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**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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Department of Animal Sciences
Purdue University

May 17 through June 21, 1985

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

REPORT ON
SHORT-TERM STAFF ASSIGNMENT
AT THE
UNIVERSIDADE DE EVORA (UE) ,
EVORA, PORTUGAL

May 17 - June 21, 1985

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PORTUGAL UNIVERSITY INSTITUTES DEVELOPMENT PROJECT

Report on Short-term Staff Assignment

Area of Assignment

- To serve as a resource person in the areas of research methodology, analysis of experimental data and design of experiments.
- To acquire knowledge of agricultural methods in Portugal and to relate these to the research program.

Specific Objectives of Assignment

1. To serve as a resource person in the areas of research methodology, analysis of experimental data and design of experiments through:
 - a) Presentation of 30 hours of lecture in a Seminar on Research Methodology;
 - b) Consultation with staff members at UE on general and specific problems encountered in selecting research topics, designing experiments and analyzing data derived from ongoing research.
2. Visit farms, research stations and personnel involved in research programs in order to acquire information regarding the status of agricultural research programs in Portugal and, if necessary, to advise changes in the research program or animal management program of a given station. Particular cases are described in Appendix III (Daily Log of Activities) under May 27 and June 17.

Portuguese Counterparts

Significant discussions and contacts were established with the following persons:

Dr. Afonso de ALMEIDA, Animal Nutrition
Engr. Jose AVO, Sheep Production
Dr. Elvira BAPTISTA, Escola Superior, Santarem
Dr. Ofelia BENTO, Forage Evaluation
Dr. Monte COSTA, Meat Science
Dr. Maria Ermalinda PINHEIRO, Plant Science
Engr. Luis FERNANDES, Swine Production
Dr. Artur MARINHO, Animal Nutrition
Dr. Jose Luis NUNES, Reproductive Physiology
Engr. Carlos ROQUETE, Cattle Production
Dr. Cancela ABREU, Animal Nutrition
Dr. Nuno POTES, Head, Department of Zootecnia

Accomplishments with Respect to Objectives

Seminar on Research Methodology:

The thirty (30) hour course outlined in Appendix I was presented over a four-week period (May 23 through June 19). There were 22 persons who attended one or more lectures. Lectures were given in English and were well received. Considerable discussion was generated in both the lecture sessions and consultation sessions. The degree of comprehension and understanding appeared to be high based on problems submitted for consultation. A list of those who attended the lectures is provided in Appendix II.

Consultation with Staff Members:

In consultation, 10 scientists were provided specific recommendations to resolve data analysis problems or improve experimental design. The problems ranged from cases of very simple analysis of variance or regression to situations involving confounding and unequal subclass numbers. Many of the research workers have knowledge of statistical methods and need to use that knowledge and gain confidence in their ability to use statistics in data interpretation. It appears that the staff members gained considerable knowledge and confidence from the material included in the seminar. I was very pleased with the response to the seminar and the progress made by staff members in analyzing results of experiments.

Visits to Farms and Research Stations:

Forage utilization, forage production, sheep production and other laboratories were visited on the UE campus. On weekends and holidays, travel and visits with farmers provided some additional knowledge of Alentejo agriculture.

An itinerary of activities is attached to this report as Appendix III.

Problems Encountered and Observed

The young members of the staff at UE are enthusiastic, energetic and intelligent. In order to meet the training requirements of Portugal (Ph.D. in eight years), the research program of each will require knowledge of statistics. Limited help is available at UE.

Members of the staff have some basic skills in statistics, but lack confidence in their ability to use those skills. Further consulting effort and consulting through correspondence are desirable to help develop confidence.

Library facilities need to be expanded to provide the information needed to support an expanded teaching and research program.

Additional computer programs and staff training to promote usage of the computer are needed in order to simplify data analyses.

Limitations in research facilities and animal resources place limitations on the kind and scope of experimentation which can be conducted. Augmentation of research facilities and animal resources would allow more comprehensive experiments to be conducted.

Recommendations

The AID project should provide some followup of this assignment by having one or more persons return to UE to consult with staff members on experimental design and data analysis. Alternatively, or in addition to a followup visit, arrangements could be made for consulting by mail. UE staff should be encouraged to contact Purdue consultants by mail with regard to questions concerning data analysis and experimental design. If problems and questions are well defined, this procedure could work satisfactorily.

Develop consulting capability at UE by providing the opportunity for a small number of UE staff members to obtain training in statistics

in the U.S. The necessary graduate training in methodology could be obtained as part of graduate training in an applied area such as plant science or animal science. The minimal level of training needed to function as a consultant would require commitment of at least one academic year to training in the U.S.

Expand the available computer programs to provide more computer help in analyzing data at UE.

Provide additional research and animal facilities for UE research programs.

Expand the library facilities.

APPENDIX I

Course Outline
Seminar on Research Methodology

APPENDIX I

RESEARCH METHODOLOGY

Presented at

Universidade de Evora

Evora, Portugal

May 23 through June 19, 1985

1. The Scientific Method:

- a. Development of hypotheses
- b. Testing hypotheses
- c. Type I and Type II errors

2. Variability and Measures of Variance:

- a. The normal distribution
- b. Degrees of freedom
- c. Distribution of means
- d. Sample size and number of replications
- e. Standard error of the mean and of differences between means
- f. Additive and multiplicative coding of data

3. Considerations in Planning Experiments:

- a. Definition of the problem
- b. Identifying important factors
- c. Selection of characters to be measured
- d. Inference space
- e. Replication and experimental error
- f. Power of the experiment

4. Tests of Significance:

- a. Chi-square
- b. t-test
- c. F-test
- d. Statements of probability

5. Analysis of Variance, One-Way Classification:

- a. Characteristics
- b. Calculations
- c. Random or fixed models
- d. Subsamples
- e. Pooling error terms
- f. Variance components
- g. Tests of significance
- h. Tests of differences between pairs of means
- i. Trend analysis

6. Analysis of Variance, Multi-Way Classification:

- a. Characteristics
- b. Interaction
- c. Effect of blocking
- d. Calculations
- e. Tests for comparison of paired means
- f. Graphic presentation of interaction
- g. Comparison of treatments when interaction is present
- h. Selection of proper error term
- i. Unequal numbers of observations in cells of the design including analysis when numbers are proportional
- j. Analysis of unequal subclass number data by method of equally weighted means

7. Regression Analysis with One Independent Variable:

- a. Functional relationships between dependent and independent variables
- b. Statistical relationship between variables
- c. Calculations
- d. Assumptions and limitations
- e. Variance due to regression, lack of fit and true error
- f. Tests of significance
- g. Variance of a predicted value

8. Correlation Analysis:

- a. Relationship with regression
- b. Calculations
- c. Tests of significance
- d. Intra-class correlation

9. Multiple Regression:

- a. The mathematical model
- b. Normal equations and calculations
- c. Interpretation of results
- d. Inference space
- e. Correlations among independent and dependent variables as a factor influencing the prediction equation

10. Curvilinear Regression

- a. Use in interpreting trends of treatment means
- b. Relationship to polynomial coefficients
- c. Fitting polynomial curves by multiple regression techniques
- d. Constructing the response curve or surface and locating points of optimal response
- e. Logarithmic, exponential, square root and reciprocal functions which are intrinsically linear
- f. Comparison of two intrinsically linear functions by using residuals

11. Analysis of Covariance:

- a. The mathematical model
- b. Assumptions
- c. Reduction of error mean squares
- d. Calculations
- e. Effects of covariance when the independent variable is affected by treatments

12. Estimation of Missing Plots:

- a. By covariance
- b. By minimizing error mean square

13. Design of Experiments:

- a. Factors considered in design
- b. Completely randomized design
- c. Randomized complete block design
- d. Complete block with factorial treatments
- e. Complete block when blocks are treatments
- f. Nested designs
- g. Split plot designs
- h. Split plots in time and space
- i. Latin Square
- j. Replicated Latin Squares
- k. Crossover designs
- l. Switchback designs

APPENDIX II

Persons who Attended the
Seminar on Research Methodology

APPENDIX II

Persons attending one or more lectures in the seminar on Research Methodology were:

Jose Antunes Afonso de Almeida, Zootecnia
Jose Maria Santos Arteiro, Quimica
Jose Jeronimo Mira Godinho Avo, Zootecnia
Elvira Sales Baptista, Escola Superior Agraria Santarem
Suzana Souto Barreiros*, Zootecnia
Joao Manuel Mota Barroso, Fitotecnia
Ofelia Pereira Bento, Zootecnia
Americo Jose do Monte Costa, Zootecnia
Maria Ermelinda, Fitotecnia
Luis Antonio Domingues dos Santos Fernandes, Zootecnia
Ricardo Freixial, Fitotecnia
Angelina Maria Coelho dos Santos Godinho*, Zootecnia
Paulo Jorge Guia*, Zootecnia
Artur Armando de Moura Marinho, Zootecnia
Maria Manuela Barreiros Martins*, Zootecnia
Antonio Manuel Murilhas*, Zootecnia
Jose Luis Tirapicos Nunes, Zootecnia
Acacio Manuel Pereira*, Zootecnia
Carlos Jose dos Reis Roquete, Zootecnia
Jesuria de Fatima Rosalino*, Zootecnia
Maria do Rosario, Fitotecnia
Jorge Manuel Reis Salgueiro*, Zootecnia

*Fifth year students

APPENDIX III

Daily Log of Activities

APPENDIX III

Daily Log of Activities

- May 18 Traveled to Lisbon and checked into the Hotel Rex.
- May 19 Carlos Roquete and family met us at the Hotel Rex and transported us to Evora where we checked in at the University Mitra Guest House.
- May 20 I visited with Carlos Roquete, Jose Avo and Jose Luis Tirapicos Nunes concerning the course and later observed cattle weighing and sheep shearing at the Mitra Farm. Avo, Roquete and I reviewed the statistical programs available on the UE computer and discussed the feasibility of some research projects. In the afternoon, I visited with Mr. Soto in the UE office of AID.
- May 21 I began work on the seminar materials and visited with Dr. Nuno Potes, Head, Department of Zootecnia. We arranged the schedule for lectures in the seminar, hours for statistical consulting and dates for some farm visits.
- May 22 I worked on seminar materials and had the first set of material duplicated. In the afternoon, I consulted with Dr. Jorge Simoes of INIA, Fonte Boa on methods of conducting contrast analyses of data.
- May 23 I continued preparation of seminar material and presented the first session of the seminar. In the afternoon, I visited with Mr. Soto and with Engr. Lino Lucio in the UE computing center. We arranged to obtain copies of computer program instructions which may be used in conducting statistical analyses of data.
- May 24 Preparation of seminar materials was continued and the second session of the seminar was presented.
- May 25 Seminar materials were prepared in the morning and we traveled to Alcacovas and Mourao in the afternoon.
- May 26 Seminar materials were prepared in the morning and we visited with Drs. Ofelia Bento and Monte Costa in their home in the afternoon.
- May 27 I traveled to Odemira with Carlos Roquete and Canceleda Abreu where we visited with Jose Figueiro of the Odemira Cooperative concerning dairy herd operations. There are approximately 5,000 cows in the cooperative in herds ranging from 25 to more than 100 cows each. We visited the Experimental Farm where we observed that the corn silage was overly mature, the hay was low quality, the concentrate mix was very finely ground and in small pellets, concentrate feeding only in the milk parlor did not allow adequate consumption to support high levels of milk production, detection of estrus was inadequate and there was inadequate usage of the records in selection of cows. A program should be initiated to (1) improve the nutritional levels, (2) improve heat detection methods and (3) computerize the record keeping system. These programs should, as rapidly as possible, be adopted by all herds in the cooperative.

- May 28 Seminar materials were prepared in the morning and I visited with Rector Azevedo in the afternoon. Afonso Almeida and Luis Fernandes described experiments which they desired to initiate in the near future.
- May 29 Seminar materials were prepared and the third session of the seminar was given in the morning. Afonso Almeida and I worked on the designs for two trials concerning evaluation of forages.
- May 30 The fourth and fifth sessions of the seminar were presented and I consulted with Dr. Maria Ermalinda on design of a field trial involving levels of application, fineness of grind and method of application of limestone. We visited Jose Luis Tirapicos Nunes and his wife in their home in the evening.
- May 31 Seminar materials were prepared and the sixth session of the seminar was presented in the morning. In the afternoon, I visited with Cancela Abreu concerning design of an experiment to test the effects of energy content and protein content of the diet on levels of hay consumption and digestibility.
- June 1 Seminar materials were prepared in the morning and we visited Jose Avo and his family, in their home, in the afternoon. We also traveled to Estremoz and Vila Vicosa with the Avos.
- June 2 I prepared seminar materials in the morning and we visited with Carlos Roquete and his family, in their home, in the afternoon. We also traveled to Evora Monte with the Roquetes.
- June 3 Seminar materials were prepared in the morning and visited with Maria do Carma in the afternoon. Telex was sent requesting DHIA and computer programs from Purdue. Worked with Afonso Almeida on interpretation of regression analyses and with Maria Ermalinda on analysis of covariance.
- June 4 I prepared seminar notes in the morning and met with Luis Fernandes concerning design of a swine feeding experiment in the afternoon. A major problem in the design was the fact that only eight pens were available and the number of treatments had to be reduced.
- June 5 Roquete, Avo and I traveled to Portalegre to attend the Agricultural Fair for Alentejo. We visited with several breeders of Alentejana cattle.
- June 6 This was a national holiday. I worked on seminar notes in the morning and finalized designs associated with two consulting problems in the afternoon.
- June 7 I developed seminar notes and gave the seventh session of the seminar in the morning. Consulting in the afternoon included (1) cattle feeding experiment with Carlos Roquete, (2) finalization of design of the swine feeding experiment with Luis Fernandes, (3) analysis of forage digestibility data with Elvira Baptista and (4) interpretation of regression analysis with Ofelia Bento.

- June 8 We visited shops in Evora in the morning and I completed preparation of the seminar notes in the afternoon.
- June 9 We visited in the home of Luis Fernandes and his family in Reguengos and traveled with them to Monsaraz.
- June 10 This was a national holiday. We visited the castle of Giraldo Sempavor and I completed work on two consulting problems.
- June 11 Avo, Roquete and I attended the National Agricultural Fair in Santarem. The national and international exhibits were very informative about the status of animal agriculture in Portugal.
- June 12 The eighth session of the seminar was presented in the morning. Jose Avo received help in the analysis of data concerning the effect of supplementary feed on preweaning growth of lambs. Afonso Almeida received help in the interpretation of data relating protein digestibility to tannin content of the diet.
- June 13 I presented the ninth session of the seminar and visited the Murteira farm. The principal enterprise on the farm is cattle rearing with emphasis on a breeding herd of Alentojana cattle. Luis Fernandes received help in the analysis of data relating pig growth rate to energy content of the diet fed to the dams.
- June 14 The tenth session of the seminar was presented. Ofelia Bento received help in the analysis of data on lactic acid assay of forages and in the design of an experiment to test the effects of type of forage on performance of pregnant and lactating ewes. Carlos Roquete received help in the design of a study to characterize breed and genetic effects in beef cattle data from the Lazerias farm and the Almeida foundation.
- June 15 We traveled to Arriaolos, Estremoz and Vila Vicosa.
- June 16 I continued the discussion of a possible genetic analysis of beef cattle data with Carlos Roquete in the morning. We visited the Avo family in their home and on the family farm in the afternoon.
- June 17 Carlos Roquete, Dr. Nuno Potes and I traveled to Lazerias Farm. We observed the beef herds and discussed the management and genetic research opportunities. The greatest difficulty to be overcome, in order to use the herds effectively, is that of cow and calf identification. We visited the dairy herd to try to identify ways of improving the level of milk production. The greatest problem appeared to be nutritional with solutions including (1) increase the protein content of the total diet by fortifying silage with nitrogen or by increasing the protein content of the concentrates to 20 or 22% (2) slightly earlier harvest of the corn silage. Genetic improvement of the herd could be accomplished by (1) using available records to identify low producing cows and culling (2) importing U.S. and Canadian semen to breed dairy cows and heifers and (3) using beef heifers as recipients of frozen embryos of high genetic potential. In the evening, we visited in the home of Maria do Carma and Pedro Silveira and their family.

- June 18 The eleventh session of the seminar was presented. Maria Ermalinda received advice concerning design and analysis of three field trials. The analyses of sheep data concerning growth, feed consumption and carcass data were discussed with Jose Avo. Possible designs for studies of accelerated lambing, use of meat-type rams on Merino ewes, estimation of age at puberty, feasibility of breeding ewes to lamb at one year of age and effects stocking rate in pastures were discussed with Jose Avo.
- June 19 The twelfth session of the seminar was presented and was followed by lunch as the guest of principal participants in the seminar. Consultations included (1) Ofelia Bento concerning use of regression analysis (2) Jose Avo concerning analysis of data on supplementary feed for preweaning lambs and (3) Afonso Almeida on interpretation of a cubic response curve. I also visited Rector Azevedo in the afternoon.
- June 20 I visited with Carlos Roquete concerning analysis of cattle growth and measurement data. We traveled to Lisbon with the Roquete family and checked into the Hotel Diplomatico.
- June 21 I visited with Jose Luis Pinheiro at the USAID office in Lisbon and concluded the project assignment.
- June 21 While on vacation, we visited Fernando Delgado and his wife in Coimbra and I saw the facilities of the Escola Superior in Coimbra. We also
to
June 30 visited our many friends in Vila Real and I helped three persons with data analysis and experimental design questions.