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REVIEW OF SOILS AND IRRIGATION DEPARTMENT UNIVERSITY OF JORDAN

JORDAN

USAID

WATER MANAGEMENT SYNTHESIS PROJECT

REVIEW OF

SOILS AND IRRIGATION DEPARTMENT

UNIVERSITY OF JORDAN

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PREFACE

This study was conducted as part of the Water Management Synthesis II Project, a program funded and assisted by the United States Agency for International Development through the Consortium for International Development. Utah State University, Colorado State University and Cornell University serve as the lead universities for the Project.

The key objective is to provide services in irrigated regions of the world for improving water management practices in the design and operation of existing and future irrigation projects and give guidance to USAID for selecting and implementing development options and investment strategies.

For more information about the project and any of its services, contact the Water Management Synthesis II Project.

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FOREWORD

This review of the Soils and Irrigation Department of the University was conducted at the request of the AID Mission in Jordan in an effort to provide further and continuing ongoing assistance to the Department's development. The intention of the review was to: critique the Department's programs; interact with and give guidance to the staff and students; and delineate research and training programs wherein the Department can best play a strategic role in improving the performance of irrigation projects throughout Jordan.

Dr. Jack Keller, who is the Chairman of the Agricultural and Irrigation Department at Utah State University, visited Jordan between June 12 and 26, 1983. Following is the itinerary of this visit:

Itinerary of Visit

Fri., June 12 Arrive in Amman, Jordan.

Sat., June 18

AM: Had meetings with the Dean of Agriculture, Dr. Marivan Kamal, and the staff of the Department of Soils and Irrigation at the University of Jordan.

PM: Had discussions with Dr. Battikhi, Chairman, and Drs. Judeh and Shatanawi of the Soils and Irrigation Department, about existing activities in the Department.

Sun., June 19

AM: Visited AID, Dr. Kenneth Laurent, ADO, and Faud Qushair, Assistant to the ADO.

PM: Had discussions with Drs. Shatanawi and Battikhi concerning research project outlines for submission to USAID.

Mon., June 20

Presented lecture on the role of Jordan University in assisting irrigation development in Jordan and also reviewed research programs.

Tues., June 21

AM: Was taken on field trips accompanied by Department staff to:
Jordan Valley Experiment Station.
Jordan Valley Irrigation Project.

PM: Had discussions with various staff members and students of the Soils and Irrigation Department at the University of Jordan.

Wed., June 22

AM: Was taken on field trip to the upper or highland irrigation projects, accompanied by Drs. Battikhi and Judeh.

PM: Wrote draft research project proposal scope for Department's submission to USAID and visited with Dean Kamal.

Thurs., June 23

AM: Visited Drs. Fahad Nature and Mohammad Bene-Hani at the Jordan Valley Authority offices.

PM: Visited with AID and Washington State Ag. Research and Extension Project Team, Drs. Gardner Shaw (Team Leader), Robert Harwood, Gordan Rodwald and Erve Dow; the Team is working with Dr. Usuf Rusti, Director of J.V. Ag. Services, who was also present.

Fri., June 24

AM: Worked on curriculum review and reports in hotel.

PM: Went sightseeing with Battikhi family.

SAT., June 25

AM: Developed research project proposal concepts for the Department.

PM: Had discussions of the contents of the research projects and final report with Irrigation and Soils Department staff and the Dean, Kamal.

Sun., June 26

Completed and left with USAID and the Soils and Irrigation Department a draft report "Review of Soils and Irrigation Department - University of Jordan" (see attached) and concept frameworks for research projects to be submitted to USAID by the University of Jordan. In addition, drafted and left behind letter covering potential future related activities in Jordan involving the Soils and Irrigation Department, NVA and AID/Jordan.

Having been particularly well and hospitably received, I wish to express my sincere appreciation to Dr. Anwar Battikhi, Chairman of the Department, and Drs. Judeh and Shatanawi for organizing my itinerary and accompanying me throughout most of my visit.

I also appreciate: my open discussions with Dean Marivan Kamal of the College of Agriculture; the cordial reception and assistance I received from Dr. Kenneth Laurent, ADO, and Mr. Faul Quashair of the AID Mission; and the frank discussions and hospitality afforded me by Drs. Fahad Nature and Mohammad Bene-Hani of the Jordan Valley Authority.

SUMMARY AND RECOMMENDATIONS

The Soils and Irrigation Department offers B.Sc. and M.Sc. programs. In addition, a diploma program is offered to entering B.Sc. students who have weak backgrounds in the Soils and Irrigation area and either wish to merely strengthen their credentials or enter the M.Sc. program (which is quite rigorous). The Soils and Irrigation Department faculty teach 33 different courses plus several seminars, special problems and special topic courses. The teaching staff is adequate and well-qualified, as there are presently 11 full-time faculty with Ph.D. level training from various North American and European universities. The composition of the faculty is quite well balanced for the program they offer.

The language of instruction is English, and up-to-date text materials are used. The standards of teaching seem to be quite strong, and there is no indication of grade inflation. In addition to the teaching and up-to-date laboratory activities, the Department also has a strong hands-on field training and research program in irrigation at their Jordan Valley Experimental Farm.

Recommendations

The following recommendations will be broken down into those concerning the specific academic programs and the thesis, professional papers and research activities.

1. The B.Sc. program appears well rounded and balanced, but lacks sufficient emphasis on computers and may profit by designating two options rather than the current single option. Computer Science should be included as a required course early in the program (the decision to do this has now been made, as is reflected in Appendix A). In addition, every effort should be made to enhance the current computer hardware facilities, including the addition of personal computers at the Department level.

   It is recommended that the Department consider two potential options as follows: "a design and management option" to produce professionals for work in the irrigated agricultural development

agencies, service organizations and large farm operations; and a "science option" to produce professionals for careers with agricultural research organizations, farm service business, extension agencies and large farming operations.

2. The M.Sc. program is flexible, can meet the individual needs of specific students and requires extensive field research activities. To strengthen the program, the experimental designs of the thesis research could be more efficiently developed and the data more creatively analyzed.

3. Overall, the thesis and staff research activities, which are closely coordinated, represent very good research performance. The staff and students appear very eager and interested in doing good research and the administration places strong emphasis on research for academic and professional advancement. However, as far as the amount and appropriateness of the research is concerned, it hardly scratches the surface of what is critically needed to better manage the water resources of Jordan. Therefore, a comprehensive research plan is essential. Periodic reviews of the research work and assistance from a senior professional on how to more fully exploit the field work would be helpful for improving the quality and usefulness of the research, and thus upgrading the staff in the Department.

4. The Department and University in general are providing training, trained personnel and needed research results for improving irrigated agricultural performance in Jordan. The staff are enthusiastic and competent and are attracting students not only from Jordan, but from throughout the region. To optimize this valuable and critical resource for improving irrigated agriculture in Jordan, it is recommended that support be found for establishing comprehensive research programs in the broad areas of: crop water requirements and production functions for the principal economic crops grown in Jordan, along with modeling to extend the information throughout the country; and interdisciplinary economic selection of irrigation methods and techniques for the important crops of the region.

REVIEW OF

SOILS AND IRRIGATION DEPARTMENT

UNIVERSITY OF JORDAN

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SOILS AND IRRIGATION DEPARTMENT REVIEW

Following are review comments covering the Academic Programs, M.S. Theses and Selected Publications and Research of the Soils and Irrigation Department of the University of Jordan, Amman, Jordan.

Academic Programs

The Soils and Irrigation Department offers B.Sc. and M.Sc. programs. In addition, a Diploma program is offered to entering B.Sc. students who have weak backgrounds in the soils and irrigation area and either wish to merely strengthen their credentials or enter the M.Sc. program (which is quite rigorous). The course requirements for these programs and brief descriptions of the courses offered by the Department's faculty are presented in Appendix A.

The Soils and Irrigation faculty teach 33 different courses plus several seminars, special problem and special topic courses. The teaching staff is adequate and well qualified, as there are presently 11 full time faculty which Ph.D. or equivalent level training from various North American and European universities. The composition of the faculty by academic fields is: 1 irrigation scientist, 2 irrigation engineers, 2 soil physicists, 3 soil chemists, 1 soil fertility specialist, 1 land use specialist and 1 soil genesis specialist. Three additional staff members are now receiving advanced trainng. Their specialties are: 1 irrigation scientist, 1 soil salinity specialist and 1 biochemist.

For acceptance into the M.Sc. program a student must have a 75 percent average from an accredited university or from the Diploma program. The general grading system at the University is as follows:

A. Course Grades

	Excellent	V.Good	Good	Pass	Weak	Fail
	A	B	C	D	--	F
%	>90	80-89	70-79	60-79	50-59	>50

B. Accumulated Grades (for whole program)

	Excellent	V.Good	Good	Pass	Fail
%	>84	76-83	68-75	60-65	>60

My general impression is that the instructional programs are quite strong. The language of instruction is English and up-to-date test materials are being used. However, I have not monitored any lectures nor reviewed the classwork or examinations. Laboratory facilities are up-to-date and appear to be in active use. In addition, the Department has a Research Farm in the Jordan Valley where students spend a few weeks during their B.Sc. program with hands-on irrigation related activities. The Research Farm is also actively used for the M.Sc. thesis activities.

A review of grading suggests that grade inflation is not a problem and it is my impression that B.Sc. or M.Sc. students with a 75 percent or better overall average should be competitive for advanced degree work in U.S. universities.

The B.Sc. Program. The B.Sc. program in Soils and Irrigation (see coursework required - Apendix A) seems quite complete. However, I have two basic suggestions:

1. Computer science should be included as a required course and the use of computers stressed early in the program. I realize that early on this is difficult to do because of the general lack of adequate computer hardware facilities, but in view of current trends in the proliferation of computers worldwide, it is essential to make every effort to strengthen the computer activities.
2. Currently the Department offers only a single option (or general area of specialty) program. Students have flexibility in selecting 23 credit hours of electives out of the required 138 credit hour program. But it appears that the elective program is not critically directed and students tend to select courses based on the relative ease of obtaining "good grades" rather than course content. To help remedy this I would suggest that the Department offer two options rather than a single option program.

The two options which I would suggest are: "On-Farm Irrigation Design, Operation and Management" and "Soils and Irrigation Science." The Design and Management option should be organized to produce professionals

for work in the irrigated agricultual development agencies, service organizations, farm advisory services and large farm organizations. The Science option should produce professionals for careers with agricultural research organizations, farm service businesses, extension agencies and large farming operations.

These two program options can be broken out by beginning with the 41 credit hours of Departmental requirements. Furthermore, the 20 credit hours of suggested electives for each option can be organized to best reflect that option. In addition to the course listed, the Design and Management option should include a course in surveying and areal photo interpretation as a required Departmental course. Required computer science courses should be included in both options. (The catalog and Departmental materials from the Agricultural and Irrigation Engineering and Soil Science and Biometeorology Departments at Utah State University will provide useful guidelines for developing the option programs.)

The Diploma Program. The Diploma program (see Appendix A) requires 48 credit hours and takes most transfer students two years to complete. From the attached it is obvious that this program should prepare a student well for the Department's M.Sc. program.

The M.Sc. Program. The M.Sc. program (see Appedix A) is comprised of 24 credit hours of course work and 12 credit hours of thesis research. The program is flexible and can be designed to meet the specific interests of individual students, as is indicated by the attached program outline.

The Department places considerable emphasis on the thesis research and normally requires rather extensive laboratory or field research efforts. Typical field research programs involve up to two years of field study with the students fully involved with the hands-on activities. Perhaps the Department requires more effort than would be necessary from the students in terms of field data collection. However, there are areas of weakness, the experimental designs could be improved and more creative analysis of the data would be beneficial.

Review of M.Sc. Thesis

The set of recent M.Sc. theses from the Department are quite well

done. For the most part they would qualify at USU or any typical U.S. Land Grant University. A list of theses reviewed and brief comments on each follows.

1. Wetting Fronts Under a Trickle Source in Some Soils of the Jordan Valley. M.G. Harvatmek, Feb. 1980.

   Appears to be a well executed and carefully carried out piece of research (quite a lot of work). The analysis stresses the increase in horizontal wetting with higher emitter discharges. I noted that while this is true, it would be more significant to note that the width of wetting is relatively insensitive to the discharge rates.

2. Scheduling Irrigation for Tomato Under Drip Irrigation. J.M.H. Quasem, May 1980.

   Another elaborate and difficult field study. Results indicated that ratios of pan-evaporation compared to ET were as high as: 2.8 for irrigations at tensions of 20 cm; 1.7 for 30 cb; 1.3 for 40 cb; and 1.2 for 50 cb. These seem a bit unbelievable and probably indicate inability to account for deep percolation. Also, yields ranged from an average of 8720 kg/du for irrigation at 20 cb tension to 6780 kg/du for 50 cb, but because the yield differences were statistically insignificant, they were considered non-existent. Incidentally, the basic yield data was not presented for review.

3. The Response of Wheat Grown in Calcareous Soils to Iron Fertilizers. I.M. Abu-Eisheh, July 1980.

   A careful and well done piece of work. Unfortunately, wheat did not appear to be an interesting indicator crop for iron problems on the soils tested because dry matter yields were essentially the same for the controls as well as all of the various iron treated soils.

4. Water Requirements and Scheduling Irrigation for Sweet Corn Under Sprinkler Irrigation in the Jordan Valley. W.A.H. El-Sharif, Dec., 1980.

   Seems to be a rigorous piece of research using standard plot

techniques. Came up with unusually high ET values for corn (up to 12 mm/day) and low sprinkler efficiencies (down to 40 percent). Irrigated at tensions of 30, 45 and 60 cb. Probably were not accurately accounting for deep percolation! Also, yields were low.

5. Crop Production Function Determinations and Nitrate Movement as Influenced by Irrigation Amounts and Urea Fertilization Rates on Sweet Corn in the Jordan Valley. A.M. Abu-Awad, July 1982.
   This is a detailed line source experiment and the results seem credible.

6. Effect of Plastic Mulches on Soil Water Conservation, Soil Temperatures, and Yield of Tomato in the Jordan Valley. S.H. Haddadin, Oct., 1982.
   This seems to be a well executed experiment with interesting results indicating that plastic mulches save considerable water (about 60 percent over base soil trickle systems) and improve yields (by about 20 percent over base soil) which gives almost double the production per unit of water consumed. I have some trouble believing that the average ET would be as high as 10+ mm/day and peak use rates of 15 mm/day for the base soil systems.

7. Soil Moisture Studies Under Rainfall Areas in Jordan. M.H.M. Saimek, Jan., 1983.
   A long rigorous study of soil moisture under rainfed conditions of fallow and cropped lands of mild and steep slopes throughout the highlands of Jordan. The thesis represents an extensive amount of field work which was a very lengthy amount of field work for an M.s. thesis. However, the analysis was not extended by modeling to estimate longer time effects and/or economic feasibilty of different cropping practices for wheat, beans and fallow. Perhaps this could still be done as an additional M.S. thesis.

Overall, the theses represent very good research performance. However, I believe the analysis lacks some imagination and there is too

much emphasis on split plot designs and statistical significance. Furthermore, the research is placing too much emphasis on and having trouble with estimating ET from soil moisture measurements (there is obviously some deep percolation which is not accounted for). As mentioned earlier, as far as the appropriatness of the research is concerned, it hardly scratches the surface of what is critically needed to better manage the water resources of Jordan. A more comporehensive research plan is essential. Furthermore, more imaginative use of actual (farmers) field information and evaluation must be incorporated into the research plan.

Review of Selected Publications and Research

I did a rather careful review of 13 of the staffs' principal papers in the general area of water management. Most of these were related to the various M.Sc. theses reviewed earlier. Appendix B contains a list of the faculty's publications with asterisks (*) by selected ones I reviewed, along with my comments.

In general, the papers are of fair to good quality. A few would be publishable in U.S. refereed journals. I feel that in many of the papers the authors were not too creative in developing and extracting information from their field work. The field research seemed to be laborously done and of good quality, but some of the most meaningful conclusions are not well developed and presented. In addition, there are needs for improvements, such as better editing and more attention to presenting summaries and conclusions.

The staff seems very eager and interested in doing good research. Furthermore, publications are required for academic advancement (see list of current research activities, Appendix B). I believe periodic reviews of the research work and assistance from a senior professional on how to more fully exploit the field work would be most helpful for improving the quality and usefulness of the research, and thus upgrading the staff and the Department.

THE UNIVERSITY'S (AND DEPARTMENT'S) ROLE

Following are notes from a talk presented by Dr. Jack Keller on June 20, 1983, at the University of Jordan, Amman, titled: "The Potential Role of the University in Improving Irrigated Agricultural Performance in Jordan." The presentation was attended by a group of 30 to 40 faculty, JVA, Department of Agriculture and AID personnel.

The traditional role of universities is not to set policy as this is the prerogative of the poliotical forces and agencies of the Government, but rather to provide useful insights and research data so that decision-makers can make better informed decisions and agencies can have needed research information to better manage their charges and provide improved informaton for dissemination to farmers.

In regard to the above, it seems that there are a number of areas where the University is best suited to assist in improving irrigated agriculture performance in Jordan. The faculty of the Department of Soils and Irrigation is perhaps the greatest resource in Jordan of trained scientists in the irrigated agricultural area with 11 young doctorates having training from recognized Western Universities.

Areas where I visualize the University can assist the Jordan Valley Authority and the Agricultural Department are in:

1. Providing a supply of well-trained traditional B.S. and M.S. professionals.
2. The provision of in-service training to improve skills and update capabilities of agency employees.
3. Providing needed applied research for improving the design and management of irrigation systems.

The technical areas which must be addressed should include: crop water requirements; irrigation practices; soil and salinity management; and general agronomical practices including fertility and crop protection for the entire variety of crops grown in open fields, under plastic mulch and in both plastic houses and plastic tunnels throughout Jordan. More specifically, research projects might be established in two broad areas.

These are:

1. Crop water requirements and production functions for the principal economic crops grown in Jordan along with modeling to extend the information to various regons for water allocation and scheduling purposes. This is needed research for properly allocating and managing the scarce water resources of the country. Such a comprehensive project would require a budget in the neighborhood of $100 tc $200 thousand dollars per year and cover a three to five year time horizon.
2. Interdisciplinary economic selection of irrigation methods and techniques for the different crops and regions of Jordan including emphasis on salinity control and optimization of the scarce water resources. Budget and time requirements would be similar to the above.

APPENDIX A

ACADEMIC PROGRAMS AND DISCIPLINES OF COURSE OFFERINGS OF THE SOILS AND IRRIGATION DEPARTMENT

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UNDERGRADUATE PROGRAM TOWARD THE
B.SC. IN SOILS AND IRRIGATION

University of Jordan
Faculty of Agriculture
Dept. of Soils and Irrigation
13/6/1983

The student in the Faculty of Agriculture majoring in soils and irrigation has to finish 138 credit hours according to the following:

I	University requirements	18 cr.hrs.
II	Faculty requirements	
	A. From Faculty of Science	32 cr. hrs.
	B. From Faculty of Agriculture	24 cr. hrs.
III	Department requirements	
	A. Compulsory	41 cr. hrs.
	B. Electives	20 cr. hrs.
IV	Free electives	3 cr. hrs.
	TOTAL	138 cr. hrs

I University Requirements

The student has to finish 18 credit hours from the courses offered by the University as follows:

Course No.	Course	Credit Hours
100	Arabic Language	3
100	English Language	3
100	Military Science	3
Plus three other courses, including Principles of Economics; and another one should be outside the courses offered by the Faculty of Agriculture. All of them should be outside of the major.		9

II Faculty Requirements

A. From the Faculty of Science:
Thirty-five credits from the courses offered by the Faculty of Science as follows:

Course No.	Name	Weekly Hours Lect.	Weekly Hours Lab.	Credit Hours	Prerequisite
B 34101	Biology 1	3		3	
B 34102	Biology 2	3		3	B 34101
B 34103	Biology Lab 1		3	1	B 34101
B 34105	Biology Lab 2		3	1	B 34102
Ch 33101	Inorganic Chemistry 1	3		3	
Ch 33102	Chemistry 2	3		3	Ch 33101
Ch 33106	Chemistry Lab	1	3	3	Ch 33102
Ph 32107	Physics*			3	
Ph 32113	Physics Lab		3	1	
Ch 33311	Analytical Chemistry	2	3	3	Ch 33102
M 31101	Calculus I	3	-	3	Ch 33106
M 31102	Calculus II	3	-	3	M 31101
M 31221	Computer (Fortran)	3	-	3	
M 31231	Statistical Methods	2	3	3	
		TOTAL		36	

*For Biological Students

B. From the Faculty of Agriculture:

1. The following courses are compulsory:

Course No.	Name	Weekly Hours Lect.	Weekly Hours Lab	Credit Hours	Prerequisite
PP 61101	Agriculture in Jordan	3	-	3	-
AE 65211	Principles of Agric. Economics	3	-	3	-
SI 64211	Principles of Soil Sciences	-	3	3	CH 33101
AP 62211	Principles of Animal Production	3	-	3	
PP 61211	Principles of Plant Production	3	-	3	
		TOTAL		15	

2. Three courses from the following list:

Course No.	Name	Weekly Hours Lect.	Lab	Credit Hours	Prerequisite
HN 63211	Prin. of Human Nutrition	3		3	
PP 66211	Prin. of Plant Protection	3		3	
SI 64221	Irrigation Principles	3		3	
AE 65222	Prin. of Ag. Extension	3		3	
PP 61251	Prin. of Farm Machinery	2	3	3	

III Department Requirements

A. Compulsory requirements (41 units):

Course No.	Name	Weekly Hours Lect.	Lab	Credit Hours	Prerequisite
SI 64323	Hydraulics	3		3	SI 64221
SI 64324	Hydrology	3		3	SI 64323
SI 64326	Irrigation Systems	3		3	SI 64221
SI 64331	Fertilizers and Soil Fertility	2	3	3	-
SI 64341	Soil Physics	2	3	3	-
SI 64351	Soil Chemistry	3	3	4	
SI 64411	Soil Conservation and Management	3		3	
SI 64412	Soil Classification	2	3	3	
SI 64421	Irrigation Practices		6	2	
SI 64424	Water Resources	3		3	
SI 64432	Plant Nutrition	3		3	
SI 64391	Seminar			1	
SI 64492	Seminar			1	
CH 33237	Organic Chemistry	4	-	4	
CH 33235	Organic Chemistry	1	4	2	
		TOTAL		41	

B. Twenty units should be selected from the following list:

Course No.	Name	Weekly Hours Lect.	Weekly Hours Lab	Credit Hours
SI 64332	Soil Microbiology	2	3	3
SI 64413	Soil Survey	3		3
SI 64423	Agricultural Drainage	3		3
SI 64441	Soil-Water-Plant Relationships	3		3
SI 64453	Soil Reclamation	3		3
SI 64495	Special Topics			
PP 61312	Vegetable Production	3	3	4
PP 66331	Entomology	2	3	3
PP 66435	Weed Control	2	3	3
G 35101	Geology	3		3
M 31201	Calculus III	3	3	3
M 31203	Differential Equations	3		3
Ch 34311	Biochemistry	3	3	4
B 34341	Microbiology	2	3	3
B 34351	Plant Physiology	2	3	3
		TOTAL		44

IV Free Electives

One course (3 units) offered by some other department.

GRADUATE PROGRAM TOWARD THE
M.SC. IN SOILS AND IRRIGATION

University of Jordan
Faculty of Agriculture
Dept. of Soils and Irrigation
13/6/1983

I Fulfill University Requirements

II Take a Minimum of 24 Credit Hours as Follows:

A. At least 17 credit hours from the courses listed below or 400 level courses offered by the Soils and Irrigation Department provided that 65491 and 65492 are included. The 400 level courses should not exceed 25 percent of total required courses.

Course No.	Name	Weekly Hours Lect.	Weekly Hours Lab	Credit Hours
SI 64501	Agricultural Statistical Analysis	2	3	3
SI 64512	Advanced Soil Genesis	3	0	3
SI 64517	Land Use Planning	2	3	3
SI 64521	Irrigation Science Theory	2	3	3
SI 64522	Agricultural Drainage	3	0	3
SI 64524	Irrigation System Design	2	3	3
SI 64525	Groundwater Hydrology	2	3	3
SI 64532	Soil Biochemistry	3	0	3
SI 64534	Advanced Soil Fertility	3	0	3
SI 64541	Advanced Soil Physics	3	0	3
SI 64551	Advanced Soil Chemistry	3	0	3
SI 64523	Water Planning & Management	3	0	3
SI 64552	Soil-Water-Plant Analyses	1	6	3
SI 64553	Saline and Alkali Soils	1	3	3
SI 64555	Soil Plant Relationships	3	0	3
SI 64561	Clay Mineralogy	2	3	3
SI 64591	Graduate Seminar	1	0	1
SI 64592	Graduate Seminar	1	0	1
SI 94594	Special Topic	-	3-6	1-2
SI 64595	Selected Topics	1-3	3-9	1-3

B. A minimum of 6 credit hours from 400 and 500 levels from the other Departments of the Faculty and/or from the Faculties of Science and/or Engineering and/or the Department of Geography.

III Submit a Thesis Based on Scientific Research (12 Credit Hours)

DIPLOMA IN SOILS AND IRRIGATION
(A 2-Year Program)

University of Jordan
Faculty of Agriculture
Dept. of Soils and Irrigation
13/6/1983

The Diploma Program requires a minimum of 30 credit hours from 400 and 500 level courses as follows:

I. 15-18 credit hours of 400 level courses.

II. 12-15 credit hours of 500 level courses with SI 64591 as an obligatory course.

III. Students can take a maximum of two courses (or 6 credit hours) of 400 or 500 level courses from other departments of the University.

Special Considerations:

Students with B.Sc. in similar areas from other universities should take the following prerequisite courses:

SI 64351	Soil Chemistry
SI 64342	Soil Physics
SI 64331	Soil Fertility and Fertilizers
SI 64326	Irrigation Systems
SI 64324	Hydrology
SI 64323	Hydraulics

Students with a B.Sc. (from the University of Jordan) other than in Soils and Irrigation may be accepted in the program provided they take all the compulsory courses (see Part III-A) for the B.Sc. in Soils and Irrigation.

DESCRIPTION OF COURSES

University of Jordan
Faculty of Agriculture
Dept. of Soils and Irrigation
13/6/83

SI 64311 Principles of Soil Science (3 credit hours)(2 lectures + 1 lab)

Concepts of: soil properties, physical, chemical, mineralogical and biological; soil water; soil ecology; mineral nutrition of plants; genesis and classification of soils; soil erosion.

SI 64221 Principles of Irrigation and Drainage (3 credit hours) (3 lectures)

Basic principles of: soil-water relationships; soil moisture retention measurements of soil moisture; evapotranspiration; water movement in the soil; groundwater and well hydraulics; flow in pipes and open channels; irrigation structures; water measurement; irrigation methods, surface, sprinkle and trickle; irrigation scheduling and mangement; water quality and salinity; drainage.

SI 64324 Hydrology (3 credit hours)(3 lectures)

Principles of: hydrologic cycle; precipitation, infiltration, evaporation, transiration, groundwater; water losses; rainfall-runoff relations, hydrographs; stream gaging.

SI 64326 Irrigation Systems (3 credit hours)(3 lectures)

Irrigation system: design, surface, sprinkle, trickle; evaluation and management.

SI 64331 Fertilizers and Soil Fertility (3 credit hours)(3 lectures + 1 lab)

Principles of plant: growth; nutrient requirements, nitrogen, phosphorus, potassium, magnesium, calcium and micronutrients.

SI 64332 Soil Microbiology (3 credit hours)(3 lectures)

Study of: soil environment; important micro-organisms, distribution, abundance, nutritional needs, influence on favorable transformation in the soil; biological transformations in soil, nitrogen and carbon cycle; phosphorus; sulfur and iron; organic matter in soil; biological degradation of chemical compounds in soil; environmental pollution.

SI 64323 Hydraulics (3 credit hours)(3 lectures)

Study of: fluid properties, hydrostatic pressure forces, kinematics of fluid motion; continuity equation; force due to fluid in motion; energy equation; momentum equation; resistance to flow; dimensional analysis; flow in pipes; water flow in open channel.

SI 64342 Soil Physics (3 credit hours)(2 lectures + lab)

Study of: soil texture; soil structure; dynamic properties; soil moisture retention and movement; soil aeration; soil temperature; soil erosion.

SI 64351 Soil Chemistry (3 credit hours)(3 lectures + 1 lab)

Study of: chemical properties of colloidal system; exchange phenomena in soils; soil reaction and saline and alkaline soils; chemistry of individual plant nutrients.

SI 64391 Seminar (1 credit hour)(1 lecture)

SI 64416 Soil Conservation and Management (3 credit hours)(2 lectures + lab)

Study of: soil media, local distribution of different kinds of soil, conditions of formation; soil properties important in soil management; erosion, causes, kinds, measurement; (USLE equation) conservation measurement; management and reclamation of saline, alkaline, calcareous, acid and desert soils; modern approaches to conservation and

management; land use. Attendance at several field studies is required.

SI 64412 Soil Genesis and Classification (3 credit hours)(2 lectures+ 1 lab)

Study of: soil forming factors, climate, parent material, relief, time, living organisms; processes of soil formation with emphasis on local and regional conditions; description, interpretation and classification of soils; soil mapping; soil map interpretation; relation of soil maps to land use. Attendance of several field trips is required.

SI 64413 Soil Survey and Land Use (3 credit hours)(2 lectures + 1 lab)

Study of: soil surveys as an interdisciplinary science; concepts of soil series; kinds of soil surveys; kinds of soil maps; use of aereal photographs and satellite imageries in soil survey investigation; agricultural and non-agricultural interpretation of soil maps and soil information; quality control of soil surveys; land use mapping; agricultural zoning; productivity rating and land evaluation. A field project assignment is required.

SI 64422 Field Irrigation Practices (2 credit hours)(2 labs)

Study: equipment, installation, evaluation and management of surface, sprinkle and trickle irrigation; pump testing.

SI 64424 Water Resources (3 credit hours)(3 lectures)

Study: hydraulics of open channel flow, gradually varied flow, backwater curve computation; precipitation and runoff analysis; flood flow frequency analysis; flood routing; reservoir capacity analysis; spillways, gates and outletworks; occurrence of groundwater; groundwater hydraulics; transient flow; wells; groundwater yield; planning for water resource development.

SI 64426 Drainage (3 credit hours)(3 lectures)

Study: sources, effects and control of excess water in soils; theory of land drainage; land drainage in relation to soils and crops; drainage systems.

SI 64432 Plant Nutrition (3 credit hours)(3 lectures)

Study of: inorganic nutrition of plants, including essential elements, function, available forms, deficiency symptoms and correction; soil as plant growth medium, nutrient uptake and assimilation; factors related to nutrient availability; nutrition and plant growth, yield response and plant quality; growth in artificial media.

SI 64441 Soil-Plant-Water Relationships (3 credit hours)(3 lectures)

The importance and properties of water, soil water and plant water; the mechanisms of water absorption by roots and water movement inside the plant; evapotranspiration and the factors affecting it are studied.

SI 64453 Soil Reclamation (3 credit hours)(3 lectures)

Study of: ideal soils and the dynamics of soil degredation; formation, chemistry, characteristics, reclamation, management and use of a saline, alkaline, calcareous and gypsiferic soils.

SI 64491 Seminar (1 credit hour)(1 lecture)

Study: professional topic preparation; mechanics of successful oral presentation; preparation and use of visual aids; objective evaluation.

SI 64495 Special Problems (1-2 credit hours)(1-2 labs)

Thorough research analysis and written resolve of selected problems.

SI 64517 Land Use Planning (3 creit hours)(3 lectures)

Study of: factors affecting land use; land use systems in arid, tropical and temperate regions; soil survey methods, field sampling, aerial photography, remote sensing; land capability classification; land evaluation.

SI 64521 Irrigation Science Theory (3 credit hours)(2 lectures + 1 lab)

Study of: science of irrigation, length-of-run, land slope, size of stream; hydraulics for different methods; scheduling irrigation; optimization.

SI 64522 Drainage (3 credit hours)(2 lectures + 1 lab)

Physics of land drainage; investigations, design and installation of drainage systems.

SI 64523 Design of Irrigation Methods (3 credit hours)(2 lectures + 1 lab)

Study: design criteria for several irrigation methods; layout, design, estimating and installation of irrigation systems.

SI 64541 Soil Physics (3 credit hours)(3 lectures)

Water, gas and heat flow in soils; physical laws and application.

SI 64551 Soil Chemistry (3 credit hours)(3 lectures)

Study of: gas solution processes; precipitation and dissolution of solid phases; adsorption-desorption processes; oxidation-reduction; chemical thermodynamics of soils.

SI 64561 Clay Mineralogy (3 credit hours)(2 lectures + 1 lab)

Study of: clay minerals; classification and nomenclature of clay minerals; structure of clay minerals; chemical and physical properties; origin and occurrence; investigational methods.

SI 64591 Graduate Seminar (1 credit hour)(1 lecture)

Preparation and presentation of oral and written professional topics; objective evaluation.

SI 64592 Special Problems (1-2 credit hours)(1-2 labs)

SI 64594 Soil Fertility (3 credit hours)(3 lectures)

Study: theories of plant nutrient absorption, active and passive; nutrients translocation within the plants; ion antagonism; viets affect, anion-cations balance.

SI 64501 Agricultural Statistical and Regression Analysis (3 credit hours)(2 lectures + 1 lab)

Study: matrix approach to linear regression modeling; multiple regression analysis; selecting regression equations; orthogonal polynomials; standardized regression and analysis of variance as applied to biologically-related topics.

SI 64512 Advanced Soil Genesis (3 credit hours)(3 lectures)

Study: principles of taxonomy and classification, Russian, FAO, British, numerical; USDA system of soil classification, concept, approach; use as a sound tool in land use planning; emphasis on Jordanian soils; numerical classification (principle and concept).

SI 64523 Water Planning and Management (3 credit hours)(3 lectures)

Study: basic concepts of water resource planning; water inventories, use and control; multipurpose project planning; irrigation project development, simulation, optimization and management; production functions; strategy for using limited water supply; irrigation operation for optimizing water use.

SI 64525 Groundwater Hydrology (3 credit hours)(3 lectures)

Study: fluid flow through porous media, solution to steady state problems, seepage under dams, transient problems;

hydraulics of well; geophysical exploration and analysis; artificial recharge; well design; numerical and experimental methods for groundwater problem solutions.

SI 64552 Soil, Water and Plant Analysis (3 credit hours)

Study: methods of chemical and physical analysis for soils and plants as tools for soil characterization and plant response to mineral nutritient uptake; chemical analysis for water quality determination.

SI 64553 Saline and Alkali Soils (3 credit hours)(1 lecture + 2 labs)

Study: origin, nature, reclamation and management of saline and alkaline soils; plant response and crop selection.

SI 64555 Soil-Plant Relationships (3 credit hours)(3 lectures)

Study: physical processes affecting crop water balance and use; chemical and physical factors affecting the behavior of nutrients in the rhizosphere.

Prerequisite: Soil-Plant-Water Relationships 441; Soil Fertility and Fertilizer 331.

SI 64594 Special Topics in Soil and Irrigation (1-2 credit hours)(1-2 labs)

Study of selected topics in soils and irrigation.

Prerequisite: Approval of Deartment Head.

SI 64595 (1-3 credit hours)(1-3 lectures and/or 1-3 labs)

Study one or more topics related specifically to soil and irrigation, or agriculture in general.

APPENDIX B

FACULTY PUBLICATIONS AND RESEARCH

CONTENTS

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Faculty Publications*	B-1:5
Faculty Research	B-6:7

*All publications preceded by an asterisk (*) were reviewed by Keller -- brief review comments are included. Comments referred to in the M.Sc. Theses are included in the main body of this report.

PUBLICATIONS BY FACULTY MEMBERS OF THE
SOILS AND IRRIGATION DEPARTMENT (1982/83)

*1. Crop Production Functions as Influenced by Irrigation Amounts and Urea Fertilization Rates on Sweet Corn in the Jordan Valley. A. Abu Awad, A. Battikhi and I. Ghawi. Dirasat., Univ. of Jordan. Taken from M.Sc. Thesis by Awad. Same comments apply. Conclusion too brief -- no abstract or summary!

*2. Nitrate Movement as Influenced by Irrigation Amounts and Urea Fertilization Rates in the Jordan Valley. A. Abu Awad, A. Battikhi and I. Ghawi. Dirasat., Univ. of Jordan. Taken from M.Sc. Thesis by Awad. Same comments apply in general. Too much detail data. Scale of plots poor in horizontal direction. More creative analysis would strengthen. Too wordy.

*3. Constraints to the Successful Application of Modern Technology for Soil Conservation in Jordan. Part I - Environmental Features and Extent of Erosion. A. Battikhi and S. Arabiat. Dirasat., Univ. of Jordan. Appears to be well done comprehensive survey of important data and report on erosion.

*4. Wetting Fronts under a Trickle Source in Two Soils of the Jordan Valley. N. Hawatmeh and A. Battikhi. Dirasat., Univ. of Jordan. Paper taken from Hawatmeh's M.Sc. Thesis. Same comments apply. The analyses could be more imaginative and presented more clearly.

5. Casing Depths, Leaks and Solute Travel Time of Wells. A. Battikhi and Don Kirkham. Water Res. Bull. Aug. 1974.

6. Planting and Improving Date Palm Tree Growth in Kuwait. (In Arabic). A. Battikhi et al. Arab Organization for Agric. Development. Khartoum, Sudan.

7. Soil Conservation from Erosion. (In Arabic). A. Battikhi. A booklet submitted to the Royal Jordanian Society for the Conservation of Nature. Published by the Arab League Educational, Cultural and Scientific Organization.

*8. Some Physical Characteristics of the "Ghor-1" Soil Series in the Jordan Valley. A. Battikhi. Dirasat., Univ. of Jordan. A useful soils report.

*9. Water Utilization by Tomato Under Drip Irrigation in the Jordan Valley. J. Gassem, O. Judah and A. Battikhi. Dirasat., Univ. of Jordan (sent for publication). Taken from M.Sc. Thesis by Gassem. Same problems; this is a poor paper. Only report data, no analysis! Has some problem as thesis (30 cm root depth).

*10. Effects of Soil Moisture Tension on Yield and Quality of Tomatoes (Lycopersicon Esculentum Mill) Grown Under Plastic House Conditions in the Jordan Valley. M. Suwwan, A. Battikhi and O. Judah. Dirasat., Univ. of Jordan. Yields were 200 T/ha (double open field yields). Best yields at 50 cb as compared to irrigating at 30 or 70 cb. Might be condensed a bit. Needs Summary and Conclusions and better Abstract.

*11. Irrigation Scheduling of Tomatoes Grown Under Drip Irrigation. Inside Plastic Greenhouse in the Jordan Valley. A Battikhi, O. Judah and M. Suwwan. Dirasat., Univ. of Jordan. (Sent for publication). Same study as Paper 10 above. Some of same comments apply. Conclusions are not too helpful in terms of what I'd expect from the title. Used about 800 mm of irrigation in 6 months. Best irrigation about every 5 days at 50 cb tension.

12. Ammonia Volatilization from Ammonium Sulfate and Urea in Some Jordan Soils (Surface Application). N. El-Khattari.

13. Transformation of Urea and Ammonium Sulfate in Some Jordan Soils. S.K. El-Khattari and N. Kharabsheh.

14. Nitrogen Loss from Ammonium Sulfate and Urea Incorporated with Some Soils from Jordan. N. Kharabsheh and S.K. El-Khattari.

15. Response of Two Durum Wheat Varieties to Different Nitrogen Rates and Sources in Two Soils from Jordan. S. El-Khattari.

16. Laboratory Studies of Phosphorus Sorption by some Soils of Jordan. S. Khadar and T. Abu-Sharar. Dirasat. (Natural Sciences) Univ. of Jordan. (Accepted for publication)

17. Soils in Palestine, Palestininian Encyclopedia (under printing). S. Khader.

18. Characteristics of Jordanian Cement Dust. S. Khader and N. Abu Rub. (Accepted for publication), Dirasat.

19. The Potential Use of Jordanian Cement Dust as a Fertilizer. S. Khader and N. Abu Rub. (Accepted for publication), Dirasat.

20. Characterisierung Typischer Liby Schen Boden. II. Characterisirung der Tonminerale. S. Khader. Tagung der Deutschen Bodenkundlichen Besellschaft, Berlin, 1981.

21. Potassium Status of Jordanian Soils. S. Khader. 2. Conf. of Arab Union Biologists - Morrocc-Fes, 1982.

22. Mobilization of Fixed Phosphorus in Soils of the Jordan Valley. S. Khader. Conf. of Tropical Agriculture, Leipzig, 1983.

23. Relationships Between Air and Soil Temperature, Arid Tropical. Awni Taimeh. 1983. (Sent for publication)

24. Relationships Between Air and Soil Temperature, Semi-Arid Region. Awni Taimeh. 1983. (Sent for publication)

25. Relationships Between Air and Soil Temperature, Arid Region. Awni Taimeh. 1983. (Sent for publication)

26. Variation of Soil Properties within Agricultural Experiment. Awni Taimeh. 1983. (Sent for publication)

27. Paleoclimatic Changes During the Quaternary in Inbid Region. Awni Taimeh. 1983. (Sent for publication)

*28. Water Requirement and Scheduling Irrigation for Sweet Corn Under Sprinkler Irrigation in the Jordan Valley. A. Wail, O.M. Judah and M. Suwwan. Based on M.Sc. Thesis by El-Sharif -- same comments apply. Kc reasonable but ETP pan seem high? Needs Summary and Conclusions.

29. Effect of Three Soil Moisture Tensions on Growth and Yield of Sweet Corn Under Sprinkler Irrigation in the Jordan Valley. A. Wail, O.M. Judah and M. Suwwan.

30. The Effect of Wind Speed, Spacing and Operating Pressure on Water Distribution from Sprinklers. A. Subhi and O.M. Judah.

*31. The Effect of Drip Irrigation Frequency and Rate of Application on Tomato Production in the Jordan Valley. O.M. Judah. Yield of 100 T/ha with 4 lph emitters on 2, 4 or 7 day frequency are good, but Kc = 1.7 seems high. There seems to be a discrepancy in presentation of depth applied and ET. The research indicates that the average ET is 10 mm/day and EP is 6 mm/day over the 70+ day season.

32. Scheduling of Tomato Under Drip Irrigation. J. Qasem and O.M. Judah.

33. Effect of Saline Water on the Growth of Olive Seedlings. I. Al-Saket.

34. Effect of Date of Harvesting on the Oil Percentage of Different Olive Variieties. I. Al-Saket and S. Habbab. (Sent for publication)

35. The Uptake of Silicon from Silicate Minerals by Sunflower Seedlings. I. El-Saket. (Sent for publication)

36. Effect of Foliar Spray of Urea on the Alternate Bearing Habit of Olive Trees in the Baqa' Valley. I. Al-Saklet and S. Habbab.

37. Effect of Plastic Mulches on Soil Water Conservtion and Soil Temperature in Field Grown Tomato in the Jordan Valley. Sh. H. Haddadin and I. Ghawi.

*38. Effect of Plastic Mulches on Growth Yield of Tomato (Lycopersicon esculentum Mill.) Under Drip Irrigation in the Jordan Valley. Sh. H. Haddadin, M. Suwwan and I. Ghawi. (Sent for publication), Dirasat. Taken from M.Sc. Thesis by Haddadin -- same comments apply. No Summary and Conclusions.

*39. Root Distribution and Salt Movement Under Drip Irrigation. M. Shatanawi. Summer Meeting of ASAE, June 26-29, 1983, Bozeman, Mokntana. I edited and reviewed this paper for Shatanawi. It is potentially acceptable for publication in ASAE Transactions. It is interesting that the roots were concentrated in top 30 cm of soil.

*40. Replenishment and Depletion of Soil Moisture in the Northern Rainfed Area of East Jordan. I - Soil Series 11. M. Saimeh and A. Battikhi. Taken from M.Sc. Thesis by Saimeh. Same comments apply. Needs summary which projects economies and more extensive time data!

RESEARCH PROJECTS IN THE SOILS AND IRRIGATION DEPARTMENT

1. Soil Conservation in Jordan. A. Battikhi and S. Arabiat.

2. Wetting Fronts Under a Trickle Source in Some Soil of the Jordan Valley. A. Battikhi.

3. Tomato Production in Jordan Valley. M. Suwwan, A. Battikhi, O. Judah, O. Issawi and H. Al-Haj.

4. The Effect of Plastic Mulch on Soil Moisture, Temperature and Roots of Some Crops in the Jordan Valley. I. Chawi and A. Battikhi.

5. Consumptive Use Determination for Different Crops in Jordan Valley and Studying Salts and Fertilizers Movement. I. Chawi, A. Battikhi, O. Judah and R. Sharayha.

6. Effect of Polymers on the Soil Physical Properties, Water Holding Capacity and Yield in Different Regions in Jordan. I. Ghawi, M. Shatanawi and M. Kamal.

7. Effect of Water Levels and Fertilization on the Yield, Soil Content and Root Distribution of Soybean in Jordan Valley. I. Ghawi.

8. Effect of Different Mulches on the Water Conservation, Soil Temperature and Yield of Different Crops in Jordan Valley. I. Ghawi and A. Battikhi.

9. Properties of Saline Soils in Jordan Valley. A. Taimah.

10. Salinity Accumulation and Distribution Under Drip Irrigation Inside and Outside Plastic Houses. A. Taiman.

11. Sulphur in the Soils of Jordan. B. Hattar.

12. Requirements of Some Crops (Citrus, Cucumber, Tomatoes) for Micronutrients (Fe, Zn) in Different Regions of the Jordan Valley. B. Hattar.

13. Shading Effect on Vegetables Production. O. Judeh and M. Suwwan.

14. Development of Integrated Agricultural Programs on Controlled Environment Techniques Using Renewable Source of Energy. O. Judah.

15. Fertilizer and Irrigation Effect on Some Vegetables in Jordan Valley. O. Judah.

16. Surge Flow Surface Irrigation. M. Shatanawi.

17. Evaluation of Irrigation Efficiency in the Jordan Valley. M. Shatanawi.

18. Evaporation, Yield and Growth of Soybeans Using Continuous Irrigation Variables. I. Ghawi and M. Shatanawi.

19. Use of Water in Agriculture. M. Shatanawi.