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9. ABSTRACT

This study develops recommendations to help the Tunisian sheep industry become more efficient. One of the objectives of the Tunisian Ministry of Agriculture's five year plan is to increase sheep production. The 5,600,000 people of Tunisia consume fifteen kilograms of meat per person per year, and this consumption is expected to rise. Lamb seems to be preferred over beef and the importation of meat has risen steadily. Thirty-four farms were visited for this study and consultations were held with various agricultural agencies. The report describes the current status of the sheep industry including production, imports, government objectives and programs, characteristics of Tunisian sheep breeds, sheep management, reproductive physiology, and sheep diseases. Specific and detailed recommendations are presented in the areas of nutrition, disease control, lambing, marketing, genetic improvement, management, and technical assistance. The study concludes that coordination between agencies and within the Integrated Livestock Project is fundamental to an effective extension sheep program and that U.S.A.I.D. should assist the O.E.P. in developing these programs.

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A STUDY OF SHEEP PRODUCTION IN TUNISIA

by

James M. Sachse  
Extension Sheep Specialist  
NEW MEXICO STATE UNIVERSITY

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I. ACKNOWLEDGEMENTS

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## II. INTRODUCTION

The purpose of this study was to analyze the Tunisian Sheep Industry and develop recommendations which hopefully will be adopted in part. My analysis and evaluation of the existing sheep production practices were obtained largely from interviews with producers, large as well as small, government-owned and privately-owned. Each field visit broadened my knowledge and I regret that time limitations restricted these field visits to about 7 weeks. During this period 34 farms were visited.

In addition to the sheep farm visits, numerous consultations were held with representatives of various GOT agriculture agencies.

Realistically, this report cannot be an answer to all the problems. Hopefully the major problems are identified, with sufficient recommendations to help the Tunisian sheep industry to become more efficient. Tunisia has a real opportunity to develop its rich natural resources and become self-sufficient in meat production. With education and the acceptance of technology there is no reason why the Tunisian sheep industry should not make significant advances in its production efficiency.

### III. SUMMARY OF RECOMMENDATIONS

The following condensation of recommendations is abstracted from the body of this report. Hopefully, the reader will refer to the sections describing the situation and explanation of recommendations for a fuller understanding.

#### A. NUTRITION

Nutritional deficiencies at the critical stages of late gestation, and early lactation, are the most apparent limiting factors to efficient sheep production, particularly when lambing in the fall.

1. A supplementation program and/or improved pasture grazing systems in late gestation and lactation is recommended.
2. Current supplementation practices, including oat-vetch hay do not meet requirements. Concentrates must be more widely used.
3. Mineral and vitamin supplementation, particularly phosphorus and vitamin A, should be encouraged.
4. Flushing the ewes prior to breeding should be strongly encouraged. Additional research is needed when breeding in the fall.
5. Rams should receive 300 grams of concentrate daily prior to and during the breeding season.
6. Lambs should be creep fed beginning at 2-3 weeks of age, when being produced in an intensive management system.
7. Early weaning is recommended as a method of reducing the stress on ewes in drought conditions, and to improve the lambs growth rate when fed at a young age.
8. More lambs need to be fed on improved pasture or in drylot to heavier slaughter weights.
9. Water is a limiting nutrient to efficient production in the south.

Hauling water to sheep grazing in areas without water should be considered.

10. Concentrate production must be capable of meeting increased demands of livestock industry. Consideration should be given to using high-energy olive pulp currently being discarded.

B. DISEASE CONTROL

1. A national coordinated effort of all livestock GOT agencies is needed to educate and inform the producer of disease prevention programs-- which includes basic management principles as well as vaccination, drenching, dipping etc.

2. Internal parasite control should be expanded to include strategic planned treatments which coincide with the season of the year and existing production system. One treatment per year is not sufficient for sheep in the north. Different products should be used on a rotational basis.

3. Dipping programs for sheep scab must be continued. Additional facilities either portable or permanent, are needed to reach the remote areas. Large farms, especially GOT farms, should strive to eradicate sheep scab, and prevent reinfestation by raising replacements, quarantining and treating all purchased sheep, and keeping small nomadic flocks off the farm.

4. Sheep pox vaccinations must be continued.

5. As sheep production becomes more intensive with improved pastures and use of concentrates, enterotoxemia will become more of a problem. Vaccination programs for enterotoxemia will have to be encouraged.

6. Conventional systems of sheep management must slowly be changed. Rotation of bed grounds, treatment of the umbilical cord of new born lambs, providing adequate clean water, eliminating wet marshy areas, and providing

protection of new born lambs are some health management practices that must become part of the overall health plan.

C. SEASON OF LAMBING

1. Lambing dates should be grouped into one - two months instead of lambing year round, as is the current practice of the small flock owner.

2. A sheep production becomes more intensified, lambing dates should coincide with available forage supply in the spring. A February lambing date is recommended for the large progressive sheep producers.

3. Thin-tail breeds would be more productive when lambed in late winter and early spring, as they are unable to store body reserves to the extent of the Barbarin.

D. ACCELERATED LAMB PRODUCTION

1. An accelerated lambing program of lambing 3 times in 2 years would be beneficial in increasing lamb production. This program is recommended only for the most efficient farms which have feed resources and management technology necessary for its success.

E. LAMB MARKETING

1. Present systems of marketing are counter-productive to industry needs. The Tunisian sheep industry must develop larger carcasses of high cutability to begin narrowing the red-meat deficit. Price structures paying premium prices on larger correctly finished lambs, and discounting lambs needing more growth is recommended.

Sales by weight instead of by head should be a long range objective of the country sales.

F. GENETIC IMPROVEMENT

1. The program of the OEP to acquire and sell performance tested rams is excellent. Likewise the Controle des Performances project of emphasising growth rate in the meat breeds and milk production in the Sicilo-Sarde is well founded. Both programs need to be expanded as resources become available.

2. Selection programs on the larger farms must be initiated to make rapid improvement in growth rate and prolificacy to produce and provide rams to the small unimproved "1 RAM" flocks.

3. A selection system used widely in the southwestern U.S., in which flocks are segregated into A, B, C, etc. flocks based on production is recommended for the larger government farms.

4. Intensified production systems should consider a crossbreeding program, which combines the desirable traits of different breeds while creating a heterosis effect for traits lowly inherited.

5. Consideration should be given to testing imported rams of the Awassi breed, from Turkey which are noted for excellent milk production and hardiness.

6. The native Tunisian goat industry is the most neglected area in Tunisian agriculture. The efficiencies of the goat should be exploited and improved. It is recommended that high milk producing goats be imported to upgrade the existing domestic goat population.

G. MANAGEMENT

1. Traditional management systems must be changed before significant improvements in sheep production can be achieved.

(a) Improved pastures - irrigated, dryland, and native are fundamental to increased sheep production efficiency.

(b) Grazing management systems are recommended to best preserve and increase production in arid regions.

(c) Pasture fencing should be considered on intensified production systems.

(d) Shearing before lambing and/or shearing before breeding is suggested.

(e) Modern shearing methods should be considered.

(f) Thin-tail lambs should be docked at an early age.

#### H. TECHNICAL ASSISTANCE

1. Additional highly trained personnel in sheep production are needed to effectively initiate improved sheep technology in Tunisia.

2. Coordination between agencies and within the Integrated Livestock Project is fundamental to an effective extension sheep program.

3. Extension workers (especially field agents) need intensive training in sheep production. Printed materials on all phases of sheep technology should be developed.

4. USAID should assist the OEP in developing extension sheep programs.

IV. TUNISIAN SHEEP SITUATION

A. CURRENT PRODUCTION

Tunisia has made substantial increases in meat production in the last few years, but is still far away from becoming self-sufficient. It is estimated there are about 5,600,000 people in the country which has increased at an annual rate of 2.3 percent since 1966.

The average yearly consumption of meat in 1973 was reported as 15 kgs per person and rising yearly with the increased standard of living. The Tunisian people seem to prefer lamb over beef, but readily eat poultry which has made significant increases in production in the last few years.

As Tunisia becomes more of a tourist center, the demand for meat is expected to increase.

Meat production increases were substantial from 1968 to 1975 as shown in the following table.

Table 1 - Meat Production Increases in Tunisia by Volume and Value, 1968 - 1975

<u>Volume 1000 T</u>	<u>1968</u>	<u>1975</u>
Cattle	34	41.2
Sheep	46.2	54.5
Poultry	10.0	28.4
	90.2	124.1 + 38%
<u>Value 1D (Millions)</u>		
Cattle	9.0	19.3
Sheep	15.2	28.1
Poultry	3.9	15.4
	28.1	62.8 + 123%

Source: World Bank Report No. 767-TUN, 23 May 1975.

Importation of meat has steadily risen over the past few years. From 1973 until 1976 importation of sheep and cattle has increased from 4.250 tons to 7.000 tons carcass basis.

The following table is a breakdown of sheep imports:

Table 2 - Sheep Imports in 1975

<u>Origin</u>	<u>Kgs Meat</u>	<u>Dinar Value</u>	<u>No. Head</u>
Bulgaria	2,022,061	1,022,968	59,993
Hungaria	118,510	59,303	3,350
Ireland	509,827	199,494	16,905
Rumania	110,000	62,200	3,683
Yugoslavia	1,809,762	829,580	60,903

Source: Statistiques du Commerce Extérieur de la Tunisie en 1975.

The majority of live lamb importations occur from August through January. Approximately 50,000 lambs are imported for the Ramadan religious holiday. Some frozen meat is imported, mostly from Argentina.

Breeding sheep numbers have steadily increased from 2,443,400 in 1972 to 2,900,000 in 1976. This represents an average annual growth rate of 4.6 per cent. The largest increase occurred in the Sicilo Sarde breed which had an annual increase of 9.9 per cent. According to the Enquête Agricole de Base, October 1976, the total sheep population in Tunisia is estimated to be 5,735,200 head. The central part of the country has the largest concentration with 2,729,100 head.

**0. GOVERNMENT OBJECTIVES TO INCREASE SHEEP PRODUCTION EFFICIENCY**

The Tunisian Ministry of Agriculture has established some obtainable objectives for increasing sheep production in its five-year plan relating to agriculture production.

The plan entails increasing the total live weight of lambs produced from 65,800 tons in 1976 to 70,900 tons in 1981. This would provide an additional 2,610 tons of meat to enter the market place.

The increase in meat production is largely associated with an estimated increase of 200,000 breeding ewes in the northern part of Tunisia. However, if it were possible to increase the slaughter weight of all lamb by only one (1) kilogram, it would be reasonable to expect an additional 1,550 tons of lamb.

Increases in total meat production must be met largely with improved efficiency and technology. The primary limiting factors are availability of forages and pastures. The plan, however, does entail increasing dry land and irrigated forage production from 362,310 hectares to 544,270 hectares by 1981.

The plan also calls for a more rigid disease and parasite control program. Hopefully, 4,000,000 sheep, or approximately 80% of the sheep, will be vaccinated for sheep pox and treated for internal parasites. Rural development projects are proposed for construction of low additional dipping vats for control of external parasites.

Table 3 gives some of the statistics which were extracted from the plan.

Table 3 - Five Year Plan to Increase Sheep Production in Tunisia

<u>Item</u>	<u>1976</u>	<u>1981</u>
<u>Number of ewes</u>		
Sicilo-Sarde	160,000	160,000
Other breeds		
North	1,040,000	1,240,000
South	1,700,000	1,700,000
<u>Total Live Weight - Lamb (tons)</u>	65,800	70,900
<u>Total Lamb - Meat (tons)</u>	34,070	36,680
<u>Net Kg. Milk/Ewe</u>		
Sicilo-Sarde	50	60
<u>Irrigated and Dry Land</u>		
Forage Production (hectares)	362,310	544,270

Source: Le Contenu Global du Vème Plan Agricole

C. GOVERNMENT PROGRAMS PROVIDED TO SHEEP PRODUCERS

1. Ram Testing

The OEP recognizes the problem of wide-spread use of inferior rams by the Tunisian sheep producer. Typically, most rams are selected from within the small individual flocks. Constant selection of replacement rams over many generations in this manner, has seriously reduced productive potential. High levels of inbreeding exists in many flocks, particularly in the smaller flocks, using only one ram. Expression of economically important traits has been hampered from inbreeding, as well as the inferior genotypes of the rams used.

The CEP started in 1974, a program to secure and provide high quality rams to the Tunisian sheep producers. The first year, 700 ram lambs were purchased from the better flocks available, mostly from co-op farms. They were selected entirely on phenotype and breed character.

Post weaning daily gain was utilized in identifying the superior rams. Approximately one third were culled and sold for slaughter.

The program has since been modified to include on-farm production records. Rams from private farmers, the co-op farms, and some from INRAT are weighed periodically, approximately every 21 days.

Daily gains are obtained from 10-30 days of age which gives some indication of the maternal influence of the ewe (milk production) and from 30-90 days of age. Ram lambs currently must gain 180 grams per day for the first phase, and 160 grams per day for the last 60 days on test to qualify.

Qualifying ram lambs are purchased (currently the price is 800 millimes/kilogram) by the OEP and pastured on government farms with some supplemental feeding in late summer. Growth records are maintained by the Contrôle des Performances Project.

Daily gain is obtained until they are yearlings. Any rams not weighing 50 kgs at 12 months of age are culled for slaughter. Last year, approximately 700 rams were sold to sheep producers and 400 were slaughtered.

The rams are checked for reproductive abnormalities, particularly epididymitis by palpating the scrotum before being sold.

Currently all rams are sold for 35 Dinars per head, regardless of quality. It is estimated that the total per head cost to the Tunisian government is 60 Dinars per ram, thus the project is being subsidized at the rate of 25 Dinars per ram.

Some of the participating farmers, who supply rams to the project, are purchasing rams at the end of the test and appreciate and recognize the importance of genetic improvement.

Problems associated with the program include the time required for processing the individual records on each ram by hand and the subsequent time delay in completing the records, before the rams are to be sold. Secondly, there is currently no follow up on rams sold. It would be good to document what change in growth rate occurs on individual farms with the use of better rams.

The selection process does not give adequate attention to reproduction efficiency. Rams born and raised as twins should be given some preference. Correction factors for type of birth and rearing could be incorporated into the overall program.

Approximately 80% of the rams on test are BARBARIN, 8% THIBAR, and 12% are the thin-tail Algerian Breed at the Borj El Amri farm. At Chenchou all rams are Barbarin.

Sixty Sicilo-Sarde rams were imported last year at a cost of 174 Dinars and were sold for 120 Dinars per head. These were sold mainly in the Mateur, Bizerte and Beja areas.

## 2. Research

Sheep production research by INRAT is limited to five experimental farms. Ousseltia, representative of the central region with 350 mm average rainfall, is engaged in selection and reproductive physiology primarily. Nutrition studies are limited to flushing levels. At the Bourbia experimental farm research has concentrated on accelerated lamb production with limited studies on estrus synchronization and fertility, with different levels of P.M.S. (Pregnant Mare Serum). The El Afareg station near Beja is concentrating on improving milk production of the

Sicilo-Sarde by selection and management. At Chenchou grazing management is emphasized.

The results of much of this research are discussed elsewhere in this report.

Mr. Khaldi who is in charge of sheep research for INRAT and Mr. Majej, Director of the Arid Land Institute near Medenine, impressed me as being extremely capable and knowledgeable of the needs and limitations of the Tunisian sheep industry. Unfortunately, they have few co-workers with sheep research backgrounds. The personnel living and working on the research farms are limited in technical training, and inexperienced in gathering research data. Consequently, most research is done on a small scale with the number of projects being limited because of lack of personnel and budget.

Printed reports of INRAT sheep research are evidently restricted because of budget limitations. The OEP staff had little on file. Research is certainly needed but it is even more important that these results be extended to the private producer. Communication and common effort between different government agriculture agencies to work toward the same goal is an absolute necessity if the Tunisian sheep industry is to become self-sufficient.

### 3. Extension Programs

The Integrated Livestock Project of OEP has been in the process of developing an effective extension education program for farmers since 1971. Currently, 16 of the 18 governorats have field extension agent offices. A central staff works out of the Tunis office.

Extension educational programs in sheep husbandry are limited. The ovine specialist section is limited to one position.

The educational activities to date have been mostly a "one on one" approach. Work has concentrated on developing individual farm demonstrations. The majority of these demonstrations have concentrated on flushing and "steaming" (supplemental feeding in late gestation and early lactation) with concentrates provided by the Office of Cereals.

A few demonstrations have been conducted on creep feeding lambs and in lambing every 8 months.

The demonstrations conducted have been largely effective in extending information to the individual farmer. However, when it is estimated there are 45,000 sheep producers just in the 7 northern governorats, a more effective method of mass communication and technology must be considered.

Field days on demonstration farms have been effective for the cattle section but have not been used with sheep. Printed educational materials are currently very limited. There is little flow of resource information from the central office to the field staff. If the OEP is to develop an effective sheep production program, more joint programs between different sections of the OEP are necessary. Economic analysis is being initiated on cattle and dairy production but not on sheep. It is most important that the dry land and irrigated agronomy section develop improved pastures for sheep grazing. Currently the majority of the pasture improvement work is being done in conjunction with the cattle section.

#### D. CHARACTERISTICS OF TUNISIAN SHEEP BREEDS

##### 1. Barbarin

Of the 2,900,000 breeding ewes in Tunisia, approximately 85% are the fat-tailed Barbarin breed. The Barbarin appears to be extremely well adapted to the existing environmental conditions of Tunisia. It is surprisingly productive, even under the poorest feed conditions. Apparently the breed is very heat tolerant, and possesses some natural resistance

to internal parasites and diseases.

The Barbarin breed must be very old as it is recorded with much the same physical characteristics, as depicted in mosaics, during the Roman era.

Selection has been entirely for meat production with wool traits being ignored. A possible exception is fleece color. Preference is given to white fleeces.

Physically, the Barbarin has an open face and is bare-legged. Its points may be black, brown, or red. Face structure and length of ear closely resemble the Suffolk breed of England and America.

The female weighs from 30-60 kgs, depending upon the nutritional state and season of the year. As much as 5-8 kgs of fat may be stored in her tail, which is deposited in periods of good feed and is "milked-off" or depleted as feed conditions become poorer.

Because of the large tail covering the vulva, the rams are assisted at mating by the workers.

The ewes exhibit two distinct peaks of oestrus activity in spring and autumn, but are capable of breeding practically year round. The majority of producers favour breeding in the spring (April and May) particularly in the north and central region of the country. It is very common to see lambs of all ages in most of the traditionally managed flocks throughout the country.

Wool is variable in staple length (2-6 inches), harsh in handle and coarse (approximately 36's - 40's spinning count). Average fleece weights range from 1.5 - 2.5 kgs.

## 2. Sicilo - Sarde

The Sicilo-Sarde was introduced to Tunisia from Sicily as a milk producing breed.

The breed is less adapted to harsh conditions and consequently is found mostly in the north with some in the upper central region of the country.

Selection has been strictly on milk production. Their lambs have a slower growth rate than the Barbarin and a higher mortality rate. The lamb crop percentage is approximately 10% less for the Sicilo-Sarde when compared with the Barbarin and the lambs are as much as 10 kgs. lighter at 5-6 months of age.

The average milk production per ewe is estimated to be approximately 40-50 kgs per lactation period.

The milk is used mostly for cheese manufacturing.

In the Mateur Governorat data collected by the OEP from 10 flocks, having a total of 2398 ewes, found the average daily production to be 670 grams with a range from 490 grams to 980 grams of milk/day. Average lactation period was 78 days.

The El Afareg INRAT station reports raising average milk production from 40 kgs to 70 kgs in three years simply by initiating sound management principals. Currently they keep rams only from ewes producing at least 100 kgs of milk. The weaning weight of one group of lambs at 90 days was 21 kgs. After weaning, the ewes are reportedly being milked for four months and some are being milked experimentally past breeding.

The higher mortality rate and slower growth rate generally reported of Sicilo-Sarde lambs may be in large part due to insufficient amounts of milk being given to the lambs.

### 3. Black Thibar

The Black Thibar was developed by the Catholic Monks in the Beja Governorat. This breed was developed by crossing native Algerian thin-tailed sheep with French Merinos. Selection in the developmental stages was placed primarily upon color. The breed now breeds true<sup>for</sup>/black color which makes the breed resistant to photosenitization.

In Northern Tunisia, a weed (Hypericum) grows in abundance in association with cereal crops. Photosenitization is still a major problem of the other white face breeds.

The Black Thibar is bare legged with an open face. Legs, face and fleece are black.

My observations of the Black Thibar are that the breed appears to be heavier boned, and more muscular than the Barbarin. Performance data indicate the Black Thibar is comparable, and occasionally better than the Barbarin in prolificacy and growth rate.

At the Borj El Amri government farm, F-1 crosses from Sicilo-Sarde ewes and Black Thibar rams averaged 29 kgs at 5 months of age.

The wool of the Black Thibar is black but still exhibits the quality characteristics of the Merino. Most fleeces I observed would grade 60's - 64's spinning count. Staple length ranged from 2-4 in.

The Black Thibar is not adapted to the heat and feed conditions of the south.

### 4. Algerian - Thin Tail

The Algerian Thin Tail is a white face breed found mostly in west central Tunisia. It is a relatively hardy breed and is adapted to harsh dry conditions. However, it is not as well adapted to heat as the Barbarin. At 36 degrees C, the Barbarin will graze an hour longer; according to grazing study results in Southern Tunisia

Its origin is from the Ouled Djellal, Tadmit and Rembi breeds of the Algerian plateau.

The breed has generally a medium grade fleece (54's - 58's) of good crimp and length.

With good feed the breeds fertility and prolificacy are equal to the Barbarin. The Algerian Thin Tail has a more restricted breeding season than the Barbarin but their mature weights appear to be greater with their lambs gaining somewhat faster. They are susceptible to photosensitization.

#### 5. Other Breeds

The Tunisian sheep industry has been slow to explore the use of other breeds of sheep which possibly could transmit desirable traits to the existing sheep population.

One lock (approximately 200 head) of SARDI have recently been placed on the Borj El Amri farm. They are a thin tail, mostly white in color, except for a black ring around the eye. The Sardi breed originated in Morocco.

Preliminary data show them not to be as prolific as the native breeds.

Ile de France rams are being experimentally used in a crossbreeding program also at Borj El Amri on Sicilo-Sarde ewes.

Ile de France is a white-faced mutton-type breed of France, originating from a Leicester-Merino cross. Selection has emphasized year-round breeding.

There are a few Merino sheep in the country. Apparently their greatest contribution at present is for the production of rams for sport fighting.

### E. SHEEP MANAGEMENT

Sheep management systems differ significantly, depending largely on area, size of flock, and landownership pattern.

The 1974 Tunisian Acreage and Livestock Enumerative Survey, Volume I, estimates, there are 45,000 farm operators who own sheep in what is now the seven northern governorats. Approximately 57% or 25,600 producers owned less than 20 head, and 11,500 producers or 26% owned from 20 to 49 head. However, those producers with less than 50 sheep accounted for only 34% of the total sheep population in the north. There were approximately 330 farms which owned 500 or more sheep.

It is estimated that more than 80% of the sheep in Tunisia are owned by private farmers. The cooperative and state farm inventories are near 20%.

The flocks of the government farms appear to be better managed, largely because of their significantly lower stocking rates and health programs.

#### 1. Traditional Management

The small family flock is managed generally in the traditional system of utilizing grazing lands wherever they are available. Often the family does not own land and grazes the sheep along roadsides, or the common, untitled grazing areas, and, when possible, on state farms. He may rent some fallow and stubble fields and occasionally buys some supplementary feed.

During the spring, annual and perennial new growth is harvested by hand from the olive groves and small grain fields. This is stored as a source of fodder for the summer.

External and internal parasites are more prevalent in the smaller, nomadic flocks. Generally the flock suffers from under-nutrition and is exceptionally vulnerable to drought. In my observations, lambs of all ages are present, and the rams are never separated from the ewes.

Lambs are sometimes sold at 10-12 kgs depending upon availability of feed. Occasionally lambs are separated from the ewes at night and are allowed to nurse only during the day while grazing. This practice is believed to conserve the strength of the lactating adults. The weaker of a set of twins is sometimes sacrificed to insure adequate nutrition of the remaining lamb.

Routine vaccination, drenching and dipping programs are not followed.

## 2. Improved Management System

The larger, private farms and most government farms are managed more efficiently. The sheep are herded in separate flocks of about 200-250 ewes. They are grazed on farm-owned pasture which very often is fallow land from which cereal crops are grown. Native pastures become more prevalent to the south.

Hay for the sheep is produced on many farms, typically poor quality oatvetch. Occasionally green-chop barley (harvested by hand) is available, and fed during the lambing period. Olive branches, atriplex and spineless cactus in severe drought are generally utilized for supplementation of the flock. Most of the larger farms purchase some concentrates from the Office of Cereals project. Very few farms have attempted to establish improved pasture. Some have established Medicago pasture, and there is a limited amount of alfalfa used for pasture.

Production of lamb is more efficient on the larger farms but mainly because of their lower stocking rate.

Many of the farm managers as well as large farmers appear to spend very little time working with the sheep. For the most part the responsibilities of day to day decisions rest with the shepherd. The shepherd and his family, usually Bedouin, camp with the sheep constantly, usually in a primitive tent. For this work the shepherd receives in cash and in incentives the equivalent of about D 50 per month.

All the sheep are bedded down at night in an enclosure, which usually is not moved. Consequently, the bed ground is a very dusty non-hygenic area which promotes respiratory and external parasite infestation. In the rainy season, many (which I observed) are poorly drained and must be conducive to foot problems as well as other health problems.

Most of the larger farmers separate their rams from the ewes and tend to favor a spring breeding season. April 15 is about the earliest date breeding begins, and on some farms the rams are not removed until September 1. As a result of the prolonged breeding season many ewes, not having a fertile mating or which possibly abort from the spring mating season, conceive 3 to 5 months late, resulting in an uneven lamb crop. Few of the larger farmers flush the ewes before breeding. Some feed the rams concentrate (usually oats) before and during the early part of the breeding season.

Rams are used at the rate of one per 20-25 ewes. Rams are kept until they are 7 to 8 years old.

Very few ewes are sheared before breeding. Generally, shearing starts in May. Sheep are shorn using primitive hand scissors (not hand shears), on the ground. Normal paid shearers receive about D 0.050 per head. A good sheep shearer can shear only 15-18 head per day. The fleece is rolled and gathered together in the dirt and sold without any further preparation.

Rams are commonly sheared only on the side and belly, particularly in the central and southern regions. The wool on top of the neck and back is allowed to grow for the life of the ram. This author wastold the cape effect gives the ram prestige and character. Another explanation offered was that it kept the ram warmer and consequently, he did not overwork himself at the start of the breeding season.

Generally the lambs are marketed without weaning at a weight of 22-28 kgs. Some farms wean their lambs at about 20 kgs and grow them out on pasture until they weigh 25-30 kg. About 20% of the ewe lambs are kept for replacements.

On the private farms and also with the small sheep producer, the normal weaning procedure is to exchange lambs between farmers, head-for-head. This exchange lasts for 1 to 2 months, after which the lambs are returned to their original owner.

Some routinely followed health program exists on most of the government farms but on many large private farms there is little or none. Several large-scale producers reported they had never treated their sheep for internal parasites. In most instances it was not necessary to ask the farmer if he ~~draco~~ checked for internal parasites as the answer was obvious.

Most of the government operated farms follow a health program as prepared by the farm veterinary officer. For the most part this schedule is as follows:

1. Enterotoxemia - Lambs are vaccinated twice (largest losses occur in older lambs when on barley and wheat at end of spring).
2. Internal Parasites - Tetramizole 7.5% is injected - 1 cc/10 kgs body weight. Once per year, usually in spring.

3. Psoroptic Mange - Dipped after shearing - occasionally re-dipped 15 days later with Lindane or HCH.
4. Sheep Pox - One vaccination in Fall.

Health programs at lambing time are non-existent. Young lambs born in the confined nightly enclosures are subject to an accumulation of many infective agents. The umbilical cord of lambs is not treated with iodine.

Docking and castration of lambs is not practiced.

Ram lambs are preferred in the market place, and by the producer, as it is well established that they have a faster growth rate and more muscle development. I personally favor marketing ram lambs, if they are young, because of their increased efficiency. The problem of allowing these ram lambs to run with the flock past puberty appears to be of little significance. This naturally would not be a problem in the fat tail breed if each individual ewe must be assisted at breeding.

Docking the tail of a Barbarin fat tail would simply cause the fat deposition to be redistributed to the rump region, which might be more objectionable to the butcher and consumer. It would, however, alleviate the labor requirements at breeding, if the ewe lambs were docked.

The thin tail breeds including the Sicilo-Sarde milking sheep, are also not docked. In my observations this long tail with its accumulation of dung and filth is an unnecessary source of contamination when these sheep are milked.

#### F. NUTRITION

Inadequate nutrition is the major limiting factor to efficient sheep production in Tunisia. Improved pasture and high quality hay are the exception rather than the rule. The livestock sector, and particularly sheep, are constrained by a lack of integration of livestock and crop

farming in the north and central areas of Tunisia.

Situation: Typically the first rains of the agriculture season fall between September and December, and continue through May. Natural vegetation becomes largely brown and dormant in the hot dry summer from June to September/October.

Ewes which were bred in the spring generally lamb on dry, bare pastures.

Supplemental feeding during this period varies with area and size of flock. In the larger, better managed state farms hay (usually oat-vetch) is normally given when the natural vegetation is exhausted. Concentrates (subsidized by the government to less than cereal prices) are fed starting about one week prior to lambing at a rate of 300 grams per ewe per day.

The majority of the sheep raised in Tunisia receive inadequate supplementation during the dry period. Many of the small farmers visited fed nothing except olive leaves and branches. Some utilized Opuntia (spineless cactus) which they harvested and fed daily.

The nutritional problem is not limited to the non-growing season. During the grazing season the number of nomadic flocks competing for available forage is tremendous. It is estimated that about a fifth of the sheep are in the hands of landless owners who wander the roadsides with their flocks and rent stubble fields and fallow when it is available.

In southern and central Tunisia the flocks are usually moved north in the late spring and summer and return south again in the fall and winter. This constant movement and converging of livestock to areas having grazing available has resulted in constant overutilization of the plant growth with accompanying deterioration and erosion of the soil. Undesirable plants, particularly thistle, dominate many range sites and

are wide-spread throughout the farming areas.

In southern Tunisia sheep migration is dependent entirely upon rainfall. In years of above average rainfall there is only a local migration of the small flocks to the flat land areas when annual weeds and grasses are available. Occasionally, sheep from the central area move south to graze these areas in the winter.

There are two large areas which are heavily used from autumn to spring. Ouara is in south-east Tunisia. In this area the perennial plant growth has been mostly grazed out. There is no water available in the entire area, and when sheep are grazed in this area, the only available water is from the annual vegetation and occasional collection of rainfall. In a good year this region will receive 100 mm of rain during the growing season.

Occasionally, the Dakar's region east of the Sahara is grazed in the winter also. It, too, has no drinking water available. In a good year it will receive 80 mm of rainfall.

The small flocks are combined into large flocks of 200-300 head when these areas are grazed. At the end of spring the flocks are separated by ownership into individual flocks of 10-50 head, and are moved to higher country where water and perennial vegetation is available.

When rainfall is limited in the south, sheep move to central and northern Tunisia.

Nutritional studies with respect to sheep are largely lacking in Tunisia. The exact nutrient requirements are not defined for native sheep breeds at different seasons and stages of production. Currently, requirements as determined in France are used.

Nutrient composition of native pasture species at different seasons is also limited.

The effect of mineral and vitamin supplementation on performance and herd health is lacking. Of all the farms visited, none fed any form of mineral.

INRAT has studied the effect of flushing ewes prior to breeding at the Ousseltia station. In this study, ewes were bred in the normal spring breeding period, in which the pasture and the sheep were in good condition. The concentrate used consisted of 70% barley and 30% beans.

Table 4 - Effect of Flushing Ewes - beginning 3 weeks prior to Breeding at Ousseltia

<u>Concentrate Level (grams)</u>	<u>No. Ewes</u>	<u>Fertility (% lambing)</u>	<u>Prolificacy (% lambs/100 ewes)</u>	<u>Ovulation Rate</u>
0	66	85.1	104.5	1.43
200	66	91.1	128.4	1.57
400	66	87.9	110.6	1.27

Studies in the United States find flushing to be most effective when done either early or late in the breeding season. Flushing usually increases ovulation rate when done early in the breeding season, and at the end of the breeding season, and may extend the breeding season somewhat. If the ewes are in good shape, flushing has little effect on the ewes bred during the middle of the breeding season.

The OEP has started a series of flushing demonstrations with private and governmental farms this year. Farmers are purchasing commercial concentrates which are formulated under the direction of the Office of Cereals in Tunis. The main concentrate used is 11.8% protein, relatively high in energy (.90 U.F.) and costs 36 Dinars per ton. The current

recommendation of the OEP is to feed 250-300 grams per head per day, starting 15 days prior to breeding, and continue for 36 days after the rams are introduced to the flock.

Another extension activity of the OEP is "steaming" demonstrations which consists of using concentrates 2 months before lambing and for one month after lambing.

Flushing and steaming demonstrations are just getting off the ground. They are most readily accepted by the large private farmer and government farms which have the resources to purchase concentrates.

Specific Problems: Crop farming and livestock production (specifically sheep) are not an integrated unit. Management treats each enterprise as two distinct units instead of one. Each could and should complement the other. Dry land and irrigated pastures must be developed if the Tunisian sheep industry is to expand and become more efficient.

Of all the farms visited, this author was most impressed with the pasture improvement work at "Gastla" which was originally part of the Enfida Agrocombinat. In 1973, 850ha of Medicago, annual medic, was planted. The area was fenced into 40 ha fields. Instead of the traditional ratio of one shepherd to 200-300 sheep, they maintain one shepherd for 900 sheep by allowing the sheep to graze in the fenced pastures unattended. The carrying capacity has been increased from one ewe per hectare to three per hectare, with sufficient quantities of hay usually being harvested in the spring to carry them through the dry period.

The "Gastla" project results should be made available to all the agrocombinat and cooperative farms, where development funds are more available, and which have the potential of adapting these principles of sheep production on improved pasture.

The traditionally managed flocks that lamb in the fall do not receive adequate quantity or quality of supplemental feeds in late gestation and lactation. The fat reserves of the ewe are exhausted ordinarily before lambing.

Research has shown that 60-70% of the fetal growth and development occurs during the last 6 weeks of gestation. Nutrient restriction during this period will result in lighter lambs at birth, increased lamb losses, and lower levels of milk production.

Restricting the amount of milk availability to the lamb at an early age has a permanent effect upon the lamb's performance and growth rate. A stunted, "pot-bellied" lamb will require much more total feed and time before it reaches market weight and condition.

Research in the U.S. has shown young lambs, when properly fed, have a feed conversion ratio (kgs of feed to kgs of gain) of 2.0 - 4.0 to 1 compared to 5 and 7 months old lambs which require 6-9 kgs of feed per kg of gain.

A management program is specifically needed to meet the nutritional requirements of the ewe in late gestation and early lactation. Ideally, this should be done with high quality, low cost pastures. The common use of poor quality oat-vetch hay, olive leaves, and harvested annuals and perennials from the previous spring does not meet the nutrient requirements for efficient production.

Because of the efficiency of young lambs in converting feed to growth, additional consideration should be given to creep feeding the lamb at an early age.

Work in this area is very limited. The Office of Cereals has a creep ration which is mostly a grain mixture and which contains only 10.5% protein. The ration costs 42 Dinars per ton.

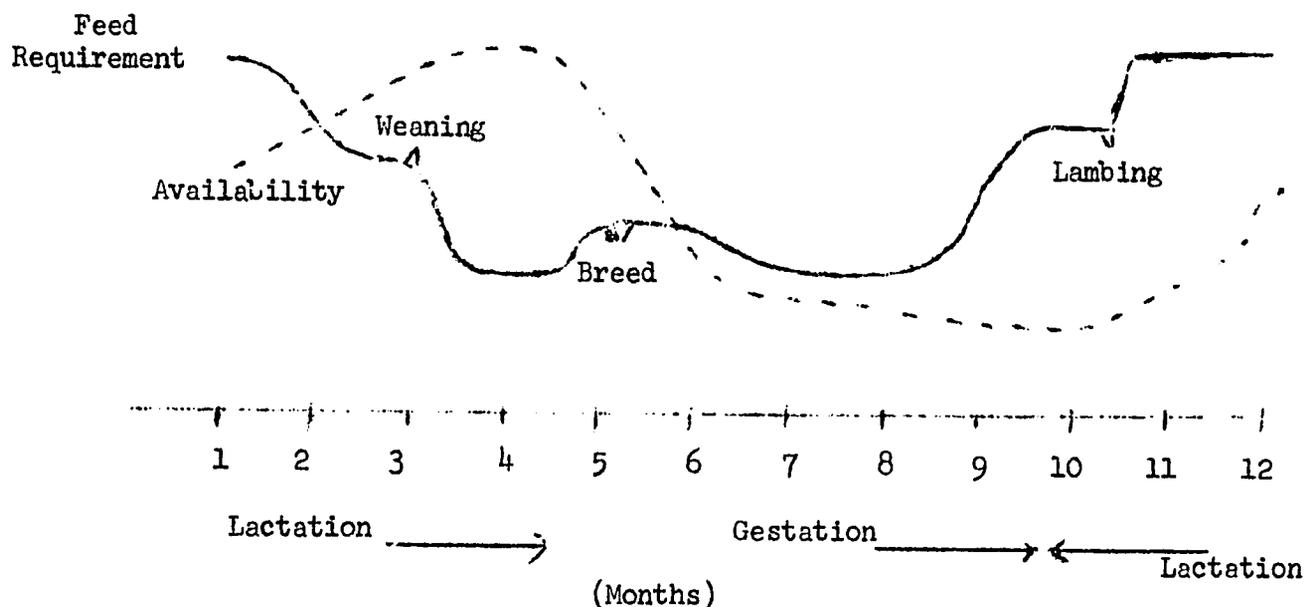
The creep ration is low in protein by United States standards. In order to develop maximum growth and muscle development, a creep ration containing at least 15% protein has been most efficient in the U.S. Lambs will begin to eat creep rations if they are palatable as early as 7-10 days of age. It is important that the lambs start early on the creep to establish rumen function and the habit of eating. The addition of antibiotics to the creep ration will aid in preventing digestive disturbances and enterotoxemia.

The following graph illustrates the seasonal availability of pasture and total dry matter feed requirement of ewes in different productive stages.

The curve illustrating feed availability may differ significantly from area to area, and also with type of pasture.

However, on improved pastures a surplus of feed does exist in the spring. Best use of this surplus feed could be made by lambing in late winter and early spring.

GRAPH: Illustrating Relationship Between Feed Requirement for Sheep when Lambing in Fall, and Feed Availability from most Pasture Systems



Water: The availability of high-quality water for sheep ranges from very good in the north to practically non-existent in the south. It is reported by numerous professional people that the southern grazing regions of Ouara and Dahar's have no available drinking water and that sheep exist on the moisture of the vegetation from late fall until spring. It is during this period that the majority of lambs are born.

This author did not have the opportunity to witness this as the current drought had forced all sheep north.

However, all studies have shown that unlimited water supplies are necessary, particularly in late gestation and lactation, for efficient lamb production. In general, water intake should be about twice the weight of air dry feed intake.

G. SHEEP DISEASES

The economic loss to the Tunisian sheep industry due to disease and parasites, through death, loss of condition, inefficient utilization of feed and carcass condemnation is extremely high.

Adequate disease and parasite control is limited because of the difficulty in promoting preventive veterinary medicine. Traditionally, help is not sought until losses are incurred. Vaccines and worming products when used in a predetermined manner could significantly reduce these losses and increase the productive efficiency of the livestock sector in Tunisia.

Disease control is further hampered because of the large population of sheep and their constant movement throughout the country, and close confinement.

There are currently 80 veterinarians of whom 62 are Tunisian and 18 are foreign. In addition, there are 135 veterinary assistants. A laboratory of diagnosis and vaccine preparation is located in Tunis under the Direction des Services Vétérinaires. Currently enterotoxemia and sheep pox vaccines are being made in the laboratory. Sore mouth vaccine was made, but has been discontinued as it was not being used.

According to Dr. Kallal, the major diseases of sheep in order of importance are:

1. Internal parasites
2. Psoroptic mange (sheep scab)
3. Sheep pox
4. Sore Mouth
5. Enterotoxemia
6. Abortions
7. Foot diseases

Dr. Thomas (Field Report, 1973) estimated internal parasites cost the Tunisian sheep industry about 2,000,000TD annually. In my estimation this is a conservative estimate, as it would amount to approximately only 600 millimes per head for all classes of sheep. Stomach and intestinal round worms must be brought under control, if the Tunisian sheep industry hopes to become self-sufficient. Taenia (tape worm), Oestrus-ovis (head grub) and Fasciola-Hepatica (liver fluke) infest many sheep.

There are at least two cestodes affecting sheep. Coenurosis (staggers) is found occasionally and Echinococcosis is serious because of its common effect to animal and man. This illness also results in condemnation of the viscera at the abattoir.

The Tunisian Direction des Services Vétérinaires has initiated a national program to treat all sheep for internal parasites, scab, and sheep pox. Dr. Kallal reports that all sheep hopefully will be treated at no expense to the producer.

The farmer currently must pay for other vaccines and services. Consequently there is little immunization against major diseases. The larger private and government farms tend to accept and practice some inoculation and parasite control programs.

Currently, no lambs are vaccinated for sore mouth which is considered to be the fourth most prevalent disease. It is treated rather than prevented.

Other diseases affecting Tunisian sheep include tetanus, photosensitization, respiratory problems associated with dust, mastitis and occasionally foot and mouth disease type A. Vitamin deficiency is common in periods of drought.

According to the February 1976 report of the subcommittee on livestock production, the following number of sheep were treated for parasites and given inoculations in Tunisia.

Table 5 - Number of Livestock Treated for Parasites  
and Given Inoculations, 1973 - 1975

<u>Disease</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>
Sheep Pox (Clavelée)	1,131,373	738,825	958,451
Enterotoxemia	9,187	5,589	50,993
Anthrax	631	1,796	356
Sheep Scab (gale)	319,538	454,953	255,387
Nematodes (Strongyloses) Sheep and Cattle	2,504,347	1,704,097	1,301,724
Liver Fluke	2,000	33,500	--
Tape worms Toeniasis (Sheep and Cattle)	135,468	1,950	750

#### H. REPRODUCTIVE PHYSIOLOGY

The fertility of most ewes observed by this author appeared to be reasonably good. Of those farms visited, prolificacy (% lambs born/100 ewes) varied from 80 to 144%. Percentage of ewes dry (barren) ranged from 2 to 15%. Mortality rate was difficult to obtain. Some farmers reported no mortalities while others reported 7 - 8%. Personally, I would expect at least a 5% death loss as being relatively close to the average.

Fertility and prolificacy are directly influenced by nutritional and physical conditions. Ewes grazing roadsides and exhibiting external and internal parasite burdens, consistently had less lambs by their side and also had lambs of all ages. Many of the traditionally managed flocks tend to lamb year round. The advantages of the year round lambing season include:

1. Some of the lambs are assured of being born when feed is available.
2. Some ewes probably lamb more often than the conventional once-a-year schedule.
3. Supply of lamb may possibly be more constant in the market throughout the year.

The disadvantages of having lambs of all ages is the inability to adopt any management program, particularly in regard to nutrition, and health practices which are most conducive to efficient production.

Currently, the normal practice is to breed in the spring and lamb in the autumn (September and October). It is estimated that about 60% of the lambs are currently "fall"-born. This practice has the advantages of:

1. Lambs may be marketed in the early spring which is normally the highest market.
2. Ewes are in stronger condition when bred as feed is more plentiful in the spring (natural flushing effect).

The disadvantages of fall-born lambs are as follows:

1. After conception, feed supplies of native pastures steadily diminish, and do not meet the nutritional requirements of the ewe, particularly in late gestation and early lactation.
2. Fall-born lambs are smaller and weaker at birth because of the heat stress during gestation, and lack of feed in late gestation.

3. Lambs not receiving adequate milk during the first few weeks of life are permanently stunted and require a much longer feeding period before they reach market weight. (Younger lambs are more efficient in converting feed to growth - refer to section on nutrition).
4. The lactation stress when feed is scarce makes the ewe much more susceptible to disease and parasites.

At the Ousseltia INRAT Station, reversal of the lambing season has been studied. One flock of 200 Barbarin ewes are bred to lamb in February and March. In the past two years this practice has significantly increased the prolificacy of the ewes while simultaneously increasing the growth rate of the lambs.

Table 6 - Performance of Ewes Bred in September

<u>Item</u>	<u>Yearling Ewes</u>	<u>Mature Ewes</u>
<u>Fertility</u> (% lambing)	87	97.5
<u>Prolificacy</u> (% lambs/100 ewes)	119	144
<u>Average Growth - Rate per Day</u> (grams)		
(Yearlings and Mature Ewes)		
10 - 30 days	245	
30 - 90 days	220	

This practice would have practical application over a wide area of northern and central Tunisia, particularly on government farms and large private farms which are beginning to establish improved pastures. Of particular significance is the increased lamb crop percentage which is 25-35% better than the best managed farms which lamb in the fall. By the same token, lamb growth rate is at least 30% greater.

At the Bourbia INRAT farm, extensive studies since 1973 have shown the Barbarin breed to be sexually active throughout the year. Highest ovulation rate occurred in the fall, with the month of September being the peak month.

A seasonal anestrus period was not observed, however, February and March tended to have the lowest ovulation rate.

The post-partum anestrus period was influenced by season of lambing and number of days in lactation.

Table 7 - Length of Post-Partum Anestrus Period - Days

<u>Season of Lambing</u>	<u>Lambs Weaned at 45 days</u>	<u>Lambs Weaned at 90 days</u>
fall born	51	64
Spring born	75	100

Regardless of season, the Barbarin ewe consistently has been shown to ovulate without showing estrus (silent estrus) 25 days after lambing.

This data would suggest that the Barbarin (and probably the other breeds as well) could easily be managed to lamb more often than once a year. An accelerated lambing program, lambing every 8 months, or producing 3 lamb crops in 2 years is physically possible. However, such a program requires only the best management, if it is to be successful. Nutrition, health and other management practices must first be perfected before an accelerated lambing program is adopted.

Accelerated lamb production studies are limited in Tunisia. To my knowledge data is only available from the Bourbia station which started in 1973, lambing 300 Barbarin ewes every 8 months. Ewes were bred to lamb in October, June and February, without hormone therapy. This program produced 310 lambs per 100 ewes in two years, which is an increase of

about 35% in number of lambs born per year.

A similar program has been initiated on the Borj El Amri government farm.

#### I. MARKETING

Lamb marketing methods are dependent largely upon flock size, and location. Most of the government farms assemble their lambs on a pre-determined day and accept bids at the farm. For the small producer, marketing is generally done through small markets which function about once a week in the different communities throughout Tunisia.

Sales are by private treaty. In the country sales, the price is agreed upon by buyer and seller on a per head basis. If the seller does not find the price acceptable he will walk his sheep home and try another day.

The larger private and GOT farms, however, do price their product by the kilogram. This spring, larger farmers reported selling lambs weighing 20 - 30 kgs for D 0.600 to D 0.700 per kg live weight.

Typically in the country sales, lambs may be sold to butchers, slaughter houses, dealers, other farmers and to consumers. In many cases lambs pass between two or four hands before finally being butchered. In Tunis, lambs are sold through commission men as well as traded directly between buyer and seller.

Live weight of lambs sold may range from 10 - 35 kilograms. Many of the lighter lambs are grown out on pasture and resold. Average live weight of lambs slaughtered under government control is about 28 kgs. It is estimated that almost one-half of the total lamb slaughter occurs on the farm and at home.

Lamb marketings peak in the spring (March-May) with another significant increase in the fall. Prices paid to the producer are influenced by supply. However, government price controls are in effect at the wholesale and retail levels which act to stabilize the price to the consumer.

The Tunis slaughter plant has a lamb kill capacity of 400 per hour. Their average daily and yearly slaughter is about 1,200 and 300,000 respectively. The slaughter plant purchases all lamb on the rail. Price paid ranges from a low of D 1.100 to D. 1350 per kilo carcass weight depending upon season of year.

Fresh lamb carcasses are sold to retail butchers at the government controlled price of D 0.800/kilo. The pelt and offal brings approximately D 0.100/kilo.

With the majority of the lambs sold by the head, there exists little opportunity to develop an effective educational program to increase size, growth rate and/or condition of the lambs sold. The producer needs some incentive if he is to be expected to increase his total production efficiency. Presently there is little reward for having the largest set of lambs on the market.

A price structure by weight, being highest per kilogram for lambs ready to slaughter and decreasing in price per kg for feeder lambs (lambs too small to butcher) would have an immediate effect in developing the incentive needed to increase production. One individual indicated a simple reward system of giving a prize or gift to the farmer with the heaviest lambs would be a start in developing this incentive.

V. RECOMMENDATIONS FOR IMPROVING DOMESTIC SHEEP PRODUCTION EFFICIENCY

Recommendations for needed changes in existing production systems are based on this author's observations and understanding of the current situation. It is recommended that the reader refer to the section describing the situation in order to more completely understand this author's reasoning for this section of the report. If, for some reason, false impressions were gathered when certain situations were observed and analyzed, the validity and adoption of the recommendations to Tunisian conditions might be so affected.

A. NUTRITION IMPROVEMENT

Inadequate levels of nutrients at critical stages in the ewe's production cycle is the single, most limiting factor to efficient sheep production in Tunisia. With the current practice of lambing in the fall, most ewes lamb when native feed supplies are practically exhausted and when the feed supply is of poorest quality. The daily nutrient requirements in late gestation and lactation are approximately 50% greater than are the requirements for non-lactating (dry) ewe. The nutrients of primary importance are protein, energy, vitamin A, minerals, and water.

Fortunately, the native sheep breeds, particularly the Barbarin, are well adapted to the local environment and are able to store large reserves of fat which is utilized in late gestation and lactation. This reserve partially offsets the insufficient quantity and quality of feed available.

Nevertheless, body reserves and native feed supplies combined are not sufficient to meet the total requirements for ultimate efficiency in lamb production.

Milk production is limited, lambs are born smaller and weaker, and consequently are stunted early in life. This condition results in substantially more total feed and a longer feeding period before the lamb can overcome the stress imposed in late gestation and early lactation.

Current practices of feeding olive leaves, dried forage collected in the spring, and spineless cactus might be sufficient for maintenance but not for gestation and lactation. On the larger farms the common use of oat-vetch hay does not meet the nutrient requirements during this period. Samples of oat-vetch hay analyzed by the INRAT laboratory show an average of 2.1% digestible protein (M.A.D.). Oat-vetch hay is commonly fed at the rate of one kilogram per ewe per day. This amount would supply only 21 grams of digestible protein per day which is less than one-half the daily requirement. This hay is badly leached and deficient in vitamins.

Improved hay quality and/or the use of silage with concentrate would significantly increase the ewes' production potential in late gestation and lactation.

Many of the larger farms have the necessary resources to develop an improved supplementary feeding system. However, the easiest method of providing increased levels of nutrients at the critical lambing period is to change the lambing date.

With an intensified production system, ewes should be flushed and bred in September to lamb when pasture and vegetation are most abundant. Lambs born in late winter could very efficiently utilize the surplus of vegetation occurring throughout the spring time. This recommendation, which will be discussed at length later, is intended for the better managed, larger farms of the north and central sections of Tunisia.

An educational program is needed to begin mineral and vitamin supplementation.

Mineral deficiency, particularly phosphorus, reduces milk production, causes weak lambs at birth, and impairs reproduction. Phosphorus is said to be universally low in most species of vegetation, and a study of feeding mineral high in phosphorus should be initiated.

I would recommend a phosphorus supplement be used year round.

Vitamin A (Carotene) is normally stored in the liver in sufficient quantities so that an adequate reserve is available for 3-4 months to maintain production. However, in periods of drought and if browse pasture is limited, a vitamin A deficiency can occur.

Vitamin A and Phosphorus requirements are highest in late gestation and lactation. When lambing occurs in the fall on dry vegetation, the probability of a deficiency certainly exists. Symptoms of Vitamin A deficiency include abortion, weak dead lambs, unthrifty condition, slow growth, and susceptibility to respiratory diseases, including pneumonia. Vitamin A injections during periods of drought and even during the regular dry seasons should be considered for study.

Nutritional levels have a direct bearing on reproductive performance. Adequate energy appears to be the most important nutrient influencing ovulation rate in the ewe. However, protein, Vitamin A, and minerals all influence the reproductive capabilities of the ewe and the ram. Current Tunisian studies of flushing have been conducted mostly in the spring when forage supplies have been near maximum. Consequently, the results of flushing in the spring are mixed, but generally favorable.

The abundance of forage in the spring largely explains the seasonal pattern of lambing in the fall. A complete study of feed requirements and flushing in the fall to produce spring lambs is needed.

A system of supplementing the rams prior to and during the breeding season should be adopted. Ram fertility and sex drive are largely dependent upon the ram's physical condition. In the many one-ram flocks it is very important that the ram be physically capable of fertilizing the ewes. The ram should be separated from the flock each day during the breeding season and fed 200-300 grams of concentrate.

Lamb Feeding : To increase the total supply of lamb to the consumer it is imperative that slaughter weight be increased, with lambs being grown out to their maximum and most efficient potential. A realistic goal would be to increase the average slaughter weight to 35 kg.

When feed supplies are limited, a program must be adopted to direct the feed resources into early efficient growth of the lamb. Early gain (up to 30 days) is largely influenced by the milk available. Adequate supplementation of the ewes (300 grams of concentrate) during the period is recommended. Secondly, as most studies show that the Barbarin's milk production is reduced by 50% at 6 weeks after lambing, a program should be adopted to feed the lamb directly at this time.

The large, more efficiently managed farms should start creep feeding the lambs at about 2 weeks of age. In addition to supplementing the milk supply, this practice would allow more rapid development of the lambs' rumen. A natural protein creep feed containing 14-16% protein should be used. Urea should never be used on young lambs. A simple creep feed of 80% oats and 20% soy-bean oil meal with leafy alfalfa hay could be sufficient.

With the present system of weaning lambs at 4-6 months of age, the only advantage the lamb derives from such a system is the companionship of its mother. The lamb is subject to internal and external parasites, is limited to the same bare pastures as the adults and is forced into a period of slowed growth from which it will require more total feed to overcome.

Research on early weaning has been conducted at the INRAT station near Gabes. Their objective was to reduce the stress on the ewes during periods of severe drought. They were not only successful in accomplishing their objective, but also reported improved lamb performance. They concluded 45 days was the minimum age for weaning and 10 kilograms was the minimum weight.

In 1975-76, lambs were weaned at an average age of 45 days weighing 12.0 kilograms. The lambs were started on creep feed three weeks prior to weaning and were used to eating concentrates. After weaning they were continued on concentrates and fresh green barley. In three months they were slaughtered weighing 22.9 kilograms.

Research in the U.S. and elsewhere shows it is approximately three times more efficient to feed the lamb directly, than it is to feed the ewe and in turn let the ewe feed the lamb.

I would strongly recommend that early weaning be considered in developing any intensified lamb production system. In the north, improved pastures should be developed for this purpose.

Lamb gains on medicago pasture from January to May at Borj El Amri have ranged from 189 grams per day with 6.6 lambs per hectare to 139 grams per day when 20 lambs were grazed per hectare. Work at Bou Rebia reported an average growth rate of 200 grams per day when lambs were fed

hay and concentrate in confinement. Average daily consumption of concentrate for the 90 day feeding period was 802 grams. Final weight was 41.92 kilograms.

The Tunisian sheep industry must be encouraged and financially rewarded for producing a larger lamb for slaughter. Government Programs which would buy light weight lambs and finish them out to heavier weights on pasture would be most helpful. Forage reserves for purposes of lamb fattening should be established throughout Tunisia.

Low cost concentrates must be made more available. It is estimated there are at least 200,000 tons of olive pulp which goes to waste each year. Methods of utilizing this product should be investigated.

B. DISEASE CONTROL

Diseases and parasites are second in importance to nutrition deficiencies, in currently limiting sheep production efficiency. Current control programs are largely hampered by constant migration of small flocks which are heavily infested with parasites and disease organisms. Close confinement of all sheep in the nightly bed-grounds further spreads disease among the flocks, particularly sheep scab or mange.

The current conceived program to treat all sheep in Tunisia for internal parasites, scab and sheep pox at government expense, is an ambitious project, but certainly warranted. The small producers with 10-20 head must be included in this program if any lasting results are to be attained.

The larger farms, particularly the government farms should make a supreme effort to eliminate sheep scab by dipping all sheep after shearing, using LINDANE. Sheep and goats kept for milk production should be dipped when not lactating. Control measures should be adopted on each large farm to prevent reinfestation by not allowing any sheep to come on the farm, unless they are first treated for external parasites and vaccinated for sheep pox. If possible sheep should be quarantined for about 3 weeks, when brought to the farm. This would apply to purchased replacements, rams etc.

Smaller producers must somehow be encouraged to dip their entire flocks. Portable dipping vats and high pressure sprayers have been used successfully in the U.S. for treatment of scabies in cattle. Sheep scab has been eliminated in the U.S. If portable facilities could be made available for use in the remote areas of the country, it would speed up the eradication and control of sheep scab.

Internal parasites will continue to inflict the greatest economic loss to sheep producers unless a national effort is made to educate the producer of the need for continuous control. Many producers visited by this author indicated their sheep were treated once and that was sufficient.

In the higher rainfall areas of Northern Tunisia it is very likely that three or more strategic drenchings might be required per year. Strategic and planned treatments should be related to the production system and the season of the year. This will vary from farm to farm. Ewes should be treated before going on to fresh pasture to prevent contamination of the pasture with worm eggs. Treatment schedules might be necessary in early fall after lambing, early spring and again in late spring before breeding. Lambs should be drenched at weaning. When possible lambs should be grazed on clean, rested pastures when weaned. Lambs are the most susceptible to parasites.

Products used for internal parasite control should be changed from one drenching to the next, as internal parasites do develop some immunity to a product if it is used continuously. THIABENDAZOLE, HALOXON, and TRAMINSOL might be used in rotation with the currently used STRONZOLE.

Very few sheep are vaccinated for Enterotoxemia. With the advent of more intensified systems of production, with increased use of improved pastures and concentrates, vaccination for this disease must become a standard management practice. As there is no treatment all emphasis must be placed on prevention.

Ewes that have not been vaccinated previously should be vaccinated twice, 2-4 weeks apart with the second vaccination being given 2-4 weeks before lambing. An annual booster 2-4 weeks prior to lambing is advisable

to protect the lamb until it is 6-9 weeks of age. Fast gaining lambs should be vaccinated at 6-8 weeks of age and again at weaning if they are fed concentrates or grazed on lush pasture.

As sheep pox is a highly infectious and frequently fatal disease it is imperative that the vaccination program as developed by the Direction des Services Vétérinaires be encouraged and expanded.

Because of the limited number of veterinarians, the OEP extension specialists and agents need to develop educational programs and workshops to encourage the acceptance of disease prevention programs. This should include basic management practices such as changing the bed ground and confinement quarters, providing adequate clean water, planning feeding facilities to prevent contamination which are easily cleaned, and care of the newborn lamb.

### C. SEASON OF LAMBING

In the small traditionally managed flocks, ewes lamb year-round. Consequently, improved management programs are difficult to employ. Problems relating to health and nutrition are particularly evident. An effort should be made to concentrate the lambing season into one-two months of the year.

In the conventional systems of once a year lambing, the majority of sheep breed in the spring when feed is most available. Feed supplies gradually diminish with the hot dry summer and regrowth does not occur until October-November.

Studies have shown the Barbarin ewe will lose as much as 28 percent of her body weight from June until January. Body reserves must compensate for the nutritional stress of gestation and lactation when lambing in the fall. Fall lambing is favored especially in the south as it is felt new vegetative growth will usually occur soon after lambing.

In the northern and parts of the central areas of Tunisia, lambing dates could be changed from fall to late winter.

Studies have shown ovulation rate to be the greatest in the fall. Results of late winter lambing have shown higher percent lamb crops born, with significantly higher growth rate of lambs.

I would recommend that the larger farms adopt a winter-spring lamb production schedule. Ewes should be bred to lamb in February. This would allow the nutritional requirements of gestation and lactation to be met by the increased vegetation available.

February born lambs would have ample time to grow out and reach slaughter weight prior to the hot-dry summer, especially if improved pasture and/or creep feed was utilized. Late lambs should be fed out and marketed later in the summer, at which time the lamb market generally is better.

The thin tail breeds which do not have the capacity to put on excessive body reserves to meet the demands of fall lambing should certainly be bred in the fall.

Breeding ewes in the fall will necessitate a flushing program as feed reserves are often lacking in August and September. For this reason I am not recommending fall breeding for the traditional inefficient producer. If it were attempted without excellent management lambing would probably continue into the early summer.

#### D. ACCELERATED LAMB PRODUCTION

Accelerated lambing implies lambing more frequently than once per year. Ewes are pregnant 5 months of the year, nurse a lamb efficiently only 3 months and can be considered idle 4 months of the year. Studies with the Barbarin breed show this breed to be sexually active all months of the year.

An accelerated lambing program of lambing every 8 months to produce 3 lamb crops in 2 years could be achieved especially in Northern Tunisia. The advantage of this program would be to theoretically produce 50 per cent more lambs per year. Under actual tests, however, a 50 per cent increase is seldom achieved. It is reasonable to expect a 35-40 per cent increase, which was accomplished at the Bou Rebia station.

In this author's opinion, an accelerated lambing program would prove beneficial in increasing lamb production efficiency.

However, it is recommended only for the larger farms which have control of abundant feed resources, and which have the management technology necessary to make the program work.

Some recommended management practices necessary for an accelerated lamb production program include:

1. Improved pastures should be available on a year-round basis. High-quality pastures will prove to be the most efficient method of providing the necessary nutrients to the flocks. Limiting the required nutrients at any time of the year will jeopardize the entire program.
2. Health programs must be excellent.
3. Lambing dates should be carefully studied to maximize use of available forage species, and to prevent breeding in the hot summer months. The lambing schedule adopted at Bou Rebia appears good. Ewes were bred to lamb in October, June and February.
4. Young ewes should not be used in this program until they have attained full growth.
5. Ewes must be bred in as short a time period as possible. It is, therefore, necessary to wean the lamb early, to allow the ewe a short recovery period before breeding. Weaning at 60 days of age would allow

30 days for the ewe to get into shape for breeding. Concentrates may be necessary to properly flush the ewe. Hormone therapy may be used to induce estrus after weaning and also to synchronize estrus. Progestogen vaginal pessaries are effective. They should be inserted into the vagina approximately 16 days before the desired breeding date and removed 12-15 days after inser

6. Extra rams may be necessary if the ewes are synchronized. Rams should be shorn and properly fed prior to breeding season.

7. Early weaned lambs will require additional management. They should be started on a creep feed at about 10 days of age.

8. In warm weather lambs should be sheared soon after weaning.

9. Ewes and rams should be sheared twice a year.

#### E. LAMB MARKETING

Live lamb marketing lacks standardization. Producers selling directly to the Tunis slaughtering plant receive D 1.100 to D. 1.350 depending upon season, per kilogram carcass weight. Large government farms sell by kilogram live weight on the farm with no reported shrink. The remaining lambs which constitute the majority are sold by the head.

1. A market system should reward the farmer producing the most efficient and desirable product. Price differentials at the slaughter plant which would favor the larger more correctly finished lambs, and discount small thin lambs would create some incentive to produce a more desirable product.

2. A second alternative would be to keep the price the same throughout the year. This would encourage the production of larger lambs, as the farmer would not have to sell early in the year to get the highest price.

3. A long-term goal of changing the country sales of selling by the head to selling by weight would be of benefit to the entire industry. This would involve great expense and change in custom and realistically will probably never be done.

F. GENETIC IMPROVEMENT

Small sheep producers with only enough ewes for one ram, are limited in the amount of improvement possible because of limited numbers to select replacements from. Secondly, many small flocks are highly inbred as rams raised within the flock are often used. This situation can only be changed by introducing unrelated rams of improve genotype. The responsibility to provide these rams rests with the larger producers who have enough numbers to effectively conduct an improvement program.

The current program of the OEP of acquiring and selling performance tested rams is excellent. The program needs to be expanded to fulfill the demand, without sacrificing production standards. Likewise the work of the Controle des Performances project needs to be expanded.

Growth rate must receive preference in any selection program. Faster gaining lambs producing heavier carcasses are needed to meet the red meat deficit. Likewise prolificacy must always be considered. The Controle des Performances project might consider within flock correction factors for type of birth and rearing, as their program develops.

In the south, mature ewes of intermediate size are preferred over larger ewes. It is felt they are more efficient. Generally, mature size is positively correlated with size at weaning. Likewise larger ewes tend to produce larger lambs. In the south with its nutritional limitations, selection based on early lamb growth rate should be emphasized. This would give preference to maternal ability (efficiency of milk production) and would probably not significantly affect mature size.

Many of the large government farms have the capability (because of large numbers of sheep) to make tremendous strides in genetic improvement. It is a common practice now to divide the ewe herd into individual flocks of 200-250 ewes, occasionally by age of ewe, which are herded throughout the year and not mixed. This division could be made on a basis of production. The most productive ewes (size, growth rate, prolificacy, conformation, breed character etc.) would make up Flock A, the next most productive Flock B, Flock C, etc.

The best ewes (flock A) are used to produce replacement ewe lambs for flock A and part of flock B. This is a continuous process and as better replacements are made available, ewes in the least productive flocks are culled. In a similar manner the rams are assigned on A,B,C, etc. rating depending upon their production. The ewes in the least productive flocks could be bred to rams of another breed. All of these crossbred lambs should be sold. The crossbred lambs would have the advantage of hybrid vigor.

Genetic potential can also be changed from crossbreeding. A well planned crossbreeding program combines the desirable traits which are lowly inherited.

Consideration should be given, in the better feed producing areas, to a cross-breeding program. An F1 female could be developed from a Barbarin and Sicilo Sarde mating. This combination would combine the milking ability of the Sicilo Sarde with the hardiness of the Barbarin. These crossbred ewes should be bred to rams noted for growthiness and carcass desirability. From this author's observations, the Algerian thin-tail would best fit this description, although the Black Thibar might work as well.

The Kelso report 1977, states 42,920 tons of milk are produced from sheep and goats. This represents about 18% of the domestic milk production. It is recommended that genetic improvement programs of the Controle des Performances project with milk production of the Sicilo Sarde breed continue and expand. Likewise genetic improvement with the use of improved breeds should be explored.

Possible consideration should be given to importation of improved milk breeds. A possibility is the Awassi, native to Turkey but found throughout Asia. The breed is reported to be heat tolerant and adapted to poor grazing conditions. It has a fat tail, resembling the Barbarin in appearance.

#### G. MANAGEMENT

The existing traditional entrenched management systems must be patiently changed before any significant improvement in sheep production can be realized.

Crop farming and sheep production must supplement each other, rather than compete for available resources.

Establishment of improved pastures is a prerequisite to most of this author's recommendations for increased sheep production efficiency. This includes establishing irrigated pastures, seeding dry-land pastures and developing range management systems to increase native pasture production in the more arid regions.

Combining small flocks into large manageable units and establishing rotation grazing systems on collectively controlled lands should be encouraged.

In the larger more intensified production systems, consideration should be given to fencing the pastures similar to the 850 ha CASTIA project of

the Enfida Agrocombinat. Two-wire electric fences have proven very effective in the U.S.

Sheep should be sheared early in the spring before lambing and/or before breeding. Accelerated production systems should consider shearing ewes and rams twice per year. Shearing in the early fall would leave ample time for sufficient regrowth for protection in the winter. Freshly shorn sheep suffer most from excessively cold wet weather, and direct exposure to the sun in the summer. Lambs shorn in early summer should have some shade in the middle of the day.

It would be advantageous to develop the use of modern shearing technology. A flock could then be sheared in a few days instead of the current practice of shearing 12-18 head per year.

The thin-tail breeds should be docked. Removal of the tail facilities natural breeding, and removes the source of disease and parasite infestation of young lambs which occurs when new born lambs nuzzle and attempt to nurse on the tags of the tail. The Sicilo-Sarde breed should be docked to lessen contamination of the milk when these ewes are hand milked.

Docking should be done before the lambs are two weeks old. An elastrator (heavy rubber ring) is a simple bloodless method. New elastrator rings should be used each year, to lessen chances of tetanus.

#### H. TECHNICAL ASSISTANCE

Current technical assistance to the Tunisian sheep industry is extremely limited. There are few highly trained personnel in sheep production technology. The most highly trained are in research, but by their own admission their programs suffer from lack of trained personnel. The OEP Extension Staff needs assistance and more highly trained personnel before

it can effectively reach the thousands of sheep producers in Tunisia.

Development and utilization of better sheep production methods is largely limited to the INRAT sheep stations and a few of the larger government farms.

There is a lack of coordination of effort between various agencies. The Integrated Livestock Project of OEP must take the leadership in developing an organizational structure which most efficiently collects and transfers technology to the individual sheep producer. Information from INRAT, Control Performances, Veterinary sources should be free flowing among the agencies. Technical information and objectives of the different agencies should be constantly disseminated to the extension agents in the field.

The final transfer of technology to the sheep producer will depend largely upon the competence of the field agent. Field agents need intensive training workshops in sheep production. Office handbooks on sheep production, and additional hand-out material on various aspects of sheep technology would prove beneficial to the field workers.

Within the Integrated Livestock Project there needs to be more coordination of effort of the different specialists. Joint package programs including forage production and economics should be included in developing complete educational programs in sheep production.

Tunisia needs the assistance of USAID to help develop its sheep industry. Current emphasis of USAID on cattle and milk production is certainly warranted, but realistically additional emphasis should be given to the Tunisian sheep industry.

The efficiencies of the sheep in converting natural and improved

forages into meat, milk and fiber, with minimum use of concentrates should be capitalized upon.

Sheep will continue to be the major livestock enterprise of the country regardless because of their natural adaptation to the Tunisian environment, and the preference of the Tunisian people for lamb and mutton.

In the interest of Tunisian agriculture, assistance in developing this large industry is fundamental to any planned efforts of meeting the projected demands for meat in the years to come.