

BEST AVAILABLE DOCUMENT

The Small Ruminant CRSP in Morocco

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Introduction

Collaborative research between US CRSP and Moroccan scientists was initiated in 1981 in the areas of Range, Sociology and Nutrition, with a Breeding/Reproduction project added in 1982. Collaboration from IAV scientists in other disciplines was initiated in 1984-85, with the addition of a Farming Systems component to the Sociology project; Parasitology, to the Range project; and Environmental Physiology, to the Breeding/Reproduction project.

Both the Range and Sociology projects have concentrated their efforts to date in range production systems, mostly in the Middle and High Atlas, while the Nutrition and Breeding/Reproduction projects have focussed work at IAV's Tadla Farm, representing a mixed crop-livestock production system with a combination of grazing and confinement feeding of harvested forages and by-product feeds. In the first system the work involves both sheep and goats, while in the second the work to date has been with sheep only.

Because of the differences between these two systems and of the importance of both to total sheep production in Morocco, it has been decided in 1985 to formalize the emphasis on the two systems in the Morocco CRSP in the future. Coordinators have been appointed to bring together program participants within each of the two systems, and to coordinate work on development of technology packages suitable for field testing and application. An overall coordinator will continue to provide leadership for the Morocco CRSP as a whole.

The sections which follow present descriptions of the two systems and a short summary of current and projected work in each. Areas of potential complementarity and collaboration between the two are then listed, followed by a general discussion of possible future directions of the CRSP in Morocco.

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2. Production Systems

Throughout Morocco, sheep production systems can be classified according to the respective importance of the range forages and farm-produced feeds in meeting the nutrient requirements of animals. We can, therefore, schematically identify two major types of systems:

2.1. SYSTEM 1 in which farming provides an important part of the animals' needs (mixed crop-livestock production system).

2.1.1. Cereal producing Zones

In these zones, the annual ovine feeding calendar can be summarized as follows:

June to October:	stubble
October to January:	straw, concentrated feed and range
January to June:	fallow and range

In this system, sheep production is closely tied to cereal production: lambs benefit from grazing young barley, ewes use stubble and straw; barley grain is used by all of the animals. According to the significance and the quality of the range, its position in the feeding calendar varies.

The practice of fallow grazing is justified by farmers for the maintenance of the level of fertility of the soil and for meeting the animals' needs at the same time.

Concentrated feeds are given especially at the time of lambing and during periods of rain and cold.

Examples of regions: Settat, Casablanca, Tanger, Meknès, Fes, Khemisset, Rommani...

2.1.2. Irrigated Zones

In these regions, the sheep production system can be similar to the preceding if irrigation has not brought about the following modifications:

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The fallow and range have virtually vanished

- Industrial cultivation and planting provide significant quantities of by-products which can be used by sheep: olive foliage, citrus foliage, beet leaves and tops, by-products of market gardening
- cultivated forages exist but are basically reserved for milk cows.

Under these conditions, the feeding calendar for sheep is generally:

June to October:	stubble, by-products, grazing by roadways and canals
October to January:	straw, concentrated feeds, by-products, grazing by roadways and canals
January to June:	transhumance to a range area situated close to an irrigated perimeter

Examples of regions: Tadla, Gharb, Tassaout, Haouz

A notable exception to this system is that of the Ziz and Draa valleys where the ovine feeding calendar scheme is:

February to November:	green alfalfa, straw and by-products
November to February:	alfalfa hay, straw and by-products

In this case, alfalfa replaces fallow, stubble and range at the same time.

1.2. SYSTEM II in which range lands provide for the animals' basic needs year-round.

In this case, small ruminant (goats as well as sheep) production is based, above all, on the range (clear or in forest) which provides for up to 90% of the animals' total requirements per year. The rest of the requirements are met by:

- stubble between June and October
- straw and concentrated feeds between December and March, during lambing/kidding or times of severe cold,

Examples of regions: Middle Atlas, High Atlas, Anti-Atlas, Oriental...

Relative Importance of the Different Systems

Table 1, based on 1982 survey results, gives an idea of the relative importance to Morocco of the previously described production systems. (This relates to sheep; for goats, a higher proportion of animals are found in System II.)

<u>SYSTEM</u>	<u>NUMBER OF HEAD (1000's)</u>	<u>%</u>
System I		
Cereal producing zones	4100	42
Irrigated zones	2100	22
System II	3500	36
	<hr/>	<hr/>
TOTAL	9700	100

This table shows that the cereal producing zones are sustaining more than 40% of the actual total sheep, followed by the regions predominated by range areas and then by the irrigated zones. This distribution should be considered a rough estimate, given the overlap in the majority of the country of production systems I and II, previously defined.

3. Present and Projected Activities

3.1. Mixed crop-livestock production system

3.1.1. Goals and present status

Projects presently involved in this system include Breeding/Reproduction, Nutrition and Environmental Physiology.

The general goals of the program are to develop new knowledge which can be translated into information to increase the efficiency of sheep production within this agricultural system in Morocco.

Specific goals of the Breeding project are:

1) to evaluate the potential of sheep carrying varying proportions of inheritance from the prolific D'Man breed, in combination with the larger but less prolific Sardi, for increasing efficiency of sheep production in this system

2) to develop information on means of utilizing these sheep effectively in the area, and to carry out field evaluations of the sheep and accompanying production technology.

3) A more basic scientific goal of the project is to determine the genetic basis of the exceptional prolificacy of the D'Man.

Goals of the Environmental Physiology component of this project are to quantify physiological differences between the different genetic types, in responses to the wide temperature and humidity variations of the area, and similarly to compare ewes carrying one, two or three lambs. This information can then contribute to development of improved management systems for sheep of different production potential.

Goals of the Nutrition project are:

1) to develop information on the feeding value of different forage and by-product feeds of potential use to sheep producers with traditional types of sheep for the area.

2) to collaborate in developing efficient feeding programs for sheep of improved genetic potential.

Research with sheep at IAV's Tadla Farm was initiated in 1982. Prior to that time there had been no livestock on this 262 Ha farm, on which the principal crops are wheat, alfalfa and sugar beets. A major emphasis of the Breeding

project has been development of facilities for a 600-ewe breeding flock; CRSP Prolific Sheep Project and County Work Group Funds have also contributed to this development. In 1984 the first part of the facilities for nutrition studies were completed. These facilities provide for individual as well as group feeding. Extension of these facilities in 1985 will provide the capability for carrying out nutritional trials on a larger scale, using both growing lambs and adult ewes from the breeding project.

By the end of 1985 five lamb crops will have been produced in a 36 month period on an accelerated lambing schedule. The mating plan has been designed to provide for a comparison of animals carrying 0, 25, 50, 75 and 100% prolific breed inheritance. Evaluation of these sheep will contribute to the objectives of the breeding project, and the flock will also provide animals for the proposed field tests. Data from these animals will be used for the dissertations of three doctoral candidates in the Reproduction and Animal Production Departments at IAV.

Data on the performance of the two parent breeds and F_1 crossbred offspring, and on the effects of season/nutrition on reproduction and growth of these sheep are currently being analyzed and prepared for publication. Marked breed differences in degree of seasonality of mating activity and marked seasonal effects on lamb growth rate have been documented. These results will be used in the development of plans for effective exploitation of the different types.

Some data have been recorded on wool production, and animals in the project are scheduled to be used in a study to help define goals for selection for improved wool production of Moroccan breeds. This aspect of the work is expected to have applicability to range production systems as well.

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Two surveys of sheep production operations in the Tadla area (dryland and irrigated) have provided information on the importance of sheep in the area, size and structure of flocks, feed resources and feeding systems used, reproductive rates and overall productivity.

The Tadla Farm is the major site for the evaluation of feed resources locally available, which include cultivated forages (alfalfa, clovers), crop residues (straw and stubble) and agro-industrial by-products (beet pulp, citrus pulp, waste palm dates). Some data have been collected on the value for growing animals of mixed rations containing alfalfa and various types and amounts of by-products. This information will provide the basis for improved feeding programs to increase meat production. Publications are now prepared on these topics. Data on nutrient requirements of different breeds of sheep are now being analysed at the ENA Meknès and will be published later.

3.1.2. Expected status of the work in 1987

Completion of facilities, including working corrals and nutrition research pens, is necessary for more intensive research at Tadla Farm.

The Nutrition group will focus efforts on the study of stubble grazing by pregnant ewes during summer. Surveys planned will provide a more complete diagnosis of current practices with regard to use of stubble. Long term and repeated experiments at the Station are needed to develop sufficient understanding of the nutritional contributions and limits of stubble as a feed resource and to come up with practical recommendations for farmers.

Animals from the breeding project will be used in studies of genotype-nutrition interaction. The main factors to be studied include level of intake; diet quality; stocking rate and seasonal effects; influence of grain species, variety and yield; and supplemental strategies.

By 1987, characterization of the D'Man and Sardi breeds \otimes F_1 crossbreds should have reached the stage of making recommendations to producers. Based on the estimates of F_1 performance to date, it is planned to initiate field trials with F_1 rams, and these should be underway by 1987.

Detailed evaluation of contemporary purebreds, F_1 's, F_2 's and backcrosses (0, 25, 50, 75 and 100% of each parent breed) will be approaching mid-point, but because of the need to evaluate mature ewe performance, this phase cannot be completed before 1989 or 1990.

Environmental Physiology research on D'Man, Sardi and F_1 ewes will be initiated at Tadla Farm in 1985. By 1987, this should have produced results from that environment, to compare with those previously obtained with Moroccan breeds of sheep in a location with less extreme temperature variation, where breed differences in response to stresses have already been well documented.

The project on nutrient requirements and carcass evaluation of different breeds and crosses, including the D'Man, currently being carried out at ENA, Meknes will be integrated more closely with the Tadla CRSP project beginning in 1985, including exchange of animals. This will provide information on another component of performance of the Tadla Farm animals. Also, ewes of different groups from the Tadla flock may be compared at ENA Meknes in 1986-87, in a terminal crossing program, adding to the information on performance of ewes of different potential in different management systems.

By 1987 two participants in the program, one from the Animal Production Department at IAV and one from ENA, Meknes should have completed doctoral research, based primarily on work at other locations, but also involving CRSP work at Tadla. Several more doctoral candidates from IAV will be in mid to late stages of their doctoral research, based primarily on animals in the CRSP projects at Tadla, and

other third cycle and doctoral students are expected to use Tadla Farm animals. These candidates represent several areas, including Genetics, Reproductive Physiology, Nutrition, Environmental Physiology, Biochemistry and Veterinary Medicine. Thus by 1987 the Tadla research flock will be a major focus of sheep research for IAV.

3.1.3. Expectations if project is continues to 1990

As indicated above, several aspects of the work cannot be completed by 1987. In fact the project has progressed very rapidly, through prompt development of facilities and use of an accelerated lambing schedule. However, breed evaluation and development of new combinations require a minimum of two generations, and estimation of lifetime performance requires at least five years. With the first lamb crop in this research program born in 1983, 1990 is the earliest that a comprehensive evaluation of the different types can be completed.

Several aspects of the Nutrition research program are also long term, requiring repetitions across years for full validation, and thus work toward the current goals will not be complete by 1987. Also, one of the key IAV participants in the Nutrition project will be just returning from the U.S. phase of his graduate training in 1987.

Work to be carried out during the period 1987-1990 would include:

- 1) Completion of the phase II genetic evaluations, and assessment of the basis of inheritance of the D'Man prolificacy.
- 2) The major part of the work on genotype x nutrition/management interaction, to assess the suitability of different types to different management systems.
- 3) Collection of data on reproduction and wool and lamb production on progeny of Tadla Farm rams placed in field tests.

- 4) Studies of the responses of ewes pregnant with one, two or three lambs, and of growing lambs, to the stresses of high ambient temperatures under different levels of nutrition.
- 5) Evaluation of production technology systems for higher genetic potential sheep under field conditions, involving collaboration of Genetics, Nutrition and Physiology projects and, it is hoped, with input from Economics, Sociology and Parasitology.
- 6) Initiation of selection programs for improving growth and wool traits of existing breeds and improved strains developed in the project.
- 7) Evaluation of stubble as the main source of feed for sheep during gestation and early lactation.
- 8) Nutritive value of some poor quality forages (straw) and good quality forages (alfalfa) produced in the Tadla area.
- 9) Nutritive value of some by-products available in Tadla (caroub, molasses, beet tops and leaves). These data will be used as part of the doctoral thesis of a faculty member in Nutrition.
- 10) Nutrient requirements for growing lambs and ewes during gestation and lactation.
- 11) Carcass evaluation of different breeds under different levels of nutrition
- 12) Fattening rations for lambs
- 13) Field testing of economical feeding schedules based on data collected

3.2. Grazing and rainfed mixed farming system (Middle and High Atlas mountains)

3.2.1. Background and goals

Grazing and rainfed mixed farming are common land use in the Moroccan mountains. These ecosystems represent 35% of the total rangeland of the country, and are the home base of respectively 25% and 35% of the sheep and goat populations recorded in Morocco. Demographic pressure in

these regions and the resulting expansion of cultivation into lands previously devoted to livestock and silviculture are causing overgrazing, loss of vegetation cover and acceleration of erosion processes.

The herd productivity in these mountains is usually low. This is the result of poor nutrition, inadequate husbandry practices and insufficient control of parasites. In addition to these biological constraints, social limitations imposed by the collective nature of land use are worsening this situation. Consequently most pastoralists in these areas are operating at a subsistence level, and their incomes are extremely low.

The Middle Atlas and High Atlas mountains have received in the past different levels of attention from the government of Morocco. While the Middle Atlas has a well established administrative infrastructure and benefitted from several development programs during the last decade, the High Atlas remains an extremely isolated region that has received almost no attention except from a few academic investigators. In both situations, however, the opportunities for improvement and progress are great. The approach to fulfill these opportunities requires the definition of an intergrated package of technology adapted to these regions and including recommendations on range development, animal husbandry and animal health practices. In parallel an understanding of the social constraints to the functioning of the pastoral system is needed in order to earn the pastoralists' support for such packages.

Existing programs related to the target system

Disciplines involved in the target system described above include range management, sociology, farming systems and parasitology. The overall research goal of the sub-projects proposed by these disciplines is "to increase small ruminant productivity through an improvement of the

forage resources and production efficiency." Specific objectives of each subproject are as follows:

Range Management

- a) an ecological assessment of range forage resources, in which the ecological potential for important range sites are being determined, in addition to monitoring of plant community changes in relation to physical environment and land use.
- b) an understanding of plant-animal relationships, including the description of the annual forage cycle and animal feeding behavior, the examination of forage intake in relation to nutritive requirements, and the evaluation of animal performances.
- c) an investigation on range management and improvement techniques, such as the effect of grazing pressure and pattern on the plant community composition and production in addition to the definition of establishment characteristics of selected rangeland plant species.

Sociology

- a) description of the context in which small ruminant producers make decisions about animal production
- b) identification of the role of animal production and its interaction with other activities
- c) evaluation of the effectiveness of traditional Moroccan resource management systems, particularly the "Agdal" pasture reserve system, as a range management tool.

Farming Systems

- a) characterization of the evolution and the actual situation of sheep production in the High Atlas
- b) assessment of the interaction between components of farm systems

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c) definition of sound systems of sheep production and the identification of actions to be demonstrated by extension services for each system.

Parasitology

- a) determination of the parasitic fauna infesting sheep in the Middle Atlas
- b) evaluation of the degree and rate of infestation throughout the seasons
- c) establishment of the parasitic population kinetics and hence the period(s) requiring action for parasitic control in the Middle Atlas.

Accomplishments to date

Since parasitology and farming systems became components of SR-CRSP in Morocco in FY 1984-85, only range management and sociology disciplines will be considered in this section.

Research accomplishments

Field research in Morocco was initiated in 1981-82. In general, the data collected so far led to the basic understanding of the small ruminant production systems operating in the site being investigated. They also allowed to identify some of the biological and social constraints limiting the efficiency of these systems.

More specifically, the Sociology group conducted an exhaustive survey of the Rheraya valley in the High Atlas. The data generated from this survey will allow a thorough description of the agro-pastoral system in use in this region. In addition a study of the transhumance phenomenon was undertaken in order to identify the relative importance and contribution of summer ranges. The biological soundness of the deferment of a portion of these ranges ("agdal") was also examined.

The Range group on the other hand concentrated its effort in three range sites in the Middle Atlas: the oak woodland (El Hajeb - Ifrane), the mountain grassland (Timahdit) and the sagebrush grassland (Boumia). Data produced by this group allowed an assessment of the ecological and grazing potentials of plant communities investigated. Thus, the seasonal changes in the biomass, nutritional quality and palatability of key plant species were evaluated for the three range sites. In addition, effects of stocking rates and grazing systems on the survival of desirable plant species and animal performances were (or are being) elucidated. Preliminary recommendations could already be drawn from the available data. These recommendations relate to the nature and the period of dietary supplementation of grazing sheep and goats, definition of the proper grazing pressure, indications on grazing plan allowing regeneration of degraded sagebrush sites, and adaptability of different perennial grasses to low rainfall areas.

Institution building

SR-CRSP funds contributed to the equipment of basic laboratories for nutrition and ecophysiology at both IAV Rabat and ENA Meknes. These funds also helped initiate a range experimental station at Boumia. In addition funds allocated by the SR-CRSP permitted the organization of a special session on range problems and research in Morocco at the Second International Rangeland Congress held in May 1984 in Australia. During this session, ten technical papers were presented by American and Moroccan scientists (six of them involved in the SR-CRSP project).

Training

Education was a highly valuable accomplishment of SR-CRSP in Morocco. Two Moroccan faculty participants in the CRSP are completing doctoral research in range with partial support from the CRSP. Three American students

... supported by SR-CRSP to complete their Ph.D. (1) and MS (2). In addition, the SR-CRSP provided partial support to eight Moroccan students at the MS degree level and 12 at the BS degree level.

3.2.2. Expected status of the program by 1987

During the last three years, the research output was remarkable in the Middle Atlas and the High Atlas sites, as illustrated by the number of publications (10) and student theses (1 Ph.D., 10 MS, and 12 BS).

As we would expect, during this first phase of the project, efforts were primarily discipline oriented. At present, given the amount of baseline information collected, all participants are recognizing the need for more integration among disciplines. In this context the parasitology and range management activities are fully integrated, likewise for sociology and farming systems. Also, toward these ends, the disciplines involved are beginning to develop an adapted package of technology to be used as a pattern by the pastoralists.

3.2.3. Areas of potential collaboration between the Range and Mixed Crop-Livestock Production system components of the Morocco SR-CRSP

The descriptions and plans outlined above emphasize the distinctive features and research needs of the two production systems. However, there are important areas of common interest, and regular communication, with collaboration where appropriate between scientists working in the two systems, is an important goal of the Morocco CRSP.

Some areas of common interest include:

- 1) Information on feeding value of various feedstuffs or combinations of feeds developed at Tadla for the

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crop-livestock production system may be very useful to range production systems where supplements are fed at certain times of the year.

2) The development of a grading system for Moroccan wool and of selection criteria for improvement of fleece quantity and quality should be applicable to both systems.

3) While improved prolificacy is not a goal for the harsher range areas, in the better range areas some increase in twinning may prove to be advantageous (as it has in range areas of other countries). In these situations, use of rams from strains of intermediate prolificacy developed at Tadla could prove to be advantageous.

4) Design and conduct of field tests of improved feeding and management practices and improved genetic stocks in either system will benefit from input from sociologists and economists familiar with the goals and methods of the CRSP.

The SR-CRSP in Morocco Beyond 1987 - 1990

It is easy to justify continuation of SR-CRSP activities in Morocco beyond 1987, for many of the same reasons that the program was initiated in 1982, and because of progress to date. As indicated in the preceding sections, several aspects of the work underway, by the nature of the work, will require several years to complete. However, the level of the SR-CRSP program beyond 1987 will depend on several unknowns, both internal and external.

Justifications include:

- importance of small ruminants to Moroccan rural economy and food production.
- the potential for extrapolation of data from Moroccan ecosystems to many other countries of North Africa, the Middle East and the Sahel.
- maturity and seriousness of purpose of the Hassan II Institute and ENA Meknes.
- built-in training component, with 3rd cycle thesis students at Rabat and 2nd cycle memoir students at Meknes.

- built-in extension component, with existing formal and informal linkages of Hassan II Institute and ENA with Direction d'Elevage and producer associations.
- built-in international component, with participation of 2nd and 3rd cycle students from a dozen or more countries throughout all of Africa.
- the investment in facilities and laboratory improvement already made by the U.S. and Moroccan institutions, at the Tadia Farm especially but also at Rabat and Meknes, over the 1982-85 period; the return from this investment has just begun to be realized.
- better understanding of the correct research questions has now evolved; more time is needed to generate answers.
- a large investment by other USAID projects (such as the University of Minnesota program) in scientist training is still underway; by 1987-88 many more scientists will be trained to the Ph.D. level and will be available as collaborators. Continued financial support to these well-trained people will yield great rewards for the SR-CRSP, for the Moroccan institutes, and for the individual scientists.

The optimum level of SR-CRSP activity for the 1987-1990 period is more difficult to predict. Certain information, not yet available, will help in this assessment. Some unknowns include:

- overall funding level of the SR-CRSP worldwide after 1987.
- potential success of the new emphasis on developing technology packages for testing in two major ecosystems, launched this year.
- success in forming meaningful linkages with other development projects in Morocco.
- success in attracting new funding from USAID/Rabat or elsewhere.
- finding budgetary flexibility to fund interdisciplinary projects and expand the team of scientists (perhaps to include visiting scientists from outside Morocco).

Based on the situation with regard to each of these points, the optimum program of the SR-CRSP could be fixed at any one of the following alternatives.

1. Major expansion. This will happen only with an infusion of outside funds. Internal funding of the SR-CRSP as it is presently organized will not allow any program expansion, and may not keep up with inflation. However, in other countries participating in the SR-CRSP, there has been significant augmentation of CRSP activities through funds from other sources (U.S.A.I.D. Mission and other agencies), and such opportunities may develop in Morocco also.

2. Stay as we are with about four U.S. institutional projects, each with several Moroccan collaborators. This will be an attractive alternative if the new coordination and technology testing endeavors succeed.

3. Terminate the entire program in 1987. This is the "worst-case" option and hopefully will not come about. Also, if the SR-CRSP funding must be withdrawn for any reason, a concerted effort by all parties should be made to find alternative funds for all productive elements of the program.

MOROCCO HOST COUNTRY FUNDS

INCOME

Host Country Funds	\$138,000
End of Project	5,000
Vehicles (End Project funds)	<u>9,000</u>
	\$152,000

EXPENSES

Overhead	\$ 19,000
Site Coordination	30,000
Integration	17,000
Nutrition	20,000
Sociology	15,000
Range Research	19,000
Genetics	20,000
Pick-up truck	9,000
Photocopier	<u>3,000</u>
	\$152,000