achieved without the initiative of the establishments, especially not without voluntary (and even determined) interaction between researchers and entrepreneurs, guided by the feeling of belonging to the same socio-cognitive group (that of 'technologists', facing up to a patrimonial society). This period has perhaps already begun.

2.2.2.4 Researchers' reactions: recognition at last, but...

Researchers' opinions are divided on the new policy and on the sudden enthusiasm for a particular scientific ambition ⁽³⁰⁾. Generally, they feel they have gained some recognition at last. Calls for tender offer the opportunity to show the media (and government) the wealth of research the country has to offer. They also reveal the diversity of subjects tackled, highly promising themes, the dynamism of research teams and their productivity, and their international reputation. However, gaps have been exposed in some areas.

Certain researchers (especially academics) are worried about an excessively strong government hand in scientific orientation (even though basic research is sustained). They are also reluctant to accept the systematic assessment procedures. Some complain that these

²⁹ The association has chosen several research and development proposals submitted by companies or individuals. It will support six schemes for 'incubators'. These are units devoted to developing the results of academic research for industrialisation and marketing. The idea is to bring to fruition a commercial project whose feasibility has yet to be demonstrated, and then to set up a company based on it.

³⁰ We have interviewed about 30 researchers on these matters. Sampling was done methodically, setting quotas so as to place discipline and level of 'performance'. The survey was conducted mainly at Casablanca, Rabat and Marrakech, and we visited specialist *écoles* as well as universities. Most interviews were held with researchers in the exact sciences.

are not completely equitable or transparent. Does this reflect the inexperience of a new institution or is it a pretext for the lofty rejection of the whole practice?

Besides, universities have had to withstand formidable difficulties for 15 years. They are torn between defending their general educational role (without a direct link to production) and the requirement to train qualified people for the job market (insisted on by the new Charter for Education). Considerable strain is caused by having new educational duties, on the one hand, and the concern for contributing to the country's development through research, on the other. The community seems split across several 'generations' of groups, as follows.

The 'builders' (a minority of whom remain at university, if they do not hold a post in the present government). They provide unshakable support for research, often of the academic kind. This generation arrived at the universities in the 1970s.

The 'educationalists' formed the intake of the 1980s. As a generation, they had to face the expansion of universities to mass entry, coming just as Structural Adjustment Plans began to bite. They seem quite attached to research and seek to leave the universities to make the most of their status by selling their expertise or entering private enterprise.

The 'inheritors' entered university in just a trickle during the 1990s. They wanted to show their worth. They decided to play the game with the government, by grasping any opportunity offered to demonstrate their institution's dynamism.

2.2.3 CONCLUSION

In Morocco, development of scientific research and the harnessing of technology are recurring themes of political discourse. They are currently taking on added force with the forthcoming strengthening of links with the European market, and the noticeably increased exposure of national industry to world markets.

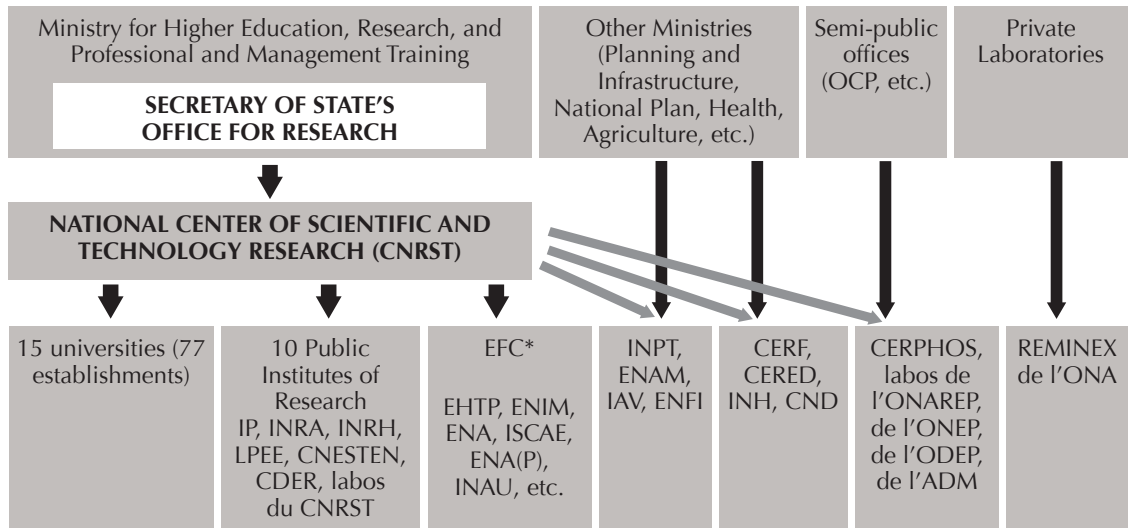
The government's line is not just a declaration of intent. It has invested strongly in the creation of a country-wide higher education system. It has preserved (and what is more recently added to) a network of technologically-oriented research centres, employing full-time researchers, some with an entrepreneurial spirit.

Admittedly, these efforts have not always had any noticeable effects in terms of social or material improvement nor have they enhanced the technological capability of an industry that is fairly obsolete today. Also true is the fact that several sectors have developed separately, with quite different scientific styles (e.g. academic in universities, and technological in the specialist technical and engineering *écoles* and research centres).

Moroccan research is, nevertheless, rising spectacularly in strength. Its growth rate (in terms of publications in the best international journals) is the highest in Africa. And Morocco is now the third science producer on that continent. The government has recently

given itself 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 on a succession of initiatives. It could effectively give added impetus to the dynamism already in motion, and give it direction.

Appendix 1. Organisation of scientific and technological research in Morocco



Appendix 2. Organisation of scientific and technological research in Morocco

