

PURDUE UNIVERSITY
International Education and Research
International Programs in Agriculture



**PORTUGAL UNIVERSITY
INSTITUTES
DEVELOPMENT PROJECT**

(Contract AID/NE-C-1701)

**REPORT ON
SHORT-TERM STAFF ASSIGNMENT**

**Submitted by
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Purdue University**

October 11 - December 10, 1982

PDAAN 646

PORTUGAL UNIVERSITY INSTITUTES DEVELOPMENT PROJECT
(Contract AID/NE-C-1701)

REPORT ON
SHORT-TERM STAFF ASSIGNMENT
AND
LIVESTOCK IMPROVEMENT AND PRODUCTION SEMINAR

at the

Instituto Universitario de Tras-os-Montes e Alto Douro (IUTAD)
Vila Real, Portugal

and

Universidade de Evora (UE)
Evora, Portugal

October 11 to December 10, 1982

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1. Area of Assignment

- a. To serve as a resource person in the areas of Genetic Improvement of Livestock (selection, inbreeding, crossbreeding, standardization of production records and construction of selection indices), Research Methods and Data Analysis.
- b. To acquire knowledge of animal production methods, performance testing programs, native breeds and policies concerning importation of livestock in Portugal and to use this knowledge in developing ideas which may be used in genetic improvement programs in Portugal.

2. Specific Objectives of Assignment

- a. Serve as a resource person in the areas of Genetic Improvement of Livestock, Research Methods and Data Analysis through
 - (1) Presentation of 15 hours of lecture in a seminar on Animal Improvement and Animal Production given by Drs. Martin and Outhouse at IUTAD. The total course contained 30 hours of instruction.
 - (2) Administration, with Dr. Outhouse, of a Purdue University course (ANSC 691, 1 credit) for graduate credit at IUTAD. Enrollment was open to persons who participated in the seminar and who held the equivalent of a Baccalaureate Degree.
 - (3) Visiting classes and assisting and advising where possible in an effort to strengthen the teaching programs.
 - (4) Presentation of a seminar on Genetic Improvement of Livestock at University of Evora.
 - (5) Consultation with staff members at IUTAD and UE on general and specific problems encountered in selecting research topics, designing experiments and analyzing data.
- b. Visit farms, research stations and personnel involved in research and extension programs to acquire information on the status of Animal Improvement programs in Portugal.

3. Portuguese Counterparts

In the process of attempting to meet the objectives of the program and working through and with Professor John Foley and Dr. James Ahlrichs at IUTAD and Dr. John Sanders at UE, significant discussions and contact were established with the following persons:

a. At IUTAD, Vila Real

- (1) Dr. Joaquim Lima Pereira, Head of Zootechnia
- (2) Dr. Jorge Colaco, Animal Genetics
- (3) Dr. Jose Potes, Dairy Production and Reproductive Physiology
- (4) Engr. Jorge Azevedo, Sheep Production
- (5) Dr. Aura Colaco, Animal Physiology
- (6) Engr. Carlos Sequeira, Animal Nutrition
- (7) Engr. Arnaldo Silva, Animal Nutrition
- (8) Engr. Nuno Moreira, Pastures and Forages
- (9) Engr. Fernando Martins, Pastures and Forages
- (10) Engr. Virgilio Alves, Beef Production

b. At UE, Evora

- (1) Engr. Carlos Roquete, Beef Production
- (2) Engr. Jose Avo, Sheep Production
- (3) Dr. Nuno Potes, Head of Zootechnia and Animal Physiology
- (4) Engr. Jose Luis Tirapico, Physiology of Reproduction

4. Accomplishments with Respect to Objectives

- a. An itinerary of activities is attached as Appendix I. These activities will be described in sections relating to the specific objectives.
- b. Seminar on Animal Improvement and Production:
 - (1) The thirty (30) hour course described in Appendix II was presented over a three-week period (October 18 through November 5) and was augmented by three special seminars presented by Dr. Claire Terrill (U.S. Dept. of Agriculture), Dr. Fernando Orozco (INIA, Spain) and Dr. Neil McCall-Smith (farmer from Scotland). Sixty (60) persons attended the series of lectures. Translation was provided by Dr. Luis Monteiro of the University of Porto for the twelve (12) hours on Genetic Improvement of Animals and by Engr. Carlos Sequeira for the 18 hours on Sheep Production and Cattle Production. The lectures were well received, but would have been more effective if Drs. Outhouse and Martin had been able to present them in Portuguese.
 - (2) Twenty-six (26) of the persons attending the seminar held the equivalent of the Bachelor of Science degree. Thirteen (13) of these elected to register for graduate credit in Animal Science 691 and twelve (12) completed the course. In addition to attendance, an interpretive report was required. The student was to select a topic and present information on the current situation, policies affecting change, research needed, a proposed program of improvement and anticipated economic results of getting the proposed program adopted. The reports showed a wide range of analytical ability and served not only to stimulate analytical thought on the part of students but to inform us (Drs. Martin and Outhouse) of the status of the animal industry in Northern Portugal.

c. Assistance in Teaching

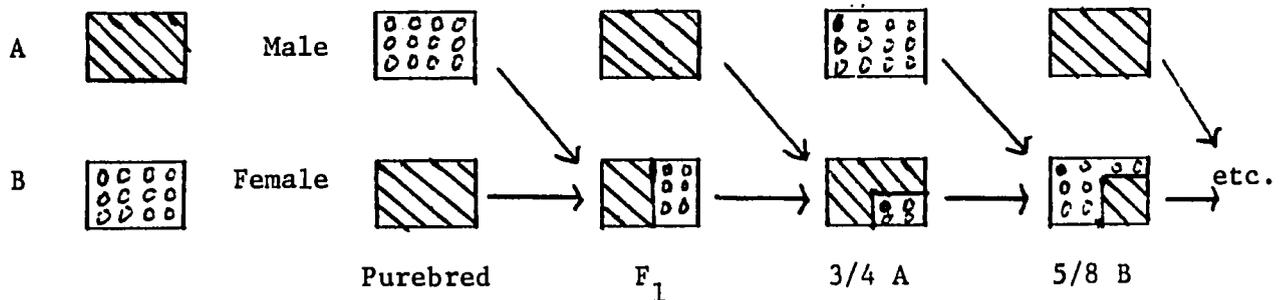
Two lectures were presented in the Dairy Production class taught by Dr. Jose Potes and several other class sessions were visited. Several discussions with Dr. Jorge Colaco concerned material included in Statistics and Animal Genetics classes. These experiences, plus numerous discussions with staff members, led to the general observation that the fundamental concepts are well covered in classes at Vila Real. The element that is missing in many courses is knowledge of methods of application and practical use of the material.

d. Seminar at Evora:

The seminar consisted of two parts. First was a synopsis of our 22-year project selecting Angus cattle for 365-day weight. The effectiveness of the selection program and the need for performance data on animals involved in the selection program were emphasized. Portugal is badly in need of performance data on dairy cows for milk yield, beef cattle for growth and reproduction, and sheep for growth, reproduction and, where appropriate, milk yield.

Second, a summary of a Purdue crossbreeding project was given. The 5 to 10% heterosis for growth rate of crossbred calves, plus the 15 to 20% heterosis for maternal ability of crossbred dams, were used as the basis for recommending consideration of a crossbreeding program in South Portugal where herds are larger.

The program recommended would involve two segments: first, a rotational program involving two maternal type breeds (breeding each cow to a bull of the breed least represented in that cow's pedigree). Designating the breeds A and B, the following diagram illustrates the system:



Breed A should be one of the local breeds well adapted to Alentejo conditions. Either the Mertolengo or Alentejano could serve in this role.

Breed B could be:

- (1) The other local breed so that the system would be a rotational cross between Mertolengo and Alentejano. Since the two breeds have similar origins, this cross would not be expected to produce maximum heterosis.
- (2) A dairy breed like the Friesian or Brown Swiss would put milk yield on the female side. This system has worked in other localities. However, the long dry summers with feed shortages will probably lead to cows of this cross failing to rebreed since it has been shown that high milk yield breeds will sacrifice reproductive cycling in favor of milk production.
- (3) Another beef breed of distinctly different origin. Breeds like the Angus (small size, high fertility and good maternal instincts) might be imported and breeds from Northern Portugal, such as the Marones, Aroquesa or Barracao, might be used.

The second part of the program would involve mating A x B crossbred cows (about 50%) to a rapid-gaining, large breed of sire (Breed C) such as Charolais or Simmental. All of these calves, both males and females, would be marketed as slaughter calves. The breed composition of slaughter calves might be:

<u>C</u>	<u>A</u>	<u>B</u>	<u>Dam</u>
1/2	1/4	1/4	F ₁
1/2	3/8	1/8	3/4 A
1/2	3/16	5/16	5/8 B
1/2	11/32	5/32	11/16 A

etc.

This program takes advantage of calf heterosis for growth, maternal heterosis, use of breeds with maternal ability as dams and large, rapid growing breeds as sires. The net effect might be as much as 30% greater productivity.

This program could be made to work in Southern Portugal, but would be much more difficult in Northern Portugal due to small herd size (one to 10 cows).

e. Consultation with Staff Members:

At IUTAD, discussion of research topics and analysis of data led to presentation of a three-hour session on least-squares analysis. This session was, unfortunately, attended by only four members of the staff. The situations with regard to staff composition, research needs and research facilities are very similar at IUTAD and UE.

At IUTAD, there are 10 full-time members of the staff with only one having completed the Ph.D. while at UE, there are 11 full-time members of the staff which includes one Ph.D. Those members who have not earned the Ph.D. hold D.V.M. or Engr. degrees with a few having earned the M.S. degree. Under Portuguese law, these staff members must obtain the Ph.D. within 8 years or face dismissal. As a result of this pressure, there is a great deal of desire to become involved in research in order to obtain the Ph.D. These young people have little training or experience in research methodology, and there is a distinct limitation on the animal and laboratory facilities available to them.

At IUTAD, the Quinta consists of 52 hectares and less than 10% of the land is allocated to support 85 cattle and 300 sheep and goats. At UE, the animal resources at the Mitra consist of 40 Friesian cows, 40 Alentejano cows, 33 sows and 5 Lusitano mares. However, possibilities of using herds belonging to Foundations and State Farms are much greater at UE than at IUTAD.

The research developments at both universities have run parallel courses.

- (1) The nutrition or forage evaluation research has advanced reasonable well with two staff members at IUTAD and one staff member at UE approaching completion of research which will be used as the basis for the Ph.D. dissertation. Work at IUTAD has concentrated on chemical treatment of straw to enhance its food value and evaluation of forages used in Tras-os-Montes and Minho. At UE, the work has been pointed toward describing forage intake, digestibility and composition at various seasons of the year. The equipment for routine and mineral analyses of forages is in place at both institutions.

- (2) Research on physiology of reproduction is just beginning at both places. Neither university has the sophisticated equipment needed to do radioimmunoassay estimates of hormonal levels present in the blood of animals. Neither university is equipped to preserve semen in the frozen state. At the present time, the only research possible would seem to be estimation of environmental (seasonal or climatic) or nutritional effects on female reproduction (conception, litter size in sheep and swine) or on male maturation and semen characteristics. This type of research usually requires large numbers of animals and often would not produce results having adequate precision if limited to the herds available on University Farms. It would be helpful if non-university herds could be used in research of this nature. As an aid to increasing productivity in Portugal, accurate knowledge of nutritional, seasonal and climatic effects on production is an important input in designing management systems. Estimation of hormonal levels provides basic type information of interest in describing the reproductive process but only occasionally provides information which influences managerial decisions.
- (3) Genetics or Animal Breeding research is almost non-existent in Portugal. INIA has some crossbreeding research, and the Director General Pecuaria (DGP) has instituted a milk testing program for dairy cattle. The most immediate need is for establishment of performance testing programs in all species. This cannot be accomplished by the Universities alone. In order to produce meaningful data for evaluation of selection or crossbreeding programs, the Universities and MACP of DGP must work together to establish national performance testing programs and to involve herds and flocks located on the farms operated by MACP. Establishment of national performance testing programs will be almost impossible in the absence of an effective Extension program. Through cooperation with the Procalfer program, there should be some data generated on sheep and goats which could be used to estimate genetic parameters and/or to evaluate crossbreeding programs.
- (4) Management systems research has not been instituted at either university. At IUTAD, virtually all animals are in confinement due to the small amount of land allocated to Zootechnia. At UE, the climate is such that confinement is really unnecessary. Some promising research topics would seem to be (1) effect of season of calving or lambing on reproduction, growth, utilization of feed available and profit, (2) effect of accelerated lambing on the above, (3) effect of using fenced paddocks and rotating pastures on forage production, (4) use of alternative feedstuffs such as acorns, and (5) value of performance tested sires. Some of these could be conducted with the limited herds available at the universities, but most would be more effective if larger numbers of animals were available.

In general, the young researchers have the following questions:
(1) What do I study? (2) What animals do I use? (3) How do I begin?
(4) What traits do I measure? They have not been trained in research methods and must learn. I feel that I provided a very small amount of help in the two months of my assignment. If funds were available to send some of the more promising ones out of the country for the Ph.D. and have them return with an obligation to guide others, it would provide momentum to the research program. A second alternative would be to provide a long-term advisor specifically chosen for research skills and versatility with regard to disciplines. It would also help solve the problem if those sent abroad were sent for 5 to 6 month periods. This would allow time to take some courses, analyze some data (from Portugal or the host institution) and observe how the research program is established at the host institution.

Cooperation between MACP and the Universities in initiating more research on the farms controlled by MACP is essential if the staffs at IUTAD and UE are to be involved in meaningful research efforts. This is a national problem and involves agencies other than the universities.

f. Knowledge of Portuguese Animal Agriculture:

During the two months, I visited 18 farms and observed agricultural operations while traveling from place to place. The structure of agriculture and land ownership is very different in Tras-os-Montes and Alentejo. Some conclusions are valid at one place and not at the other.

- (1) Farms and, consequently, herds are small in North Portugal. Performance testing would have to consider the village (rather than the herd) as the principal unit in estimating contemporary comparisons. Presence of common grazing lands belonging to each village requires negotiation with village leadership when contemplating programs which alter land usage.
- (2) The farm units visited in Southern Portugal were larger, and the direct application of the technology of animal improvement used in the United States would be much easier than in Northern Portugal.
- (3) The Mediterranean climate with a long dry period in the summer months creates serious problems in maintaining an adequate feed supply in all seasons of the year. Feed storage and/or animal production systems that exploit the fall and spring forage production levels should be investigated thoroughly.
- (4) Low quality and inadequate forage supplies constitute the largest problem in livestock production in all of Portugal.

- (5) The breeds of beef cattle present in Portugal provide an adequate base for development of crossbreeding programs. The Marones, Aroquesa, Baracao, Mirandesa, etc., are adapted to the climate and production systems of Northern Portugal while the Mertolengo and Alentejano breeds are well adapted to Southern Portugal. Crossbreeding systems can utilize these breeds in producing crossbred commercial cows. The major need for importation is that of sire breeds which have rapid growth. These breeds would serve as sires of commercial cattle. Expansion of performance testing programs is essential if growth and reproductive rates are to be improved in the native breeds.
- (6) Dairy production utilizes the Friesian or Holstein breed almost exclusively. A large proportion of these cows are being imported from Britain, Netherlands and Germany. A large proportion of the bulls and/or semen is being imported from the above countries plus the United States and Canada. The opportunity exists to utilize native Friesians more fully than is now the case. The utilization of native Friesians will require the formation of an adequate and comprehensive production testing system to (1) identify high producing cows as mothers of young bulls to be progeny tested and (2) cull low producing cows.
- (7) Observations on sheep and goat production do not differ from those of Dr. Outhouse. Improvement of reproductive rate, growth rate and milk production will rely on genetic improvement as well as improvement of feeding and management. The bases for genetic improvement will be performance testing programs, planned crossbreeding and introduction of a small number of new breeds.

5. Problems Encountered and Observed

a. Staff Development:

- (1) The young members of the staffs at IUTAD and UE are enthusiastic, energetic and intelligent. In order to meet the training requirements of Portugal (Ph.D. in eight years), most will need to earn the degree in Portugal. In order to facilitate such training, there is a need for additional land and animal resources, additional laboratory facilities and long-term advisors in Zootechnie.
- (2) Attendance of international meetings is almost impossible under the current budgetary and travel restraints. The pay level (relative to other European countries) does not allow the staff to pay their own expenses, money is usually not available to pay expenses, and University-owned vehicles cannot be taken out of the country without permission of the Ministry of Education. Attendance of meetings such as the European Association of Animal Production will serve to expose staff members to new ideas, provide impetus to development of their own research programs and update their instructional material. Portugal, the universities and the individual staff members can benefit from participation in international meetings.
- (3) Contact with Spanish research workers and teachers should be encouraged. Some of these people have been trained in Britain, United States, France and other countries. They share production problems with Portugal (i.e., La Coruna and Santiago with IUTAD and Badajoz with UE). Planned exchange of information can benefit both countries.
- (4) Library facilities at both IUTAD and UE are inadequate to support the desired teaching and research programs of the two universities.

b. Cooperation Between the Universities and Other Agencies:

- (1) Ministry of Agriculture, Commerce and Fisheries (MACP) operates several farms and stations in Portugal. Most of these are not involved in research programs and some of them simply produce crops, cattle and sheep in accordance with local custom and methods. These farms should be involved in testing and/or demonstrating advanced production technology. Closer cooperation between MACP and the universities could provide the land and animal facilities needed to promote research by IUTAD and UE staff members. The information generated would provide the basis for recommendations disseminated to farmers.
- (2) Procalfer, a project supported by USAID, has initiated a project to describe the production levels of Portuguese breeds of sheep and goats and to test a few breeds of sheep from other countries. This project and the universities could produce some mutual benefits by closer cooperation. Data generated could provide thesis material for geneticists and physiologists, and such analyses would enhance the rate of data interpretation in the project.

c. Extension Program:

Though MACP has an extension program, it is structured very differently from that in the United States. There are only a very few specialists or extension agents who have direct contact with farmers. There are few extension publications; however, a high percentage of farmers cannot read. If technology brought from abroad or developed in Portugal is to be used, it will be necessary to take it to the people through tours, demonstrations, videotapes, etc. Economic improvement of the agriculture industry is highly dependent on development of an effective extension program. Information which needs to be developed and disseminated to farmers includes (1) forage preservation techniques, (2) animal feeding recommendations and (3) methods of animal selection and performance testing.

d. Genetic Improvement of Animals:

- (1) Performance testing programs are almost nonexistent for beef cattle, sheep and goats and very limited for dairy cattle. The universities, MACP and INIA should have an interest in developing these programs. Considerable research will be involved in establishing the programs though much can be borrowed from work already completed in other countries. In order to get full participation from farmers, a functional extension program will be required. Improved levels of production and profitability of animal enterprises can be generated by identifying highly productive animals. Selection based on eye appeal can do little to improve production levels.
- (2) Crossbreeding programs used at the commercial level can improve beef and sheep production by 20 to 30%. An example was given earlier for beef cattle in Southern Portugal. The information generated by the Procalfer project can provide the basis for designing programs for sheep and goats. The universities and MACP could derive much of the basic information on the value of specific breeds in specific programs by cooperating in the utilization of animal facilities available on MACP stations. Crossbreeding must be carefully planned if it is to be fully effective. Haphazard crossbreeding may yield desirable results in the first two or three generations. However, the eventual result may be mongrelization and production levels little higher than those of the purebreds.
- (3) The government has a policy of preserving the native breeds. Most of the native breeds, being locally adapted, will have a place in a planned crossbreeding program. The planned program must continually go back to the purebreds for replacement stock. Therefore, in beef cattle, about 15 to 20% of the total cattle numbers should be performance tested and highly selected purebred cattle. The policy of preserving native breeds has both negative and positive effects.

6. Recommendations

- a. Provide funds to send some staff members abroad for Ph.D. training.
- b. Provide long-term advisors in Animal Science at IUTAD and UE. Knowledge of research methods and ability to work in several disciplines should be emphasized.
- c. Provide additional land and animal resources for research at the universities. This may be accomplished by cooperation with MACP.
- d. When sending staff members to the U.S., send them for five to six months instead of periods of two months or less. The longer term can provide a meaningful training experience while the short term may be little more than a visit.
- e. Make it possible for staff members to attend international meetings and promote information exchange with related groups in Spain.
- f. Improve library facilities.
- g. Promote cooperative efforts in research which involve the universities with MA' INIA and the Procalfer project.
- h. Establish an effective extension program.
- i. Establish national performance programs directed toward genetic improvement of all species of livestock.
- j. Extend the life of this program or a similar one. The Portuguese people are industrious, intelligent and friendly. They deserve our help and aid so that they can improve the productivity of their principle enterprise which is Agriculture.

APPENDIX I

Itinerary

<u>Date</u>	
Sep 23	Traveled from Lafayette, Indiana to Lisboa, Portugal.
Sep 24	Drove from Lisboa to Evora and visited with Dr. John Sanders.
Sep 25 to Oct 2	Vacation in Southern Portugal and Southern Spain.
Oct 3 to Oct 9	Attended World Congress on Genetics Applied to Animal Production which was held in Madrid. With Dr. Jorge Colaco, made initial contact with Dr. Fernando Orozco (INIA, Spain) and Dr. Rafael Alenda (INIA, Spain).
Oct 10	Drove from Madrid to Evora and visited with Dr. John Sanders and Dr. Charles Rhykerd.
Oct 11	Official beginning of AID assignment. Drove from Evora to Lisboa, met Dr. John Foley, and traveled by train from Lisboa to Oporto and by automobile from Oporto to Vila Real.
Oct 12	Met with Reitor Fernando Real and Vice-Reitor Joaquim Lima Pereira to discuss program at IUTAD, visited the Quinta of IUTAD, and met several members of the staff.
Oct 13-14	Began preparation of overlays to augment those prepared in the U.S., organization of slides from Purdue, and outlines of material for course on Animal Production and Breeding. Attended opening session of the course given by Dr. Claire Terrill.
Oct 15	Traveled to Oporto with Engr. Jorge Azevedo, Dr. Jorge Colaco and Dr. J. B. Outhouse. Met with Dr. Luis Monteiro concerning organization of the course on Animal Production and Breeding.
Oct 16	Prepared overlays and material for lectures to be given in the first week of the course.
Oct 18 to 22	Presented twelve (12) hours of lecture on Animal Breeding (Improvement) and completed preparation of materials for lectures. Visited with Dr. Jose Potes, Dr. Jorge Colaco and Dr. Luis Monteiro concerning possible research programs in Tras-os-Montes.
Oct 25 to 29	Visited with Dr. Jorge Azevedo concerning sheep production in Tras-os-Montes, Engr. Arnaldo Silva concerning nutrition of dairy cows in Tras-os-Montes, and Dr. Aurea Colaco concerning physiological research at IUTAD. Attended eight (8) hours lecture by Dr. J. B. Outhouse and gave one-hour lecture on Rations for Dairy Cattle and one-hour lecture on Beef Carcass Evaluation in the Course on Animal Production.

<u>Date</u>	
Oct 30 to Nov 1	Weekend holiday in Spain with a visit to the La Coruna Station of the INIA, Spain, on Monday. Excellent research in Animal Improvement, Soil Fertility and Pasture Development was observed and discussed with Dr. Rafael Alenda and colleagues.
Nov 2	Prepared material for the last presentation in the Course on Animal Production and attended two hours lecture by Dr. J. B. Outhouse.
Nov 3	Traveled with Dr. Jose Potes and Engr. Virgilio Alves to Famalacao to visit the Cooperative of Milk Producers. Mr. Ferreira and Dr. Antonio Fernandes explained the operation of the Cooperative and showed us one collective milking parlor and one private herd. Attended two (2) hours lecture by Dr. J. B. Outhouse.
Nov. 4-5	Visited with three (3) staff members concerning the topics of reports to complete one credit hour of Graduate Credit at Purdue University. Presented one-hour lecture on Feeding Beef Bulls and attended one-hour lecture by Dr. J. B. Outhouse.
Nov 8	Traveled with Dr. Jose Potes, Dr. J. B. Outhouse and Mr. Neil McCall-Smith of Scotland to Aveiro to visit the Estacion Fomento de Pecuaria. Dr. Jaime Machado, Dr. Joaquim Goncalves and Miss Rosa Canha described the artificial insemination, performance testing of cows and young bull rearing program of the station. Visited a collective milking parlor operation.
Nov 9	Visited with three (3) staff members concerning topics of research for credit. Visited the sheep, goat and cattle units of the IUTAD Quinta.
Nov 10	Traveled with Dr. Jose Potes, Dr. Jorge Colaco and Mr. Neil McCall-Smith to Malhadas and Mirando do Douro. Dr. Julio Miguel and Engr. Jose Moreno explained the herdbook and artificial insemination work with Mirandesa and Friesian cattle. The commercial flock of Galego Mirandes sheep was observed.
Nov 11	Traveled with Dr. Jose Potes and Mr. Neil McCall-Smith to Lamego. Dr. Mario Fernandes of MACP explained the program of that office and hosted a visit to one herd of Aroquesa cattle and one dairy herd of 24 Friesian cattle.
Nov 12	Read the report of Dr. Warren C. Foote, Consultant to PROCALFER, dated August 31, 1982 and began preparation of notes for explanation of Least-Squares Analysis for staff members at IUTAD.
Nov 15	Read and evaluated five (5) reports for credit in ANSC 691. Met with Engr. Madureira, Director of Extension Service for Tras-os-Montes.

<u>Date</u>	
Nov 16	Read and evaluated three (3) reports for credit in ANSC 691. Attended seminar by Mr. Neil McCall-Smith and participated in closing exercise for the Course.
Nov 17	Traveled with Dr. Jose Potes and Engr. Virgilio Alves to Macedo de Cavaleiros and Mirandela (Valongo Station). Dr. Casimiro Escudeiro and Dr. Isabel Xavier explained the herdbook, artificial insemination and production testing programs of the MACP and hosted a visit to the station where the Friesian cows and Churra Badano sheep were observed. At Valongo, the crossbreeding of Sarda and Badano breeds of sheep was observed and was described by the farm manager. Well-designed plot studies of wheat and triticale were also observed.
Nov 18 to 19	Read and evaluated four (4) reports for credit, visited with staff members concerning research programs, and continued work on Least-Squares lecture.
Nov 22	Visited with Dr. Fernando Orozco (INIA, Spain), Reitor Real and Vice-Reitor Lima Pereira concerning possible exchange of information between Portugal and Spain. Completed preparations for lecture on Least-Squares and attended seminar given by Dr. Orozco.
Nov 23	Began work on final report and presented three (3) hours of lecture on least-squares analysis of data having unequal subclass numbers to four (4) staff members.
Nov 24	Completed arrangements for travel to Evora, visited with three members of the IUTAD staff, and continued work on final report.
Nov 25	Met with Reitor Real, Vice-Reitor Lima Pereira, Dr. J. Ahlrichs and Dr. J. B. Outhouse to discuss program at IUTAD and continued work on final report.
Nov 26	Worked on final report and lecture to be given at University of Evora.
Nov 29	Traveled with Dr. Jose Potes to Santarem.
Nov 30	a. Visited Fonte Boa Station of INIA and observed sheep, cattle and horse research work underway. Dr. Pires DaCosta, Dr. Ramiro Mascarenhas, Dr. Gabriel Barata and Dr. Luis Gomes explained the management, genetics and physiology programs of the station. Excellent research facilities were observed at this station. b. Visited MACP Station at Pegoes where Engr. Andre Dordio described the background of the Friesian dairy herd and the imported herd of Hereford cattle. Advice was given regarding future use of the Hereford herd. c. Traveled to Evora.

- Date
- Dec 2 Traveled with Engr. Jose Avo, Engr. Carlos Roquete and Dr. J. B. Outhouse to visit the Lazirias Station near Vila France de Xira. Dr. Nuno Potes and Engr. Jose Luis Tirapico were present during the visit of the largest state-owned farm in Portugal. The 21,000 hectares provide pasture and feed for 2000 beef cows (Mertolengo, Alentejano, Charolais and crossbred), 2000 ewes (Merino Precose by Merino), 140 dairy cows (imported Dutch and English Friesians) and a herd of Lusitano horses. The research potential of this farm is almost unlimited if funds can be identified.
- Dec 3 With Engr. Jose Avo, Engr. Carlos Roquete and Dr. J. B. Outhouse, visited Herdade das Oliveiras where Mr. Jose Potes showed us his farm operation involving 160 Merino Precose ewes, 60 Charolais by Alentejano crossbred cows and 100 Friesian cows. The problems of low forage production from subterranean clover were seen clearly. Also visited Fonte do Abade where the owner, Mr. Jose Capoulas, showed us his pedigreed herd of 250 Alentejano cattle. This farm is operated similar to those of pedigree breeders in the U.S.
- The last visit was to the Potes family farm, Vale de Melhorados, where we saw a herd of 110 Mertolengo cows. Based on the size (400 kg mature weight) and reproduction (calving interval less than 12 months), this breed seems to have traits making it desirable as a maternal breed.
- Dec 4 Met with members of the staff of the Department of Zootechnia to discuss research and extension programs. Observed students in extra-curricular activity of branding cattle at the University Farm (Mitra).
- Dec 5 Social afternoon with the Roquete and Avo families.
- Dec 6 Visited the farms of the Almeida Foundation which contributes to educational program in the Alentejo. They operate 7500 hectares with approximately 500 cows in Alentejano, Charolais and crossbred groups. Conferred with members of the staff of the University of Evora concerning research and extension programs.
- Dec 7 Presented seminar on Selection and Improvement of Cattle in the Alentejo and visited with Reitor Azevedo.
- Dec 8 Traveled from Evora to Lisboa.
- Dec 9 Visited with Mr. Buchanan and his colleagues at the AID office. Met with Dr. Carlos Fontes, Head of Director General Pecuaria of MCAP, and discussed the Portuguese Animal Industry. Visited very briefly with Dr. Warren Foote, Consultant to Procalfer, and discussed relationships between the Purdue project and the Procalfer project.
- Dec 10 Traveled from Lisboa, Portugal to West Lafayette, Indiana.

APPENDIX II

Seminar on Animal Improvement and Production

Offered at Vila Real, Portugal

Fall, 1982

Sheep Management - J. B. Outhouse

1. Accelerated lambing

Utilization of breeds with a short anestrus period and adapted to out-of-season breeding to reduce the lambing interval to 8 months, resulting in 3 parturitions in 2 years.

2. Highly prolific breeds for increased productivity

Utilization of breeds with the genetic potential to produce from 2-5 lambs per parturition. In crossbreeding with indigenous breeds producing 1-2 lambs, this can result in from 2-2.5 lambs per parturition for greater lamb productivity and greater milk production.

3. Artificial rearing of lambs

Rearing lambs on a cold, liquid milk replacer from birth to weaning. Composition of milk replacer powder and necessary equipment, training and feeds.

4. Management of lambs

Diseases and nutritional requirements of nursing lambs, treatment and prevention of nutritional deficiencies, creep feeding to supplement ewe's milk and weaning procedures.

5. Reproductive physiology

Effects of light, temperature and nutrition on reproductive performance, hormonal control of reproduction, reproduction with exogenous hormones, fertility testing of rams, pregnancy testing of ewes, artificial insemination and diseases of reproduction.

6. Milk production in sheep and goats

Factors affecting milk production, composition of milk, length of lactation, hormonal control of lactation, anatomy of the udder, nutritional requirements of lactation and lactation rations.

7. Confinement rearing systems

Housing and floors for confinement, feeder space requirements, systems of feeding, rations for confinement, adaptable breeds, behavior patterns in confinement and manure disposal.

8. Sheep handling facilities

Sorting chutes, foot baths, dipping tanks, lambing pens, feeders and waterers, loading chutes, buildings, creep for lambs and sheep equipment.

9. Carcass evaluation

Live and carcass grading, measurements to obtain yield grades, live and carcass weights, and quality factors.

10. Diseases and parasites of sheep and goats

Common diseases associated with young, nursing and growing lambs and kids, common diseases of sheep and goats, internal and external parasites of sheep and goats, and the prevention and control of each.

11. Nutrition of sheep and goats

Nutritional requirements, intermediary metabolism, ration formulation for growth, reproduction and lactation, and the kinds and utilization of pastures and forages.

Genetic Improvement of Animals and Cattle Husbandry - T. G. Martin

1. Genetic and environmental effects on animal performance

Relative importance of genotypic and environmental effects on animal performance. Heritability of major traits.

2. Changing mean level of performance through selection

The roles of heritability, selection differential and generation interval as factors influencing change in performance. Results of a long-term selection study will be reported as an example.

3. Estimating breeding value

Use of performance records on progeny, parents, siblings and other relatives to improve selection accuracy.

4. Performance testing

Adjustment of records for major environmental influences. Specific considerations in designing testing programs for dairy and beef cattle and sheep. Use of computers.

5. Selection for multiple traits

Formulation of the selection index and expected change in individual traits.

6. Inbreeding

Measurement of inbreeding and relationship. Effects of inbreeding on major economic traits.

7. Crossbreeding

The concept of heterosis (hybrid vigor). Relative importance of hybrid vigor in the offspring and in the parents. Systematic approaches to crossbreeding, including specific crosses, rotational crossbreeding and formation of new breeds. Relationship of crossbreeding to pure breeding.

8. Selecting animals for crossing ability

Selection on the basis of performance of progeny or siblings as crossbreds. Choice of breeds to be used in various crossbreeding systems.

9. Breeding for specific environments

Discussion of the nature of genotype by environment interactions with examples of situations where this is and is not important.

10. Nutritive requirements of growing bulls and lactating cows

The protein and energy required for various rates of growth and lactation. Utilization of local feedstuffs will be included in the discussions.

11. Carcass evaluation of cattle

The importance of fat cover, carcass weight, maturity and conformation will be discussed.