

---

A.I.D. Project Impact Evaluation Report No. 65

---

# The Hassan II Institute of Agriculture and Veterinary Medicine in Morocco: Institutional Development and International Partnership



---

July 1987

---

Agency for International Development (A.I.D.)

---

Washington, D.C. 20523

---

PN-AAL-096

This report and others in the evaluation publications series of the Center for Development Information and Evaluation (CDIE) may be ordered from

A.I.D. Document and Information  
Handling Facility  
7222 47th Street, Suite 100  
Chevy Chase, MD 20815  
U.S.A.  
(telephone: (301) 951-9647)

A list of all CDIE evaluation publications is available from

PPC/CDIE  
Room 105, SA-18  
Agency for International Development  
Washington, D.C. 20523  
U.S.A.  
(telephone: (703) 235-1000)

THE HASSAN II INSTITUTE OF  
AGRICULTURE AND VETERINARY MEDICINE IN MOROCCO:  
INSTITUTIONAL DEVELOPMENT AND INTERNATIONAL PARTNERSHIP

A.I.D. PROJECT IMPACT EVALUATION REPORT NO. 65

by

John H. Eriksen, Team Leader/Agricultural Economist  
(Consultant)

Lawrence Busch, Rural Sociologist  
(University of Kentucky)

Jack W. King, Agronomist  
(Consultant)

James Lowenthal, Institutional Development Specialist  
(Bureau for Asia and Near East, A.I.D.)

Rolland Poirier, Animal Scientist  
(Consultant)

U.S. Agency for International Development

July 1987

The views and interpretations expressed in this report are those of the authors and should not be attributed to the Agency for International Development.

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

100

## TABLE OF CONTENTS

	<u>Page</u>
Foreword .....	vii
Preface .....	viii
Summary .....	x
Project Data Sheet .....	xii
Glossary .....	xiii
Map of Morocco .....	xiv
1. Project Setting: Introduction to the Institute and the A.I.D. Assistance Program .....	1
2. Project Description .....	1
3. Direct Indicators of the Institute's Impacts on the Moroccan Agriculture Sector .....	4
3.1 The "Moroccanization" of the Institute and Recognition of the University Community as a Valuable National Resource .....	5
3.2 The Formation of Professional and Alumni Associations and the Creation of a Moroccan Scientific Community in Agriculture .....	6
3.3 Faculty Participation in Sectoral Planning and Project Development .....	7
3.4 The Division of Rural Development .....	8
3.5 The Institute's Documentation Center and Library Resources .....	9
3.6 Current Students and the System of Practical Fieldwork .....	9
4. Indirect Indicators of the Institute's Impacts on the Moroccan Agriculture Sector .....	10
4.1 Impacts Through Former Students .....	10
4.1.1 Improving Desert Agriculture .....	10
4.1.2 Contributing to Innovation in the Private Sector .....	11
4.1.3 Improving Dryland Agriculture .....	12
4.1.4 Improving Agricultural Planning Capabilities .....	12
4.1.5 Creating a Modern Dairy Industry .....	13
4.1.6 Creating a National Capability in Veterinary Medicine .....	13
4.1.7 Improving Agricultural Operations .....	14

TABLE OF CONTENTS (cont.)

	<u>Page</u>
4.2 The Institute's Attraction of International Interest in Collaborative Endeavors .....	14
4.3 Faculty Publication in International Journals and Enlargement of the Scientific Body of Knowledge .....	15
4.4 The Institute's Role in Regional Development .....	15
4.5 Unsolicited Requests to the Institute for Assistance and Information .....	16
5. Impact Analysis: Factors Identified as Instrumental in the Success of the Institute .....	17
5.1 "Sense of Mission" and Commitment to a Uniquely Moroccan Institute .....	18
5.2 Leadership in Institutional Development .....	18
5.3 Selectivity in Choosing Faculty and Students .....	19
5.4 Commitment to Quality and the Drive for International Recognition .....	20
5.5 Autonomy in External Negotiations .....	20
5.6 Incremental Nature of IAV Institutional Development and A.I.D. Project Assistance .....	20
5.7 Efficient Management of Multidonor Resources .....	21
5.8 Long-Term Commitment by A.I.D. and the U.S. University to the Institute's Development .....	21
5.9 The University of Minnesota's Role .....	22
5.10 The Entrepreneurial Attitudes of Institute Faculty in Building Support Constituencies .....	23
5.11 The Institute's Organizational Structure .....	23
5.12 The Integrated Curriculum Model .....	24
5.13 Receptivity of IAV Personnel to Continuing Evaluation .....	25
5.14 Concurrence of IAV Growth and Moroccan and Worldwide Economic Expansion .....	25
5.15 Morocco's Well-Developed Secondary School System .	25
6. Lessons Learned: Factors Affecting Success .....	26
6.1 Factors Under A.I.D. Control .....	26
6.2 Factors Essential to Success .....	27
6.3 Factors Contributing to Successful Institutional Development .....	27
6.4 Exogenous Factors Affecting Success .....	28

TABLE OF CONTENTS (cont.)

Appendixes

- A. An Analysis of the Institute's Evolution and Key Events in the Institutional Development Process, by Dr. Rolland P. Poirier
- B. The Future of the Institute: The Problem of Institutional Fragility, by Dr. James B. Lowenthal
- C. The Institutional Program: Curriculum and Practical Fieldwork, by Dr. Lawrence Busch
- D. Use of the Documentation Center and Library Resources, by Dr. Lawrence Busch
- E. A Profile of Institute Graduates and Their Post-Training Activities
- F. An Analysis of Changes in the Crop Sector Related to Institute Activities, by Dr. Jack W. King, Jr.
- G. An Analysis of Changes in the Livestock Sector Related to Institute Activities, by Dr. Rolland P. Poirier
- H. The Institute's Financial Situation and Sources of Income, by Dr. James B. Lowenthal
- I. Study Methodology
- J. Notes on the Authors

Bibliography





FOREWORD

The Center for Development Information and Evaluation (CDIE) is responsible for the Agency for International Development's (A.I.D.) project impact and program policy evaluations. The goal of the evaluation program is to inform A.I.D.'s policymaking process and to improve project design, implementation, and evaluation. Through examinations of A.I.D. and of other donor and recipient country experience and the preparation of special syntheses, CDIE provides a better understanding of the characteristics of development programs and lessons of what works and does not work in various settings.

We believe that this review of the Hassan II Institute of Agriculture and Veterinary Medicine in Morocco provides valuable insights into the process of institutional development and the factors affecting the success of A.I.D. projects in support of institutional development. We encourage A.I.D. staff and others engaged in similar programs to draw on this report in their planning, implementation, and evaluation of institutional development programs.

W. Haven North  
Associate Assistant Administrator  
Center for Development Information  
and Evaluation  
Bureau for Program and Policy  
Coordination  
Agency for International Development  
July 1987

PREFACE

The comprehensive appraisal of any educational institution as complex as the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) or of a long-term relationship, such as exists between the Institute and the University of Minnesota, is not easily accomplished under the best of circumstances. Without the active cooperation of the involved parties in the project experience, an external assessment team would have a very difficult time obtaining accurate data, rechecking and analyzing the information, and arriving at conclusions that are valid and fair to all concerned agencies.

In the case of the IAV assessment, the evaluation team wishes to state that the cooperation received from the Institute, A.I.D., the University of Minnesota, and agencies of the Government of Morocco was superb. During the time spent in Morocco and during the period of report writing in the United States, officials of the agencies mentioned above not only supplied the team with requested documents, opinions, and other information but often went out of their way to clarify points, raise issues, and suggest additional sources of valuable information. All team members at one time or another during the mission remarked on the high levels of cooperation and the obvious desire of all parties to improve still further an excellent partnership relationship in the interest of Moroccan development.

In presenting this report, we would like to offer our sincere appreciation and thanks to several persons whose assistance in our effort was truly outstanding. At the Institute, Dr. M. Sedrati, the director, and Mr. M. L. Firdawcy, the secretary-general, made excellent initial presentations, which allowed the team to quickly grasp the essential nature and structure of the Institute, provided virtually unlimited access to IAV faculty and students, and spent many hours of their own time in followup discussions with team members. At the USAID Mission in Rabat, Dr. M. Purvis and Mr. M. Hanafri were exceptionally supportive of the team's activities and particularly astute in guiding team members to sources of relevant information. University of Minnesota personnel, both in Morocco and on campus, offered the team good advice, thoughtful analyses of their special long-term partnership with the Institute, and ample measures of midwestern hospitality. The special efforts of Dr. D. Johnson and Dr. K. Crookston in Rabat and D. E. Welsch on campus on our behalf will be remembered fondly by all team members.

Finally, our team would like to offer all of our informants in Morocco and elsewhere total absolution concerning any of the findings, opinions, and statements made in our report. The team alone bears responsibility in these subjective matters, and to the extent that factual errors remain in our presentation, we ask the understanding of all those persons affected by such errors.

SUMMARY

Beginning in 1969, the A.I.D. project with the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) became a three-phase, 20-year period of assistance for establishing a university-level training and research institution to provide the managers, scientists, and technicians required for modernizing the agriculture sector.

Despite its relatively young age, the two-decade-old Institute has had a range of direct and indirect impacts on the agriculture sector in Morocco. Starting from a single Moroccan faculty member in 1969, the Institute has established a 350-member faculty, more than 85 percent of which is Moroccan. This highly qualified national human resource is used widely by several government, international, and private organizations for agricultural research, training, and consulting in Morocco. Students directly affect the quality of life of rural farmers by their participation in village-level problem identification and project development exercises. IAV graduates now occupy a wide range of management positions in Government agencies and state-run and private enterprises. The Institute also plays an important regional role in training students from other African countries.

The success of the Institute in meeting its objective of training top-quality researcher/trainers for the agriculture sector is unique among similarly financed A.I.D. efforts in Francophone Africa. Among the major factors that account for the success of the Institute are the sense of mission of the school's leadership; its commitment to build on a diverse body of experience in creating a uniquely Moroccan, world-class institution; strong and sustained (over 15 years) institutional and programmatic leadership; the interplay between structural autonomy and the entrepreneurial attitudes of both leadership and staff; a long-term, sustained commitment by USAID and the primary Title XII contractor (the University of Minnesota) to the development of the Institute; a curriculum model that integrates classroom experience with rural realities; and a continuing receptivity on the part of IAV leadership to new ideas and evaluation feedback. The fact that the Institute's early development occurred during a period of generally strong growth of the economy and the existence of a broad base of secondary school graduates in science also contributed to the success of the Institute.

The Institute's success is still a fragile accomplishment, particularly as it enters a phase when strong charismatic leadership in program and institutional management is being

replaced by more routine bureaucratic authority. The school is also confronting a critical recurrent cost financing burden. IAV graduates will increasingly have to seek employment in the private sector, which has demonstrated some concern about the relevance of job-related training provided by the Institute. Finally, the Institute has placed little emphasis on the integration of extension and economic sector analysis into its program.

The following key lessons can be derived from the IAV experience in the design and management of similar institutional development efforts.

- Critical inputs to institutional development efforts include high-level political commitment to a well-articulated "mission"; strong, continuous institutional leadership; structural and operational autonomy; entrepreneurial attitudes and receptivity to diverse experiences that "fit" organizational needs; a commitment to organizational quality; access to sustained resource support; development of an overlapping network of resource-provider constituencies; an incremental development approach; and flexibility in design. The more these factors are in evidence, the more likely that the effort will succeed.
- The creation of a successful university faculty was a long-term effort, requiring a supportive, 15-year commitment by A.I.D. and the University of Minnesota. Duration of commitment and conditions of U.S. university participation are the key design variables under the control of A.I.D.
- The early stage of institutional maturity is fragile; withdrawing support too soon may jeopardize the gains achieved. Shifting modalities of support may be more appropriate for consolidating long-term benefits.

PROJECT DATA SHEET

---

Project No.	Project Title	Project Dates	Total Funding (000)
608-0088	Higher Agricultural Education in Morocco	FY 69-77	US\$ 1.641
608-0134	Higher Agricultural Education in Morocco	FY 77-79	US\$ 3.300
608-0160	Agronomic Institute	FY 80-90	US\$28.508

---

Project Purpose: To assist the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) in training a Moroccan faculty and strengthening its capacity to provide to the agriculture sector qualified Moroccan professionals who understand and are sensitive to problems of small producers.

GLOSSARY

- EEC - European Economic Community
- ENA - National School of Agriculture
- ENFI - National School of Forestry
- FAO - Food and Agriculture Organization of the United Nations
- IAV - The Hassan II Institute of Agriculture and Veterinary  
Medicine
- INRA - National Institute for Agricultural Research
- MARA - Ministry of Agriculture and Agrarian Reform
- MIAC - Mid-American International Agricultural Consortium
- UNDP - U.N. Development Program





## 1. PROJECT SETTING: INTRODUCTION TO THE INSTITUTE AND THE A.I.D. ASSISTANCE PROGRAM

The institution-building process leading to the establishment of the Hassan II Institute of Agriculture and Veterinary Medicine (IAV), Morocco's largest and only graduate-level school of agriculture and veterinary medicine, began with the issuance of a directive in the Throne Speech of His Majesty Hassan II on March 3, 1963. At that time, His Majesty envisioned the creation of a National Institute of Agriculture that would be composed of scientific disciplines relevant to Mediterranean agriculture, would train both Moroccans and foreign students, and would deliver professional degrees fully equivalent in rigor to those granted by European universities (i.e., the Ingénieur Agronome degree).

This Institute was to respond to the pressing need in Morocco to train Government agricultural agents in a local institution. Prior to 1962, all higher level agents in agriculture were trained abroad, with the exception of a very limited number trained in Meknes at the National School of Agriculture. In 1962, the opening of Lycée Moulay Youssef's preparatory course in agriculture (for entry into French agricultural universities) permitted Moroccan students to reduce their training abroad from 3 to 2 years. The creation of the Institute was seen as the next logical step in the "Moroccanization" of agricultural education, in that training of higher level agricultural agents (i.e., Ingénieurs de l'Agriculture Marocain) would now take place entirely in Morocco.

Whether by fortune or planning, the Institute was able from its inception to avail itself of strong, long-term leadership. These leaders were able to put into effect the plan laid out by the King. They were also able to formulate an institutional image that was uniquely Moroccan and to seek domestic and international support to realize that image. In addition, they were able to capitalize on the King's directive to ensure the Institute an extraordinary degree of autonomy compared with other Moroccan institutions (see Appendix A).

## 2. PROJECT DESCRIPTION

Initial support for the Institute from U.S. sources started in 1969, when the Agency for International Development (A.I.D.) and the Institute entered into the first of three successive projects. The first project (and the two succeeding ones) was implemented through contractual relationships between the Institute and A.I.D. with the University of Minnesota. The

purpose of the project was to assist the Institute in planning its curriculum and in developing Moroccan advanced teaching and research capabilities in soil and plant sciences relevant to Morocco's agricultural development needs. Initial goals were to enable Morocco to "improve the quality of its higher education in agriculture by providing exposure to modern teaching, research, and problem-solving methods and to provide highly trained Moroccan manpower to assist in the development of the agricultural sector."

Under the first project, priority orientation in teaching and research was given to the needs of third-cycle students (students in the fifth and sixth years of their 6-year program, who were training for the Ingenieur d'Etat degree, a degree roughly equivalent to an M.S. degree in the United States). Additional emphasis was put on the training of 10 Moroccan faculty members for the two IAV departments through their participation in Ph.D. training programs in the United States. Less attention was paid to instruction for second-cycle students (students in their third and fourth years studying for their Ingenieur d'Application [or B.S.] degree).

During much of the 1970s, most of the A.I.D. assistance effort was used to support a small contingent of four to six resident expatriate advisers at the Institute. These individuals acted as advisers to the Moroccan faculty and assisted in course design and some teaching, but a significant portion of their time was spent on research and on supervising students engaged in research. At no time did any of the advisers assume administrative roles within the Institute.

In 1973, both the Institute's program and the scope of the A.I.D. project were enlarged to include horticulture. In January 1974, the program was broadened to include veterinary medicine, making the newly titled Institute of Agriculture and Veterinary Medicine one of the few schools in the world combining full curricula in veterinary medicine and agricultural sciences in the same program and with students sharing a common body of coursework and practical field studies during their first 2 years.

In January 1974, the IAV faculty was authorized by Royal Decree to begin preparations for a graduate program that would grant Moroccan Doctorate in Science degrees. Although the first of these doctorates was not granted until 1984, the expectation of such a program gave additional impetus to the Institute's collaborative program with A.I.D. and the University of Minnesota. The efforts to accelerate the process of training Moroccan faculty to the U.S. Ph.D. level and to deepen the Institute's capacity to conduct quality agricultural research became more intense and involved many more Moroccans in

participant training programs at U.S. land grant institutions. Moroccan candidates in U.S. Ph.D. programs increased from a single student studying soil conservation in 1972-1973 to 99 students who had studied or were studying for their Ph.D. degrees in 14 fields in 1986, with 65 of those having already finished their comprehensive preliminary examinations. Twelve of these candidates have completed all requirements for and been awarded the IAV Doctorate in Science. In addition, the three successive A.I.D. projects have permitted the training of 25 Moroccans to the M.S. level and the supplementary instruction of 190 Moroccan third-cycle students in various scientific fields at U.S. land grant universities. Considerable funding was set aside for U.S. faculty advisers to travel to Morocco to supervise dissertation research.

While the level of A.I.D. project funding increased sizably during the 1980s, the number of expatriate advisers still remained small--usually four to six. A number of these advisers remained on assignment for four to six terms and became quite familiar with the IAV faculty and the needs of the Institute. The University of Minnesota went to considerable effort to ensure that the terms and length of service of their faculty in Morocco would add rather than detract from their tenure prospects at the University of Minnesota.

From 1970 to 1986, the Institute's program gradually became more diversified, with course offerings added in such fields as food technology, biochemistry, rural engineering, surveying, agricultural machinery, and marine science. The Institute has also continued to supply student candidates for the Ingénieur d'Application degree to the National School of Forestry in Sale and the National School of Agriculture in Meknes. Finally, in 1982, the Institute's Horticultural Center in Agadir opened its doors as the first major agricultural school in southern Morocco.

In sum, the Institute has evolved in the space of two decades from 12 students taking their basic science training from non-Moroccan faculty in temporary facilities at Mohammed V University to its present status with approximately 2,300 Moroccan students and 346 faculty members (of which 85 percent are Moroccans) on its own campuses in Rabat and Agadir. The Institute now offers the Moroccan equivalents of the U.S. B.S., M.S., and Ph.D. degrees in agriculture and a doctorate in veterinary medicine. In addition, it trains approximately 250 non-Moroccan African students under the same conditions as its Moroccan degree candidates and pays the scholarship costs of all of these students from Government of Morocco budgetary allocations.

3. DIRECT INDICATORS OF THE INSTITUTE'S IMPACTS ON  
THE MOROCCAN AGRICULTURE SECTOR

Although the Institute is beginning to influence, both directly and indirectly, the agriculture sector in Morocco and the wider world, the evaluation team wishes to stress that it is still a very young institution. The first doctorates in science were granted only in 1984, and the process of "Moroccanizing" faculty positions is not yet complete. Faculty with doctorates have just begun their academic careers, and most graduates working in Government service and the private sector have been in their jobs for considerably less than 10 years.

Moreover, the Institute, like most young institutions, is a fragile one (see Appendix B), and it currently faces several problems. First, the Institute needs to make an effective transition from the charismatic leadership of its formative years to the establishment of an administrative structure appropriate to a large, complex organization. Second, the relatively limited core budget for research may reduce faculty motivation and make the Institute unduly dependent on the whims of external donors. Third, the local budget has not kept up with the growth of the Institute, in part as a result of its relations with the Finance Ministry and in part owing to the fiscal situation in Morocco. Fourth, as a result of budget constraints, IAV salaries are no longer competitive with those of similar institutions elsewhere. Fifth, as the IAV doctoral program becomes operational, there is a risk of inbreeding; this would undermine the innovativeness attributable in part to the diverse education received by current staff. Sixth, as noted above, the Institute was established with the intent of training Government officials; with those positions now largely filled, the Institute must become more responsive to the needs of the private sector. Finally, certain program areas remain weak, including aspects of extension education, natural resource conservation, and economic analysis.

These issues were considered by the evaluation team members in assessing the Institute's impacts to date. The team believes that the Institute is now generating the types of impacts on the agriculture sector that one would expect from an institution less than 15 years after graduating its first class. In this sense, impacts to date are clearly superior to those that were evident at U.S. land grant institutions 10 to 20 years after their founding.

### 3.1 The "Moroccanization" of the Institute and Recognition of the University Community as a Valuable National Resource

The major direct impact of the Institute on the Moroccan agriculture sector is that a quality agricultural institution now exists in Morocco where none existed 20 years ago. Moroccans constitute 85 percent of the administrators and faculty at the Institute, and the process of "Moroccanization" will be complete within 5 years.

For the first time in Moroccan history, therefore, a university-level agricultural institution exists that is staffed by Moroccans, focuses on solving Moroccan crop and livestock problems, and is recognized by both Moroccans and outsiders as a valuable national resource. The Institute now ranks as the equal or superior of many universities in the country with far older histories and is unique as a repository of agricultural knowledge.

It should also be noted that Moroccanization has meant considerably more than merely replacing foreign staff with Moroccans. Indeed, the Institute has developed a series of policies and programs that involve several distinctly Moroccan features. These include the following: (1) the full integration of the veterinary program into the curriculum, with all students learning some veterinary science and thus having a greater appreciation of the interrelationships between crops and livestock; (2) an intensive professional training program of unusually broad scope, which resembles more a professional school than a U.S. college of agriculture; (3) a program of rural development-oriented fieldwork that exposes all students to the problems faced by Moroccan smallholders (see Appendix C); and (4) a scholarship program for students from Sub-Saharan Africa financed by the Moroccan Government.

The Government of Morocco has realized substantial cost savings in being able to train in-country virtually all agricultural students at the B.S. and M.S. levels. Full-time access to Moroccan agricultural specialists for consulting and research activities, as related below, is also an impact and a direct consequence of the Institute's growth and development in the past 15 years. The existence of the Institute has also made possible for the first time development of linkages between the separate Moroccan agencies charged with agricultural education, research, and extension.

Although the structure of these linkages is still preliminary and long-term relationships are not yet fully articulated, there is now a potential in Morocco for a well-integrated system for agricultural planning and development at all levels and with all local crops and livestock.

### 3.2 The Formation of Professional and Alumni Associations and the Creation of a Moroccan Scientific Community in Agriculture

In the creation of a Moroccan scientific community in agriculture, the Institute has taken the lead in establishing both an IAV alumni association and many professional associations grouped by discipline or around agricultural problems.

The IAV alumni association is fast becoming an important link between agriculture sector activities, Government administrators, and the Institute, with important impacts in all three directions. Feedback from alumni has already led to changes in IAV's curriculum, which is now directed at producing graduates with more practical experience in agriculture and more prepared for positions in the private sector. The alumni association has also developed into a significant support group vis-a-vis the Government, advocating both adequate budgetary support for the Institute and better ways of linking agriculture education with research and extension activities. Finally, the presence of an active alumni association promotes the rapid dissemination of new ideas and technologies in the agriculture sector for discussion, refinement, and promotion to crop and livestock producers.

Similarly, newly created professional agricultural associations, like the National Association for Animal Production, have been instrumental in bringing debates on national agricultural problems outside the corridors of Government agencies and into the public arena. For example, the aforementioned association sponsored a well-attended national debate on the advantages and disadvantages of using Moroccan barley and other foodgrains for livestock feeding versus its use for human consumption. This association is also participating in ongoing discussions on the roles of imported beef breeds and artificial insemination in the development of a Moroccan beef industry.

In another field, the National Horticultural Association, in collaboration with IAV faculty in Agadir, has been working on a process for local production of high-quality potting materials for vegetable seedlings. Previously, these potting materials were imported from Europe; however, with this new collaboration, a cheaper process has been found to produce a local substitute for the imported materials. Testing is nearly completed, and a local private company will be formed to produce the new potting materials for local vegetable growers.

### 3.3 Faculty Participation in Sectoral Planning and Project Development

As might be expected at this stage in the Institute's development, the individual impacts made by faculty members in agricultural development are somewhat easier to isolate than those made through associations and other groups.

In sectoral planning activities, for example, the Institute's present director, Dr. Sedrati, individually and as president of the livestock subsector analysis committee, has had a major voice in changing legislation to allow Moroccan veterinarians to open private practices and to put all Government work on a specific contractual basis in the future. Similarly, Mr. Larbi Firdawcy, the IAV secretary-general, is a ranking member of the national committee on human nutritional planning. As a final example, Mr. Driouchi Ahmed, a doctoral candidate and faculty member at both the Institute and the National School of Agriculture, has recently completed work on an A.I.D.-sponsored study of the impacts of Government agricultural pricing policies in Morocco that proposed major recommendations for policy changes.

Regarding sectoral activities and project development, the formal linkages between IAV researchers and the National Institute for Agricultural Research (INRA)/Mid-American International Agricultural Consortium dryland agricultural project in Settat have resulted in greater emphasis on the integration of crops and livestock in the area. This is the result of joint research, which showed, among other things, that local farmers deliberately overplant their grain fields and then thin their plant stands to desired densities, using the thinned plant materials as early rainy season feed supplements for their animals. When properly evaluated, this system was shown to produce greater overall returns for farmers than the one initially proposed by the project and based strictly on agronomic considerations.

This is but one example of the relatively good cooperation between the Institute and INRA. Numerous IAV graduate students are placed at INRA stations for their thesis research, and many faculty have participated in INRA-sponsored projects. In addition, many IAV graduates are now serving at INRA. Relations have been hampered occasionally by INRA's tendency to expand more rapidly than its financial resources permit, a problem currently being corrected. In contrast, relations with the extension service have been much more limited, owing in part to the limited expertise and finances of extension and in part to the lack of an extension mandate for the Institute. However, the Institute's Division of Rural Development activities partially compensate for this (see Section 3.4).

In another instance, investigations by IAV faculty members uncovered a company in Agadir selling banana suckers with heavy nematode infestations to unsuspecting local farmers. When presented with the evidence, the Government stepped in to close down the company, and now approximately 5,000 disease-free banana plants are being produced in Agadir annually by the producers association itself.

With the establishment of a highly competent soils science department at the Institute, faculty members have been heavily involved in the first wide-scale soil mapping exercises in Moroccan history and have set up a soil analysis laboratory for local farmers. Similarly, other faculty are conducting studies of the efficiency of and losses from traditional underground grain storage systems and improved designs for common farmstead structures.

### 3.4 The Division of Rural Development

The Institute's Division of Rural Development serves a unique function as the organizer of faculty and student activities at the development project and farm levels. Its stated purpose is to make concrete changes in the rural sector. Examples of its present activities include the following:

- Fieldwork with the World Bank-sponsored Middle Atlas project, centered on developing acceptable management schemes for lands held collectively for cropping, live-stock grazing, and forestry activities
- Technical and socioeconomic research with the Gharb irrigated agriculture project to determine why local farmers have not adopted new techniques proposed for cereal production in the area
- Several water development activities, whereby faculty members have consulted on the optimal layouts and operating procedures for both village water supplies and small irrigation perimeters
- An international project with the Government of Mauritania to introduce improved water-lifting devices into desert oases, using the skills of Moroccan artisans and techniques developed in collaboration with IAV hydraulics specialists and sociologists



### 3.5 The Institute's Documentation Center and Library Resources

With substantial assistance from the United States, Canada, and the Food and Agriculture Organization (FAO), the Institute has developed the finest agricultural library and documentation center in Morocco. Although still modest by U.S. standards, the library and documentation center are recognized as Morocco's repository of agricultural information. As such, they are integrated into a national system of information centers serving not only the universities but Government agencies and the general public.

The IAV center has made agricultural information available to a broad spectrum of clients during its first full year of operation. In the 12 months preceding the evaluation team's mission, the center had serviced almost 100 specific documentation requests from 36 non-Institute clients, including various Government ministries, parastatals, private companies, and individual technicians and researchers. This list (see Appendix D) does not include use of the IAV library resources, including its large file of periodicals, by walk-in clients other than students.

The evaluation team believes that as the IAV library resources grow and more clients become aware of the materials available, this center may become one of the most important and long-lasting contributions that A.I.D. has made to the Institute and indirectly to agricultural development in Morocco. All of the evaluation team members can cite numerous examples from their consulting experiences of programs and projects designed without sufficient knowledge either of local conditions or of similar efforts conducted in the same or adjacent countries. By making such information broadly available, the IAV center holds out the distinct possibility that such mistakes can be eliminated in Morocco's case.

### 3.6 Current Students and the System of Practical Fieldwork

As stated previously in this report, annual field exercises are an integral part of each IAV student's training. In the third and fourth years of these exercises, the concentration is on detailed analysis of constraints to agricultural production at the farmer and village levels. Students are required to work in groups to analyze the constraints and propose solutions to local problems based on their own theoretical knowledge and their consultations with faculty advisers. These proposed solutions are then discussed in detail with the concerned local people--both at the village and during farmer visits to the Institute.

In discussing these field exercises with students and faculty, the evaluation team was convinced that many small and incremental changes have taken place in Moroccan villages as a result of this IAV program. Unfortunately, the data from student notebooks have not yet been computerized, and the team did not have time to read enough of the notebooks to gain a comprehensive grasp of actual impacts. A thorough investigation of these notebooks, however, would be an instructive exercise for a researcher endeavoring to learn about farm-level constraints in Morocco and their possible solutions.

#### 4. INDIRECT INDICATORS OF THE INSTITUTE'S IMPACTS ON THE MOROCCAN AGRICULTURE SECTOR

##### 4.1 Impacts Through Former Students

The Institute, in collaboration with the National School of Agriculture and the National School of Forestry, has graduated approximately 2,500 4-year agricultural technicians, 300 veterinarians, and 1,000 6-year agricultural specialists since 1970. Of these graduates, 75.5 percent are employed by Government ministries and agencies, 13 percent are employed at agricultural training institutions, and 11.5 percent work in the private sector (see Appendix E).

For all categories, over 75 percent of the graduates have been in their current positions for less than 5 years. Most have not attained sufficient seniority in leadership positions to be individually responsible for major impacts on the agriculture sector. There are, however, several examples of impacts on the sector by graduates--as detailed below--that the evaluation team believes are early indications of the types of impacts many more IAV graduates will have in the medium term.

##### 4.1.1 Improving Desert Agriculture

Separated from the more populous areas of the country by the Atlas Mountains, the date-palm-growing areas of Morocco are among the more marginal parts of the agriculture system. About 1.5 million people depend on date palms for their livelihoods. Moreover, date palms are grown almost exclusively in oases where they form the "roof" for a complex microclimate. Under them are planted citrus trees and cereal crops. Since the 1880s, a fusarium virus, which kills the infected date palms, has been noted. Only in the last 20 years, however, has this virus

assumed significant proportions. It is now estimated that 10 million trees--or two-thirds of the total palm plantations--have been affected by the virus.

IAV- and U.S.-trained scientists are now working at the INRA research station in Marrakech, and its substations in several oases, to develop fusarium-resistant date palm cultivars and to increase cereal crop yields. They have already succeeded in producing the fusarium in vitro and in culturing date palms from tissue cultures with a 95-percent success rate. The cultured plants are infected with the virus, and those that show resistance to the virus are grown out. Because date palms normally take 10 years to mature, it is too early to tell if the research has been successful. Nevertheless, introduction of tissue culture techniques has speeded up what otherwise would have been a lengthy breeding program.

Success has already been achieved in developing an improved wheat variety for the oases. The new variety was field-tested on farmers' fields, where it yielded 3,000 to 3,500 kilograms per hectare, a significant improvement over the traditional varieties. Farmers are now multiplying the seed and selling it to their neighbors. At the same time, a germ plasm bank has been established at the station to preserve displaced varieties.

#### 4.1.2 Contributing to Innovation in the Private Sector

The impact of the Institute on the private sector has also occurred through its graduates. One 1976 food technology graduate of the Institute, after several years as a Government official, went to work for OLEOR, a major producer of edible oils. He is now in charge of production, maintenance, and materials purchasing at OLEOR, a totally Moroccan company employing 250 workers.

As head technician, he designed and installed a system for using wastes from the plant to manufacture soap. He also realized that substantial energy savings could be had by redesigning the oil-processing system to use wasted heat from the cooling process to heat incoming oil. He designed, built, and installed equipment to do that and was able to increase production speed by 50 percent as well. The Italian company that built the original equipment was astonished at the soundness of his plans and the low cost involved in the redesign.

As a co-founder of the IAV alumni association, he believes that the Institute's education is not yet practical enough; he is encouraging reform while defending its value as an institution.

#### 4.1.3 Improving Dryland Agriculture

IAV graduates are involved in many efforts to improve both crop and livestock production in the rainfed agricultural areas of Morocco (see Appendix F). For example, the joint INRA/A.I.D. dryland agriculture project and Aridoculture Center in Settat are almost wholly staffed on the Moroccan side by IAV graduates. The researchers are actively working on a broad array of problems prevalent in the rainfed areas, including the technical and economic aspects of weed control, improved varieties and better cropping systems for forages, cereals breeding for Hessian fly resistance, soil fertility analyses to formulate improved inorganic fertilizer recommendations for local farmers, and computer modeling of wheat growth patterns based on 60 years of weather records to limit the scope of necessary field trials.

In addition, the core group of cereal breeders within INRA --again almost all IAV graduates--has developed 12 new varieties of barley and wheat. These varieties are now going through the final steps in the Moroccan varietal cataloging process and are being multiplied for distribution to cereal producers in the near future. Similar breeding programs are also underway for alfalfa and other forage varieties and for several grain legumes.

#### 4.1.4 Improving Agricultural Planning Capabilities

One of the major constraints to effective technical planning in regional development projects in Morocco has been the lack of soil and land classification maps for key agricultural areas. Prior to the establishment of the Institute, the country had no local capacity to conduct soil and land mapping and classification exercises. Both the Government and donor agencies had to hire international firms at considerable expense to map specific small project areas (e.g., irrigated perimeters). Since 1970, the Institute has produced a cadre of Moroccan soil specialists and land mappers that is now capable of handling all local mapping operations. In collaboration with IAV faculty, this group has already classified and mapped over 300,000 hectares of land in the Settat and Meknes areas, in addition to virtually all of the irrigated perimeters. This work has been particularly important in allowing provincial officials to formulate integrated regional development plans and to implement them with donor assistance.

#### 4.1.5 Creating a Modern Dairy Industry

To be economically justifiable in Morocco, any local dairy industry must be highly productive and economically efficient. Three major components of any such dairy industry are efficient herd management techniques, access to superior genetic materials, and modern dairy recordkeeping systems. In all three areas, IAV animal science graduates have been industry leaders (see Appendix G).

A very high percentage of all dairy unit managers on the irrigated perimeters are IAV graduates trained in modern herd management techniques. Other graduates are serving as technicians in the dairy breeding program, which is importing international genetic materials--Holstein sires and heifers from Canada and frozen dairy semen from U.S. artificial insemination centers. Finally, IAV graduates have strongly promoted and been responsible for the installation of a national Dairy Herd Improvement Association program--modeled on the U.S. system--that allows herd managers to maintain adequate herd records, to compare their individual performances to a national average, and to cull inefficient cows rapidly to improve herd efficiencies.

#### 4.1.6 Creating a National Capability in Veterinary Medicine

Since 1971, the Institute has trained and graduated just under 300 local veterinarians. These graduates have displaced the expatriate veterinarians who staffed local veterinary services through the mid-1970s. The training of these Moroccan veterinarians is heavily oriented to on-farm treatment of domestic livestock. The Moroccanization of veterinary services has led to several changes in local veterinary practices and has saved the Government money in several instances.

For example, treatments for liver flukes in cattle and small ruminants had been administered in the spring because French-trained veterinarians assumed that such infestations occurred in Morocco at the same time they occurred in France. Local IAV-trained veterinarians, however, discovered that the liver fluke infestations actually occurred at other times of the year--because of pronounced differences in rainfall patterns--and that treatments administered in the spring were essentially useless in control of this parasite. Treatment schedules have since been adjusted in line with the findings of this local research.

#### 4.1.7 Improving Agricultural Operations

Although the Institute graduated its first class of agricultural machinery technicians only in 1982, the evaluation team heard reports countrywide about the effectiveness of these technicians and their immediate usefulness to both Government operations and the private sector. Not only are these technicians establishing quality programs in use and maintenance of agricultural machinery on state and private farms, they are also participating in a broad program of research and field testing of new techniques in farm mechanization. Elements of this program, which is assisted by the Federal Republic of Germany, center on funding improved methods for soil manipulation to improve the timing of field operations at the start of the growing season in rainfed areas, investigating solar energy applications in irrigated agriculture, and increasing the efficiency of crop harvesting techniques through the introduction of improved machinery.

#### 4.2 The Institute's Attraction of International Interest in Collaborative Endeavors

One of the more significant impacts of the Institute's development and growing reputation over the last 2 decades has been its attraction of international interest in collaborative research programs and regional outreach activities. For example, Morocco was selected as one of a handful of countries to participate in the A.I.D.-supported Small Ruminants Collaborative Research Support Program largely because IAV faculty members were willing and able to join with international researchers in studies of small ruminant breeding, production, and management. Moreover, an IAV faculty member is currently serving on the international board of directors for this worldwide program.

Another example of such participation is the planning currently underway for a regional center for irrigation technology to be established in southern Morocco under the direction of the Institute and Utah State University. This center will serve as a training and research center in irrigation system technologies, specifically for technicians from north and Sahelian African countries.

IAV faculty and administrators continue to provide leadership for the Association of Faculties of Agriculture in Africa. This association, which was founded in 1973, brings together 72 faculties and institutions of agriculture in Africa for the purpose of increasing their effectiveness and efficiency in

national and regional development. In collaboration with many international organizations, this association has sponsored seminars and workshops on a wide range of general development issues and specific problems related to higher education in agriculture. A partial listing of these activities includes the following:

- A training course on "Teaching Methods in Crop Protection" for lecturers and postgraduate students from Francophone institutions in July 1977
- A 6-week course on "Pedagogic Training for Lecturers of Anglophone and Arab Speaking Countries" in 1978
- An AFAA taskforce on the "Integration of Population Components in the Research Training and Extension Programs of Faculties of Agriculture in Africa" in 1980
- A "Comparative Study of All Institutions of Higher Agricultural Education in Africa" in 1980
- A workshop on "The Revision of Higher Education Curricula and the Introduction of Social Sciences in Agricultural Teaching" in 1983
- A workshop on "The Role of Women in Rural Development in Africa" in 1983
- A workshop on "Food Security in Africa" in 1984

#### 4.3 Faculty Publication in International Journals and Enlargement of the Scientific Body of Knowledge

A survey of publications listed in University of Minnesota project reports from 1976 through mid-1985 showed 73 publications by IAV faculty. Twenty-four of the senior authors for these publications were Moroccans. By far the greatest amount of published work to date (58 percent) has been done on subjects relating to plant pathology for a wide range of cereal and horticultural crops. The remainder of the papers are evenly divided between field management and veterinary medicine.

#### 4.4 The Institute's Role in Regional Development

IAV activities in teaching, research, and extension often have impacts beyond Morocco's borders. Unfortunately, the team's schedule and available resources did not permit observa-

tion and assessment of these activities. We have had to content ourselves, therefore, with a list of potential indirect impacts, to be fully evaluated at a later date.

Clearly, the most fertile area of indirect impacts elsewhere in Africa is through the hundreds of non-Moroccan IAV graduates who have returned to their countries. For example, in Senegal, as observed by one team member in the context of another consultancy, several IAV graduates are now employed as crop researchers with the Senegalese Institute for Agricultural Research. In March 1986, senior researchers from that institute expressed great satisfaction with the results of the IAV training programs and are currently investigating ways of expanding such bilateral cooperation, particularly through development of irrigated perimeters in the Senegal River Basin.

Another example of regional cooperation is in the development of appropriate technologies for Mauritanian oases. IAV faculty and local Moroccan artisans are now installing and testing improved water-lifting systems and complementary irrigation technologies at four oases in the Mauritanian desert. This project is apparently so successful that the Government of Mauritania is actively seeking international donor support to extend the improved technologies to all oases in the country.

Finally, many IAV faculty members are currently working on research projects in collaboration with researchers from international research centers such as IITA in Ibadan, Nigeria; ICRISAT in Patancheru, India; ICARDA in Aleppo, Syria; and CIMMYT in Lourdes, Mexico.

#### 4.5 Unsolicited Requests to the Institute for Assistance and Information

Another way to gauge the Institute's impact on the agriculture sector is to identify situations in which individuals or organizations seek out productivity-enhancing assistance or information from the Institute. To the extent that these requests are demand-driven (i.e., they flow from needs defined by agricultural producers), they represent an indication of the Institute's value for these users.

The evaluation team found two examples of unsolicited requests for assistance. The first involved a group of small farmers who visited the office of the chairman of the Food Sciences Department to inquire about bio-gas technology. The farmers, who had heard about a faculty member's research in this area, had traveled 3 hours from south of Settat to the Institute to invite Dr. Sinhadji to visit their farms and to recommend



uses of bio-gas technology in their farming operations. The second example involved a citrus grower who visited the Agadir Horticulture Complex to request soil analysis assistance before launching an extensive banana-producing operation.

Both examples demonstrate the existence of an informed client population that believes the Institute can make a contribution to agricultural productivity. In the future, the Institute will have to test the market value of this assistance in the interest of extending services to a wider range of beneficiaries. (See Appendix H on the Institute's financial status.)

5. IMPACT ANALYSIS: FACTORS IDENTIFIED AS INSTRUMENTAL  
IN THE SUCCESS OF THE INSTITUTE

In reviewing the evolution of the Institute, the evaluation team was impressed by the growth and development in instructional and research programs and in the size of the trained Moroccan faculty and the student body. In 20 years, the Institute has grown to a size and complexity of operations that equals or exceeds most of the U.S. land grant institutions. It has done so while building four very credible degree programs and developing a Moroccan faculty essentially from the ground up. As such, the Institute is one of the premier examples of institutional development in agricultural education in Francophone Africa.

The logical questions we posed to Institute faculty and students, A.I.D. staff, University of Minnesota resident professors, and other people in public and private life in Morocco were as follows:

- How was all this growth and development achieved so quickly?
- What were the key factors in the success of the Institute to date?

After examining the reports for more than 200 individual interviews conducted in January and February 1986, the team determined that the factors discussed in the following subsections (in priority order) have been instrumental in the Institute's success.

### 5.1 "Sense of Mission" and Commitment to a Uniquely Moroccan Institute

One of the things most evident to the evaluation team is that the Institute in 1986 is not a carbon copy of the idealized U.S. land grant university (i.e., based on the classical American teaching, research, and extension model).

It is a unique hybrid institution, built on the foundation of a genuinely Moroccan sense of what is appropriate for Morocco in undergraduate and graduate education in agriculture. The Moroccans decided for themselves which elements of the higher education systems of the United States, France, Germany, Belgium, and several other countries were appropriate for adoption and incorporation into their evolving Institute. This process of investigation, evaluation, and adoption/rejection of outside elements has given the Institute a feeling of uniqueness and a high esprit de corps among faculty, administrators, and students.

### 5.2 Leadership in Institutional Development

The Institute has benefited during its first 20 years from an unusual degree of continuity in leadership from several outstanding individuals.

The second IAV director, Mr. Abdallah Bekkali, held his position for 18 years. During much of this time, he held a joint appointment as the Director of the Office for Agricultural Education in the Ministry of Agriculture and Agrarian Reform and thus had substantial influence over the evolution of the entire agricultural education system in Morocco. Mr. Bekkali's unique style of personal leadership allowed him to vigorously defend the Institute's mandate and interests vis-a-vis outside and competing individuals and agencies. At the same time, he allowed his carefully selected and highly motivated faculty members the latitude to develop their own skills and contribute to the Institute's development--often through rigorous and extended debates on controversial issues with the Director himself. Finally, Mr. Bekkali began investigating the merits of the U.S. system of higher education in agriculture as early as 1962 and was thoroughly grounded in what could be expected from cooperative endeavors with land grant universities when he assumed the Directorship in 1966.

Other leaders have also contributed to the Institute's intellectual development and attitudinal orientation. Mr. Paul Pascon, the late director of the Institute's Rural Development

Division, contributed enormously to development of the unique system of practical field exercises (stages) in which students seek to use the observational and analytical skills they have developed at the Institute in actual village situations during their first 4 years of study. The attitude prevalent among faculty and students that they must remain close to the agricultural conditions in Morocco if their teaching and research are to be relevant and that such work is best conducted in multidisciplinary groups can be directly traced to Mr. Pascon's influence.

Finally, the leadership of individuals like Mr. Larbi Firdawcy, the Institute's current secretary-general, in bridging the generational gap between the older leaders of the 1960s and 1970s and the emerging leaders of the 1980s and beyond should not be overlooked. The ability of Mr. Firdawcy, himself a product of the educational reforms in France in the late 1960s, to assume this difficult transition role by articulating new ideas and carrying on the process of self-appraisal has been critical to the evolving institution.

### 5.3 Selectivity in Choosing Faculty and Students

The Institute has been particularly fortunate in being able to select its students from among the best available secondary school graduates. Unlike the situations in many other countries, where agricultural higher education is often viewed as the undesirable last alternative for many students, competition for admission to the IAV program has been intense. This appears to be, in equal parts, a function of the Institute's age (i.e., it is one of the older Moroccan institutions of higher education), its reputation for high-quality education, and the certainty students have had (until recently) of job placement after graduation. Moreover, the rigorous selectivity in the academic program continues throughout a student's career, with a strict rating system for overall performance and end-of-year examinations.

IAV faculty members are also carefully selected. Former Director Bekkali and senior faculty members set high standards for teaching and research performance from the start, and these standards have been consistently applied ever since. Faculty have been selected not only for their academic merits but also for their willingness to take the initiative in aggressively seeking research support, and for their commitment to the Institute and its goals.

#### 5.4 Commitment to Quality and the Drive for International Recognition

The evaluation team was impressed by the willingness of the Institute's founders and its present faculty to base teaching and research programs on accepted international standards of content and quality. The IAV orientation has consistently been directed toward degree requirements that are at least as strict and comprehensive as those of top-rated U.S. and European agricultural universities. Doctoral committees and final degree granting review committees at the Institute are directed and staffed by distinguished international and Moroccan professors. Finally, IAV faculty research outputs are published in internationally recognized professional journals to ensure recognition, relevance, and high quality.

#### 5.5 Autonomy in External Negotiations

From the start of IAV operations in 1968, its formal mandate provided for a large degree of autonomy in daily operations and long-term planning. However, formal grants of authority and the realities of daily control often differ, with real power being held by supervisory ministries or national financial authorities. In this case, under the leadership of people like Mr. Bekkali and Professor Pascon, the Institute managed to preserve and enlarge the autonomy granted it in its formative years by using informal networks of supporters and contacts to defend the Institute's budgets and prerogatives. This tradition has been admirably upheld by IAV administrators under the present considerably strained economic conditions in Morocco.

IAV leadership has had a cascade effect on its faculty. It has allowed faculty members to show high degrees of skill and aggressiveness in identifying and obtaining important resources from outside sources and in developing a unique style in institutional operations.

#### 5.6 Incremental Nature of IAV Institutional Development and A.I.D. Project Assistance

The evaluation team believes that IAV, A.I.D., and the University of Minnesota have been well served by the incremental nature of IAV development and A.I.D. project assistance. IAV administrators have been careful to develop necessary precondi-

tions at the Institute before expanding the teaching and research programs. Both course and degree offerings have been added only as institutional capacities have been developed to handle them.

Similarly, A.I.D. assistance has been incremental, with the University of Minnesota staff initially participating only in soil sciences and agronomy and then only in collaboration with similar assistance from Belgium. Only as the proffered U.S. assistance in the initial disciplines demonstrated its credibility and relevance to the Institute's development were new areas of opportunity explored and additional assistance provided in veterinary medicine, forestry, animal sciences, and other disciplines.

This approach allowed project development from the bottom up, with the result that the University of Minnesota has only recently become involved in providing IAV faculty with instruction in university administration (held at the University of Minnesota). Given the gradual development over the past 15 years of awareness concerning both the actual functioning of the academic departments and the constraints to their operational efficiency, the present assistance in university administration is much more relevant and effective than it would have been had it been imposed on the Moroccans in the early years of project assistance.

#### 5.7 Efficient Management of Multidonor Resources

Because the Institute's evolution has depended heavily for its success on external donor support, in terms of both financial and human resources, effective management of these diverse resources has been essential. IAV administrators have proved very effective in negotiating effective support without relinquishing control of the IAV program, or even of individual departments, to the donors. Moreover, they appear to have succeeded admirably in resolving potential conflicts among donors with different approaches to higher education and in providing leadership that facilitated coordination among expatriate staff on the campus.

#### 5.8 Long-Term Commitment by A.I.D. and the U.S. University to the Institute's Development

One of the most striking elements of the Institute/A.I.D./U.S. university relationship has been its continuity. The evaluation team found the evidence of A.I.D.'s perseverance in this case very refreshing. It is remarkable that substantial

assistance continued to flow through three successive projects with the Institute over 15 years, despite a very negative first project evaluation and several major differences of opinion on how the Institute should evolve. The evaluation team knows of few other instances in A.I.D.'s institutional history of support for higher education in which assistance has been both so lengthy and so continuous.

The commitment of the participating U.S. land grant university, in this case the University of Minnesota, has been similarly outstanding. Site visits to the university campus and interviews with over 20 faculty members and administrators confirmed the authenticity of this commitment.

### 5.9 The University of Minnesota's Role

The University of Minnesota's role as the lead university in the project over the 15 years of U.S. assistance and collaboration must set some record for U.S. higher education. The dedication of University of Minnesota faculty and staff to the Institute's success is obvious in many ways. The length of stay for staff resident in Morocco has been considerably longer than the normal sabbatical plus 1 additional year of departmental leave. Several Minnesota faculty members have served more than one tour at the Institute--often with several years between tours--and have served as faculty advisers in Minnesota during the intervening periods. Moreover, the University appears to have gone to considerable lengths to ensure that faculty members serving in Morocco would not be penalized in their academic careers for their participation in the project--and, in fact, at least two such faculty members received tenure at Minnesota during or shortly after serving in Morocco. In addition, one has recently been promoted to full professor based almost entirely on academic achievements in Morocco.

In addition, two individuals, Drs. Blackmore and Purvis, have played particularly important roles in maintaining long-term continuity on the project. Dr. Blackmore was instrumental in initiating the project and, as Director of International Programs at the University of Minnesota, was responsible for project administration from 1968 to 1977. Dr. Purvis joined the project in 1978, when he was appointed Assistant Dean for International Programs, and then became Agriculture Officer in the USAID Mission in Rabat in 1983. This provided both continuity and a strong link between the University of Minnesota and the USAID Mission.

The University's role in arranging and coordinating the participation of over 30 other land grant institutions in training and research efforts with the Institute is also to be highly

commended. Because the number of Moroccans studying at any single U.S. institution, other than the University of Minnesota, is relatively low (i.e., one to five students), placement and supervision of students is a labor-intensive and complex task that could not be feasibly accomplished by the Institute from Morocco. Furthermore, we doubt that the recent transition from issuance of U.S. Ph.D.s to the granting of only the IAV Doctorate in Science to Moroccan degree candidates, even when the bulk of the students' graduate work was accomplished at U.S. universities, could have been accomplished so successfully without the participation of the University of Minnesota as an intermediary with its sister institutions.

#### 5.10 The Entrepreneurial Attitudes of Institute Faculty in Building Support Constituencies

The history of U.S. land grant institutions reveals a strong dose of entrepreneurial opportunism. Deans and researchers at these universities aggressively sought Federal, state, county, and private funds for agricultural research (Busch and Lacy 1983; Rosenberg 1976). They actively pursued potential clientele in agriculture and government throughout the United States. This activity, without question, contributed to their success by establishing clear, definable, and mobilizable constituencies for their universities.

This same type of behavior appears quite markedly among IAV administrators and faculty. Instead of relying on aid from a single external donor, they have actively sought to create scientific and financial linkages with a wide range of donors, thereby reducing their dependency on any single donor. Instead of acquiescing to static annual budget proposals from the Moroccan Government, they have, with a few exceptions, argued for significant budget increases. Finally, they have been willing to push the bureaucracy to its limits rather than passively accept administrative decrees.

#### 5.11 The Institute's Organizational Structure

The Institute has developed an organizational structure that is uniquely Moroccan in several ways:

- Agricultural sciences, veterinary medicine, and forestry studies are united in a single institution, thereby creating a single strong center capable of articulating its needs to Government officials.

- The Institute, with over 350 faculty and 2,300 students, is very large by both Moroccan and international standards. If it were a U.S. land grant university, it would rank in the top 10 in size.
- The Institute has gradually developed a type of matrix organizational structure. Lines of authority appear to be quite flexible, resulting in sharing of resources and information when appropriate.
- The structure of the Institute permits and encourages scientists to take the initiative. For example, a scientist may initiate negotiations for funding a particular research project by going directly to a funding organization.
- Extramural funds are managed separately from direct Government budgetary support. A special account, managed directly by the Institute, is used for this purpose. Thus, these extramural funds represent a supplement to the Institute's budget rather than a reduction in direct Government support.

Although the faculty have been encouraged to publish in international journals, the reward system of the Institute has also encouraged activities more directly linked to the improvement of Moroccan agriculture, such as participation in fieldwork and engaging in applied research in rural villages. However, this should be attributed more to the general esprit de corps than to the formal reward system, because no salary increases have been received for some years now. How long this can continue without resulting in a gradual deterioration of faculty productivity remains to be seen.

#### 5.12 The Integrated Curriculum Model

The IAV curriculum is unusual in that it exposes students to virtually the full range of agricultural sciences before focusing on a particular specialty. As such, it differs significantly from the U.S. and French models, in which students develop competence within a relatively narrow area. Given Morocco's overall level of agricultural development and the likelihood that students will be placed in positions somewhat removed from their particular specialization, this appears to have been a wise development decision.

In addition to classroom instruction, the Institute has a series of progressively more difficult field training exercises (i.e., stages) that all students must successfully complete.



This program exposes students to the realities of Moroccan agriculture and village life and encourages them to apply theoretical knowledge obtained in classes to real problems as members of multidisciplinary work teams.

These curriculum innovations have had the twin effects of creating a real esprit de corps among the students and establishing the Institute's reputation as a unique national institution.

#### 5.13 Receptivity of IAV Personnel to Continuing Evaluation

IAV administrators and faculty have been exceptionally open to evaluation by outsiders. Given the number of donor agencies involved in various aspects of the IAV program, frequent evaluations are perhaps a fact of life at the Institute. Nevertheless, the evaluation team was impressed by the receptivity of IAV personnel to its questions and comments. This behavior is reflective of the Institute's general attitude toward continual self-evaluation, adaptation of useful outside ideas, and improvement of the existing program.

#### 5.14 Concurrence of IAV Growth and Moroccan and Worldwide Economic Expansion

Fortuitously for the Institute, its development occurred during a period of relatively sustained economic growth in both the Moroccan and international economies. This permitted the Institute to grow without having to compete for an increasing share of a static or shrinking economic pie. This was the case for both the domestic budget and foreign aid availabilities. It also meant that IAV graduates could be guaranteed immediate employment by Government agencies and parastatals and that faculty members could find support for further study, research, and special needs with relative ease.

Unfortunately, the Institute reached its maximum size as world and domestic economies slumped. Adjusting to static or declining resource availabilities will not be an easy task.

#### 5.15 Morocco's Well-Developed Secondary School System

Finally, it must be pointed out that the selectivity that the Institute has been able to sustain in student selection has been possible because of Morocco's widespread and high-quality

secondary school system. For example, it is because the Moroccan secondary school system produces numerous graduates with diplomas in science and mathematics that the Institute can require applicants to have that type of diploma. This factor should not be underestimated; in many years, the Institute denies admission to more secondary school graduates with science or mathematics diplomas than the number of students graduated from the secondary schools of many other African countries.

## 6. LESSONS LEARNED: FACTORS AFFECTING SUCCESS

In addressing the lessons learned from this analysis of the Institute and its evolution over two decades, the evaluation team assumed the perspective of an A.I.D. project design team charged with analyzing the possibility of a major A.I.D. investment in agricultural higher education in a developing country other than Morocco. As this hypothetical design team, we tried to isolate and categorize the factors leading to the Institute's success and to assess their relevance to the new situation. Our analysis sorts the key factors into the categories discussed in the following subsections.

### 6.1 Factors Under A.I.D. Control

The evaluation team's analysis of the Institute concluded that the following factors are endogenous to most design situations in agricultural higher education and are largely under A.I.D.'s control. A design team's members, therefore, must determine at the outset of the project design A.I.D.'s degree of commitment with respect to the following factors.

1. The necessity for a long-term commitment to institutional development. Is A.I.D. willing to plan for and commit itself to 15 to 20 years of financial and technical assistance for the development of an institution, and is it realistic to assume that A.I.D. can sustain such a commitment over that period?
2. The incremental nature of institutional and project development. Is A.I.D. willing to start the project with limited objectives in one or two academic departments with the expectation that larger commitments may evolve as mutual trust and expertise develop between participants?
3. Setting the conditions for participation by U.S. universities. Can A.I.D. set conditions for a contractual relationship between one or more U.S.

university contractors and a host institution that will strongly encourage long-term commitment and flexibility by all parties?

## 6.2 Factors Essential to Success

The following factors are endogenous to most project design situations. They are, in the opinion of the evaluation team, also prerequisites to the success of any higher education project. Based on the IAV experience, the team would caution against proceeding with any project design unless both the host country institution and A.I.D. (and its contractors) evidence the following characteristics:

- A "sense of mission" and commitment to develop an institutional structure to serve unique local needs
- Demonstrated capacity by local personnel for leadership in institutional development
- An institutional commitment to high-quality program and personnel development
- A degree of institutional autonomy in relations with external donors and vis-a-vis national government ministries and agencies
- A demonstrated institutional capacity for efficient management of multidonor resources by local administrators
- Demonstrated interest in the specific institution-building effort and the strong prospect of long-term commitment and flexibility by one or more U.S. universities
- Flexibility and a capacity for self-criticism on the part of all parties to the institutional development process

## 6.3 Factors Contributing to Successful Institutional Development

The evaluation team believes that the following factors are highly desirable and, if present at the outset of the design process, are strong indicators of potential institution-building project success. If such factors are not present initially, concerted efforts should be undertaken in project design to build them into institutional orientations and activities.

- A high degree of selectivity in choosing faculty and students
- A willingness to establish institutional measures of quality based on international standards
- Entrepreneurial attitudes among leadership and faculty that are oriented toward seeking necessary resources and building needed support constituencies
- An organizational structure that encourages maximum participation by and multidisciplinary linkages between faculty members, administrators, and students
- Curriculum models that integrate teaching, research, and practical fieldwork for students and faculty
- A receptivity to continuing evaluation linked to high-quality program development

#### 6.4 Exogenous Factors Affecting Success

The evaluation team believes the following factors must also be assessed by any design team even though they are usually exogenous to the institutional situation. They are key elements in the success or failure of any higher education project, as demonstrated in the case of the Institute.

- Reasonable prospects for economic growth during the institutional development process
- A secondary education system of sufficient scope and quality to consistently produce highly qualified applicants

## APPENDIX A

### AN ANALYSIS OF THE INSTITUTE'S EVOLUTION AND KEY EVENTS IN THE INSTITUTIONAL DEVELOPMENT PROCESS

by Dr. Rolland P. Poirier

The Hassan II Institute of Agriculture and Veterinary Medicine (IAV) has had a relatively short academic history. Having formally opened its doors to students only in 1968, it has developed in a way that has permitted fast growth and increased reliance on Moroccan faculty members.

This following short description highlights only key points in the Institute's evolution.

#### 1. AGRICULTURAL EDUCATION IN MOROCCO DURING THE FRENCH PROTECTORATE

The Institute did not suddenly spring from nowhere as an agricultural institution, and certain aspects of its development are easier to understand in the context of events that occurred before its creation.

Before the French Protectorate of 1912, Morocco did not have a concept of formal education strictly applied to agriculture as food and livestock production. Only in 1912, with the creation of an Agricultural Service within the Public Works Department, did the first elements emerge of an agricultural extension activity directed toward farmers. In 1915, another step was taken with the establishment of a Department of Agriculture, Commerce, and Colonization to supply French farmer/colonists with agricultural credit and technical advice. Through the primary school system, the French also tried to provide rudimentary agricultural training to the Moroccans who would be hired by these French farmers.

In 1940, the Phillipe Petain Center was created in Meknes, Morocco with the sole objective of providing agricultural training to the sons of French colonists. The Center required the highest level of secondary school diploma (i.e., the baccalauréat) for admission to its 3-year program.

Later, the Center was renamed the National School of Agriculture (ENA). The school produced 120 agricultural graduates (i.e., ingénieurs) from 1945 to 1956, but only two of these were Moroccans. It was only after independence in 1956 that significant numbers of Moroccan students were permitted to attend classes at the school.

## 2. AGRICULTURAL EDUCATION IN MOROCCO BETWEEN INDEPENDENCE IN 1956 AND 1968

Immediately after independence in 1956, there was a struggle between the Ministries of Agriculture and Education for control of Moroccan agricultural training. The Ministry of Agriculture proposed a program oriented toward practical education in agricultural skills, whereas the Ministry of Education favored a more academic, theoretical approach to the agricultural sciences. In 1958, a decision was made in favor of the Ministry of Education approach.

During this period of Ministry of Education direction of agricultural education, Morocco signed a convention with France (1962) that enabled a limited number of Moroccans to receive Ingenieur d'Etat degrees in French agricultural schools. These individuals, upon graduation, were employed by the Moroccan Government as teachers at ENA. As a result of this influx of Moroccan teachers, the school in Meknes was able to extend its curriculum from 3 to 4 years and was authorized to grant the degree of Ingénieur d'Application (i.e., the Moroccan equivalent of an American B.S. degree in agriculture.)

In the early 1960s, there was increasing discussion of Morocco's need to develop greater capacity to implement a full system of higher education in agriculture. In 1962, with the opening of the Lycée Moulay Youssef's preparatory course in agriculture for entry into French agricultural universities, Moroccan students were able to reduce their training abroad from 3 to 2 years. Then, on March 3, 1963, His Majesty Hassan II in his Throne Speech made the following declaration:

We foresee the creation ... of a National Agricultural Institute based on disciplines of particular relevance to Mediterranean agriculture; prepared to receive Moroccan, as well as foreign students; and to deliver a degree rigorously equivalent to that of the European Ingénieur Agronome degree.

The Institute thus embarked on its development process with a clear mandate issued directly by the King. It was to be a public institution under civil law with substantial administrative and financial autonomy. Control of the Institute--and the rest of the agricultural education system--was transferred from the Ministry of Education to the newly created Ministry of Agriculture and Agrarian Reform (MARA). Students were to be trained in conformance with the needs of the Moroccan agricultural sector, chiefly for public employment of agricultural agents, as articulated by MARA and the Institute's Board of Governors.

The Institute's board of governors was to be composed of the Minister of MARA (president) and the Ministers of National Education and Finance; the directors of the various services concerned with agricultural extension, research, professional training, and forestry; and the director of the national office of manpower training. Program development and content at the Institute was to be directed by an advisory committee composed of senior representatives of public and parastatal agencies, Institute faculty, and appointed members from the private sector.

The Institute director was to be named directly by the King and was to be the executor of decisions made by the board of governors. He would be legally authorized to undertake all necessary actions in his own name and to represent the Institute in relations with Government and with public and private agencies at all levels. The director was to be given authority to appoint all Institute faculty and other personnel, with the concurrence of the Minister of MARA, and to contract with outside parties within the statutory limits set by MARA and the Ministry of Finance. Financial support for the Institute was expected to come from four sources: direct Government budgetary support, payments for Institute services rendered to clients, revenues from farms and other facilities under Institute control, and project support negotiated with foreign aid donors and other external sources.

### 3. FORMAL CREATION OF THE INSTITUTE IN 1968 AND ITS FIRST 5 YEARS

The Institute was formally inaugurated by Royal Decree on April 8, 1968. This decree stated that "the Institute is to teach the scientific, economic and social disciplines which are relevant to agriculture, to conduct studies and research, and to train specialized Ingénieurs Agronomes."

The plan from the start, then, was to train students in three different stages, as follows:

1. An initial cycle of 1 year of common study in basic sciences for all students
2. A second cycle of 3 years in a specific agricultural discipline, after which a B.S.-level degree in general agriculture would be granted
3. A third cycle of 2 more years, with more specialization, leading to an M.S.-level degree

In 1966, 35 candidates took the Institute's first entrance examination; only 12 were accepted. By 1969, the number of students had grown to 119. By 1972, enrollment stood at 378 students: 194 first-cycle students, 155 second-cycle students, and 26 third-cycle students. The third-cycle students were then still obliged to attend overseas agricultural universities for the 2 years of their specialization. Thus, these students were actually enrolled at six different institutions in France, two in Belgium, and one in the United States (under the first A.I.D. project, which started in 1970).

#### 4. THE INSTITUTE FROM 1974 TO 1980

In January 1974, the Institute's curriculum was broadened to include veterinary medicine. This innovation made the renamed Hassan II Institute of Agriculture and Veterinary Medicine (IAV) the first and only Francophone African school of higher education that combined full curricula in veterinary medicine and agricultural sciences in the same program, with all students sharing a common body of scientific coursework and practical field studies in their first year of study.

Later in 1974, IAV faculty were authorized by the King to prepare for a full graduate program that would result in the granting of a Moroccan Doctorate of Science degree. Although the first of these degrees was not granted until 1984, the expectation of such a program gave additional impetus to the Institute's collaborative program with A.I.D. and the University of Minnesota. The A.I.D. project entered its second phase in 1975, with efforts to accelerate the process of training Moroccan faculty to the American Ph.D. level and to deepen the Institute's capacity to conduct quality agricultural research. As a result, many more Moroccans entered participant training programs at U.S. land grant institutions during this period.

Over the 1974-1980 period, the Institute's program gradually became more diversified, with course offerings added in such fields as food technology and biochemistry, rural engineering, surveying, agricultural machinery, and marine science. The Institute also began to supply student candidates in quantity for the Ingenieur d'Application degree to the National School of Forestry (ENFI) in Sale and the National School of Agriculture (ENA) in Meknes.

By 1975, there were 1,050 students in the system of higher agricultural education in Morocco, including 40 students from other African countries. The students were distributed among the three schools as follows.



1. The Institute had 770 students: 293 in the first-cycle core science courses, 175 students in different programs for the Ingenieur d'Application degree, 76 in the veterinary medicine specialization, and 226 in the agriculture specialization for the Ingenieur d'Etat degree.
2. ENFI had 69 students in the forestry specialization for the Ingenieur d'Application degree.
3. ENA had 167 students in programs for the Ingenieur d'Application degree.

There were also 44 third-cycle students studying at foreign institutions for their fifth and sixth years (25 in France, 10 in Belgium, and 9 in the United States).

In 1975, the Institute also began its first exercise in tying projected Government agricultural manpower needs (detailed in the Government of Morocco's 5-year development plan) to quotas for its training programs. As future trained manpower requirements were identified, a series of quotas was established for a minimum number of students to study in each training category every year. Moreover, all Moroccan students had to sign a work agreement with the Government, promising to work for a minimum number of years after graduation.

#### 5. THE INSTITUTE FROM 1980 TO THE PRESENT

With inauguration of the Plan for Economic and Social Development (1981-1985), the IAV quota system for agricultural training reached its most complex stage. The Institute and its sister institutions, ENFI and ENA, were linked in an overall training plan. The quota system was seen as the main source of the trained agricultural and livestock specialists needed to implement the planned agricultural development.

The most recent agricultural manpower development plan (completed as our impact assessment mission took place) provided for the following levels of training after completion of first-cycle basic science coursework:

	Annual Quota
1. <u>Third-Cycle IAV Students</u>	
Agriculture (20 speciality areas)	100
Veterinary medicine	50

2. Second-Cycle IAV Students

Food technology	50
Rural engineering	40
Surveying	40
Agricultural machinery	10
Horticulture	25
Landscape architecture	5
Plant protection	20
Marine sciences	10

3. Second-Cycle ENA Students

Agricultural techniques and development	60
Animal production	40

4. Second-Cycle ENFI Students

Forestry and water management	20
Total students to be trained	<u>470</u>

Given this general manpower training plan, Moroccan higher education enrollments for agriculture and veterinary medicine for 1983-1984, the last year for which we have complete information, looked like this:

1. 2,145 students at the Institutes in Rabat and at the new horticultural complex in Agadir, which opened in 1982
2. 250 students at ENA in Meknes
3. 150 students at ENFI in Sale

Of this total of 2,545 students, approximately 14 percent were non-Moroccans and 19 percent were women.

Over the last 5 years, the most important change at the Institute has been its increasing capacity to conduct all the necessary training for its students through the Ingénieur d'Etat (i.e., M.S.) degree-level. The number of students having to go abroad for M.S.-level training has been declining each year. This decline is reflected in the declining number of students in the University of Minnesota participant training program; the annual input of M.S. degree candidates has dropped from 25 students in 1982 and 26 in 1983 to only 9 in 1985.

With the greater concentration on developing a fully qualified Moroccan faculty at the Ph.D. level, the current and third successive A.I.D. project (1980-1990) has progressed rapidly.

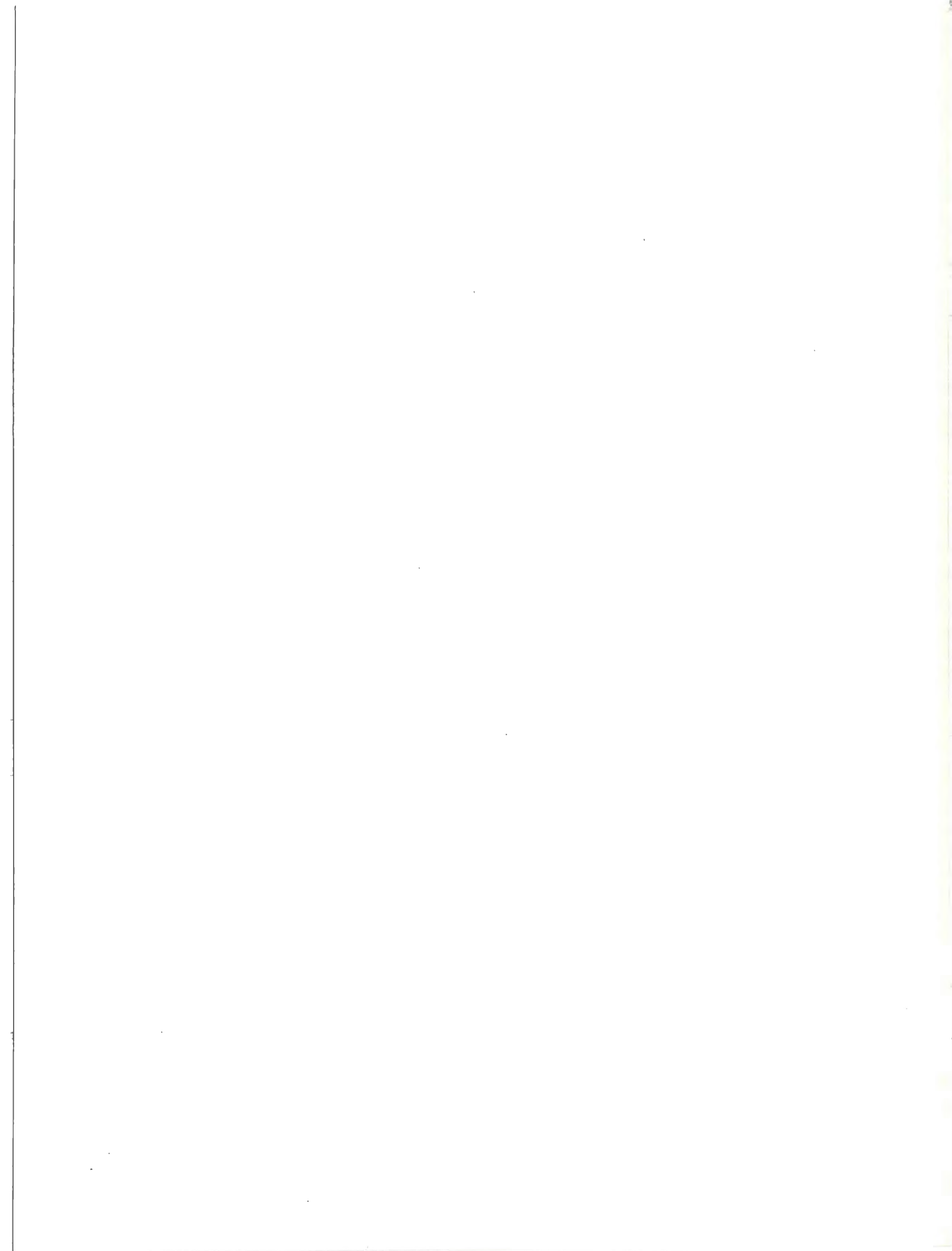
To date, 130 actual and potential faculty members from the institute, ENFI, and ENA have participated in doctoral studies in the United States. As of the end of 1985, 15 of these candidates had received their doctoral degrees (six from U.S. land grant universities, five from the Institute, and four from both U.S. and IAV doctoral programs).

In sum, then, the Institute has gone from 12 students in 1966 taking their basic science training from non-Moroccan faculty in temporary facilities at Mohammed V University to its present status of over 2,100 students and 346 faculty members (of which 85 percent are Moroccans; see Table A-1) on its own campuses in Rabat and Agadir. The Institute now offers degrees equivalent to the American B.S., M.S., and Ph.D. degrees in agriculture and a doctor of veterinary medicine. In addition, it trains over 200 non-Moroccan African students under the same conditions as its Moroccan degree candidates--and pays their scholarship costs from Government of Morocco budgetary allocations.

Table A-1. The "Moroccanization" of the IAV Faculty, 1966-1985

Year	Moroccan Faculty	Foreign Faculty	Total Faculty	Moroccans as Percentage of Total Faculty
1970/1971	6	49	55	11
1971/1972	11	36	47	23
1972/1973	15	51	66	23
1973/1974	24	77	101	24
1974/1975	36	74	110	33
1975/1976	44	117	161	27
1976/1977	62	110	172	36
1977/1978	80	111	191	42
1978/1979	104	109	213	49
1979/1980	146	101	247	59
1980/1981	194	103	297	65
1981/1982	225	81	306	74
1982/1983	257	70	327	79
1983/1984	279	60	339	82
1984/1985	291	53	344	85

Source: IAV Records, 1986.



## APPENDIX B

### THE FUTURE OF THE INSTITUTE: THE PROBLEM OF INSTITUTIONAL FRAGILITY

by Dr. James B. Lowenthal

Although not strictly part of an impact assessment, the evaluation team believes that the following discussion is appropriate for inclusion in this report. Although the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) has had a very successful evolution over the last 15 years, it is still a young and fragile institution. Given this situation, the team believes that the Government of Morocco and participating aid donors should remain aware that the Institute will continue to require assistance in the medium term as administrators and faculty strive to consolidate past gains and chart a future in the uncertain economic climate of the late 1980s. The team has, therefore, identified what it perceives to be the major potential problems for the Institute in the period through 1990.

#### 1. SUSTAINED LEADERSHIP, FLEXIBILITY, AND CONSOLIDATION OF PAST GAINS

The Institute in 1986 is clearly an institution in transition, passing from a period of rapid initial growth and development under charismatic leadership to a period of maturity as a large and complex agricultural university. The generation of leaders who brought the Institute to this point in its history is rapidly passing from active participation in IAV affairs. The new administrators and faculty, under the leadership of Dr. Sedrati, face the challenges of creating administrative systems to run the larger and much more complex institution, while preserving the measure of flexibility in daily operations necessary to inspire full participation by faculty and students in IAV affairs. Given the uncertain economic conditions in Morocco at present, a successful transition is not guaranteed, and the evaluation team believes there will be ample scope for creative donor assistance in university planning and administrative systems.

#### 2. EFFECTIVE CONTROL OVER RESEARCH ACTIVITIES

A large percentage of the funds available for IAV research is effectively tied to donor projects and other externally financed programs. To date, IAV researchers have used these

funds creatively in research activities. However, the fact remains that the Institute itself neither generates nor controls any substantial quantity of research monies, and the Government of Morocco is unlikely in the medium term to be able to supply such funds, given its debt repayment and other macroeconomic problems.

As the Institute continues to evolve, the evaluation team foresees potential problems in this situation. First, promising and highly motivated faculty members will be increasingly unable to secure sufficient funding to carry on their individual research programs and therefore will become increasingly disillusioned with the prospects of academic life. Second, the Institute will be unable to control the directions of its overall research programs because of declines in the total availability of donor funding for Morocco. It is likely that aid donors will not be sufficiently comprehensive in their awareness of agricultural problems in the country to fund certain areas of needed research. One possible solution to this problem is the creation of a donor-supported fund that would constitute an effective endowment for future IAV research programs.

### 3. MOROCCAN BUDGET PROBLEMS AND MEETING THE INSTITUTE'S RECURRENT COSTS

For over 5 years, former IAV director Bekkali was unable to negotiate with the Ministry of Finance an operating and equipment budget adequate to keep pace with the needs of the Institute (i.e., the budget was static or declining in real terms from 1979 to 1984). However, Dr. Sedrati, the present director, has been able to negotiate major increases in the Institute's budget. He has also streamlined the operations of the Institute's three farms, which were millions of dirhams in debt, and they will turn a small profit this year. Finally, he is endeavoring to unify the Institute's accounting systems and improve financial management as an essential step to future planning.

Even with these constructive steps, however, the fact remains that Government of Morocco contributions to the Institute's total annual budget are limited. Excluding Government contributions to the investment budget and donor assistance, the total budget comprises four parts: the operating budget--87 percent of which is personnel salaries--receipts from sales and services, external grants, and supplementary appropriations in 1984/1985. The supplementary appropriations are always decided on late in the year, making it impossible to forecast for purposes of planning and guaranteed expenditures. The 1985 budget contributed from all Moroccan sources (i.e., exclusive of exter-

nal support) is only 50 million dirhams, a sum estimated by IAV administrators to be at least 10 million dirhams short of what is necessary to adequately fund IAV operations.

What is most disconcerting, however, is that the Institute would essentially be unable to function as a training and research institution in 1986 if external assistance grants--in cash and kind--were withdrawn or reallocated to other activities in Morocco. IAV administrators, moreover, are the first to admit that given the uncertain economic conditions in the country, there is virtually no hope that the Government of Morocco could sustain the full recurrent costs of IAV operations at any time in the foreseeable future.

Although it was not the evaluation team's purpose to fully analyze all these budgetary issues, this problem was mentioned over and over again in our interviews. Given the enormous success of the Institute to date, the team believes that it will continue to be an extremely valuable asset for the country in the future. However, that future can only be assured when the Institute is put on a sound financial basis.

#### 4. INCENTIVES AND THE RETENTION OF QUALIFIED FACULTY

Related to the overall financial crisis is the problem of providing adequate incentives to retain the Institute's highly trained and motivated faculty members. All of these professionals have high opportunity costs for their services, both in Morocco and in the international community. One of the incentives for these faculty members in the past was a salary scale up to 30 percent higher than that of their colleagues with comparable credentials and seniority in other Government positions. As of this year, these differentials have been eliminated through Government salary reforms. Moreover, IAV personnel have not had a general salary increase in 5 years and, consequently, there has been a considerable decline in the living standards of IAV faculty and staff in absolute terms and relative to colleagues. Finally, IAV faculty currently work on 11-month appointments and cannot receive direct payments for outside consulting assignments. By contrast, other university faculty of equal status now receive equal salaries for 9-month appointments and can do consulting during the other 3 months of the year.

5. THE POTENTIAL FOR FACULTY INBREEDING AND  
LACK OF CROSS-FERTILIZATION

After carefully questioning respondents at the Institute and elsewhere, the team was concerned about the potential for faculty inbreeding if the Institute requires an IAV Doctorate in Science for faculty appointees in the future. Just as the A.I.D. projects have been criticized in the past for the very high percentage of participant trainees who received their academic coursework at the University of Minnesota--to the virtual exclusion of other land grant universities--the evaluation team believes the Institute must take steps to ensure that academic diversity at the doctorate level is maintained and that faculty are not selected exclusively from the pool of IAV graduates. This problem has the potential to loom ever larger as the Institute increasingly takes over both the coursework and research components of the local doctoral programs.

6. THE POTENTIAL FOR ADAPTATION TO THE NEEDS OF  
THE MOROCCAN PRIVATE SECTOR

Until very recently, IAV students were deliberately programmed into and obligated to an overall Government of Morocco manpower development plan and were guaranteed employment on successful completion of their degree programs. The Government of Morocco is no longer able to offer these employment guarantees, and the expectations now are that an ever-increasing portion of each year's graduating class will have to be employed in the Moroccan private sector.

Although the evaluation team believes that any national agricultural institute should be capable of training students for both government and private sector employment, this rather sudden transition in the manpower situation has generated adjustment problems for the Institute. The team's interviews revealed that many potential private sector employers of IAV graduates have some misgivings about the IAV program:

- Current graduates have insufficient immediately applicable practical skills in agriculture to justify the higher salaries they demand.
- The Institute is not sufficiently emphasizing development of decision-making skills among its students that will prepare them to assume roles as middle-level managers at all levels of the economy.



- Most graduates have little or no appreciation of economic factors in agriculture and therefore are poorly prepared to function in private sector situations where losses cannot be transferred to the national treasury or otherwise conveniently written off the company books.

Although none of these problems is inherently insurmountable in the Moroccan situation, more consideration must be given to them in the near future if the Institute's training programs are to be truly relevant to the changing employment patterns in the country. In this situation, there may be a useful donor role in supporting a survey of present and potential private sector employers of IAV graduates to determine the qualitative factors they value in their potential employees, the salary levels that could be expected for different types of agricultural skills, and some indication of the likely dimensions of the total private market for IAV degree holders at all four levels.

7. PROGRAM BALANCE: WEAKNESSES IN RESPONDING TO  
MOROCCAN DEVELOPMENT PROBLEMS IN AGRICULTURAL EXTENSION,  
NATURAL RESOURCE CONSERVATION AND UTILIZATION,  
AND ECONOMIC ANALYSIS

A review of the composition and quality of IAV training programs indicates considerable imbalances in outputs compared with the range of Moroccan development problems. The three areas of weakness generally recognized in interviews were in agricultural extension, natural resource conservation and utilization, and economic analysis of agricultural conditions at all levels.

In all areas, the weaknesses in training and research are generally reflective of deficiencies in the agriculture sector itself. The shortcomings of the existing agricultural extension system are the subject of intense discussion within the Government, and many modifications have been proposed. In the field of natural resource conservation and utilization, the existing manpower pool is poorly deployed and employed. Prior legislative decisions that gave authority for resource utilization to local groups have not been effective in promoting concomitant responsibility from these groups in preserving the national resource heritage. Much of the subject matter and techniques taught in economics courses appear to be irrelevant to the analytical needs of the economy--at both the Government and private sector levels.

In all areas, IAV administrators and faculty demonstrated serious concern about the weaknesses in training and research, a willingness to modify IAV programs, and a desire to participate actively in wider reform efforts in the Government and with the assistance of the private sector.

## APPENDIX C

### THE INSTITUTIONAL PROGRAM: CURRICULUM AND PRACTICAL FIELDWORK

by Dr. Lawrence Busch

As is common in the education systems of many countries, entry to the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) requires passing a special examination that is open to all secondary school math and science graduates. Competition is quite intense for the limited places at the Institute. Since 1971, the first year of the program has consisted of a "preparatory year of higher education in agriculture" (see Table C-1). The purposes of this year are as follows:

1. To ensure a smooth transition between secondary and higher education
2. To provide an education in the basic sciences and the rural social sciences
3. To help students decide on their choice of specialization

At the end of the first year, students take final examinations and select, by order of preference, their academic specializations. Those with high grades, especially in the selected subject matter, are generally assigned their first choice. The students with lower grades tend to receive their second or third choices until all the available places are filled, according to the manpower need estimates set in conjunction with the Ministry of Planning and the Ministry of Agriculture and Agrarian Reform. A computer program is now used to aid in the selection process. Approximately 80 percent of students are assigned places in this manner. The rest are dropped from the program.

A central part of the IAV program is its field training (stage) program. The purpose of this program is to give students direct experience with agricultural practices and rural life and to familiarize them with experimental methods and scientific reasoning.

The first-year field experience ("discovery of nature") is designed to familiarize students with teamwork under difficult field conditions. Teams of 10 students are given maps to direct them over an 80-kilometer walk, during which they are expected to take detailed notes on Moroccan flora, fauna, geology, topography, and human settlements. Over this 8-day field-study

period, students are checked on by their teachers at fixed points each day. The various roles in the group are rotated so that each student gets to try each role over the 8 days.

Table C-1. Typical Coursework for the Preparatory Year at The Hassan II Institute of Agriculture and Veterinary Medicine

Subject	Course Hours	Hours of Directed Coursework	Hours of Practical Work
Mathematics			
Algebra	45	45	
Analytical Work	45	45	
Physics			
Mechanics	50	50	
Electricity	30		30
Chemistry			
General	40	20	
Organic	40	20	16
Cell Biology	40		
Crop Biology	30		
Animal Biology	40		
Geology	25		30
Geography	20		
Design	20		

Source: Hassan II Institute of Agriculture and Veterinary Medicine, Rapport d'Activités--Pedagogie (1984).

In second-year field experience ("initiation to rural life"), groups of three students are sent to a rural village chosen by the faculty. The three students have to get admitted to the village and pay a small sum to a village family for room and board. Then they must make detailed observations on weather, technology, nutrition, social and economic relations, and the history of the village. Observations are formally recorded on special forms and in a group notebook. These documents are later graded by the faculty, and the students receive a group grade for the exercise.

The third-year field experience is designed to provide students with a farmer's perspective on operating a farm. Groups of two students spend 2 weeks each in autumn, spring, and

summer in the countryside. They are expected to produce a lengthy report on the agronomy, livestock, ecology, socioeconomic conditions, nutrition, and technology of the farm. In addition, the participating farmers are invited to the Institute--with transport and room and board provided--to spend 3 or 4 days with the students, discussing the fine points of the group's report and being introduced to IAV operations.

In the fourth year, students are introduced to the development problems of the region in which they examined a farm during the previous year. Through field-study questionnaires and interviews, the students attempt to determine the principal problems of the region. A faculty member accompanies each team to the field, and local technical service agents are invited to contribute to the study.

Thus, over the course of their first 4 years, students are exposed to a wide variety of problems in several different regions of the country. In addition, the field training serves as a kind of "rite of passage," developing a strong feeling of group cohesiveness among the participating students.

The field training program constitutes the backbone of the pedagogical program of the Institute by demanding that students integrate materials from diverse disciplines. It also provides students with direct experience that enables them to ask faculty members challenging questions in class.

From the second year onward students are organized into groups based on their field of specialization. Within each field, students take a specific group of courses, in a manner more reminiscent of American medical or law schools than colleges of agriculture. For example, the agronomy specialization begins with the basic sciences, followed by courses in ecology, irrigation, engineering, crop production, animal production, social sciences, and field training (see Table C-2). All students must take all courses within a given program. This reduces the students' flexibility in selecting coursework (there are no elective courses) but makes possible a much more integrated and broad-based program than exists in the United States. This breadth is reflected in the wide range of expertise present in the faculty (see Table C-3).

Table C-2. Agronomy Curriculum at the  
Hassan II Institute of Agriculture and Veterinary Medicine

Second Year

Subject	Course Hours	Hours of Directed Coursework	Hours of Practical Work
Mathematics	35	20	
Statistics	35	20	
Physics	60	30	
Inorganic Chemistry	25	15	32
Physical Chemistry	15		
Biochemistry	80		40
Crop Physiology	20		10
Animal Biology	40		40
Animal Physiology	40	15	32
Geology	20		40
Geomorphology	25		
Economics	40		
Regional Geography	34		
Fieldwork			

Third Year

Subject	Course Hours	Laboratory and Fieldwork
Crop Physiology	20	10
Soil Microbiology	20	
Genetics	25	10
Applied Statistics	14	16
Introduction to Soil Science	22	2
Soil Chemistry	20	10
Crop Ecology	20	
Crop Systematics	16	28
Zoology	20	12
Agronomy	30	24
Plant Pathology	25	42
Virology	15	
Entomology	12	18
Animal Hygiene	10	
Animal Anatomy	12	4
Animal Physiology	18	
Reproductive Physiology	18	
Animal Nutrition	26	20

Table C-2. Agronomy Curriculum at the  
Hassan II Institute of Agriculture and Veterinary Medicine

Third Year (cont.)

Subject	Course Hours	Laboratory and Fieldwork
Agricultural Machinery	26	4
Materials Sciences	26	20
Fluid Mechanics	30	10
Farm Management	24	16
Sociology	16	
Rural Institutions	28	
Economics	14	6
English	30	
Field Training		300
Sports		80

Fourth Year

Subject	Course Hours	Laboratory and Fieldwork
Computer Use	12	22
Biometrics	14	16
Nutrition	30	
Applied Pedology	16	17
Soil Conservation	15	
Marine Fisheries	10	4
Biological Control	20	
Pasture Management	30	
Weed Science	6	4
Animal Production	38	10
Animal Genetics	20	8
Animal Products	14	2
Cultural Practices	30	
Plant Improvement	25	6
Plant Pathology	14	
Major Crops of Morocco	14	18
Arboriculture	16	6
Agricultural Machinery	30	
Hydraulics	35	20
Intro. to Food Technology	38	
Theories of Social Development	30	
Sociology of Development	15	

Table C-2. Agronomy Curriculum at the  
Hassan II Institute of Agriculture and Veterinary Medicine

Fourth Year (cont.)

Subject	Course Hours	Laboratory and Fieldwork
Food Planning	28	
Production Economics	15	
English	30	
Field Training		300
Sports		80

Source: The Hassan Institute of Agriculture and Veterinary Medicines, Rapport d'Activités--Pedagogie (1984).

Each trimester of each academic year is organized according to the following schedule:

- 40 days of coursework
- 15 days of field training
- 15 days of reflection on the field training and additional coursework
- 10 days of examinations

In addition to regular coursework, students must complete a personal thesis during their terminal year (e.g., either their fourth or sixth year, depending on their academic degree program).

Table C-3. Sections and Departments of  
the Hassan II Institute of Agriculture and Veterinary Medicine  
as of December 31, 1984

Academic Field	Number of Faculty
Basic Sciences	
Biochemistry and Chemistry	10
Animal Biology	11
Crop and Cellular Biology	16
Geology	5



Table C-3. Sections and Departments of  
the Hassan II Institute of Agriculture and Veterinary Medicine  
as of December 31, 1984 (cont.)

Academic Field	Number of Faculty
Mathematics	7
Applied Mathematics	5
Physics	9
Social Sciences	11
Field Training	5
Agronomy	
Crop Ecology and Pasture Management	10
Water and Forests	3
Soil Sciences	9
Zoology Laboratory	8
Plant Pathology and Entomology	7
Crop Production	
Plant Improvement	3
Agronomy	10
Animal Science	8
Veterinary Medicine	
Microbiology and Contagious Diseases	4
Pharmacology and Toxicology	4
Anatomy	4
Physical Therapy	4
Medical and Surgical Pathology	11
Reproduction	7
Parasitology	4
Hygiene	4
Histology	3
Food Technology and Human Nutrition	34
Marine Fisheries	7
Horticulture	4
Irrigation and Rural Works	15
Agricultural Machinery	14
Topography and Geodesy	13
Horticultural Complex at Agadir	30
English	6
Electron Microscopy Laboratory	1
Experimental Farms at Gharb and Tadla	2
Sports	1

Source: The Hassan II Institute of Agriculture and Veterinary Medicine, Rapport d'Activités--Pedagogie, 1984.

The choice of subjects for this thesis--or memoire--is proposed by the teachers and is often linked to ongoing research projects or specific needs of Government agencies. Laboratories, experimental fields, means of communication, and calculators/computers are made available to students as necessary to complete their thesis work. Students defend their thesis before a jury of four to five persons, including their adviser, another member of the faculty from the same department, and two or three experts from outside the Institute (researchers or professionals with an interest in the subject).

A novel feature of the IAV program is that students who have completed the 4-year B.S.-level program may, after 3 years in professional service, pass an examination and be readmitted to the Institute to complete the 6-year M.S.-level program. Thus, many of the 6-year program students bring significant field experience to their studies.

Recently, the Institute began offering the Doctorate of Science degree. For this program, most coursework--usually 2 years beyond the M.S. degree--is taken abroad and a dissertation is prepared and defended in Morocco. For this degree, a jury composed of both Moroccan and international specialists in the specific disciplines is formed, and it is their sole responsibility to recommend award of the doctorate. IAV expects eventually to eliminate much of the overseas coursework but to retain the jury mechanism for the doctorate.

## APPENDIX D

### USE OF THE DOCUMENTATION CENTER AND LIBRARY RESOURCES

by Dr. Lawrence Busch

The library and documentation center of the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) has about 30,000 volumes--not counting the small departmental libraries whose collections are not catalogued. The Institute plans to have 70,000 volumes within 5 years. The Institute also has subscriptions to 300 serials and plans to increase them to 600, with help from A.I.D. and the Moroccan Government. Rising costs, however, may make it difficult to reach both of these projections.

A central feature of the documentation center is its HP3000 computer system. The computer was furnished by A.I.D. with software provided by Canada. The software is compatible with that used in many other agricultural libraries and by the Food and Agriculture Organization (FAO) and A.I.D. for cataloguing and accessing agricultural documents.

As the national agricultural library for Morocco, the documentation center uses AGRIS worksheets to catalogue documents and forwards copies to FAO for entry into its data base. The center also provides AGRIS bibliographic searches for faculty and other requestors. Finally, the computer provides an on-line listing of all current agricultural research in Morocco. It functions in a manner similar to the Current Research Information System at the U.S. Department of Agriculture.

The documentation center appears to have a truly national role. During 1985, the center filled 86 walk-in requests by persons or agencies outside the Institute. This count does not include unfilled requests or requests by departmental libraries. It also does not include unrecorded walk-in requests for journals. Table D-1 lists the users of the Documentation Center in 1985.

Table D-1. The Hassan II Institute of Agriculture and  
 Veterinary Medicine Documentation Center Users,  
 by Number of Requests, 1985

Documentation Center User	Number of Requests
Ministry of Agriculture and Agrarian Reform	4
Ministry of Energy	2
National School of Agriculture at Meknes	4
National School of Forestry at Sale	3
Horticultural Complex at Agadir	1
National Agricultural Credit Bank	2
Department of Water and Forests in Rabat	1
National Seed Company	2
National Institute for Agronomic Research	7
National Company for Irrigation Engineering	1
University of Rabat	13
University of Casablanca	6
University of Mohammedia	6
University of Information Sciences of Marrakech	6
National Institute of Architecture and Urbanism	5
National Institute of Statistics and Applied Economics	1
National School of Administration	2
In-Service Training Institute at Kenitra	3
Institute of Journalism	1
Other Miscellaneous	16

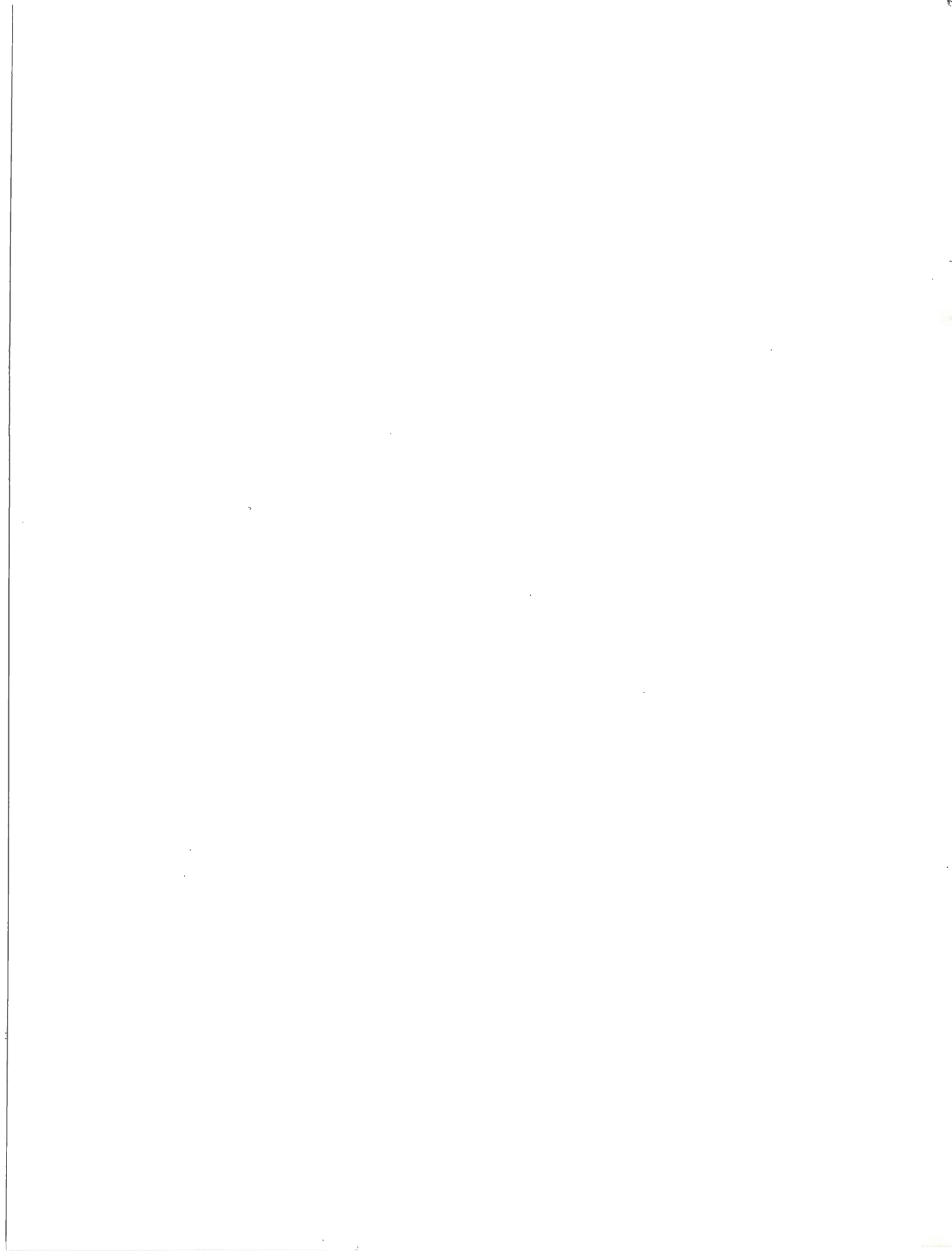
APPENDIX E

A PROFILE OF INSTITUTE GRADUATES AND THEIR  
POST-TRAINING ACTIVITIES

Table E-1. Employers of 1,572 Graduates of the Hassan II Institute of Agriculture and Veterinary Medicine, From 1972 to 1982

Employer	As Percentage of All Graduates
Ministry of Agriculture and Agrarian Reform	14.0
Provincial Departments of Agriculture	28.0
Regional Irrigation Authority Offices	18.0
State and Parastatal Enterprises	2.0
Other Ministries	4.0
Other Government Offices	3.5
National Institute for Agricultural Research	6.0
Agricultural or Other Training Institutions	13.0
Private Laboratories	2.0
Private Sector Companies	8.0
Other Private Sector	1.5

Source: Firdawcy (1985).



## APPENDIX F

### AN ANALYSIS OF CHANGES IN THE CROP SECTOR RELATED TO INSTITUTE ACTIVITIES

by Dr. Jack W. King, Jr.

Three facts should be considered when examining the influence of the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) on the crops/soils sector in Morocco:

1. The role of the Institute has been primarily teaching, with the goal of supplying personnel for Government programs.
2. The duration of IAV activity has been short in terms of the time required to see results in this sector.
3. Personnel developed at the Institute are working at a wide variety of jobs and in many instances have joined ongoing programs or have worked with personnel who were not trained at the Institute. In such circumstances, it is difficult to identify and gauge the contribution of Institute-trained personnel.

Developments that show promise as potential impacts of IAV activities would include the following:

- An improved barley variety, soon to be released
- Work on Hessian fly resistant wheat for Morocco
- Use of tissue culture techniques for screening and propagation
- Introduction of Medicago forages for fallow land and grazing areas
- Use of soil and land classification to help predict the transferability of field research
- Work on "Bayoud" disease (*Fusarium oxysporum* f. sp. *albedinia*) of date palm

The majority of IAV graduates are working in the public sector and are generally more appreciated there than in the private sector. However, the Institute has competed successfully with private firms to participate in development projects. IAV departments related to crops and soils seem to have made the most progress in working with the private sector through companies dealing with engineering and soils.

The single most impressive fact about the Institute's program is the quality of people that it is supplying to the crops/soils sector. With few exceptions, those interviewed by the evaluation team were enthusiastic about their work and able to explain exactly what they were doing and why. Most laboratories showed a high ratio of available equipment in use. Offices showed evidence of writing in progress. Although incidental and informal, these are convincing indicators of well-directed professional activity.



## APPENDIX G

### AN ANALYSIS OF CHANGES IN THE LIVESTOCK SECTOR RELATED TO INSTITUTE ACTIVITIES

by Dr. Rolland P. Poirier

As noted in Appendix A, the Hassan Institute of Agriculture and Veterinary Medicine (IAV), with its sister institutions, has already graduated approximately 1,000 Ingenieurs d'Etat, 300 veterinarians, and 2,300 Ingenieurs d'Application since 1970. Of these trained personnel, the veterinarians and approximately 150 livestock specialists have been trained specifically in aspects of animal production. Many of the others have received some training in animal husbandry and, along with their more general duties, have a role in improving the livestock sector in Morocco.

In Morocco, livestock is an important part of the agriculture sector. It now employs 21 percent of the agricultural work force--versus only 10 percent in 1960. The sector uses approximately 35 percent of the total nondesert land in the country. Demand for livestock products is increasing and is projected to grow rapidly for the next 20 years (3.5 percent per year for red meat, 2.4 percent for dairy products, and as high as 5.1 percent for eggs). This is largely due to the continuing increase in urbanization, which tends to increase demand for higher protein and more convenient foods.

This appendix presents some of the changes that have occurred in the livestock sector and relates them to IAV activities.

#### 1. CHANGES AND IMPROVEMENTS IN THE SECTOR THAT CAN BE LINKED DIRECTLY TO IAV ACTIONS

The most important change that the Institute has created in the livestock sector is its development of a cadre of trained specialists who can address the problems and challenges of livestock production in Morocco. Their expertise can now cover the gamut of production, from the very small peasant farm of 5 hectares and a few animals, to extensive pastoral systems, to intensive livestock production under irrigated and industrial conditions.

A series of timely IAV actions have improved Moroccan livestock production and allowed it to progress from a system based on traditional practices in the 1960s to the point where

many new technologies are available to a large proportion of livestock raisers. Examples of such actions are detailed in the following subsections.

1.1 Unification of Professional Training in Animal Sciences and Veterinary Medicine

The Institute is one of the few institutions of higher education in the world where animal sciences and veterinary medicine are not only taught on the same campus but have an integrated curriculum that includes many of the disciplines useful to both types of specialists. Moreover, the faculty members from both disciplines often work together on common problems and conduct joint research projects. This approach has produced graduates for the livestock sector who have a better understanding of the complementarities of their professional training experiences.

1.2 Influence of the Livestock Association Located at the Institute

The National Association for Animal Production, headquartered at the Institute, is a professional association that has affected the formulation and implementation of public sector policies and the dissemination and discussion of technical and scientific information. A faculty member is its secretary-general. Frequent meetings and seminars take place on the IAV campus, benefiting the teaching staff and the student body. Recent seminars have addressed genetic improvement in local livestock, improved feeding techniques for ruminants, better use of available agricultural and industrial by-products, mineral supplementation, animal health, and control of eco- and endoparasites.

1.3 Convention Between the Institute and the Government Livestock Service

In 1984, the Institute signed a convention with the Livestock Service of the Ministry of Agriculture and Agrarian Reform that allows the parties to collaborate in solving the numerous problems related to the extension of research results and other technical information to all levels of Moroccan livestock producers. This work is just beginning, but the objective of closing the gap at the end of the information chain through more effective extension work is very important to the future of the livestock sector.

#### 1.4 Outreach Contracts Undertaken by the Veterinary Group

The faculty veterinary group at the Institute is presently implementing four contracts with livestock producer groups, and more are expected in the near future. These contracts enable the group to follow on a daily basis the production cycles and production problems of approximately 1,500 dairy cows and to collaborate with a large pastoral association in bringing modern technologies to very traditional livestock producers. Participation in such contracts allows the veterinary group to gather valuable field data for teaching and research purposes and to participate at the practical level in development of useful innovations for producers.

#### 1.5 Research Projects

The entire livestock group at the Institute, including veterinarians and animal scientists, is active in many research activities directed at finding solutions to basic constraints in the livestock sector. In the field of genetic improvement, the group is involved in upgrading the local dairy breeds through crossbreeding with French Pie-Noire and Dutch Friesian cattle. It is also analyzing, in close collaboration with the A.I.D.-supported Small Ruminants Collaborative Research Support Program, the main characteristics of the more important breeds of Moroccan sheep. One prolific sheep breed has already had two known pregnancies per year, which, in many cases, have resulted in twins, triplets, and even quadruplets. The ultimate goal of this research is to produce by crossbreeding a composite sheep breed that can be distributed to Moroccan small ruminant producers to greatly improve their productivity.

The livestock group has also contributed to the improved efficiency of systems for delivering livestock health services, including parasite control, mineral supplementation, and methods of improving reproductive performance. At the IAV Gharb farm, the group has developed and promoted a practical system to supply a well-balanced, continuous livestock ration of hay, green-cropped forages, and silage production under a zero-grazing scheme.

## 2. CHANGES AND IMPROVEMENTS IN THE SECTOR THAT CAN BE INDIRECTLY LINKED TO THE INSTITUTE THROUGH ITS GRADUATES

### 2.1 The Dairy Plan

Fifteen years ago, Morocco had to import approximately 80 percent of the dairy products consumed domestically. The annual per capita consumption of these products was 33 kilograms in the rural areas and only 25 kilograms in the cities and towns. In response to this situation, the Government formulated a dairy plan aimed at simultaneously raising per capita consumption of dairy products and the percentage of dairy products produced domestically.

Today, the annual per capita consumption of dairy products is estimated to have increased to 46 kilograms in the cities and towns while remaining constant in the rural areas. Moreover, more than 50 percent of all dairy products are now produced domestically, and Morocco has developed a system of milk collection points and processing plants. Most of the milk is still consumed in pasteurized fluid form, but some of the processing plants have started to manufacture butter, cheese, and milk powder.

The most important challenge to dairy expansion remains the need to develop a more even seasonal distribution of milk production. Milk production during the rainy season is now sometimes double that of the dry season. Better management of the reproductive cycles of dairy cows, together with more efficient methods of feed conservation for the dry season, are now being promoted to farmers, and some of the better farmers have already established more uniform milk flow patterns in their operations.

Much of the successful work in this area can be attributed to IAV graduates working in the irrigated perimeters throughout the country and managing dairy production units in both the public and private sectors.

### 2.2 Animal Health

The recent influx of large numbers of well-trained Moroccan veterinarians from the Institute has enabled Moroccan agriculture to improve the health of its livestock population. There are now several regional service laboratories staffed wholly by IAV graduates, and necessary vaccines are now being produced by local technicians in Rabat. Moreover, although much of the animal health care delivery system is still controlled by

Government or parastatal organizations, Moroccan veterinarians have recently convinced the Government to allow them to set up private practices. This would eventually mean that all animal health care in the country would be handled by private veterinarians working directly with their own clients or on contracts with the Government for specific tasks.

Finally, the large core group of professionals trained at the Institute has not only kept the livestock of Morocco free of serious epidemic diseases, but it also has ensured that local animal products reach consumers in a hygienic form through a strict product inspection service.

### 2.3 Artificial Insemination

Artificial insemination, which has proven so useful for genetic improvement and better reproductive management of cattle under intensive production systems, is now available to some Moroccan dairy and beef cattle producers. The artificial insemination program is run largely by IAV graduates. Trained manpower also exists to go one step further and introduce ova transplants in cattle, should this method prove to be economically viable.

### 2.4 Genetic Improvement of Livestock

IAV graduates are involved in many activities dealing with genetic improvements in local livestock. There is a program to upgrade the local breeds of dairy cattle by crossbreeding with French Pie-Noire and Dutch Friesian sires. In addition, breeding programs are using imported Holstein sires and frozen semen from the United States and Canada to upgrade dairy cattle on the irrigated perimeters.

This program has resulted in substantial increases in the milk production capacities of many local dairy cows. For example, on the COMAGRI dairy complex in the Gharb area, improved genetic potential and better dairy cow management have resulted in an increase in annual mean milk production from 3,350 liters per cow in 1981 to 5,250 liters in 1984. Furthermore, this complex has become recognized as an excellent source of dairy heifers for local dairy producers and has bred and sold over 8,000 improved dairy cows in the area. The manager and his staff are almost all IAV graduates.

Breeding work is also proceeding with the progressive introduction of Santa Gertrudis beef cattle into Morocco. These animals, originally bred at the King Ranch in Texas, thrive

under Moroccan conditions and to date have proven to be quite resistant to the prevalent local diseases. So far, the total Santa Gertrudis herd numbers about 20,000 head, and further improvements are being achieved by importing semen from a supplier in California. This program has contributed to the increase in the supply of high-quality beef for the local market.

## 2.5 Poultry Production

From 1970 to 1985, annual poultry production in Morocco increased from 30,000 tons to 120,000 tons and egg production from 300 million to 800 million units. This rapid expansion was made possible by the creation of a modern poultry industry based on imported basic genetic lines, but with all hatching and multiplication being done in-country. The main poultry complexes are now large, vertically integrated operations with internal capacities for reproduction, rearing, and processing of both layers and broilers.

A major reason for this rapid increase in local poultry capacity was the technical competence of those Moroccans trained at the Institute and the National School of Agriculture. Although these graduates are now working with expatriate specialists from international poultry companies, there is every expectation that, with additional experience, local poultry operations will become entirely "Moroccanized."

## 2.6 Pastoral Production

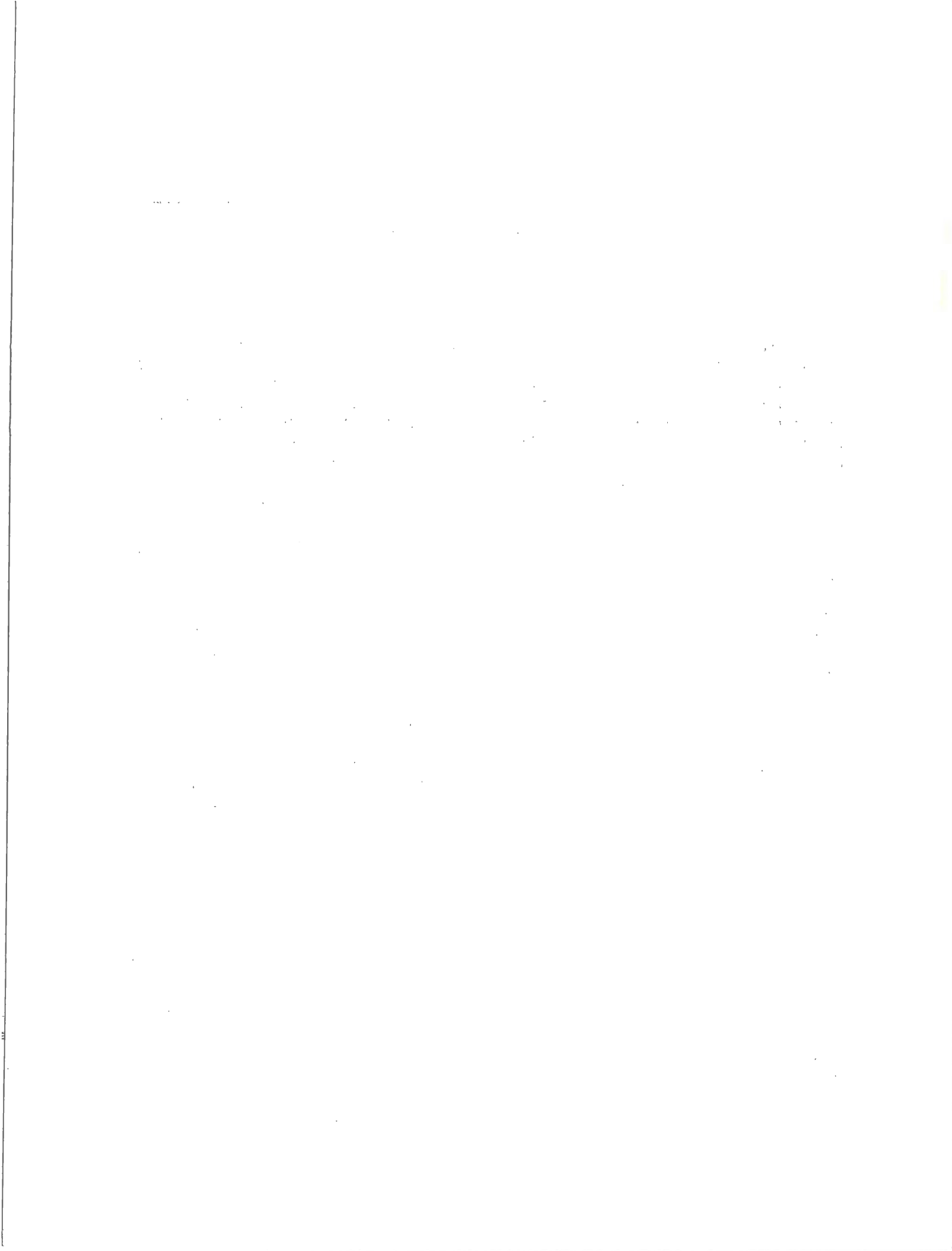
A significant portion of the meat and milk produced in Morocco is still produced under extensive grazing schemes, in which herds are moved around to take advantage of short-lived vegetation covers. Although exact methods vary by sites and systems, the only practical ways of improving such production is by supplying animal health services and improving pastures and their utilization.

In Morocco, pasture improvement has often been an integral part of development projects, but the task has been very difficult and results have often been disappointing. Results will improve only when pastoralists realize that they must impose a degree of discipline on their members in order to improve their common production systems and range conditions and raise their standards of living. In this respect, the problem may initially require more sociological than technical inputs.

The Institute, in collaboration with the A.I.D./University of Minnesota project, has provided excellent training for the cadre of range scientists now working in Morocco. Without these people, the pastoral situation would probably be worse than it now is; however, much remains to be done before the problem of deteriorating range conditions is reversed.

### 3. CONCLUSION

The livestock sector in Morocco has very recently begun to move away from traditional, extensive production methods toward more modern and intensive systems. The transition has been led by the poultry and dairy industries, followed by beef and sheep producers. The transition is far from complete, and improvements are still needed everywhere. What is different in Morocco, however, is that the usual shortage of trained scientific personnel for various aspects of livestock production is not a constraint on further progress, due largely to the excellent training opportunities afforded Moroccans through IAV programs.





## APPENDIX H

### THE INSTITUTE'S FINANCIAL SITUATION AND SOURCES OF INCOME

by Dr. James B. Lowenthal

#### 1. INTRODUCTION

Increasingly, the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) is facing a crisis of recurrent costs. The regular allocations from the Government of Morocco's budget to support the ongoing operating costs of the Institute are inadequate to maintain the quality of the teaching and research program and may even jeopardize the sustained commitment of faculty to produce at consistently high levels. Contributions to the investment budget have also lagged, resulting in a deterioration in the Institute's plant and equipment.

The Institute has been able to avoid "bankruptcy" by mobilizing funding from external sources. The principal resource has been the support of foreign donors with whom the IAV leadership has negotiated effectively for prolonged and generous commitments. A.I.D.'s projected 20-year involvement is a striking example of this commitment. At the same time, the Institute's Rural Development Division has established relationships with an increasing number of Moroccan and foreign entities to carry out specific contractual research and consulting assignments. The income from these two sources has served to offset the deficits in national budgetary support for ongoing operations.

The material presented below provides a glimpse at the structure of financial obligations incurred by the Institute and the sources of income that are mobilized to meet these obligations. Where available, historical data are presented to demonstrate the deteriorating financial position of the Institute.

#### 2. ANNUAL ALLOCATIONS

Each year, the national budget--under the direction of the Ministry of Finance--allocates a portion of the Ministry of Agriculture and Agrarian Reform's (MARA) resources to operate the Institute. As indicated in the text of this report, these allocations are determined through a process of negotiation between the Institute, MARA, and the Ministry of Finance. Regardless of the outcome of these negotiations, the actual spending authorization for the Institute occurs late in the

fiscal year for which the budgetary resources are intended. In recent budgets, the Ministry of Finance has frequently renewed the previous year's amount despite the increases requested by IAV leadership. For example, the library and teaching supply line items have remained unchanged for the past 10 years (i.e., at 325,000 and 620,000 dirhams, respectively), although the number of students has increased almost tenfold.

The following analysis of a typical annual operating budget indicates the difficulties faced by the IAV administration. The major elements of the 1982 Operating Budget are displayed in Table H-1.

Table H-1. 1982 Operating Budget for the Hassan II Institute for Agriculture and Veterinary Medicine

Line Item	1982 Authorization (000 dirhams)	Percentage
Equipment	5,047	14
Personnel	28,078	76
Supplies and Utilities	1,170	3
Transportation	2,276	6
Other Costs	<u>555</u>	<u>1</u>
Total	37,126	100

As these data show, over 75 percent of the 1982 budget was allocated to salaries. By 1985/1986, personnel salaries as a percentage of the total operating budget had climbed to 87 percent. The annual increases from the national budget for operating expenses have essentially kept pace with the expanding Moroccan faculty, but other key support elements of the budget have been almost totally neglected. (See Table H-2 for the evolution of operating expense allocations.) For the first time in 1985, the Institute has had to use funds from one of its research/consulting contracts to pay the logistical costs of the innovative field training component of the curriculum.

Table H-2. Operating Expense Budget Allocations for the Hassan II Institute of Agriculture and Veterinary Medicine, 1969-1985 (thousands of dirhams)

Budget Year	Budget Allocation
1969	2,455
1970	2,852
1971	2,940
1972	3,050
1973	4,000
1974	5,200
1975	7,120
1976	11,253
1977	12,440
1978	14,956
1979	19,046
1980	25,336
1981	28,461
1982	35,559
1983	33,663
1984	37,736
1985	38,736

The difficulty IAV administrators have in keeping pace with actual expenses can be seen from the development of the plant and equipment budget during the 5-year-plan period, 1981-1985 (see Table H-3). Over that period, actual allocations represented only 46 percent of requests and 61 percent of planned allocations agreed to by the Ministry of Finance.

Table H-3. Evolution of the Plant and Equipment Budget for the Hassan II Institute of Agriculture and Veterinary Medicine, 1981-1985 (thousands of dirhams)

Year	Requested	Planned	Received	Shortfall (planned vs. received)
1981	10,600	4,600	4,600	0
1982	9,800	8,300	3,500	4,800
1983	8,800	7,196	4,500	2,596
1984	8,700	7,096	5,400	1,696
1985	8,500	7,890	3,300	4,590

### 3. FOREIGN SUPPORT

The Institute has relied on external support to provide advanced degree training for its faculty and students, to develop the teaching and research capabilities of the departments, and to meet the operating cost deficits. Table H-4 displays the current levels of support from the major external donors. The most significant changes over the levels of support as reported in the 1983 mid-term project evaluation (RONCO 1983) have been from A.I.D. and the Federal Republic of Germany. In 1985, A.I.D. increased its commitment from US\$9.75 million to US\$28.5 million and extended the life of the project from 5 to 10 years (from 1980-1985 to 1980-1990). In 1984, the Federal Republic of Germany made available US\$500,000 in support of the Department of Agricultural Machinery. With the exception of the A.I.D. agreement, much of the ongoing foreign support for the Institute is scheduled to terminate in 1986 and 1987.

In addition to the support from foreign donors through bilateral and multilateral agreements, the Institute has increasingly mobilized resources through research and consulting agreements. These agreements or contracts are funded either through national budgetary allocations to a local agency (i.e., a Regional Irrigation Authority Office) or through consulting funds available through a project agreement. Table H-5 presents the list of research and consulting agreements for 1980 to 1985.

A review of these agreements indicates that the Institute is charging only for direct operational costs, excluding salary, a fact that enormously reduces the cost of using IAV technical support--as compared with the use of expatriate consultants. These contracts are important because they provide support for research and field training, which could not otherwise be financed through the national budgetary allocation. Over the past 5 years, contracts and agreements amounting to approximately 12.5 million dirhams have been established by the Institute, an average of 2.5 million dirhams per year--or equivalent to the entire transportation budget for the year. Discussions with Division of Rural Development personnel demonstrate that the Institute is establishing increasing credibility with local organizations and that funds from this source may become even more important in the future.

The success with which the Institute has mobilized external resources presents, paradoxically, a threat to the institutionalization of long-term national support for its research and training programs. From the beginning of our study, IAV faculty were reluctant to discuss the level of resources generated from outside sources. These faculty feared that the Ministry of Finance would substitute soft money support from these external sources for a portion of the normal national budget allocation

Table H-4. Contributions of Foreign Donors to the Hassan II Institute of Agriculture and Veterinary Medicine, 1981-1986

Donor	Project Funding (U.S. dollars)	Duration of Project	Nature of Assistance and Recipient Department
United States	28,500,000	1980-1990	Five advisers, participant training, commodity support, broad institutional development
Canada	N/A	1986	Six visiting professors, training in forestry and geodesy
Federal Republic of Germany	560,000	1983-1986	Funding support for five veterinary medicine students and five experts and five students in agricultural engineering; commodity support
Belgium	40,000	1986-1987	Logistical support only; three student training slots, 20 visiting professors, 8 experts associated with the University of Gembloux-Louvain in soils, biometrics, veterinary medicine, hydrology, and horticulture
United Kingdom	N/A	1983-1986	Two student training slots per year and five visiting professors
Sweden	N/A	1983-1986	One visiting professor and one student training slot
EEC	N/A	N/A	Six student scholarships--two each in France, Spain, and Italy
Holland	6,000	1982-1985	One development project with the Dutch Government and one with the Universities of Amsterdam and Wageningen
France	60,000	1983-1987	Thirteen experts, 12 volunteers, 30 scholarships, 65 visits by French professors, 15 exchange visits by Moroccans, logistical support, and library support

Table H-5. Research and Consulting Contracts of the Hassan II Institute for Agriculture and Veterinary Medicine, 1980-1985

Project Funded	Supporting Donor(s)	Participating Department
Chaouia Regional Devel.	A.I.D./MIAC	Rural Development
Ounein Regional Devel.	FAO	Rural Development
Aqua Regional Devel.	UNICEF	Rural Development
Hassi Regional Devel.	FAO	Rural Development
RAB Regional Devel.	UNDP	Rural Development
Middle Atlas Reg. Dev.	World Bank	Rural Development
Small Ruminants Collaborative Research	A.I.D.	Animal Sciences and Veterinary Medicine
Animal Reproduction	France	Veterinary Reproduction
Animal Physiology	France	Veterinary Physiology
Animal Parasites	France	Veterinary Parasitology
Potassium Fertilizer	France	Agronomy
Regional Soil Microbiology Courses	FAO	Soil Sciences
Foreign Student Support	FED	Administration
Agronomy Training	France	Agronomy
Animal Parasites	EEC	Veterinary Parasitology
Faculty Research Support	EEC	Several
Topographical Service	Oman	Topography
Ecoles Coraniques	Canada	Social Sciences
Newcastle Disease	EEC	Avian Diseases
El Hajeb	World Bank/GOM	Pedagogy
Pedology, Settat	GOM	Soil Sciences
ABDA/HMAR Regional Devel.	GOM	Several
Genetique Lait	GOM	Animal Sciences
Frumat	GOM	Food Sciences
Recyclage en Electro-mecanique	GOM	Hydrology
ARD Regional Devel.	GOM	Social Sciences
Douar Regional Devel.	GOM	Hydrology
Regional African Center for Technology	United Nations	Food Technology
MAB Regional Development	UNESCO	Several
Career Profiles	A.I.D.	Pedagogy
MIRCEN	UNESCO	Soil Sciences
Total Funding Available: 12,499,389.83 dirhams		
Average Yearly Funding During The Five Years: 2,499,878 dirhams		

Note: GOM is Government of Morocco.

for the Institute. Although the evaluation team could not ascertain the accuracy of this impression, the current economic circumstances of Morocco will cause budget analysts to seek reductions where possible.

#### 4. CONCLUSIONS

Despite the impressive progress achieved by the Institute in establishing an internationally recognized teaching and research program, the inability of the Government to provide the minimum level of operational support now and in the near future is threatening the viability of the Institute. Clearly, external donors will be called on to continue funding both specific and broad aspects of the program.

In addition, three areas of support appear promising. First the Institute can continue to expand its research and consulting practice, pricing these services closer to market levels. Agreements should include support for overhead and faculty salaries. The Institute should also consider incentives for continuing faculty involvement--similar to summer salary or consulting day arrangements at U.S. universities.

Second, the Institute can begin marketing services to the private sector. The Agadir complex, for example, has tremendous potential for the production of tissue-cultured bananas.

Third, by increasing the number of foreign students financed at market prices by either their own governments or external donors, the Institute could mobilize substantial support for its teaching program. Presently, the Institute provides scholarships from its national budget allocation for about 200 non-Moroccan students each year. The average per student cost is US\$4,000. Because the Government is no longer committed to hiring IAV graduates, the number of Moroccan students seeking admission is likely to decline, thus opening up additional spaces for foreign students. Donor agencies operating in Francophone Africa could finance scholarships at the Institute rather than in Europe or the United States, where the average cost of training per year is often US\$25,000.

Ironically, the greatest threat to the viability of the Institute has become apparent just as it is reaching its institutional maturity. To prevent the erosion of the investments made thus far, it is critical that both the Institute and its collaborating donors address the recurrent cost issue immediately. Although donor support has prevented the collapse of the high-quality teaching and research programs to date, the need for support and the inability of the national treasury to meet

this need has become more pressing. The Institute's entrepreneurial skills, which have been so important in the past, will be even more important in the future. Concomitantly, the authorities will have to recognize the necessity of management structures that allow the Institute to creatively deploy newly mobilized financial resources to confront its fiscal crisis.



## APPENDIX I

### STUDY METHODOLOGY

The field research for this study was conducted in Morocco from January 20 to February 15, 1986. Given the short history of the Hassan II Institute of Agriculture and Veterinary Medicine (IAV) and the time constraints on the impact assessment team, the team used a snowball sampling approach. Under this approach, indepth interviews are conducted both to gather the desired information and to solicit suggestions for additional contacts. This rapidly broadens the field of respondents and maximizes variance so as to obtain as complete a response range as possible within the time allotted.

Initial interviews were conducted at the Institute's Rabat campus. After obtaining an overview of the Institute's structure and operations, the team split into two groups and conducted interviews on the campus. To maximize use of the time available, group interviews were conducted whenever possible. As interviews at the Institute were completed, additional interviews were conducted with people within driving range of Rabat. During the third week, the team split into two groups, one going northeast to the Meknes-Fez-Moyen Atlas area and the other going south to the Marrakech-Agadir-Haute Atlas area.

Most of the principal agricultural regions of the country were represented in the interviews, as were the IAV campuses in Rabat and Agadir, the National School of Agriculture in Meknes, and the National School of Forestry in Sale. Wherever possible, former students, farmers, and users of IAV research information were contacted. The final week in Morocco was spent drafting a report for presentation to IAV and USAID officials and filling in gaps with a few more interviews.

In addition to the formal interviewing, a written questionnaire was distributed to all Moroccan degree participants in the IAV/University of Minnesota graduate training program. Approximately 50 of these questionnaires were given to respondents in Morocco. Information derived from the returned forms was incorporated into the team's conclusions.

Finally, additional interviews were conducted by three team members at the University of Minnesota (March 19-21, 1986) with university senior administrators, staff of the project office, faculty representatives, and Moroccan graduate students studying at the University.



## APPENDIX J

### NOTES ON THE AUTHORS

John H. Eriksen is a Senior Partner and Principal Executive Officer for Ithaca International Limited, a firm specializing in economic and technical consulting services and client-specific training programs in Africa and Asia. He received his Ph.D. degree in Agricultural Economics from Cornell University. Dr. Eriksen has extensive experience in Africa, serving as Regional Agricultural Economist for West Africa with A.I.D. (1976-1979) and as Peace Corps Country Director in Swaziland (1971-1973). He was Deputy Director of the National Livestock Experiment Station in Toukounous, Niger (1962-1965). He has also undertaken frequent short-term consulting assignments in Africa relating to farming systems research and livestock and agricultural sector analysis.

Lawrence Busch is a Professor in the Department of Sociology, University of Kentucky. He received his Ph.D. degree in Development Sociology from Cornell University. Dr. Busch was a Peace Corps Volunteer in Togo. He is the author of several books and numerous articles on issues relating to the sociology of the agricultural sciences and the institutional dynamics of agricultural research. He has been a consultant to the Brazilian Agricultural Research Agency (EMBRAPA) and to the French Scientific and Technical Aid Agency. His research on the agricultural sciences has been funded by the National Science Foundation and the Ford Foundation.

Jack W. King, Jr. is a consultant in agricultural development. He has a Ph.D. degree in Soil Science from Cornell University. From 1967 to 1972 he was a secondary school teacher in Accra, Ghana, and from 1974 to 1981 he was Agricultural Projects Director, Seventh Day Adventist World Service, in Washington, D.C. Dr. King has extensive consultancy experience in Africa in the areas of agricultural research, extension, and training.

James Lowenthal is an Agricultural Development Officer in the A.I.D. Bureau for Asia and the Near East. He has a Ph.D. degree in Organizational Sociology from Vanderbilt University. From 1981 to 1985 Dr. Lowenthal served with USAID/Niger as project manager for a large integrated rural development project. Prior to this assignment he served in the Office of Rural Development of the A.I.D. Bureau for Science and Technology. From 1972 to 1979 Dr. Lowenthal worked as a freelance management and human resource consultant.

Rolland P. Poirier is a consultant in agricultural development. He has a Ph.D. in Animal Science from Iowa State University. He was the founding Dean of the Faculty of Agriculture at Laval University in Canada. From 1967 to 1975 he was Assistant Deputy Minister, Canadian Department of Agriculture. He was a Vice President for the Canadian International Development Agency from 1975 to 1977. Dr. Poirier also served as Chairman of the Board and Chief Executive Officer of the Farm Credit Corporation of Canada. In 1982, he was appointed to the Board of Governors of the International Development Research Center.

## BIBLIOGRAPHY

- Agency for International Development. "Noncapital Project Paper: Higher Agricultural Education, Morocco. Project No. 608-11-110-088." Washington, D.C.: A.I.D., July 28, 1969.
- Agency for International Development. "Project Paper on Higher Education, Project No. 608-0134." Washington, D.C.: A.I.D., September 15, 1975.
- Agency for International Development. "Project Paper, Morocco: Agronomic Institute. Project No. 608-0160." Washington, D.C.: A.I.D., April 1980.
- Agency for International Development. Final Evaluation: Range Management Improvement Project 608-0145 Morocco. Washington, D.C.: A.I.D., November 1985.
- Agency for International Development. Study Design for Institute of Agronomic and Veterinary Sciences Morocco. Washington, D.C.: A.I.D., December 1985.
- Alpert, D. "Performance and Paralysis: The Organizational Context of the American Research University." Journal of Higher Education 56, 3 (May/June 1985).
- ANAFID, ANPA, ANAPPAV, et Institute Agronomique et Veterinaire. Hommes, Terre et Eaux: Revue Marocaine des Sciences Agronomiques et Veterinaires. Rabat, Morocco: IAV, various issues.
- Arrif, A. Pratiques Pedagogiques et Pratiques Sociales dans la Socialization des Eleves-Ingenieurs en Agriculture: Le Cas de l'Institut Agronomique et Veterinaire Hassan II Maroc. Doctorat de Troisieme Cycle, Tomes I et II, Université de Paris I, Pantheon-Sorbonne. Paris, France: UER Science Politique, December 1982.
- Association of Faculties of Agriculture in Africa. AFAA/FAO, Rockefeller Foundation and Alexandria University, Egypt-- Workshop on Home Economics in Rural Development in Africa, Alexandria, Egypt, 17-22 October 1983. Rabat, Morocco: Association of Faculties of Agriculture in Africa, February 1984.
- Association of Faculties of Agriculture in Africa. Ten Years of AFAA Activities, 1973-1983. Presented at AFAA 5th General Conference, Swaziland 22-28 April 1984. Rabat, Morocco: Association of Faculties of Agriculture in Africa, April 1984.

- Association of Faculties of Agriculture in Africa. AFAA: Addresses of High and Middle-Level Agricultural Education Institutes in Africa (With Addresses of Some Veterinary Institutes), General Directory. Rabat, Morocco: Association of Faculties of Agriculture in Africa, January 1986.
- Bawden, R.J. "Systems Thinking and Practices in the Education of Agriculturalists." Agricultural Systems 13 (1984):205-225.
- Bell, R.D., W.E. Splinter, and G.E. Thierstein. Report of the Agricultural Engineering Program Review Team--INRA/MIAC Dryland Farming Applied Research Project. Settat, Morocco: Mid-American International Agricultural Consortium, January 1986.
- Bouderbala, N., et al. La Question Hydraulique, 1. Petite et Moyenne Hydraulique au Maroc. Rabat, Morocco: Presses de Graphitec, S.A., 1984.
- Buddemeier, W.D., et al. Overview of Development and Future Needs of Hassan II National Institute of Agriculture and Veterinary Medicine and of the Ministry of Agriculture, Morocco. Washington, D.C.: A.I.D., October-November 1978.
- Busch, L., and W. Lacey. Science, Agriculture, and the Politics of Research. Boulder, Colorado: Westview Press, 1983.
- Casas, J., and J. Baeza. L'Institut Agronomique et Veterinaire Hassan II, ou les Promesses de l'Etablissement d'Enseignement Superieur Agricole Marocaine. Rome, Italy: OAA/FAO, July 1980.
- Ceremonie de Remise des Diplomes par S.M. le Roi aux Laureats de l'Institut Agronome et Veterinaire Hassan II le Juin 1975. undated.
- Commission de l'Adequation Entre la Formation Professionnelle et l'Emploi. Rapport de la Sous-Commission: Systeme d'Information sur la Formation Professionnelle et l'Emploi--Synthese et Recommendations. Rabat, Morocco: Ministere de l'Equipement, de la Formation Professionnelle, et de la Formation des Cadres, undated.
- Direction du Développement Rural. Chaouia Project II--The Socio-Economic Component of the Dryland Agriculture Applied Research Project 608-0136 Integrated Plan of Work 1984-1985. Rabat, Morocco: IAV, April 1985.

Direction du Développement Rural. Objectifs, Organization et Bilan d'Activité de la Direction du Développement Rural. Rabat, Morocco: IAV, May 31, 1985.

Direction du Développement Rural. Chaouia Project II--The Socio-Economic Component of the Dryland Agriculture Applied Research Project 608-0136 Integrated Plan of Work 1985-1986. Rabat, Morocco: IAV, December 1985.

El Bakkali, A. Report of Outside Users of the CDA at IAV. Rabat, Morocco: IAV, January 24, 1986.

El Gharbi, R. "Honneur Royal a l'Institut Agronomique et Veterinaire Hassan II." Maroc-Business, October 1983.

Eriksen, J.H. A Review of Selected Agricultural Policies in Morocco. Washington, D.C.: RONCO Consulting Corporation, November 4, 1982.

Firdawcy, M.L. Profils des Carriers Professionnelles des Laureats de l'Institut. Rabat, Morocco: IAV, 1985.

Firdawcy, M.L. Association des Facultés Agronomiques d'Afrique: Un Systeme de Formation Intégrée des Cadres de l'Agriculture--Cas du Maroc. Rabat, Morocco: IAV, June 1979.

Government of Morocco, Ministry of Agriculture and Agrarian Reform. Le Message--Vulgarization Agricole. Rabat, Morocco: Ministry of Agriculture and Agrarian Reform, undated.

Government of Morocco, Ministry of Planning. Plan of Economic and Social Development 1981-1985. Vols. I and II. Rabat, Morocco: Ministry of Planning, April 1982.

Hassan II Institute of Agriculture and Veterinary Medicine. Actes de l'Institut Agronomique et Veterinaire Hassan II--Revue Scientifique et Technique Multidisciplinaire. Rabat, Morocco: IAV, various issues.

Hassan II Institute of Agriculture and Veterinary Medicine. Complet Rendu d'Activités. Rabat, Morocco: IAV, various issues from September 1966 to 1972-1973.

Hassan II Institute of Agriculture and Veterinary Medicine. Rapport d'Activités. Rabat, Morocco: IAV, various issues from 1973-1974 to 1983-1984.

Hassan II Institute of Agriculture and Veterinary Medicine. Rapport d'Activités--Recherche. Rabat, Morocco: IAV, various issues from 1982-1983.

- Hassan II Institute of Agriculture and Veterinary Medicine. Rapport d'Activités--Pedagogie. Rabat, Morocco: IAV, various issues from 1982-1984.
- Hassan II Institute of Agriculture and Veterinary Medicine. Conference Secheresse, Gestion des Eaux et Production Alimentaire. Agadir, Morocco: IAV, 21-24 November 1985.
- Hassan II Institute of Agriculture and Veterinary Medicine and University of Minnesota. "Sixth Annual Work Plan and Budget, Agronomic Institute, Morocco (608-0610) October 1, 1985-September 30, 1986." Rabat, Morocco: IAV and University of Minnesota, 1985.
- Keller, J., and M.A. Kadi. International Irrigation Center/Morocco--Concept Planning Document. Rabat, Morocco: IAV, December 1, 1985.
- Mid-American International Agricultural Consortium. "INRA-MIAC Aridoculture Project Integrated Work Plan 1985-1986--Dryland Agriculture Applied Research Project. Project No. 608-0136." Settat, Morocco: MIAC, 1985.
- Pascon, P. Etudes Rurales: Idées et Enquetes sur la Campagne Marocaine. Rabat, Morocco: SMER, 1980.
- Pascon, P. Le Haouz de Marrakech. Tomes 1 et 2. Rabat, Morocco: IAV, 1983.
- Pascon, P. La Maison d'Iligh et l'Histoire Sociale du Tazerwalt. Rabat, Morocco: SMER, 1984.
- Pascon, P. "30 Ans de Sociologie du Maroc (textes anciens et inédits). Bulletin Economique et Social du Maroc (Janvier 1986).
- Pascon, P., and H. van der Wusten. Les Beni Bou Frah: Essai d'Ecologie Sociale d'une Vallée Rifaine (Maroc). Rabat, Morocco: IURS/IAV, 1983.
- Pattinson, I. Potential USAID Activities in the Fertilizer Sector of Morocco. Rabat, Morocco: USAID, December 20, 1985.
- Popp, H. La Question Hydraulique. Tome 2 et Atlas des Cartes. Rabat, Morocco: IAV, 1984.
- Practical Concepts Incorporated. Evaluation of A.I.D./Morocco Assistance to Hassan II Institute of Agronomy and Veterinary Science--Final Report. Washington, D.C.: Practical Concepts Incorporated, May 1975.



Ref-5

- RONCO Consulting Corporation. Mid-Project Evaluation, Project 608-0160 "Agronomic Institute" Morocco. Washington, D.C.: RONCO Consulting Corporation, September 1983.
- Rosenberg, C.E. No Other Gods: Science and American Social Thought. Baltimore, Maryland: Johns Hopkins University Press, 1976.
- Royaume du Maroc. Institut Agronomique et Veterinaire Hassan II--Textes Reglementaires. Rabat, Morocco: Royaume du Maroc, undated.
- Schuh, G.E. "Revitalizing the Land Grant University." Paper presented at the Colloquium, Strategic Management Research Center, University of Minnesota, St. Paul, Minnesota, September 28, 1984.
- Skogerbee, G.V. "International Irrigation Center/Morocco-- Activity Proposal for FY 1986-87." Logan, Utah: Utah State University, August 1, 1985.
- Suisse-Guillaud, A. Rapport des Semences des Cereals. Rabat, Morocco: USAID, December 1985.
- Tantawy, A.O. (ed.). Proceedings of the AFAA Fifth General Conference on Food Security in Africa, Swaziland, 22-28th April 1984. Rabat, Morocco: Association of Faculties of Agriculture in Africa, December 1984.
- University of Minnesota. Annual Report--Morocco Agronomic Institute Project, 1983/84. St. Paul, Minnesota: University of Minnesota, January 1985.
- University of Minnesota. Agronomic Institute Project, Morocco, Fifth Annual Report, 1984-1985. St. Paul, Minnesota: University of Minnesota, January 1986.
- USAID/Morocco. Country Development Strategy Statement. "Annex 1, Description of the Moroccan Agricultural Sector." Rabat, Morocco: USAID, December 1985.
- Wardlow, G.W., J.C. Sentz, and J.D. Wilcoxson. Proceedings: Morocco--Partnership Program on Institution Building. The Mid-Program Conference, May 6 and 7, 1985 University of Minnesota. St. Paul, Minnesota: University of Minnesota, 1985.





