FAO ANIMAL PRODUCTION AND HEALTH PAPER 40

intensive sheep production in the near east

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by
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FOREWORD

Sheep meat is the preferred meat in the Near East and in some countries it constitutes a major part of the total meat supply. In the Eastern Mediterranean countries, sheep milk is also a valuable commodity. In recent years the demand for sheep meat has grown dramatically and the traditional extensive system of production is not able to cope with it. Consequently, the high-income countries have resorted to imports; mainly from outside the region.

In some countries of the region, the potential for increasing sheep production is limited, while in most of the other countries the land, animal and feed resources can be appropriately developed and utilized to produce sufficient meat for domestic consumption and in some cases for export. There are many possibilities of increasing meat production through improved management of rangelands and the range sheep. Similarly, in arable lands and higher rainfall areas, meat and milk output can be greatly increased by establishing intensified patterns of sheep production. Small or medium scale intensive sheep production has been popular in some countries of the region and needs to be promoted in others.

The FAO Workshop on the Improved Utilization of Feed Resources for Sheep Fattening in the Near East held at Amman from 25 - 29 April 1981, pointed out the need to identify and demonstrate appropriate procedures for intensifying sheep production in breeding/fattening as well as in fattening units. The practical aspects of animal management in such units needed to be compiled and documented. In 1982, FAO requested Dr. Soterios Economides of the Agricultural Research Institute, Nicosia, Cyprus, to undertake this task. He has had long experience in sheep production research and extension and has conducted regional sheep production courses organized by the FAO regional project on animal production and health, MINEADEP.

The report prepared by Dr. Economides is presented in this paper. It is hoped that the material presented in the paper will be useful to the producers and extension workers in the countries of the Near East region.

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Chapter 1 INTRODUCTION

The Near East region, i.e. from Morocco and Mauritania to Pakistan, raises some 240 million sheep or more than one-fifth of the world's total (Table 1). The present productivity of these animals is very low and experimental data suggest that their production potential is not adequately utilized. The demand in the region for sheep meat is very high. The data given in Table 1 indicate that notwithstanding intra-regional trade, about ten million live sheep and a quarter-million metric tons of sheep meat were imported into the region. Moreover, the price of fresh meat from animals slaughtered in the country is much higher than that of imported meat. Cheeses made from sheep milk also fetch a very high price. This provides a favourable economic climate for intensifying sheep production in the countries of the Near East.

An intensive sheep production system involves confinement of the flock with only limited grazing, the aim of which is to attain heavier lambs at slaughter, lower lambing interval and higher weaning percentage than that found in flocks maintained under extensive grazing conditions. Such a system requires improved forage production and utilization, use of concentrates, a high level of veterinary care and better housing and feeding facilities which could be mechanized whenever the required managerial skills are available.

Major advantages of an intensive system are as follows:

- forage production can be improved and grazing can be controlled;
- feed requirements are reduced because of reduced walking;
- sheep can be penned or separated in groups on the basis of their productive stage and managed accordingly;
- lamb losses due to diseases and predators are reduced;
- internal and external parasites are more easily controlled;
- feeding programme can be mechanized or even automated in order to save labour;
- a more stable supply of fresh meat and milk is assured throughout the year making the processing, storage and marketing more efficient.

These advantages add up to a high output per ewe, both in terms of meat and milk. Increased animal performance, efficient labour utilization and higher prices for the quality produce usually justify the initial investment in construction and equipment.

Chapter 2 of the paper indicates the levels of production that could be expected by following the various procedures involved, while Chapters 4 and 5 describe the management practices that should be followed. In Chapter 3, the constructions and equipment required are described and illustrated. These are based on the experiences gained in Cyprus and may need to be modified and improvised to suit the specific requirements of the enterprises in the other countries of the region.

Table 1 Sheep Production and Imports in the Countries of the Near East - 1981

Countries	Sheep Population 1000 heads	Live Sheep Imports 1000 heads	Sheep Meat Imports (MT)	Estimated Sheep Meat Supply/Person		Sheep Milk Production (1000
				Kg/Year	% of all	
Afghanistan	20 000 F			4.5	55	225 F
Algeria	13 600 F	15	9 100 *	3.9	47	164 F
Bahrain	7 F	115 *	1 100 *	10.2	18	
Cyprus	525 F		1 175	10.5	17	26 F
Djibouti	330 F		15 *	3.0	23	
Egypt	1 599	50 *	9 207 *	0.9	6	23 F
Iran	34 377 F	1 200 F	124 000	9.2	39	705 F
Iraq	11 650 F	300 F	30 700 *	5.1	23	130 F
Jordan	1 000 F	430	14 703	6.2	35	25 F
Kuwait	158 F	2 101 *	11 000 F	22.4	47	5 F
Lebanon	148 F	320 *	5 000 *	5.2	21	15 F
Libya	6 258 F	1 800		17.5	55	40 F
Mauritania	5 200 F			5.0	19	57 F
Morocco	14 840			2.3	18	21 F
Oman	116	50 F	7 795	9.8	29	
Pakistan	28 468	-1 E	51	1.6	19	39

Qatar	50 F	400	3 800 F	29.8	49	2 F
Saudi Arabia	4 201 F	6 029 N	32 801	5.9	16	84 F
Somalia	10 200 F	-1 510 E		4.0	7	98 F
Sudan	18 125 F	-850 E		4.5	20	127 F
Syria	11 738	646		10.0	53	476
Tunisia	4 967 F	30 *	500 F	7.1	53	25 F
Turkey	48 630	-1 919 E	-24 712 E	6.8	35	1 200 *
United Arab Emirates	139 F	300 F	18 700 *	22.0	32	3 F
Yemen Arab Republic	3 159 F	160 F		2.8	58	49 F
Yemen People'sDem.Rep.	987 F	150	1 100 *	3.7	32	12 F

Source: -FAO Production and Trade Yearbooks, 1981.

-FAO Computer data.

E: Exports;

F: FAO estimate;

*: Unofficial figure;

N: Including imports for non-food use.

**: Total supply of cattle, buffalo, camel, sheep, goats, pig and poultry meat.

Chapter 2 POSSIBILITIES OF INCREASING PRODUCTION

2.1 Semi-intensive and intensive production systems

The low productivity of Near East rangelands, the need to reduce grazing pressure and the present movement of pastoral people to urban areas would inevitably lead to the establishment of semi-intensive or intensive sheep production enterprises in areas where:

- better grazing can be made available in areas with marginal or higher rainfall;
- forage can be produced under irrigation through the introduction of forage crops in rotation with food crops;

- fallow land in rainfed areas can be replaced by forage legumes; and

- agricultural and agro-industrial by-products are available in large quantities for sheep feeding.

In such areas integration of crop and livestock farming systems would increase the efficiency of land and labour utilization and would lead to increased sheep production.

About 70-90 percent of the local production of mutton and lamb in most Near East countries comes from sheep that are raised in natural grazing areas. The low productivity of these animals is associated with low forage availability and lack of adequate management. It was estimated in 1980 that the lambing crop in the Bedouin sheep of Jordan was 61 percent, weaning weight of lambs at 60 days was 13.5 kg and milk production per ewe was only 45 kg. This level of production can be increased considerably with supplementary feeding of ewes and lambs and better management as has. been demonstrated in government farms in Jordan.

The importance of the rangelands for sheep production will undoubtedly continue in the future. At present, there is a growing interest in the implementation of development programmes which would prevent the deterioration of grazing areas and would increase their animal carrying capacity. One of the main aspects of these programmes is the early offtake of lambs from rangelands and their finishing in organized fattening units in areas close to consumption centres or sources of feed. The advantage of such stratification of production is that the grazing pressure on rangelands is reduced and more forage is available for breeding animals. In addition, meat production from lambs will be increased considerably under proper management and feeding. A good example of this type of intensification is the fattening system that has recently been established in Syria in the form of sheep cooperatives. Experiments in Iraq and Libya have indicated the importance of raising lambs on balanced diets. It has also been shown that lamb rations could include urea and agro-industrial by-products in order to increase meat production per animal at reduced costs.

Considerable work has been carried out in Cyprus on the intensive rearing and fattening of lambs and on the establishment of intensive sheep breeding/fattening units. This work is relevant to the other Near East countries and is described in this chapter. It indicates the level of ewe and lamb productivity that may be expected under intensive feeding and management conditions.

Sheep enterprises in Cyprus may be classed in two categories: the semi-intensive and the intensive system. In the semi-intensive enterprises, the animals are grazed throughout the year on natural vegetation, improved pastures, cereal stubble or crop residues and are fed conserved forage derived from cereal/legume or cereal-grain/cereal-forage rotation systems. The grazing is supplemented with concentrates, the quantity of which depends on the availability of roughage and the productive stage of the sheep.

In the intensive system, sheep are grazed for only about two hours daily and are fed mostly on cut forage (cereal hay, legume hay or cereal-legume hay mixtures), conserved hay (from alfalfa or sudex) and baled straw. Supplementary feeding is also carried out with concentrates, the quantity of which depends again on forage availability and the productive stage of sheep. Since the preference for both sheep meat and sheep milk is high in Cyprus, sheep production systems are directed towards increasing the level of milk production together with meat production. This is achieved by improving the genetic potential of the animals and applying improved feeding and management practices. In order to increase income in a dual purpose sheep enterprise the marketable milk must be increased by limiting milk consumption by suckling lambs and the early weaned lambs should be reared under intensive conditions of feeding and management. Early weaning and use of milk replacers should not affect the meat output per ewe,

2.2 Early weaning and suckling regimes

The rumen of the lamb starts functioning at 3-4 weeks of age and prolonged suckling is not advisable. The milk consumption of lambs per unit weight gain increases with increasing weaning age as is shown below in the case of Chios lambs.

	Weaning age (days)			
	35	42	60	70
Weaning weight (kg)	12	15	20	21.5
Milk consumption (kg/lamb)	47	53	84	93

Marketable milk yield can be increased through restricted suckling or partial suckling of lambs. Trials with Chios lambs weaned at 35 days (suckled continuously or for.8 hours daily) or weaned at 70 days (suckled continuously or for 12 hours daily) showed that the total milk yield of ewes was similar with continuous suckling but when partial suckling was applied a higher marketable milk yield was obtained. Partial suckling is profitable in the early stages of lactation provided that the milk left to the lamb and the intake of solid feed are sufficient to sustain satisfactory growth. Other experiments where partial suckling was extended to 120 days of age showed that ewes are depleted of their body reserves and re-breeding is delayed. In addition, more feed is required for ewes to replenish the liveweight losses, the solid feed intake by lambs remains low and more labour is involved in handling ewes and lambs. Therefore prolonged partial suckling is not advisable.

Increase in marketable milk can be achieved by weaning lambs at a young age and applying partial suckling towards the end of the suckling period. In experiments where lambs were separated from their dams at birth or at two days of age, the milk yield, lactation length and the growth of lambs were adversely affected. These effects were more pronounced in the local fat-tail breed than in the Chios breed. It is thus advisable that in the case of the fat-tail breed at least one lamb should remain with the ewe until weaning.

Further trials with suckling lambs until weaning and with growing lambs on solid feed showed that, with the existing prices of sheep milk and lamb meat compared to those of concentrate mixtures, it is more profitable to wean lambs early on limited quantities of ewe milk, and to fatten them on concentrates until slaughter. These results showed that the conversion of milk to lamb carcass is 10;1, i.e. 10 kg of milk is required to produce 1 kg of carcass whereas the conversion of solid feed to carcass after weaning is 8.25:1.

A 42-day weaning with partial suckling (8 hours suckling daily) during the last two weeks has been adopted at the Cyprus Agricultural Research Institute. The average perfor-mance of Chios lambs and ewes until weaning was as follows;

The Performance of Chios Lambs

	Males	Females

Birth weight (kg)	4.50	4.20
Weaning weight (kg)	15,60	14.00
Milk sucked (kg)	53	51
Carcass weight at birth (kg)	1.9	1.8
Carcass weight at weaning	7.4	6.6
Milk (kg)/carcass gain (kg)	9.9	10.6

The performance of ewes

	Single Lambing	Twin Lambing
Milk yield (kg)	108	134
Commercial milk (kg)	49	41
Liveweight loss (kg)	1.8	2.5
Feed consumption (kg):		
- hay	34	34
- concentrates	95	97

The cost of meat production was reduced considerably when weaning was practised at 42 days and lambs were fattened on concentrates until 84 or 140 days of age as is shown below:

	Age at slaughter (days)		
	42	84	140
Carcass weight (kg)	7.5	13.0	21.5
Feed efficiency	-	-	-
Milk or solid feed (kg) per kg carcass gain	10	8	8.5

Cost/kg carcass gain (US $/kg)	5.8	2.1	2.3
Total cost (US $/lamb)	30	42	66

Intensive lamb production provides the opportunity of utilizing edible and inedible offals (slaughterhouse by-products) for animal feeding, thereby increasing total income. Carcass weights and edible and inedible offals of lambs slaughtered at different ages are given below:

	Age at slaughter (days)			
	42	84	100	140
Carcass weight (kg)	7.5	13.5	15	21
Edible offals (kg) (head, liver, sweetbreads)	1.7	2.8	3.3	4.8
Slaughterhouse by-products (blood, feet, digestive tract and gut contents)	3.9	6.8	7.8	9.8
Skin	1.7	3.5	4.0	5.8

2.3 Fattening

The supplementation of a basic concentrate diet containing 16 percent crude protein with a trace element and/or a vitamin mixture (A, D, E) significantly improves the daily gain and feed efficiency of male lambs as is shown by the following results of a trial.

	Basic diet	Basic diet + trace elements	Basic diet + vitamins	Basic diet + trace elements + vitamins
Weaning weight (kg)	17.4	17.0	17.0	16.8
105 day weight (kg)	32.1	33.6	37.0	38.7
Feed intake (kg)	58	59	67	66

Feed/Gain	4.22	4.10	3.94	3.77

Broad beans, common vetch seeds and urea were fed to lambs in order to test the possibility of replacing soyabean meal in the basic diet with other sources of nitrogen. The performance, of lambs was not affected when broad beans (second grade, not used for human consumption) were included in the diet at the rate of 10 or 20 percent. This is indicated by the following results:

	Control diet	Broad beans (10%)	Broad beans (20%)
Weaning weight (kg)	16.2	16.0	16.5
125 day weight (kg)	45.2	45.4	45.1
Concentrate intake (kg)	110	112	112
Feed/Gain	3.81	3.83	3.83

Feed efficiency was slightly reduced when 30 or 49 percent of broad beans or 30 and 43 percent of common vetch seeds were included in lamb fattening diets to replace partially or completely soyabean meal. The performance of lambs was as follows:

	Control diet	Broad beans		Common vetch	
		30%	49%	30%	43%
Initial weight (kg) (49 days)	18.50	18.30	18.30	18.30	18.40
105 day weight (kg)	38.20	37.30	37.0	36.5	37.5
Feed intake (kg)	66	68	67	68	69
Feed/Gain	3.34	3.60	3.58	3.76	3.59

Urea was also used in lamb diets containing 16 percent crude protein to replace 50 percent of soyabean meal from weaning (6 weeks of age) to 45 kg liveweight. In the first period from 42-84 days, the daily gain and carcass gain of lambs on the urea diet was lower but was equal to that of lambs on the diet without urea during the period from 84 to 140 days. Feed efficiency in both periods was better with the diet containing soyabean meal. Total feeding cost was about US $ 1.4 lower with the diet containing urea.

Chapter 3 CONSTRUCTION AND EQUIPMENT

Sheep housing and other facilities such as feed storage, feeders and waterers, lambing pens, creeps, etc., are important factors in protecting animals, feed and equipment, saving labour and aiding in effective management. In planning a sheep breeding/fattening operation decisions have to be made depending on the production system to be adopted, the size of the operation, the housing and feeding system, environmental conditions and the location. The cost of housing must be kept low, with buildings providing only the most essential facilities. Sheep housing should retain the flexibility of internal subdivisions in order to make more intensive use of the

buildings.

3.1 Choice of location

The location where the farm buildings are to be constructed must fulfil the following conditions: 1) it should be on land that is not suitable for crop production; 2) buildings should be located in such a direction that animals would be protected from prevailing winds (usually from a south-easterly direction); 3) the land should be at a slope away from the buildings (3-4 percent); 4) water supply should be adequate in quantity and quality; 5) the farm should be accessible from a main traffic road; 6) electricity should be available for yard lights and other electrical conveniences.

3.2 Housing system

Open front barns with open yards providing adequate shelter for protection from heat and rains are the most suitable. The roof shape should be of the shed type (Figure 1) sloping toward the open yard. The roof should be constructed from galvanized corrugated sheets placed on a wooden frame, but preferably on mild steel tubes. Galvanized iron poles should be used to hold the roof. The roof may be insulated with materials such as polyurethane providing protection from high temperatures. The height of the ceiling should be about 3 metres at the lowest point of the slope to 3.5 metres at the highest point at the back of the shelter. Cement blocks should be used to build the three wall sides (15 cm wide) . The water from the roof should be collected in a concrete gutter on the ground and directed out of the yard. Fenceline feeding bunks should be constructed on the two sides of the open yard or under the sheltered area. The front side should be fenced and a door constructed in the middle (3m x 1.2m) for tractor access. Lighting should be provided by a 100 watt electric lamp for each 40 square metres area.

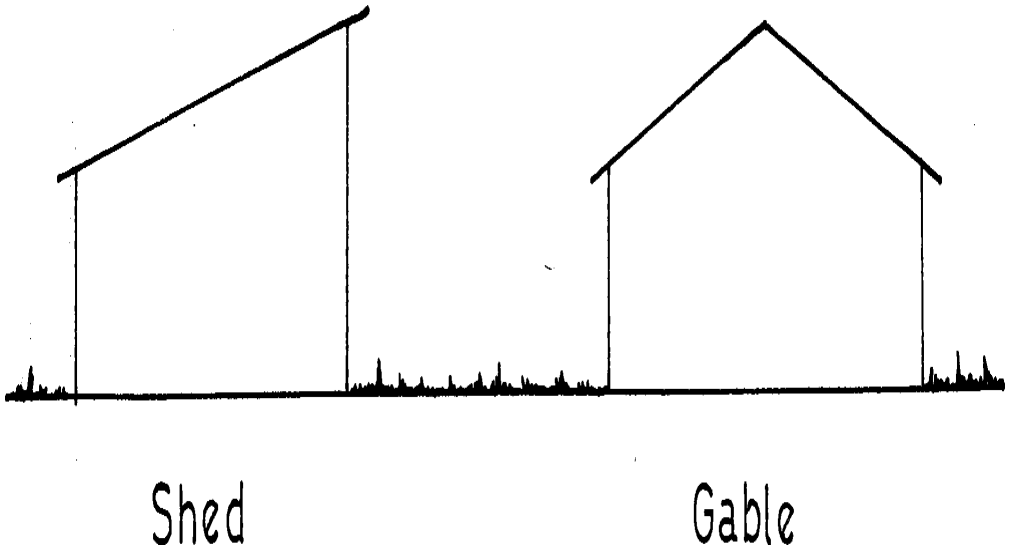


Figure 1 -Types of roof shape.

3.3 Floor and floor space

The barn floor should be solid,sloping (2 percent) toward the open front. It may be constructed from crushed limestone or a mixture of sand, gravel and compacted clay (5-10 cm deep). Along the open front and the yard a concrete apron (25 cm width) should be constructed sloping to a ditch of 10-15 cm. The surface of the yard

should be compact and well drained.

A slatted floor may be used for large lamb fattening units. It has certain advantages (no bedding, less labour, reduction of space requirements per animal, a dry, clean floor, better control of parasites and more comfort in hot weather) but also certain disadvantages (temporary lameness, shortage of feeder space and more expensive to construct). Slatted floors are constructed from galvanized steel mesh with openings of 0.8 cm x 5.5 cm.

The following sheltered floor space per animal is recommended:

- Adult dry ewes or rams 1.0- 1.2 square metres (m^2)
- Pregnant ewes 1.2 m^2
- Ewes with one lamb 1.8 m^2
- Ewes with two lambs 2.2 m
- Ewe lambs (replacements) 0.7 m^2
- Artificially reared lambs as a group 0.3 m^2/lamb
- Fattening lambs 0.6 - 0.8 m^2 /lamb
- Feeder lambs (older lambs) 0.8 - 1.2 m^2/lamb

The space per animal in the open yard should be about twice the above recommended figures.

3.4 Ventilation

Ventilation is of paramount importance. It is a continuous process to remove moisture from inside the building, to provide fresh air for animals, to remove excess heat in hot weather and odour and gases from animal waste. The aim should be free circulation of air above the animals' heads. Air movement is controlled through fixed openings (open front) and a continuous slot (10-15 cm) at the top of the back wall, or adjustable openings (windows and wall panels on the back wall).

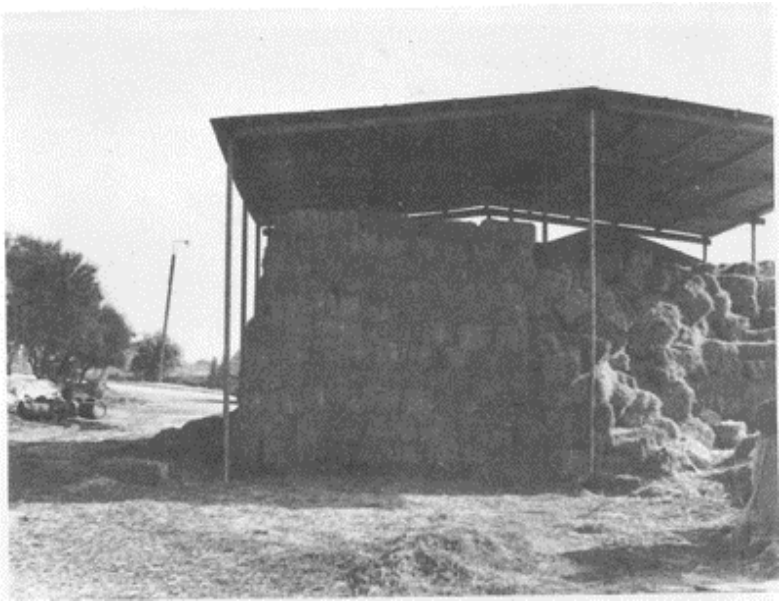
3.5 Manure handling

The common practice is to handle manure as a solid which involves scraping, loading and hauling. The design of the buildings should be such that a tractor and scraper have easy access for manure removal. The manure is placed either directly in the field or is stockpiled. Manure, urine and water runoff are first collected through small ditches into a settling tank, where solids settle and liquids are diverted to a holding pond for field spreading. Solids from the basin are removed as required. The holding pond is emptied as required and the effluent may be used for irrigation.

3.6 Feed handling facilities

The type of facilities for feed handling depends on the size of the unit and whether feed ingredients are purchased and rations prepared at the farm,or. compound feeds are purchased regularly.

Storage sheds should be built for roughages like hay, straw or alfalfa (Photograph 1) when they are available for use later in the year. Storage sheds (Figure 2) should be constructed with galvanized iron pipes and galvanized corrugated sheets and the frame made from mild steel tubes. The quantities to be stored depend on the number of animals and the feeding programme. The volumes required per ton of alfalfa hay, non-legume hay and straw, when stored loose, baled or chopped, are indicated below.



1. Storage shed for hay

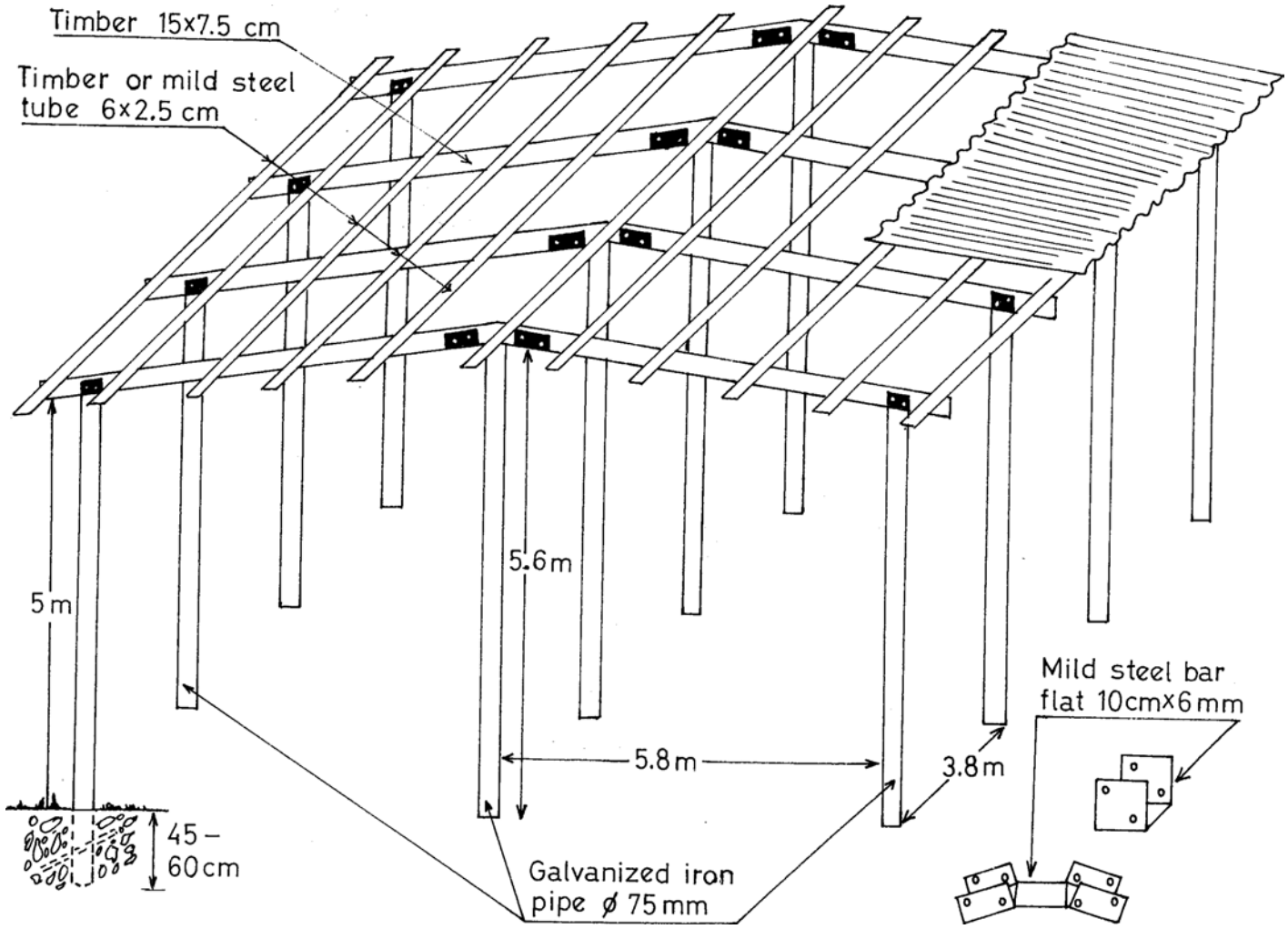


Figure 2 - Hay storage shed. Dimensions depend on the quantity of hay to be stored.

	Loose		Baled		Chopped	
	m^3/ton	Kg/m^3	m^3/ton	Kg/m^3	m^3/ton	Kg/m^3
Alfalfa hay	13-14	70-65	6-9	160-95	8-10	110-80 (cut 4 cm)
Non-legume hay	13-17	70-55	7-9	130-95	8.5-11	105-80 (cut 8 cm)
Straw	19-28	48-30	11-14	80-65	7-10	130-15

Feed stores should be built from cement blocks near the barns for purchased compound feeds. When feed rations are prepared at the farm the ingredients are stored in a building with the necessary equipment for metering, elevating, grinding, mixing and delivering feeds to metal or fibre glass bins. The handling system may be a bulk bin from which the feed can be augered to self-feeders or feed may be fed by hand. Pellets can be purchased in bags or in bulk and stored in a bin from which they can be$_3$ augered to self-feeders or hand fed. Stored concentrates require a volume of about 1.5 m^3 per ton.

3.7 Feeding facilities

Feeding facilities should be planned to prevent contamination and to allow for frequent cleaning. Sheep should be fed only in troughs or from feed racks which should be constructed.so that the animals cannot stand in the feed and contaminate it with droppings.

Feeding space per sheep is determined by the size of the sheep and the number of sheep that eat at one time. For adult sheep hay and grain bunkspace is 30-45 cm/sheep and 25-35 cm for older lambs. In self-feeding systems about 4 cm for creep-feeding lambs, 6 cm for weaned lambs and 10 cm for older lambs should be allowed.

Plans for the fabrication of portable troughs are given in Figures 3 and 4. Photograph 3 illustrates a well-fabricated feeder for both hay and concentrates. Plans for grain and hay racks are given in Figure 5.

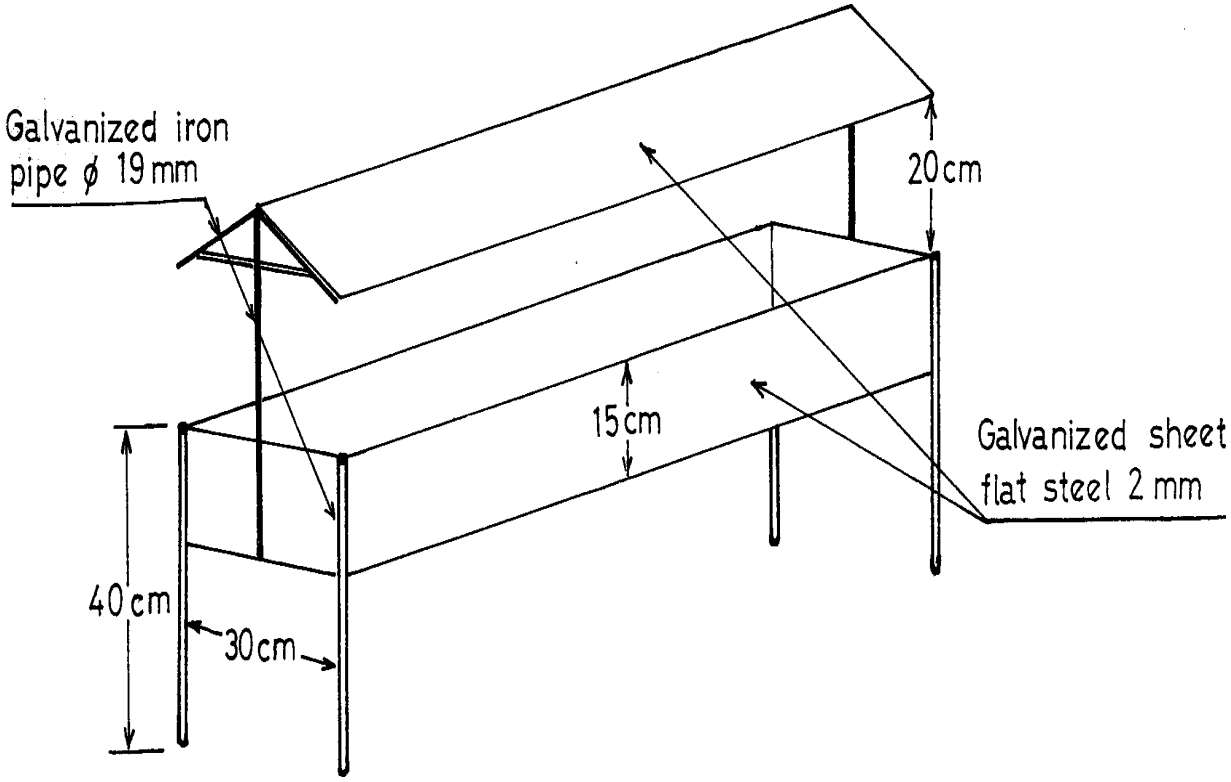


Figure 3 - Portable grain trough with cover. The length is variable. Cover is optional. Small quantities of hay can also be fed.

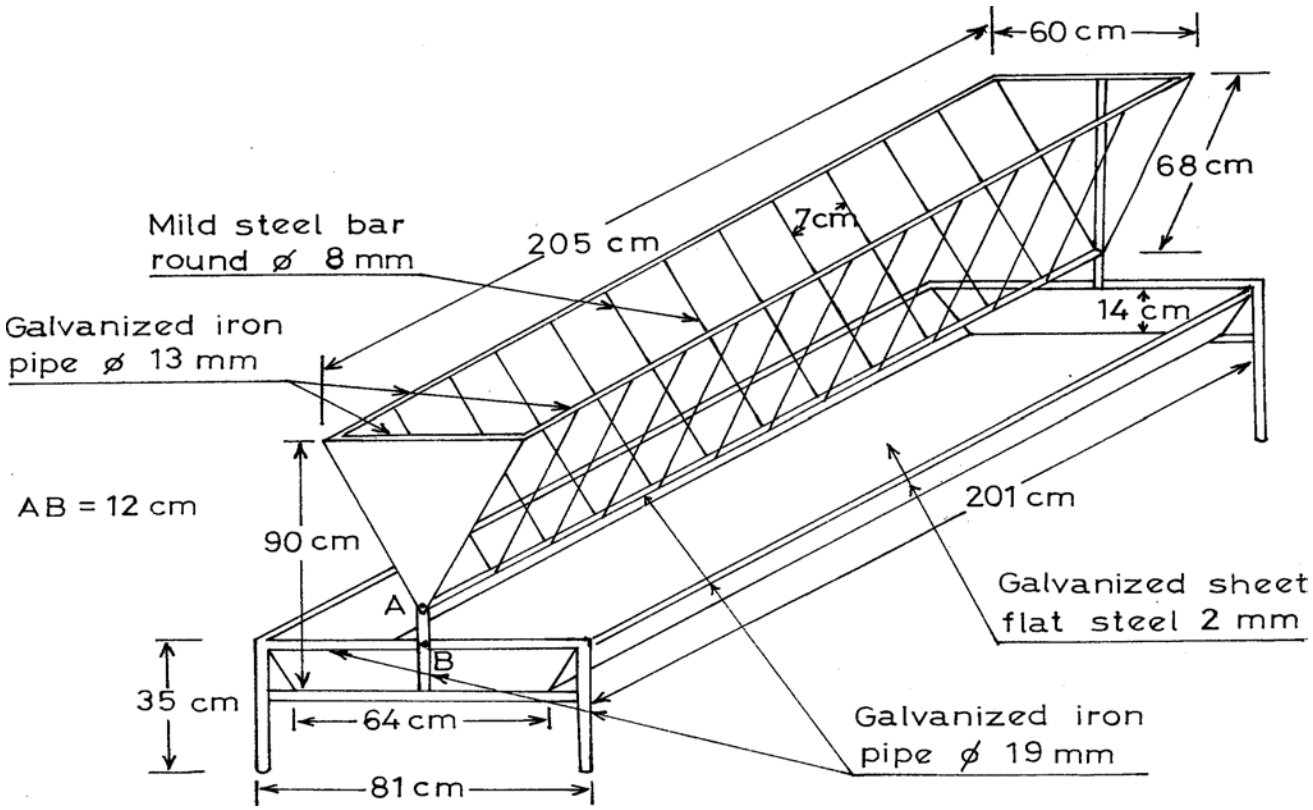


Figure 4 - Portable grain and hay feeder. Hay is placed on the top. It is used for small groups of ewes (see also Photograph 3).

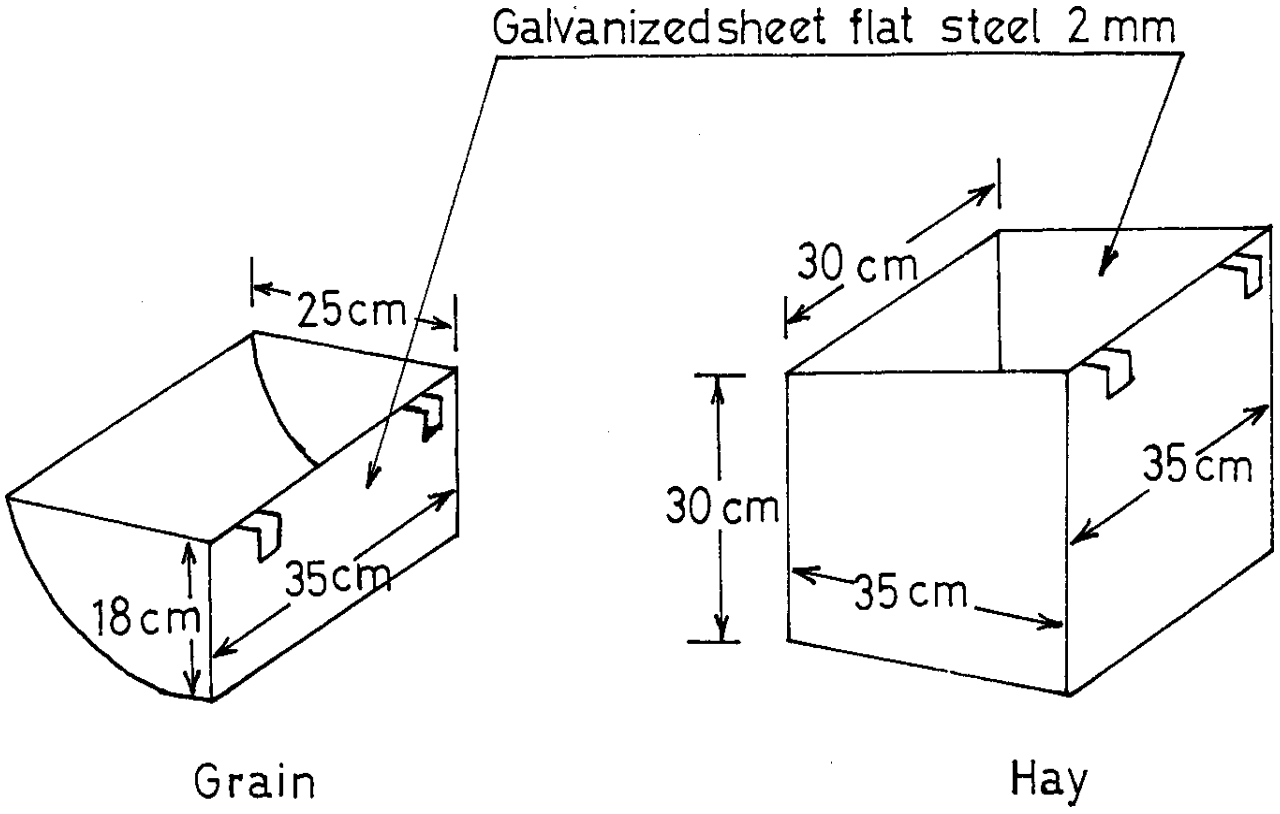
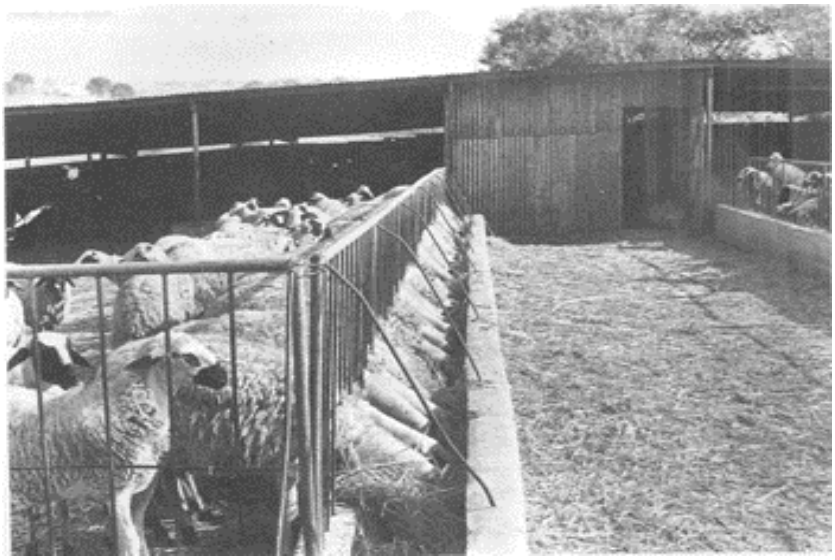


Figure 5 - Grain and hay racks.



2. Fenceline feeding bunk and feed storage shed

3. Portable trough for roughage and concentrates

Self feeders (Figure 6) allow more efficient use of labour, the feed remains clean and there is no wastage. There is also maximum consumption of feed resulting in improved rate and efficiency of gain. Self feeders are not usually used in the case of ewes.

Figure 6 - Grain self-feeder for lambs. The length is variable. Lambs can be fed from one side(single)or both sides(double).

Various types of concrete bunks are also constructed for feeding. Bunks for mechanical feeding are often constructed on the dividing line between two lots and sheep are fed from both sides. The throat height for the bunk should be a maximum of 38 cm for ewes, 33 cm for feeder lambs and 25 cm for creep fed lambs.

Fenceline feeding bunks (Figure 7 and Photographs 2 and 4) are useful for easy delivery of feedstuffs. Feeders

are constructed on the perimeter of the feeding area so that they can serve as a feeder as well as a fence. They can be used for ewe flocks or feedlot lambs. Fenceline bunks are often oriented from N-S or NE-SW with the buildings constructed at the north end.

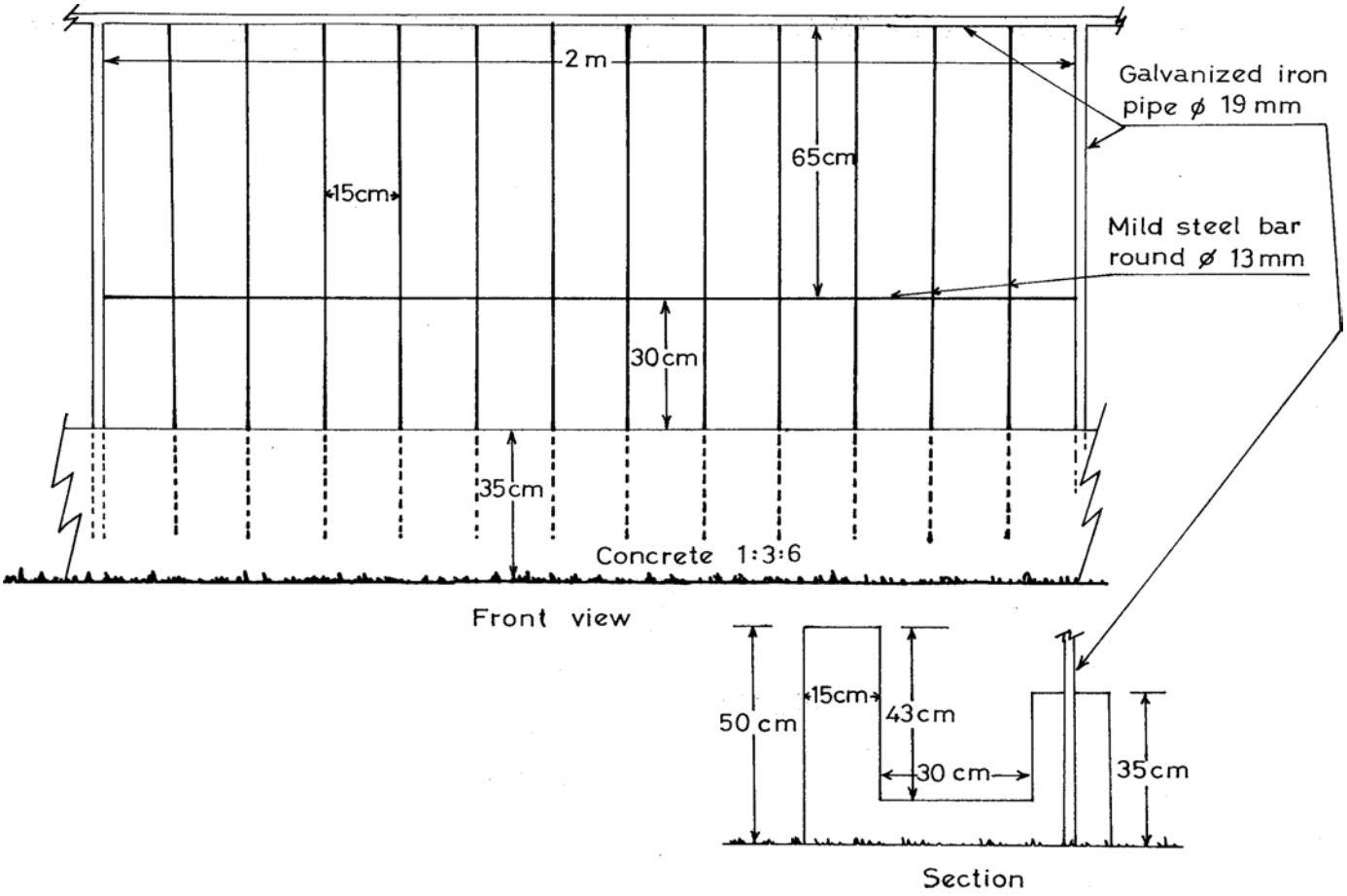
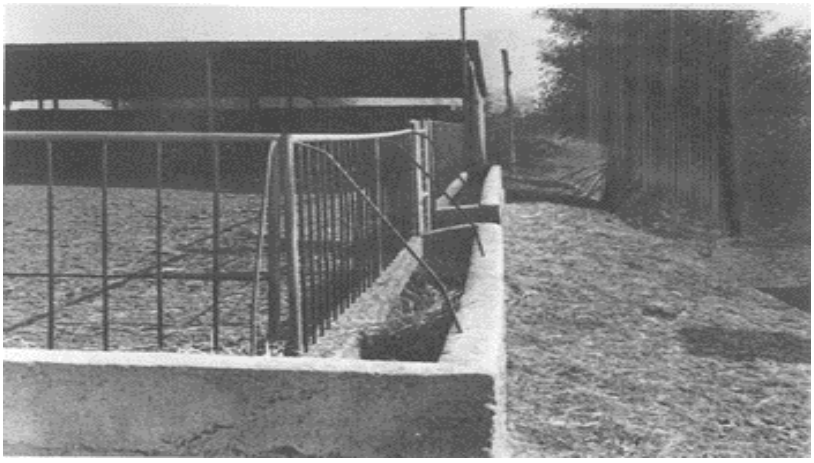


Figure 7 - Fenceline feeding bunk. Hay and grains or complete diets can be fed. The bunks are constructed on the perimeter of the open yard or under the sheltered area (see also Photographs 2 and 4).



4. Fenceline feeding bunk

Small flocks or small groups of ewes are often hand-fed. For this purpose bunks are located in areas where they

can be kept dry. The floor height of the hand-fed bunks is about 2.5-5.0 cm above the sheep's feet. Outdoor bunks may be raised to keep the sheep and dirt out of the bunks. Pavement along or around the feeders (1.5 m width) with 2.5 percent slope away from the feeders is adequate to prevent muddy conditions. Gravel or compacted clay is often used. Walkways should be provided from the barns to the feeding areas.

Creep feeding constructions (Figure 8, Photograph 5) are essential in early weaning systems to provide feed for the lambs during the nursing period.

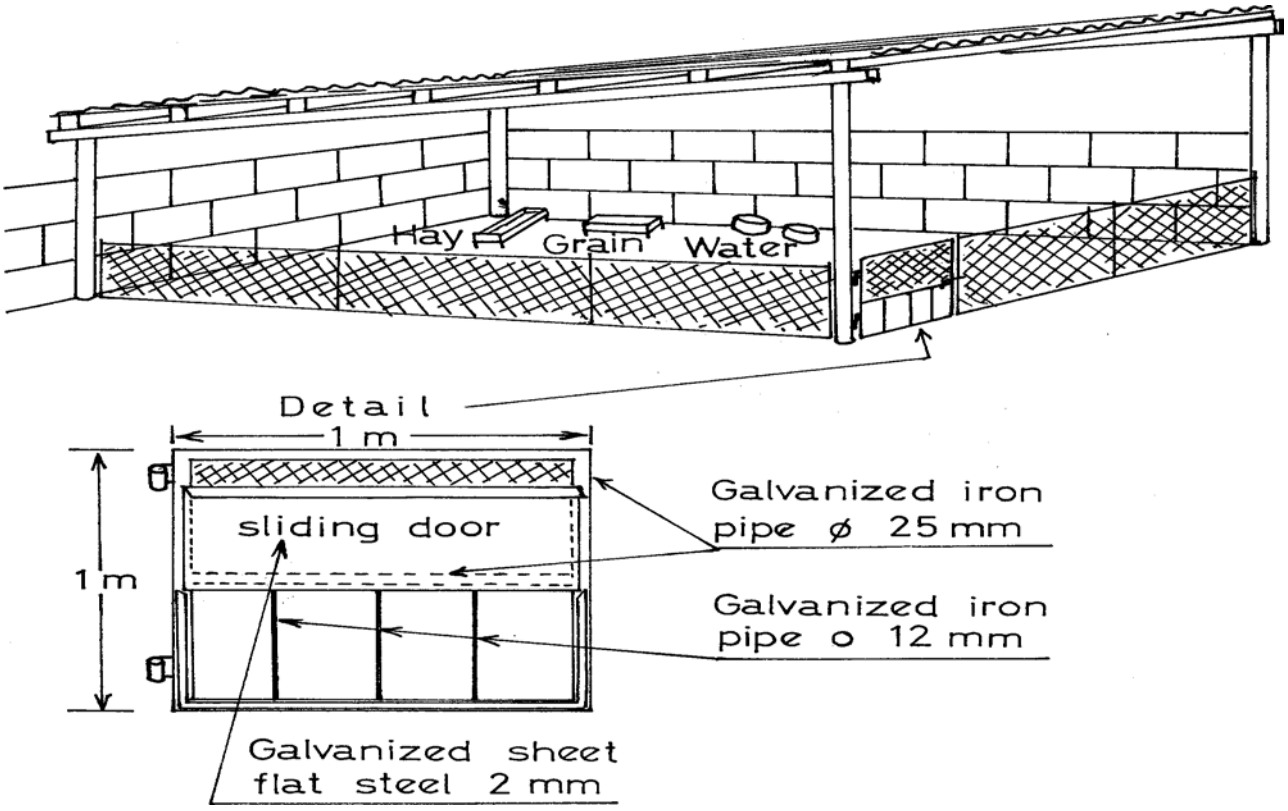
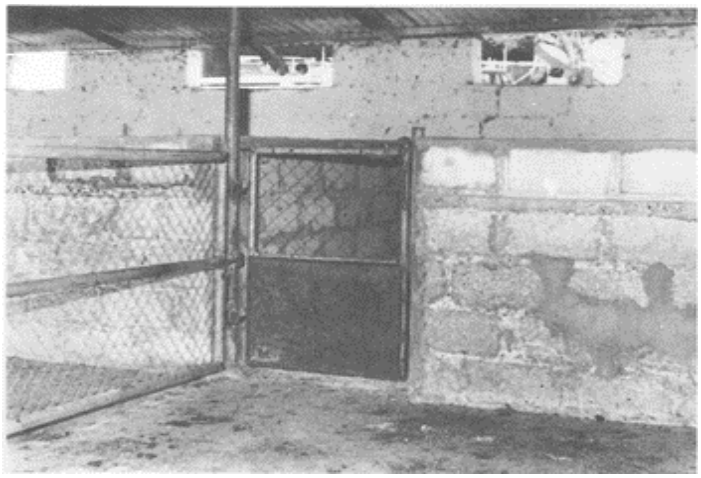
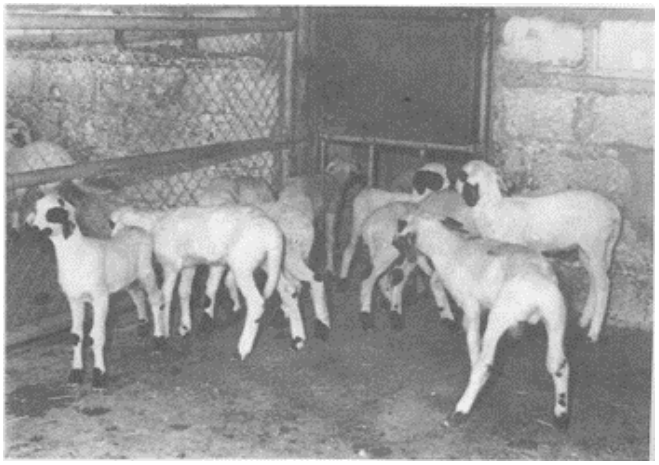


Figure 8 - Creep feeding and partial suckling enclosure. Creep feeding starts two weeks after lambing. When partial suckling starts after the fourth week, a sliding door or a fence is used to close the creep panels and isolate the lamb's from the ewes. A similar construction without the creep panels is used for lamb-bar. Milk is placed in plastic containers outside the enclosure and suckling teats inside, connected with plastic tubing (see also Photograph 5).



5. Creep feeding and partial suckling enclosure - Creep panel closed



5. Creep feeding and partial suckling enclosure - Creep panel open

3.8 Watering facilities

An adequate quantity of clean water should be available at all times and should not be allowed to become unreasonably warm or cold. Adequate space for drinking should be provided for all animals. Watering facilities should be properly located so that droppings cannot contaminate them and drainage should be planned so as to prevent muddy areas around them. Pavement with gravel or compacted clay, sloping away from the waterer, as for feeders, may be constructed. The tank with a float valve (Figures 9 and 10) or an automatic waterer (Figure 11) is used. The tank waterer may be constructed from concrete (Figure 9) or from cut oil drums (Figure 10). About three centimetres of tank perimeter per animal is adequate. Up to 40 sheep can be watered per automatic bowl.

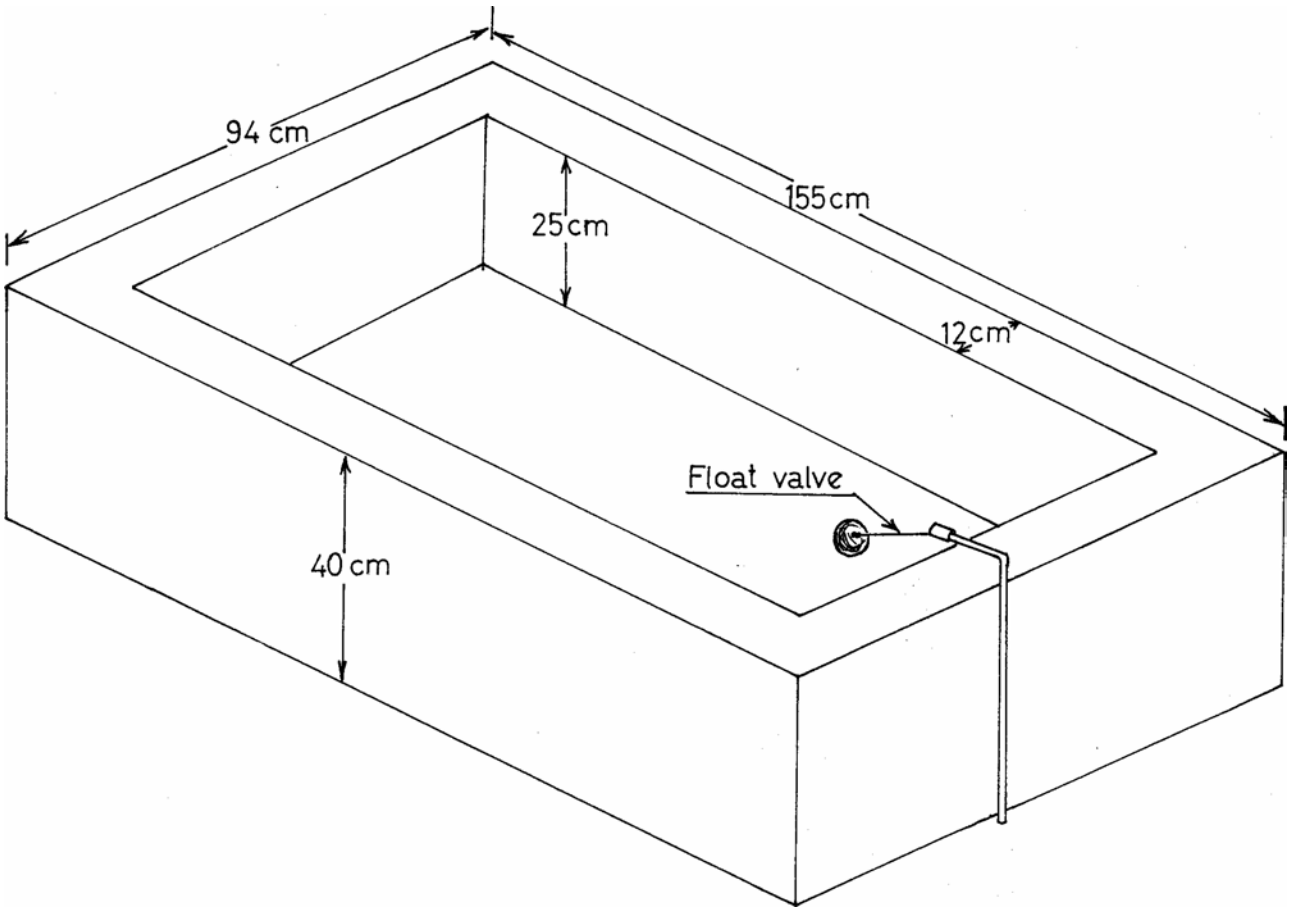


Figure 9 - Concrete waterer with float valve. The length is variable.

3.9 Fencing

Fencing can be used to fence areas inside and around the barns to enforce the utilization of pastures and to save labour. Electric fencing can be used successfully with grazing sheep at a much lower cost than other types of fences. A two-strand electric fence should be used, the first strand being 20 cm from the ground and the second strand 20 cm from the first strand. Boundary fence is made from galvanized chain link fencing with barbed wire on the top. The height of the galvanized chain link fencing should be 1.0-1.5 m with three strands of barbed wire on the top giving an additional height of 60 cm. All fence posts should first be set, the corner or end posts being supported on each side by another post at an angle after which the wire is fastened (Figure 12).

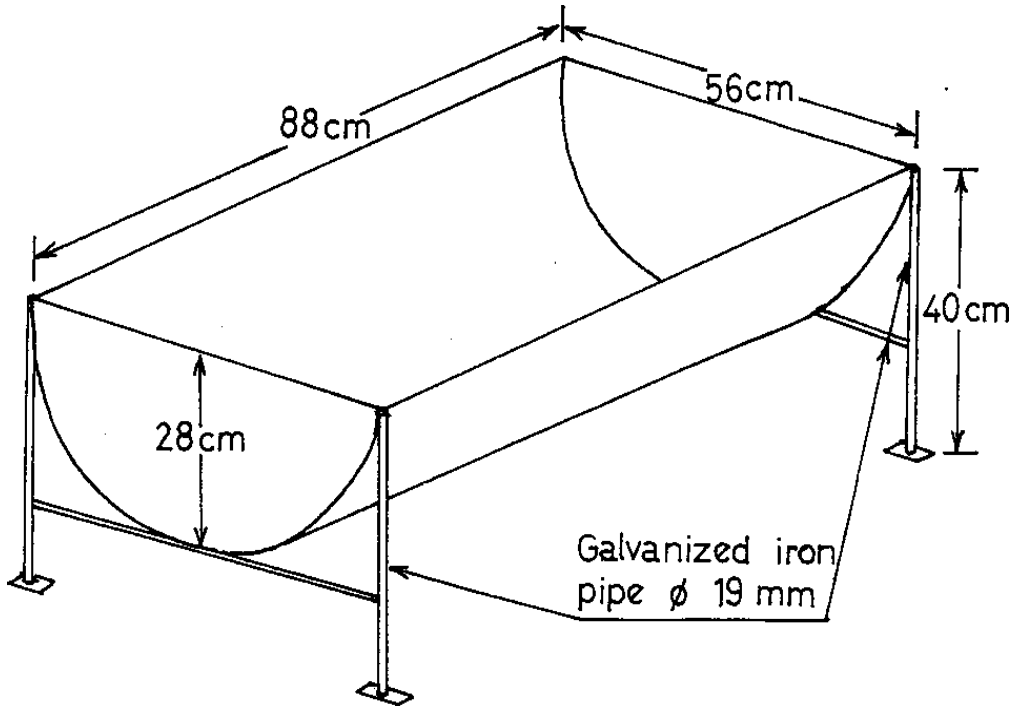


Figure 10 - Oil drum waterer. Float valve may beinstalled if connected to a water pipe.

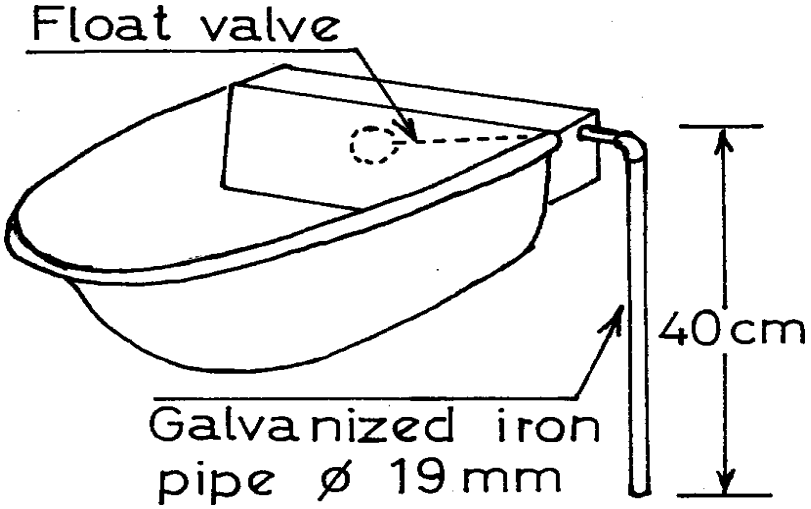


Figure 11 - Automatic waterer.

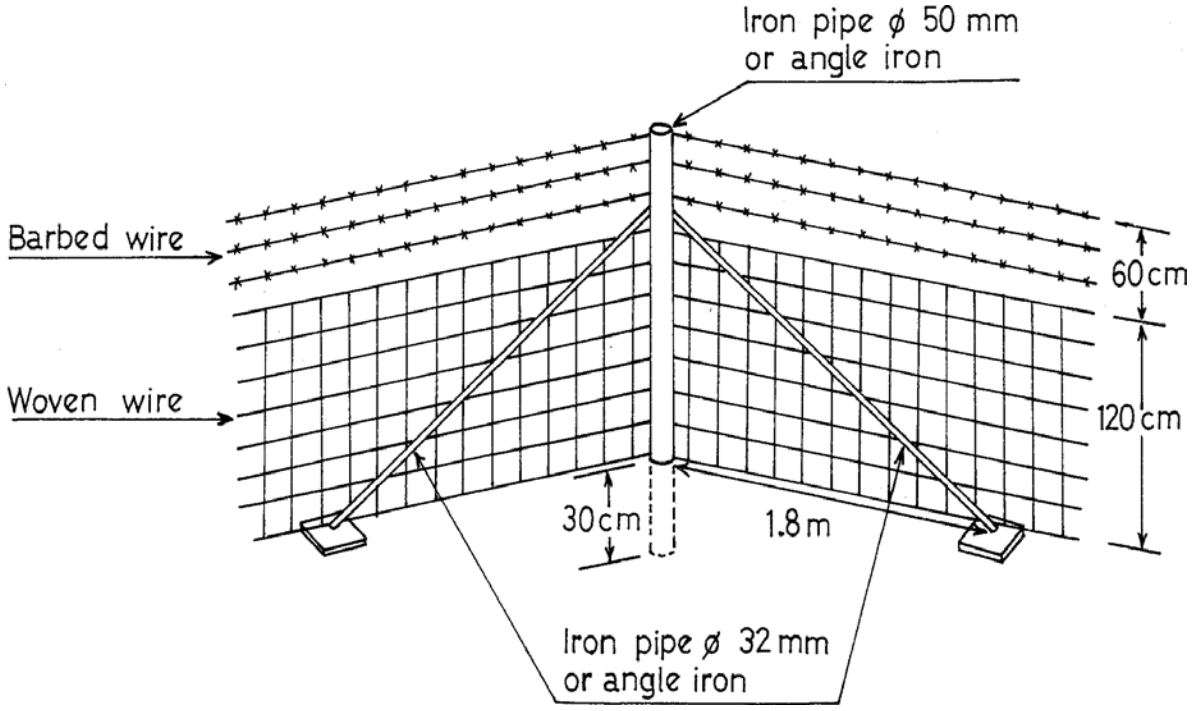


Figure 12 - Fencing: corner post. With barbed wire to fence the perimeter of the barns or of the pastures. Without barbed wire for divisions inside the barn or the paddocks.

A plan for a metal gate is given in Figure 13 and a plan for sorting chutes is illustrated in Figure 14.

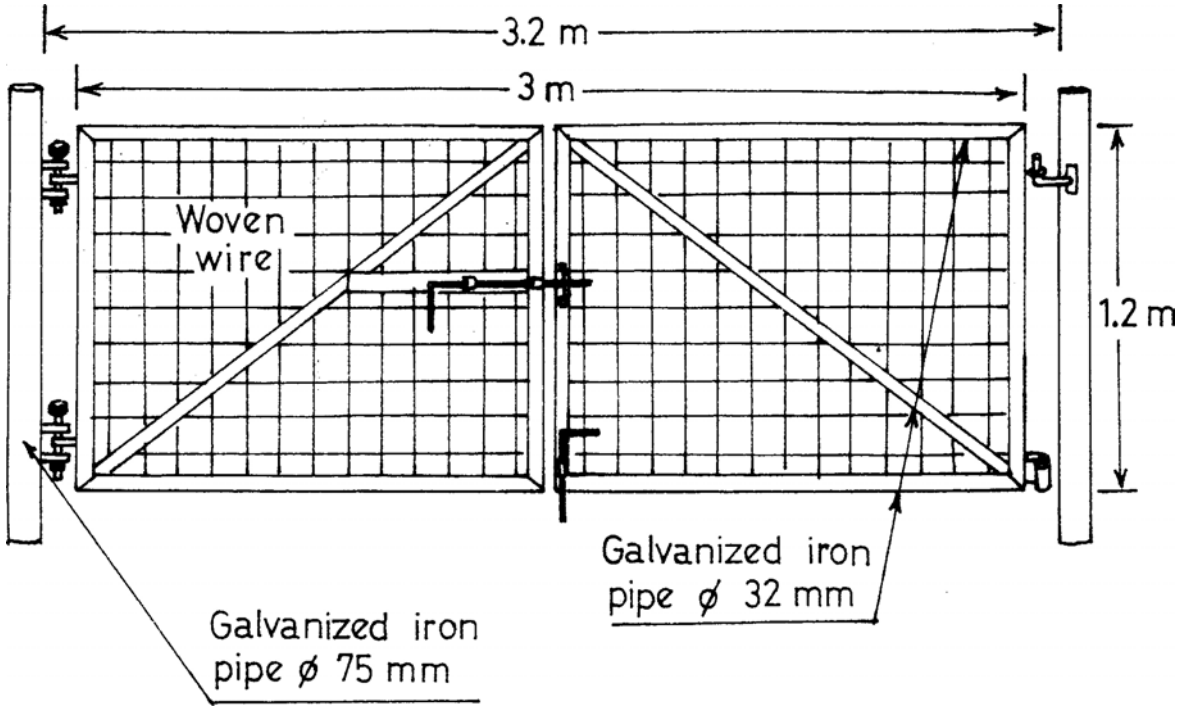


Figure 13 - Gate. Width of three metres for tractor access in the yards.

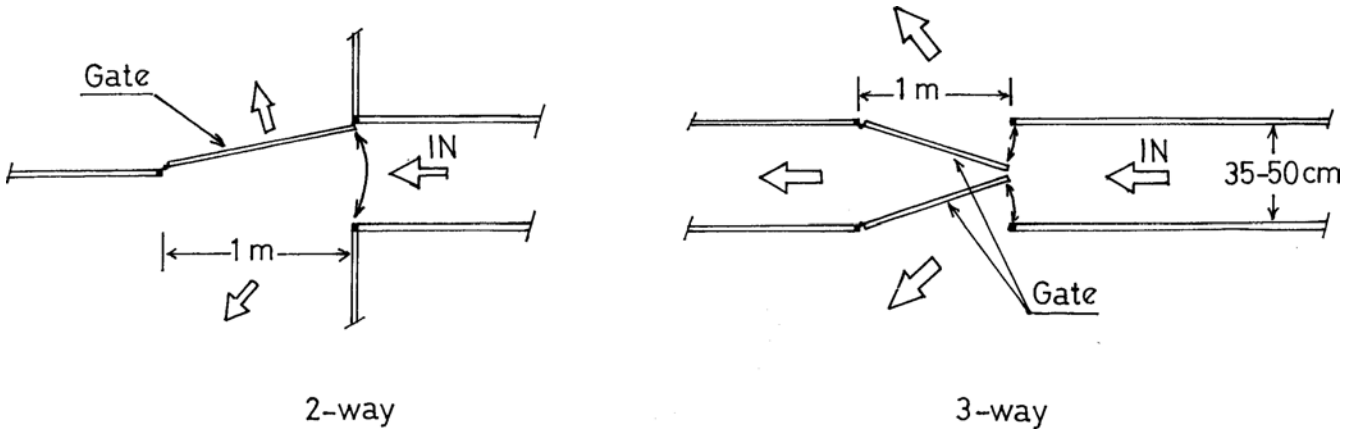


Figure 14 - Sorting chutes. Two way (left) or three way (right) sorting chute.

3.10 Building materials

The materials to be used for the constructions depend on what is available on the market and on their price. However, the substitution of wooden materials by other materials such as galvanized iron, pipes for poles, framework from mild steel tubes, etc. is preferable since the latter last longer. Walls can be constructed from cement blocks; poles for the sheds from galvanized pipes; framework from mild steel tubes; ceiling from galvanized corrugated sheets, feeders from flat sheet steel; bars from mild round steel bars; fencing posts from angle iron or galvanized iron pipes; hurdles for subdivision or temporary constructions (lambing pens and partial suckling enclosures) from galvanized iron pipes with or without galvanized chain link fencing, and water tanks from flat sheet galvanized steel. Lead-free paint must be used in all places where sheep have access to lick or eat it.

3.11 Farm layout

The correct layout of the barns for ewes and fattening lambs, auxiliary buildings, temporary subdivisions (lambing pens, creep feeding facilities, partial suckling enclosure), feed and watering facilities, dipping and spraying facilities, etc., will contribute to better management, feeding and health control resulting in higher efficiency of production. The recommended layout and the type of construction are in accordance with the climatic conditions of the Near East which require protection from heat and good ventilation and with a dual purpose sheep production system. Lambs are weaned early, following a partial suckling regime for the last two weeks before weaning, and fattened to slaughter weight under a system of maximum consumption of concentrates and minimum consumption of roughage. Ewes are grazed for 2-3 hours daily and milked in a milking parlour after weaning. The use of wooden materials should be limited.

A sheep breeding/fattening unit includes the following:

- barn with sheltered and open area for breeding ewes with subdivisions for the weaning of lambs (lambing pens, pen(s) artificial rearing, creep feeding area, partial suckling enclosure);

- barn for growing and fattening lambs after weaning;

- milking parlour;

- pen for males;
- isolation pen for sick animals;
- operators room;
- toilet;
- hay storage shed;
- store-house for concentrates;
- fencing of the whole breeding/fattening unit.

A farm layout for 100 ewes and 50 fattening lambs is presented in Figures 15 - 18. Female lambs selected for replacement of ewes are moved at 100 days of age from the fattening to the breeding barn. The layout for larger units can be constructed by repeating the layout of 100 ewes and 50 fattening lambs.

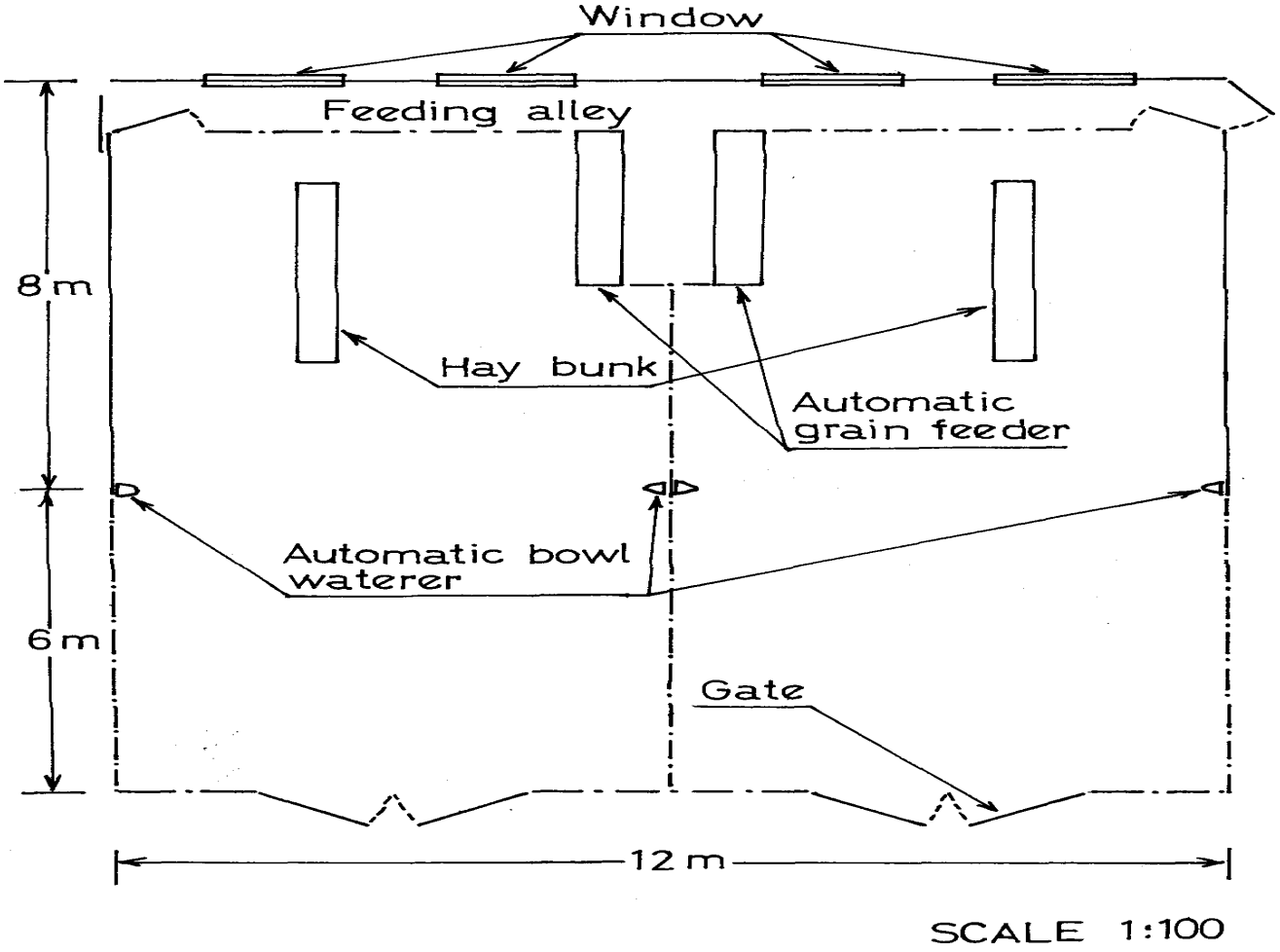


Figure 15 - Fattening unit for 50 lambs from weaning up to 40 kg liveweight. Sheltered area of 6m x 8m

including feeding alley and feeding troughs for 50 lambs. Windows for better ventilation during hot weather. Gate three metres wide for tractor access. Feeding alley is used for sorting. Perimeter of the open yard with permanent fencing. Division between the two open yards permanent fencing or movable hurdles.

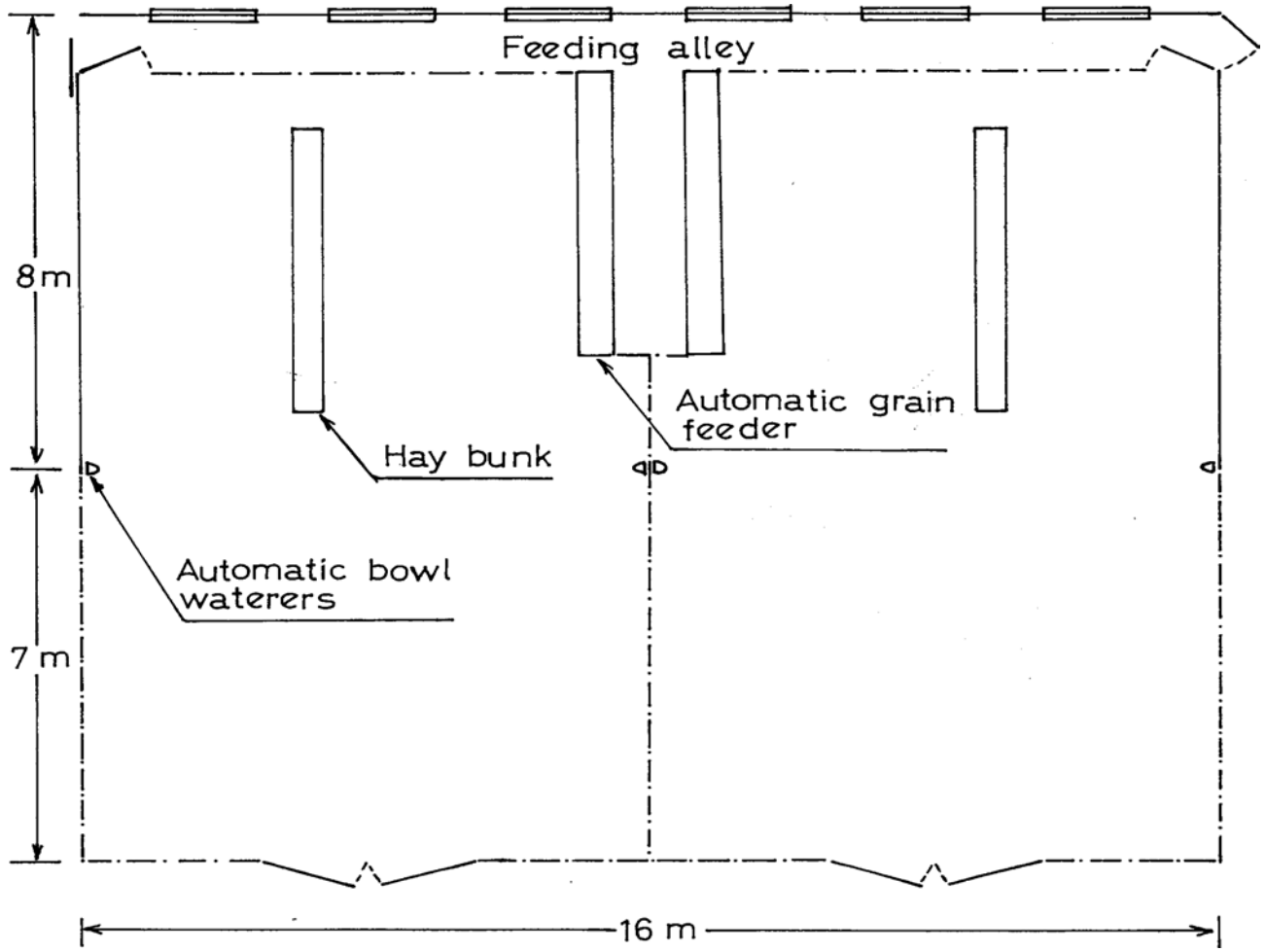


Figure 16 - Fattening unit for lots of 50 feeder lambs over 40 kg liveweight. Sheltered area 8m x 8m for 50 lambs. Other details as in Figure 15.

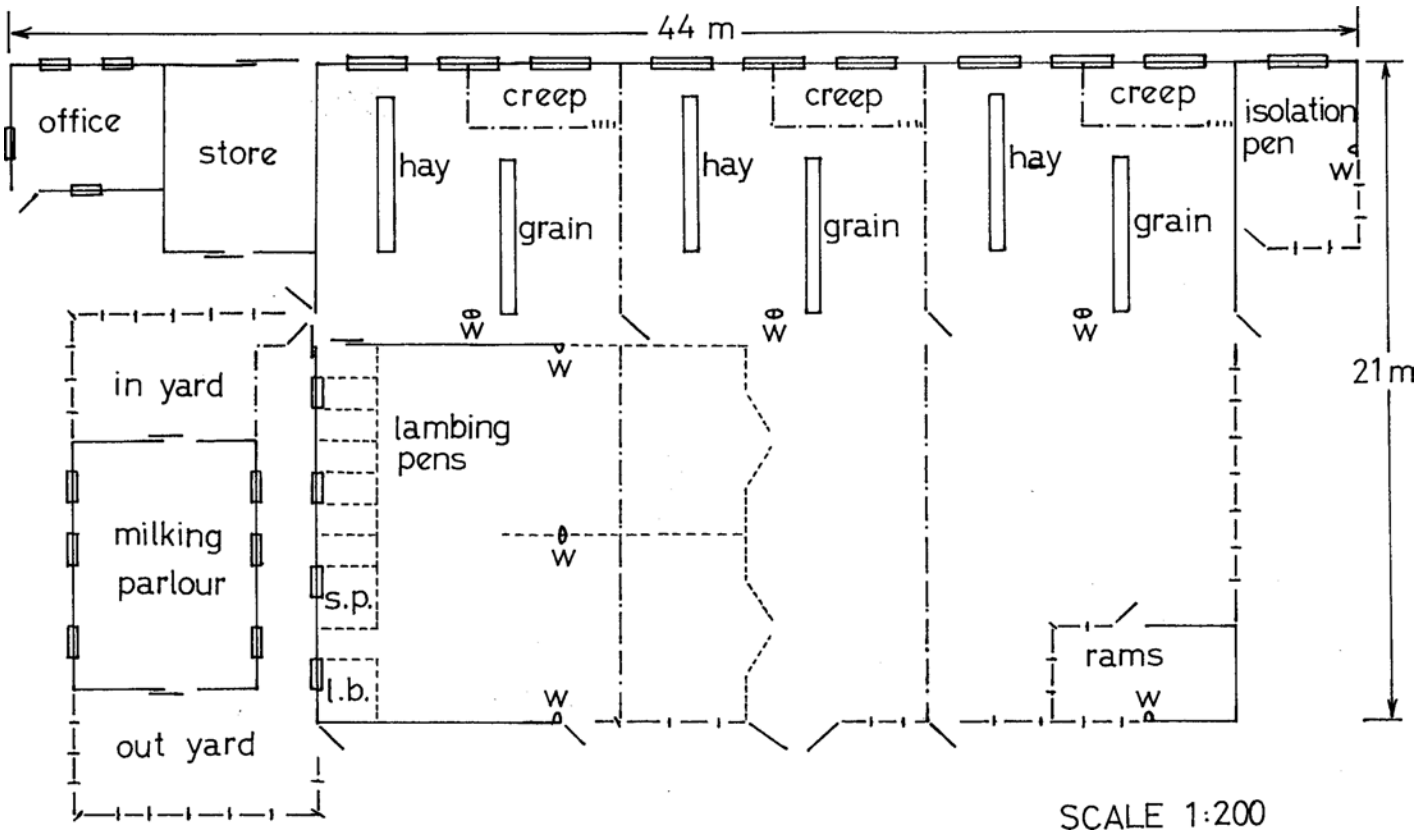


Figure 17 - Farm layout for 100 ewes. Hay and grain bunks are used. W = Automatic waterer. Creep = Creep feeding area and partial suckling enclosure. S.P. = Starter pen. l.b. = lamb-bar. Office includes a small toilet. After lambing the area of lambing pens is used for lamb fattening after weaning. Hurdles for divisions in the barn are moved after weaning. Permanent fencing (-/-/-/-/) hurdles (-.-.-), alterations after lambing to form the fattening unit (-------).

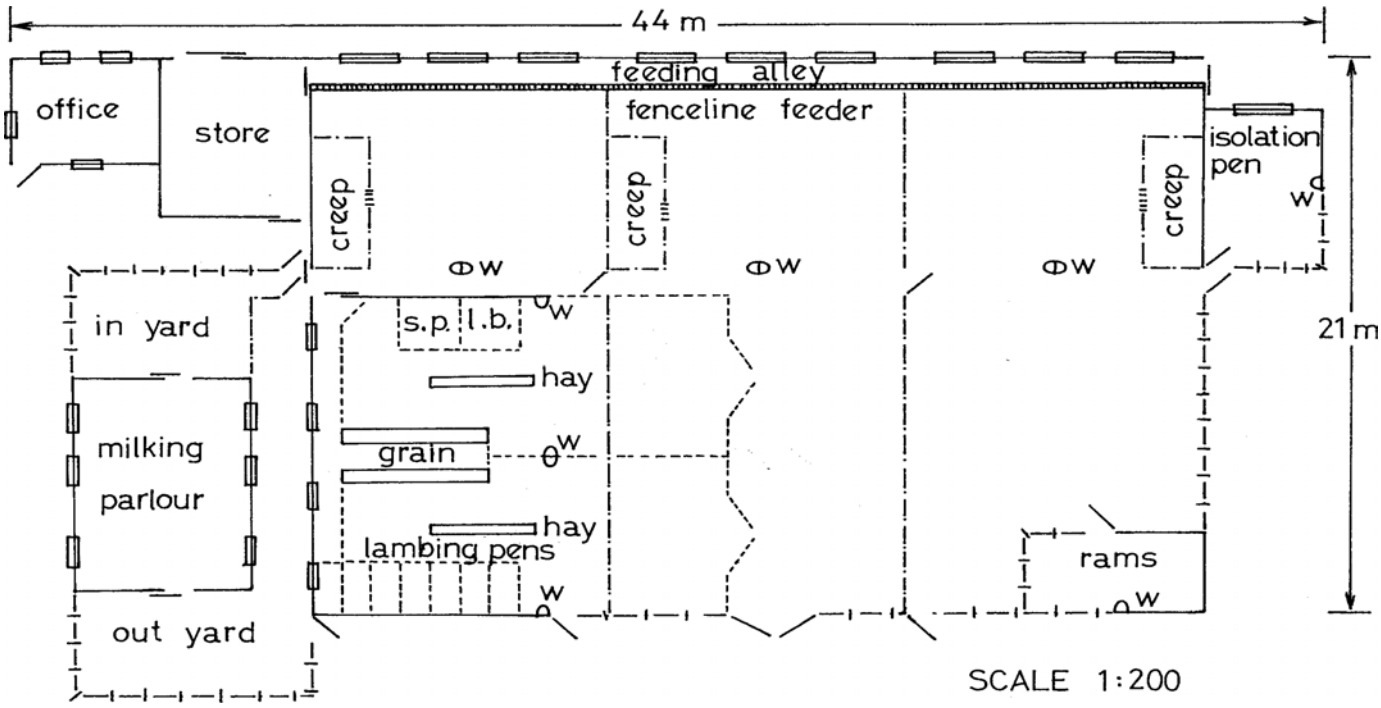


Figure 18 - Farm layout for 100 ewes. Fenceline bunk is used. Other details as in Figure 17.

Plans for the construction of lambing pens, milking stands or milking parlour and dipping trench are given in the next chapter.

Chapter 4 MANAGEMENT OF BREEDING FLOCK

4.1 Improving breeding efficiency

Breeding efficiency is a major component in the overall efficiency of sheep production. Usually the best basis for any type of sheep production is the native (indigenous) animal. Under poor extensive conditions long term breeding efficiency is achieved at a lower reproduction rate; prolificacy is not desirable. However, under intensive conditions breeding efficiency (prolificacy, frequency of lambing and weaning percentage) should be increased. The genetics of the native breeds may be improved by selection or crossbreeding with other breeds characterized by higher prolificacy and longer breeding season.

Practical methods of selection include selection of ewe lamb replacements born as twins or born as singles from younger ewes and producing higher milk yields than the average milk yield of the flock and the selection of twin born rams or rams from ewes with a high level of twinning throughout their lifetime and which have a higher post weaning growth rate than the average post weaning growth rate of the ram lambs in the flock.

The desirable traits in a crossbreeding system in additon to improving breeding efficiency are higher milk yield, improved growth rate, feed efficiency and market desirability of lambs and better adaptability of ewes and lambs to the environmental conditions. To avoid inbreeding; mating is confined to individuals that have no common ancestor nearer than one great grand-parent.

All ewes in poor condition, dry ewes which were not pregnant after the mating period, ewes with low maternal

instinct, non-functional udders or with extremely large teats, or suffering from chronic diseases, should be culled. Ewe lambs that fail to breed in the same breeding season with other ewe lambs should also be culled. Rams with limited fertility and sex drive, suffering from lameness or any chronic respiratory disease should be replaced with young rams.

4.2 Early breeding of ewe lambs

Early breeding of female lambs is an important method of intensifying sheep production in the self-replacing flock because it can increase the annual flock output, reduce the unproductive phase and thus overhead costs, facilitate selection programmes and also increase total lifetime productivity. Early breeding of well managed and adequately nourished ewe lambs has no detrimental effects on their subsequent performance and reproductive efficiency.

The important principle to bear in mind is to keep the lambs growing and gaining weight after weaning so that by breeding time they will be sufficiently mature physically to mate successfully. First oestrus is affected by age and body weight which in turn are influenced by the breed and nutrition. Female lambs are kept separately from ewes until lambing. Excessive feeding in late pregnancy should be avoided in order to reduce the incidence of dystocia. During the last two months of pregnancy the level of energy intake should be between that of a mature ewe carrying a single lamb and one carrying twin lambs.

If early breeding is not practised feeding should be adjusted to low levels in order to achieve the desired liveweight at breeding time.

4.3 Management at mating

Good planning for mating results in a short lambing period which allows efficient scheduling of mating, lambing and division of the flock into smaller groups according to the time of mating. This leads to an improvement in labour utilization and to overall management efficiency. Ewes and rams must be in good body condition at mating.

Replacement rams, selected as described earlier, should be used for mating at the age of 12 to 18 months. These rams should be checked before mating for general health. Physical examination should be made of the external reproductive organs particularly the testes. These must be well developed and free from obvious abnormalities and hardness. Examination of the semen under the microscope is necessary to determine the presence and concentration of spermatozoa and to evaluate their motility and freedom from abnormality. Semen samples are most conveniently taken by electro-ejaculation.

However, there is a variation in libido among rams with high fertility. This can be checked at an early stage with a small number of female animals. Younger rams are generally more active. The rams should be checked before the following mating season for high fertility and sex drive.

Rams should be sheared before each mating season, drenched and dipped for internal or external parasites and vaccinated against enterotoxaemia. Regular trimming of feet and horns should be carried out. Trimming the horns may be carried out with a dehorning wire or using a hack saw in older rams.

Good nutrition is necessary to maintain the mating ability of the ram. Supplementary feeding should be done during mating, consisting preferably of good legume hay or about 250 g of concentrates above the energy requirements for maintenance (which are about 15 percent higher than that of females or wethers of the same breed). A vitamin A injection is necessary before mating. Good body condition at mating is desirable but overfatness should be avoided because it reduces the animal's working performance. After mating all rams

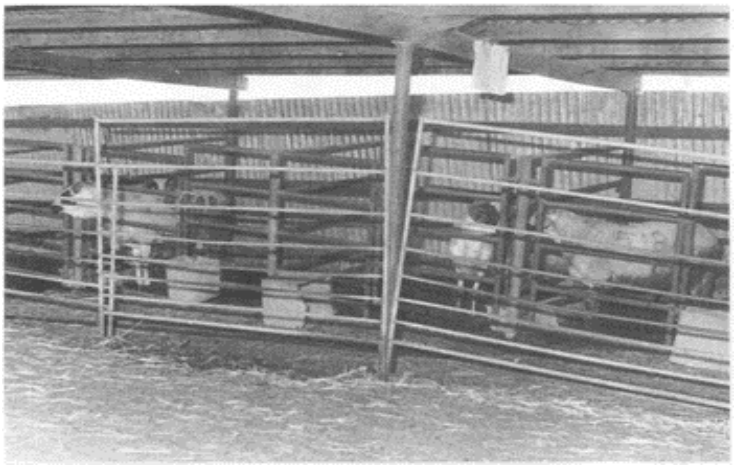
should be examined and a decision taken on which animals are to be replaced by younger rams.

Most sheep are seasonal breeders and the ewe's annual breeding pattern usually involves a period during which there are regular oestrus cycles followed abruptly by a period of anoestrus when cycling virtually ceases. Natural mating is practised during the breeding season or synchronization of the oestrus with the use of exogenous hormones employed with the objective of achieving a limited lambing period. During the anoestrus period exogenous hormones are used to induce oestrus.

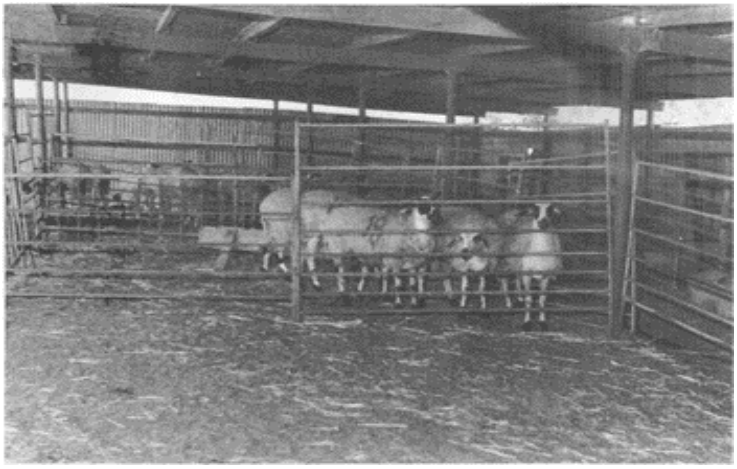
Under natural mating one ram for 25-30 ewes is needed and when synchronization or induction of oestrus is applied one ram for 6-10 ewes, unless artificial insemination is practised. Provided that the necessary number of rams or artificial insemination services are available, flocks can be timed to lamb within a period of one week if lambing facilities and labour permit. Synchronization of oestrus is achieved by the administration of either natural progesterone or a synthetic progestagen compound, on an intra-vaginal sponge or as a subcutaneous implant 10-15 days prior to target mating. The injection of 500 IU of PMS on the withdrawal of the progesterone is given to ewes bred during the anoestrus period. For increasing breeding efficiency by shortening the frequency of lambing the most suitable system is lambing three times in two years.

The following systems of mating may be practised:

1. Hand mating - Teaser rams are used to run with the ewes for 15-20 minutes twice daily and to identify the ewes on heat. All ewes found by teasers to be in heat are separated into a smaller enclosure prepared from movable hurdles and near the individual ram pens (Photographs 6 and 7). Each ewe is mated to a certain ram to avoid inbreeding. A list of ewes to be mated by a certain ram is prepared before hand from the individual records of each animal. Each ewe is mated twice within 24 hours. If found in heat in the morning the ewe is mated once in the morning and again in the afternoon using the same ram. If found in heat in the afternoon it is mated once in the afternoon and for the second time on the following morning. With this method the time of expected lambing is known and the identity of the born lambs is also known. Unsuccessful matings of ewes during the mating season are identified by the teasers and the ewes are mated again. After the mating period teasers are used to run with the ewes to identify possible non-pregnant ewes.
2. Teaser rams with marking harness or painted brisket are run with the ewes all the time and marked ewes are removed from the flock to the mating enclosure thereafter using the procedure described earlier. This method is used when daily supervision is not available and also when it is necessary to identify ewes in heat during the night. The method is also used after the mating period, changing colours every 16 days in order to detect non-pregnant ewes.
3. Ewes are run in a group (25-30) with a single ram. Teaser rams with or without harness are used after the mating period in order to detect possible non-pregnant or problem ewes.



6. Rams in mating pens



7. Ewes identified in heat in the mating enclosure

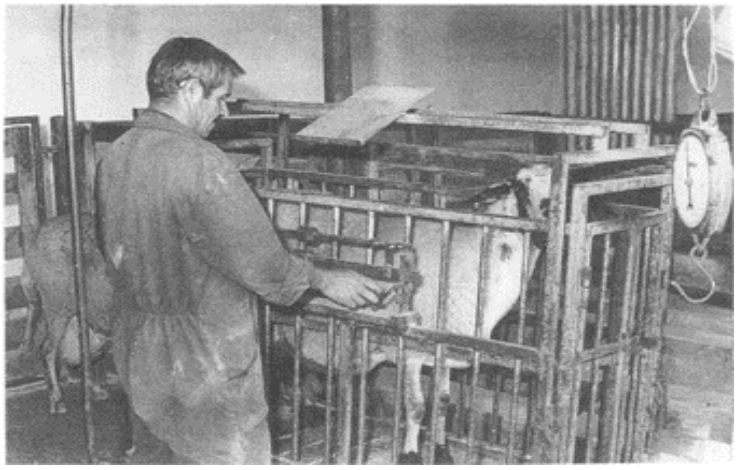
Mating activity during the breeding period is higher in the morning and in the afternoon. In warm weather rams may be rested during the day and turned out with the ewes in the afternoon until the following morning.

An effective method of increasing the synchronization of naturally mated ewes is to run harnessed rams or teasers with the ewes at the end of the anoestrus period and start mating 15-20 days later. There is a delay in breeding of a lactating ewe which is more marked in the suckling ewe. For better long-term performance in an intensive system, weaning and/or cessation of milking should be timed so as to allow the ewe about 60 days of a recovery dry period before lambing.

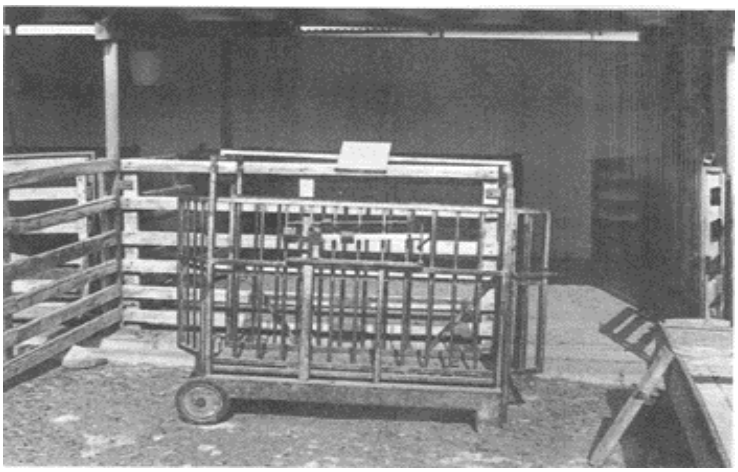
4.4 Management of ewes and suckling lambs from birth to weaning

Ewes are moved the last ten days before lambing in smaller group pens with open yards. They are allowed to lamb and just after lambing are transferred to lambing pens (Figure 19). After the expulsion of the placenta the ewes and lambs are taken to a group pen where they are weighed (Photographs 8-11), lambs are ear-tagged (Photograph 11) and in addition to birth weights, the sex of the lambs is recorded. The hooves of the ewes are trimmed, the wool on the tail and hindquarters is sheared and the udder, water bag and legs are cleaned with water. The teats of the ewes are checked as to whether they are functional. Any surplus colostrum left after the lambs have suckled is milked by hand and either fed to other lambs, the mothers of which did not produce an

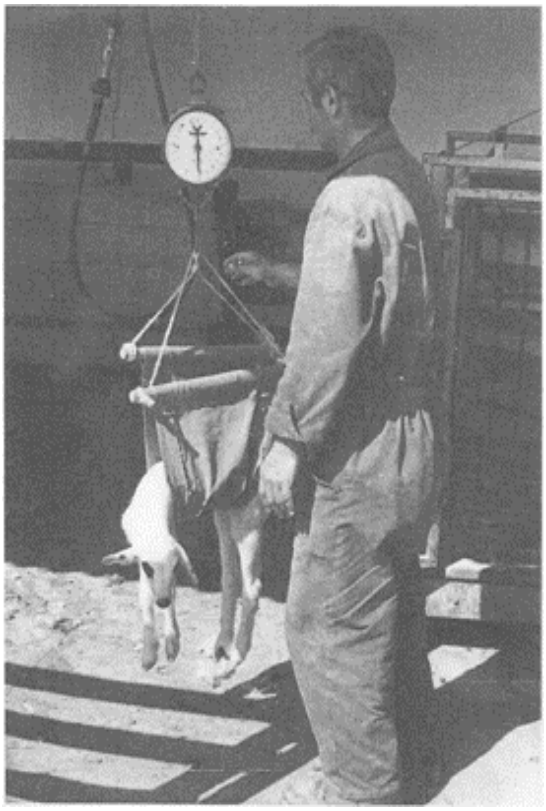
adequate quantity of colostrum, or stored in a deep freeze for future use.



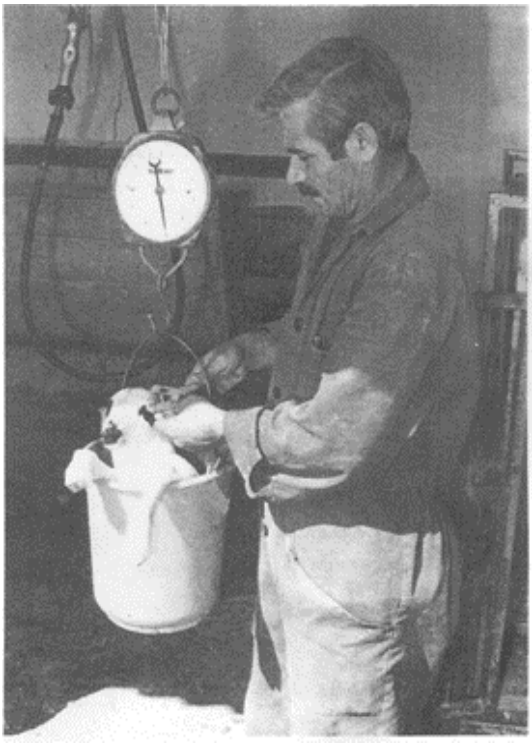
8. Recording of ewes' weight after lambing



9. A portable weighing scale



10. Recording of birth weight of lambs. The sling can also be used for larger lambs



11. Eartagging of lamb at birth together with weighing in a bucket

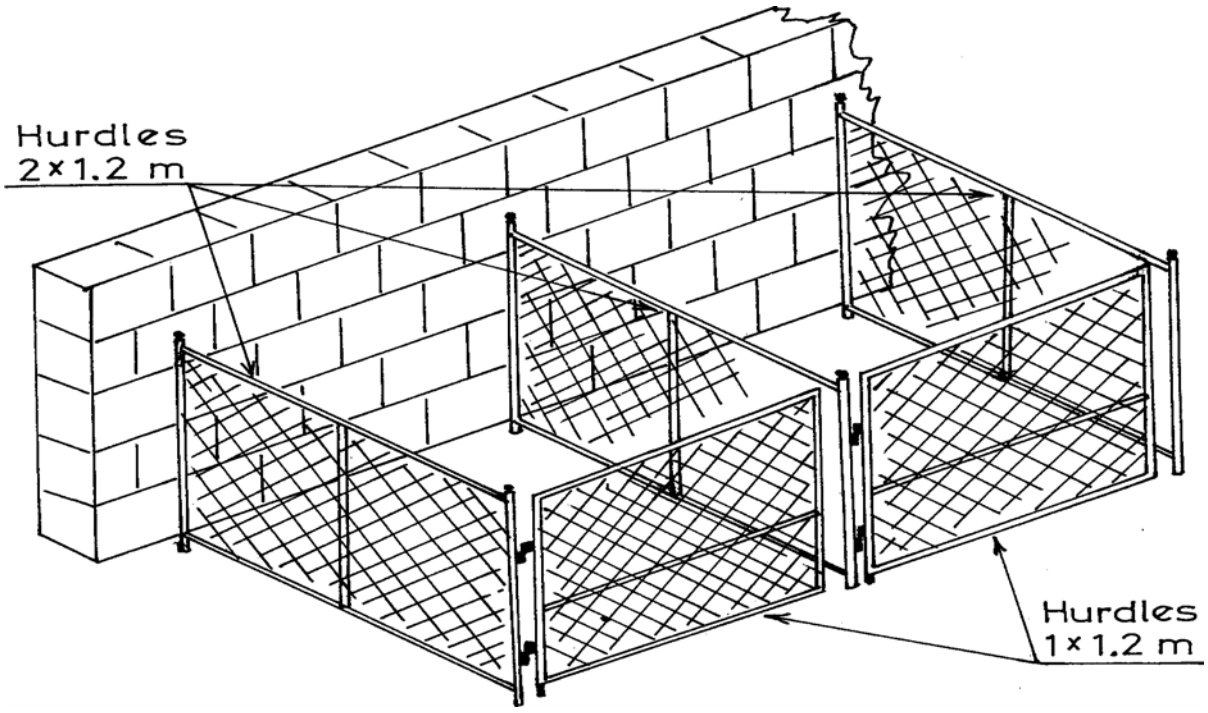
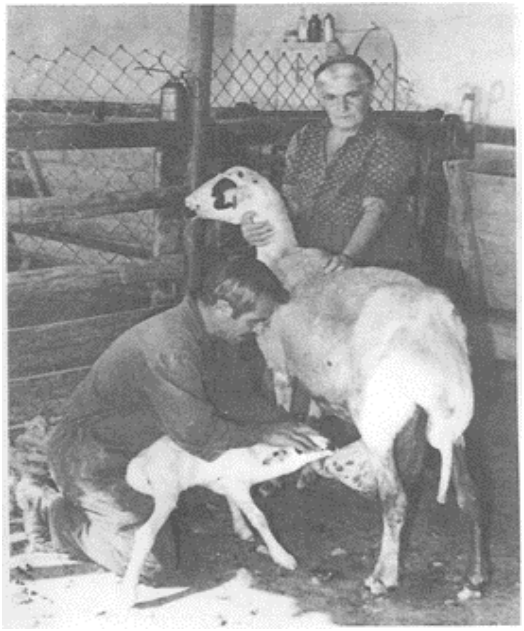


Figure 19 - Lambing pens. Prepared from movable hurdles. Side walls of 2 metres. Front doors of 1.2 metres. Height 1 metre.

Normal lambing should occur within 30-45 minutes after the rupture of the water bag. If it does not occur the ewe should be examined. Supervision during lambing is necessary to minimize lamb and ewe losses resulting from dystocia. Many of these losses can be avoided by giving timely assistance to relieve the dystocia. Immediately after birth membranes and mucus must be removed from the head of the lamb. Gentle pressure is applied on the ribs and blowing into the mouth of the lamb helps to stimulate breathing. The coat of the lamb is dried off and if chilly, heat is provided. The navel should be clipped with a pair of scissors and disinfected with a 7 percent iodine solution or any other appropriate disinfectant (Photograph 12).

12. Disinfection of lamb's navel

Lambs should be encouraged to nurse the ewe as soon as possible. The teats of the ewe should be checked to see that the teat canal is open or that the shape of the teat is suitable for easy suckling. Weak lambs may need assistance in nursing or it may be necessary to provide supplemental colostrum or milk (Photograph 13). The safest method of feeding a weak lamb is by a stomach tube (0.5-0.75 cm diameter) which can be inserted into the stomach and milk administered with a syringe through the tube.



13. Assisting lamb in sucking colostrum

The lambs should receive colostrum immediately after birth for three reasons:

- it contains immune antibodies and protects them from diseases;

- it is high in protein and energy and is vital for their survival under adverse climatic conditions; and

- it is laxative and aids in the excretion of the meconium lining of the digestive tract.

The effectiveness of the transfer of antibodies from the colostrum depends on its antibody concentration, the level of intake by the lamb and the timing of consumption in relation to birth. A large quantity of colostrum (about 200-300 ml) should be consumed within 6-15 hours after birth because the ability of the lamb to absorb antibodies diminishes rapidly after the first 12 hours of life. Lambs which are very small or weak or the dams of which produce inadequate colostrum are bottle-fed supplemental colostrum. Frozen natural colostrum or frozen cow colostrum is thawed and warmed to body temperature and offered to the lambs. Colostrum deprivation can result in reduced performance and higher mortality under normal conditions.

A sufficient number of lambing pens is necessary. Ewes and lambs are penned for one or more days after lambing to ensure sound ewe-lamb pairings. Each lambing pen should have an area of 2-2.5 square metres and should have a solid floor and access to feed and water. These pens are movable and made from hurdles (Figure 20). Their number depends on the number of the ewes lambing at each time and the concentration of lambings (1 pen for 4-10 ewes). Orphans or lambs from multiple births or disowned lambs are fostered by ewes that have lost their lambs or put onto those with a single lamb. Fostering is more successful if the ewe and lamb are put in close confinement soon after the ewe is lambed.

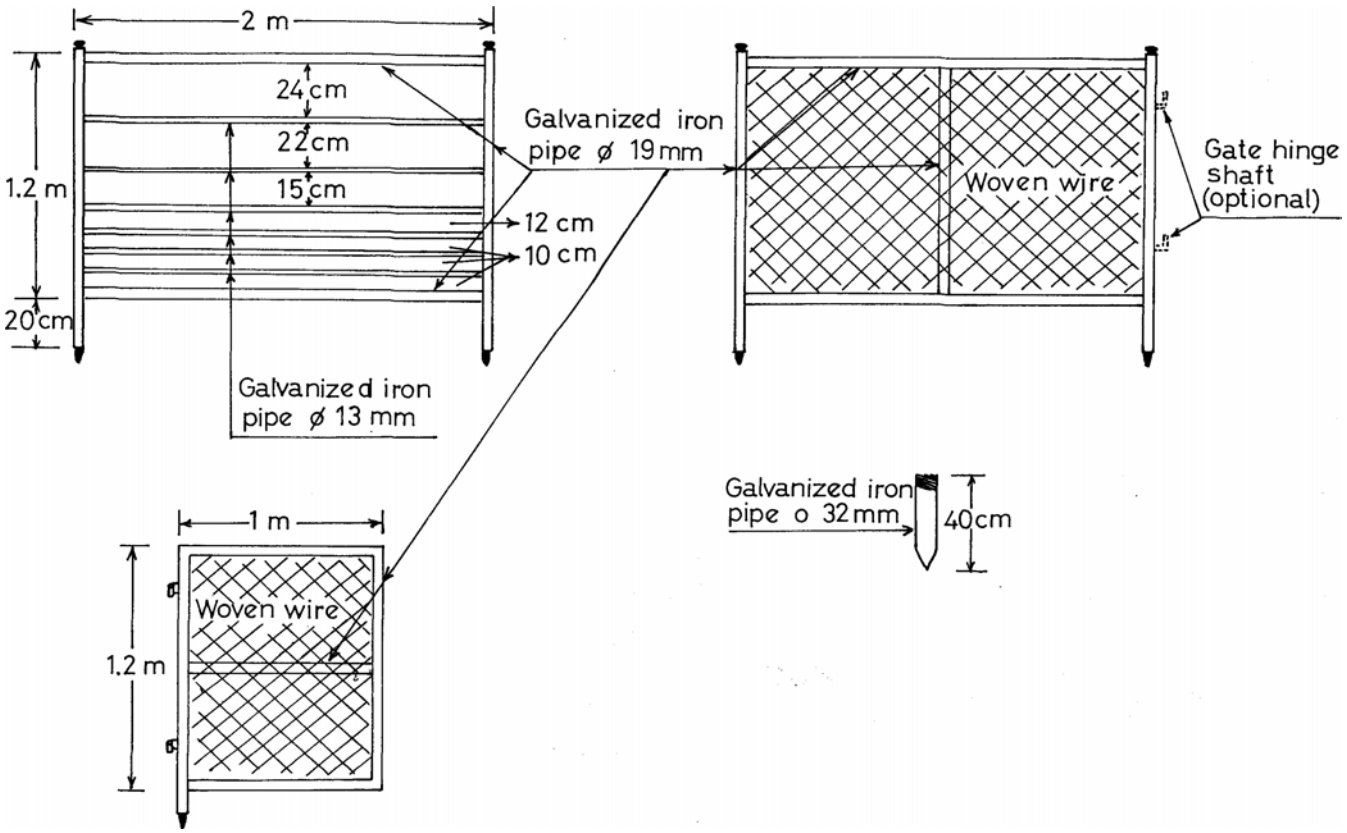


Figure 20 - Hurdles. Prepared from galvanized iron pipes (left), usually for large animals, or frame from galvanized iron pipes, and woven or chain link wire (right). Movable doors (bottom left). Hurdles are placed in

the ground (bottom right) with the legs of the hurdles placed inside.

Ewes and lambs after the colostrum feeding period are moved from the lambing area to other barns, older ewes suckling single lambs being kept separately from ewes suckling twins and separately from first lambing yearlings. There is a close association between the yield of milk by the ewe in early lactation and the growth of the lamb. During this period one unit of lamb liveweight will result from five units of milk consumed. The lamb becomes progressively less dependent on the ewe's milk as its solid feed increases.

4.5 Weaning

The weaning age of lambs may vary from four weeks to four months. However, when meat and milk are the primary objectives of sheep production,efforts should be directed to increasing both the commercial milk yield and the lamb carcass per ewe. In order to increase the milk yield,age at weaning should be reduced in association with a reduction in milk consumption by the lamb.

The advantages of an early weaning system are the following:

- the saving of expensive roughage for breeding ewes and the relief of grazing pressure on pastures;
- an increase in commercial milk yield of ewes and carcass output per ewe by intensive rearing of lambs;
- reduction of parasitism in the lambs pastured with ewes;
- reduction of losses of lambs from predators;
- ewes alone can more easily be given proper management than ewes and lambs together;
- ewes early weaned can be rebred more easily;
- feed efficiency of growing early-weaned lambs is high;
- an increase in the profitability of the sheep breeding/fattening enterprise.

A system of weaning at 42 days of age may be applied. After the colostrum feeding period lambs are allowed to suck their dams at will until four weeks old. From the second week onwards roughage of excellent quality (alfalfa or other legume hay), a pelleted concentrate mixture containing 16 percent crude protein (as fed), and water are made available to lambs in separate troughs in the creep feeding area into which ewes cannot enter because of their size (Photograph 14). Barley grain and soyabean meal are the basic ingredients of the creep feed.

14. Lambs start on solid feed

Solid feed intake is very low until four weeks when the lambs are suckling at will. After the fourth week lambs are allowed restricted suckling for 8-10 hours daily. The lambs are separated from their dams in the afternoon and the following morning the ewes are milked first and then ewes and lambs are joined during the day. Solid feed intake is strongly influenced by milk intake and restriction of milk causes an early acceleration in solid feed consumption. By the time of weaning feed intake is adequate for maintenance and the growth of lambs.

Restricted suckling is applied to groups of lambs with eight days difference in age. When restricted suckling begins the age of lambs may range from 24 to 32 days and at weaning from 38 to 46 days. During the first four weeks ewes are checked once daily and surplus milk is removed by hand. After the fourth week the morning milking of ewes is carried out by hand or by milking machine. When hand milking is practised, milking can be done in the barns or in the milking parlour where machine milking is also practised. Though lambs will not consume significant amounts of feed until the fourth week of age, the small amounts consumed at an earlier age are critical for establishing both rumen function and the habit of eating. An antibiotic (aureomycin) may be included in the creep feed (35-40 g/ton of finished feed).

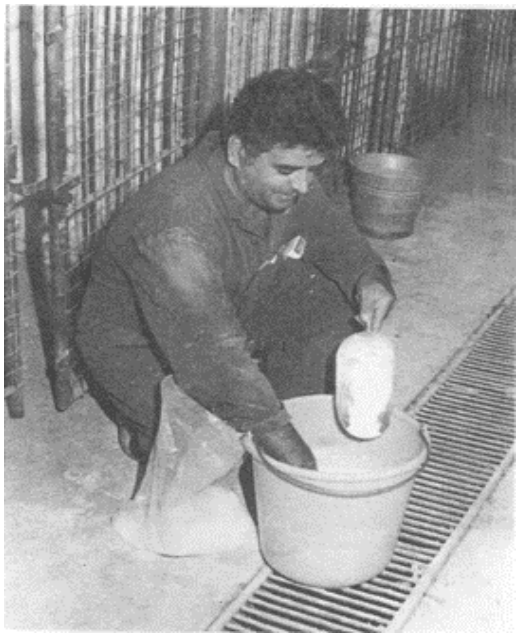
4.6 Artificial rearing of lambs

Orphans, lambs from multiple births, mis-mothered lambs, lambs born to ewes with nonfunctional udders or low milk yields, weak lambs in their first week of life, or lambs born as twins to yearling ewes may be taken away for artificial rearing. Lambs should be removed from the ewes for artificial rearing on the first day if they have sucked adequate colostrum. Otherwise the lambs are fed colostrum from a bottle equipped with a teat. All lambs are first put in a pen for 2-4 days (the starter pen) where they are trained to nurse from the nipple bar. The trained lambs are then grouped by size and moved into the regular pens. Problem lambs remain in the starter pen for a few more days before being transferred to the regular pens.

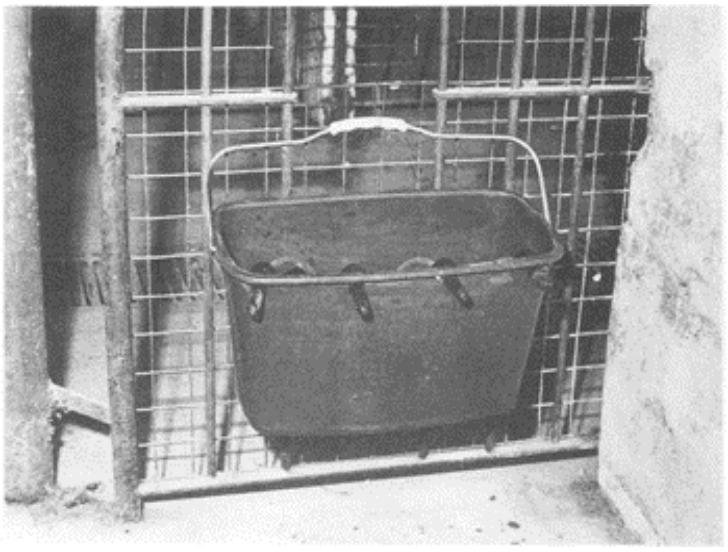
There are two types of artificial rearing units. In the first type the artificial rearing unit is equipped with a variable number of individual pens. Each pen is 0.6 m x 0.3 m (0.18 m^2) in size and is fitted with a milk feeder, water container and solid feed troughs. Hand feeding is practised. In the second type the lambs are kept as a group in pens. Milk is distributed through a pipeline system to individual nipples in the pen (large units) or, more frequently, the nipples are supplied from hard plastic containers filled daily.

The latter system is called the LAMB-BAR (Photographs 16-17) . It consists of a number of rubber suckling teats (nipples) each connected through a plastic tube with the liquid milk replacer. The upper side of the plastic tube should be inserted into the rubber drinking nipple. The lower side of the plastic tube is provided with a

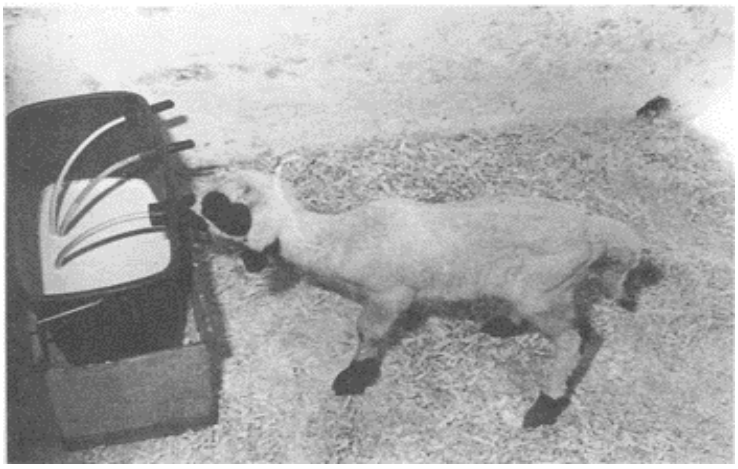
non-return valve so that after the first and following actions of the lamb, the proper vacuum in the tube will be maintained until the liquid milk replacer arrives in the mouth of the lamb. The non-return valve maintains the column of milk in the tube, and there is no return flow of the fluid. When the rubber nipple is properly fitted to the plastic tube there is practically no loss of milk by leaking. The lower end of the plastic tube (with the non-return valve) should be inserted into the drinking pail near the bottom. The nonreturn valve is needed the first week only.



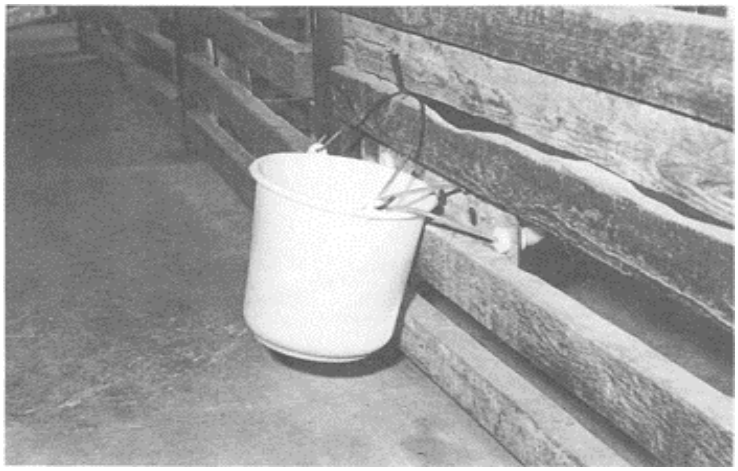
15. Milk replacer is reconstituted to give a dry matter of 20 percent



16. Lamb-bar - Portable plastic container fitted with nipples



16. Lamb-bar - Portable plastic container fitted with nipples



17. Lamb-bar. Plastic container with milk outside the pen

The milk solution is prepared in a tank or other container where the appropriate milk replacer is diluted with only half the quantity of the water (water temperature about 50^0C). This mixture is thoroughly stirred with a stirring rod. Then the remaining half of the water is added under constant stirring. Warm water is used only during the first week. Each pen holds 10-15 lambs (for better supervision), with a total area of 4-6 m^2 , there being two to three lamb bars with 3-4 nipples in each lamb bar. The container, nipples and plastic tubing should be washed daily.

The milk replacer should be of excellent quality and should contain 25-30 percent fat, 25 percent protein, 0.10 percent fibre, 5-10 percent ash, vitamins, trace elements, antibiotic and antioxidant. Lactose content should be less than 50 percent. It should be stored in a dry place. The protein of the milk replacer should be derived from milk products. The replacement of milk proteins by other protein sources has not been very successful. Milk replacer is reconstituted to give a dry matter content of about 20 percent (Photograph 15). When one part of milk replacer containing 25 percent fat is diluted with four parts of water it gives five parts of milk containing 5 percent fat.

Increasing the dry matter content of the diluted milk results in a decrease of milk intake of the lambs and an increase in water intake, but there is no effect on overall performance .

About 8-10 kg of milk replacer is fed per lamb until weaning (42 days). The conversion of milk replacer to

lamb liveweight. is about 1.2-1.4:1. Diluted milk replacer is fed cold twice daily. During the last two weeks (28-42 days) milk intake is reduced (feeding once daily in the morning) in order to promote a higher consumption of solid feed by lambs. Artificially reared lambs are offered the same solid feeds as those fed to the suckling lambs. When artificial rearing is practised the performance of the lambs on a particular milk replacer depends on the replacer's original quality and its quality at the time of feeding. The decision to use milk replacer depends on the price relationships between sheep milk, milk replacer, concentrates and labour. Under Near East conditions the use of milk replacers is recommended.

After weaning, suckling or artificially reared lambs remain in the same barn for one week before being moved to the growing unit. After the removal of each batch of lambs from the artificial rearing unit the whole unit is cleaned and disinfected.

4.7 Milking

Immediately after lambing the lambs are allowed to suck colostrum and any surplus quantity of colostrum is milked by hand and either fed to the lambs or stored for future use. With an early weaning system (6 weeks) and restricted suckling in the last two weeks ewes should be milked once daily in the morning. Even during the first four weeks when suckling is unrestricted the ewes should be checked and milked, particularly during the first ten days when milk intake by lambs is low. Hand milking during the first four weeks is practised, but during the last two weeks hand or machine milking is practised.

After weaning the milk yield of the ewes declines sharply, particularly in the case of twin suckling ewes, and more slowly thereafter. Ewes during this period are milked twice daily. Toward the end of lactation or when the milk yield of the ewes is low, hand milking once daily will save labour, milk yield being reduced only slightly.

Milking of ewes is stopped when the daily milk yield drops to 200 g daily. At this low level of production drying off the ewes is easy. However, the ewes are checked and milked completely once or twice if milk has accumulated in the udder. Ewes should always be dried off at least two months before the next lambing. When the milk yield of the ewes is high,drying off is applied gradually. Ewes are first milked once daily, then every other day, and then every three days. They are checked weekly for any milk accumulated in the udder. Simultaneously feed and water intake is reduced. It is preferable to isolate these ewes from dry ewes. Seven weeks before lambing "dry cow" therapy is applied if mastitis is a problem. Intramammary ointment is inserted in each teat to reduce the incidence of mastitis during the following lambing period.

Traditionally ewes are milked by hand. However, hand milking is a very laborious and time consuming job. For this reason modifications to the traditional facilities and practices are necessary in order to improve the working conditions and the efficiency of milking.

The milking parlour, located in a shed or a building, consists of a collection yard, where ewes are collected before milking, wooden or metal stands (Figure 21; Photograph 18) where ewes are milked and a second yard where ewes are held after milking. The ewes from the collection yard enter through a passage onto the stand. A ramp leads to the entrance of the stand and, after milking, the ewes are released through a hand-operated opening gate to a second ramp leading from the stand to the holding yard where the ewes wait until the milking is completed. The two yards may be prepared from hurdles or fencing. There are two or more stands in line and each milker while milking sits in front of each stand. Ewes are milked from behind and the milk is collected in a metal pail. The milking parlour area, including the stands and the metal pail, must be cleaned and disinfected.

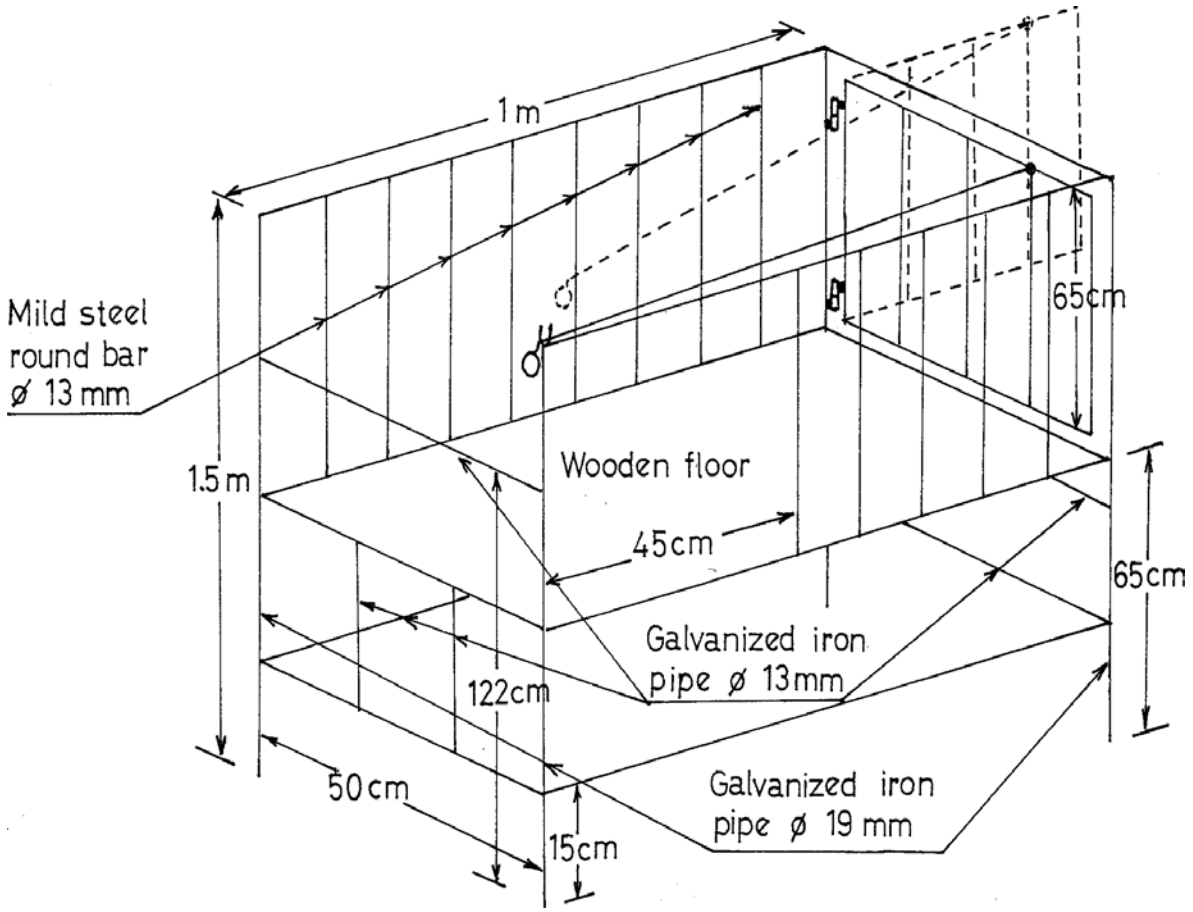
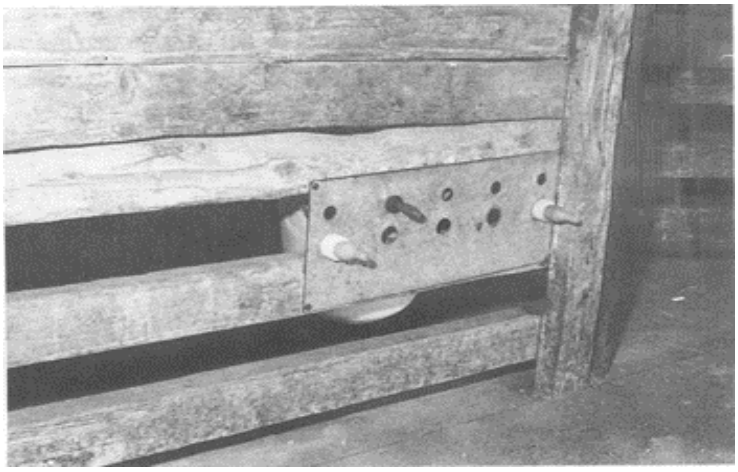
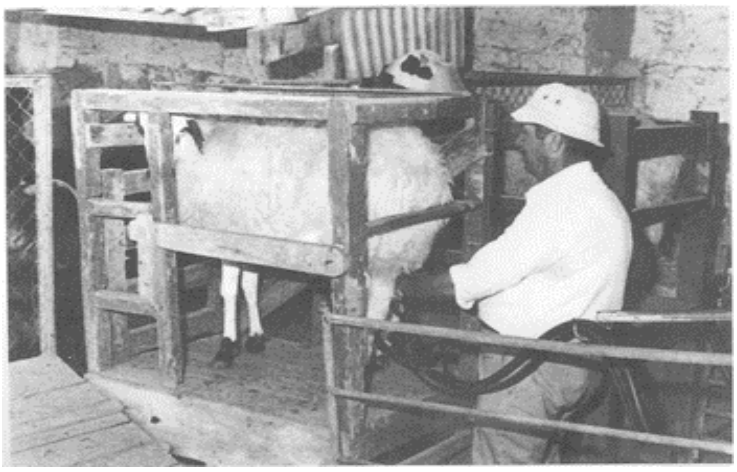


Figure 21 - Milking stands. A wooden ramp leads to the wooden floor through an opening (45cm x 45cm). Another ramp leads from the opening gate to the collection yard.



17. Lamb-bar. The nipples are attached on a piece of flat sheet steel fixed on the inside of the pen



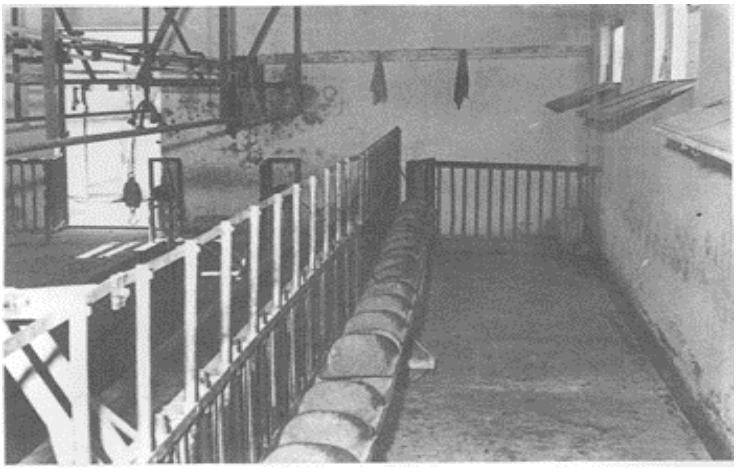
18. Ewe on a milking stand; machine-milked by a porable unit

The milker should wash his hands before and after milking and behave gently during the milking. The milker must check whether the milk is of normal composition. If there are any changes in the milk he should not continue milking, the ewe is isolated, the milker washes his hands with water and disinfectant and then continues the milking of other ewes. The isolated ewes are milked at the end of the milking period, milk samples are taken for laboratory diagnosis and veterinary advice is sought regarding any treatment. This procedure is also followed in the case of machine milking systems.

4.8 Machine milking

The aim of mechanical milking is to improve the working conditions of the milkers, increase their productivity and improve the quality of the milk. Milking ability of the ewes utilizing machine milking depends on the shape and dimensions of the udder and teats. Udder massage, machine stripping or hand stripping may be needed for the evacuation of the udder.

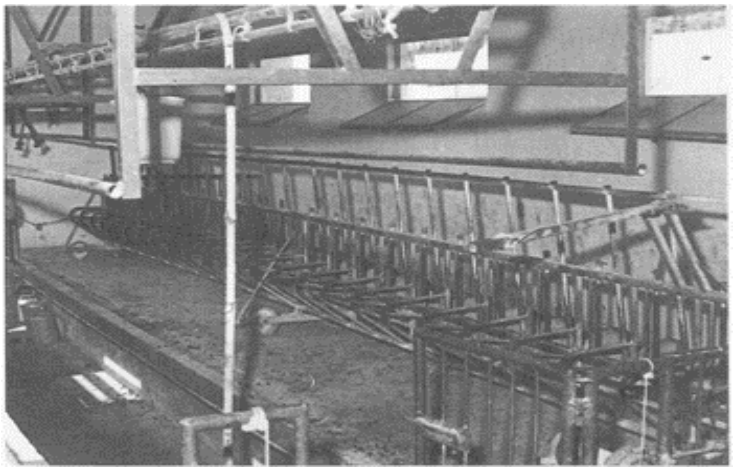
There are three main milking systems; the abreast or pit (Photographs 19 - 20), the rotary and the portable (Photograph 18) systems.



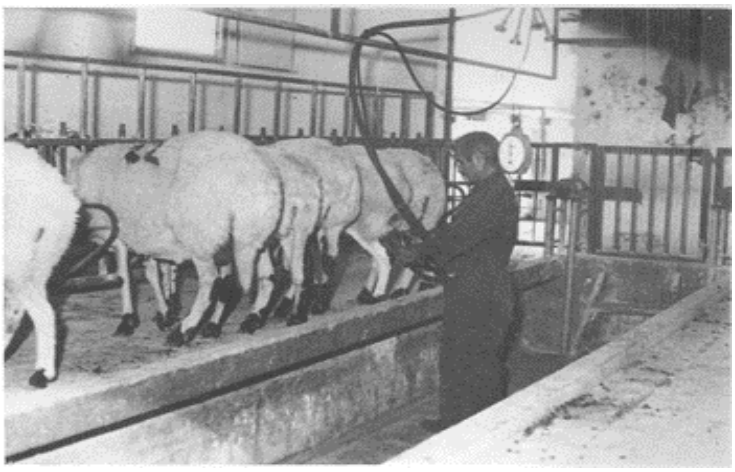
19. Milking parlour, pit system. Individual grain racks attached to the yokes (optional)

The abreast milking system or the pit system (Figure 22) has two levels with a difference in height between them of 90 cm. The milkers stand on the low level (the pit) and on the high level, on each side of the pit, the

rows of yokes are mounted on a mobile framework (Figure 23). Whilst sheep enter the parlour the yokes are positioned at the far side and this allows the easy movement of the animals to enable them to find vacant spaces and lock themselves into the yokes (Photograph 20). After the sheep are all in position the whole framework is gently retracted toward the pit, either manually or by automatic means so as to move the sheep backwards and bring them up to the milker in a convenient position for milking. After removal of the clusters, the stalls are returned to their original position from which the ewes are released and replaced by the next batch. Usually a low level milk pipeline is used and occasionally a high level milk pipeline. Variable numbers of milking units are used to reduce the time of milking.



20. Milking parlour, pit system. Position of yokes before milking



20. Milking parlour, pit system.

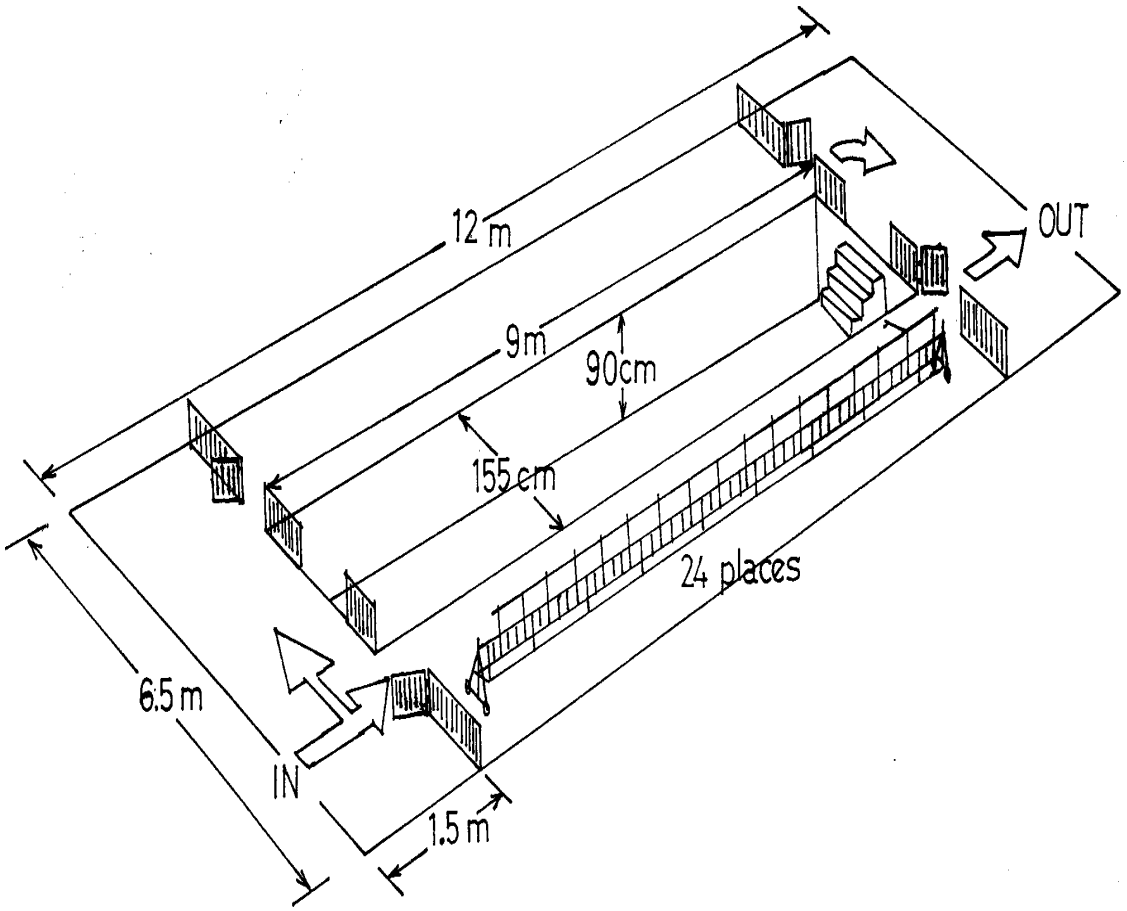


Figure 22 - Milking parlour. Layout of the pit system. The pit is 90cm deep.

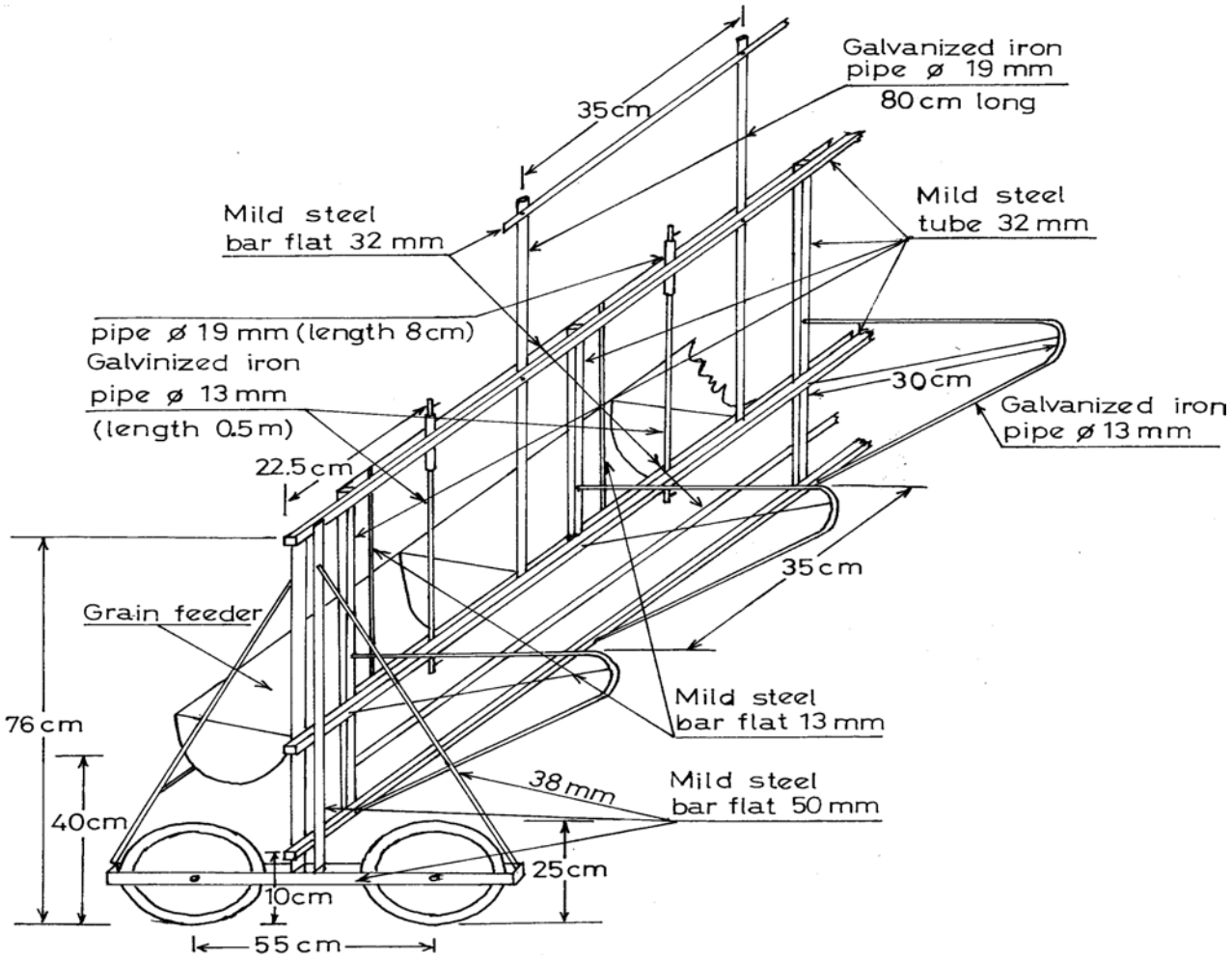


Figure 23 -Yokes. Details of the mobile framework and the yokes. Grain feeder is optional.

The rotary milking system consists of a rotating, raised, circular platform from the collecting area and up to a ramp from which the sheep walk onto the platform from the inside, facing outwards. The operators work in the central area. As the platform rotates the sheep are presented to the operator for application and removal of the clusters. The functions of the parlour are controlled from a centrally placed panel.

The portable milking system is a small mobile unit operating with a petrol engine or electric motor. It has two bucket units and enables the simultaneous milking of two sheep. The stands used for hand milking, abreast systems or low platforms may be used for holding the sheep.

Milking methods are based on the labour of two to three workers, one of them looking after the introduction of the sheep to and from the milking parlour. With all milking systems there are two yards, prepared from hurdles or fencing, one before milking for collection and one after milking, for holding until milking is finished, with narrow entrances and exit passages to the milking parlour. Strict sanitary conditions should be maintained in the milking parlour all equipment being washed and disinfected after each milking. Usually milking machines for sheep are operated with a vacuum of 44-47 kPa (33-35 cmHg), pulsation rate of 90-120 pulsations per minute and a pulsation ratio 50:50 or 40:60 (suction: massage).

4.9 General disease control measures

The economic loss to sheep production due to disease and parasites as a result of mortality, loss of condition, inefficient utilization of feed and carcass condemnation, is high. With the increasing intensification of sheep production the stress on the sheep's defences is more marked. This stress is the result of the higher productivity of the animals, the unusual diets they may be offered, the confinement of large numbers in small areas, and in sanitary conditions. Stress may develop from severe problems after storms or sudden changes in weather conditions, after sheep have been transported, sheared and trailed a long distance or following an abrupt change of feed. While planning to establish a sheep enterprise,sanitation and disease prevention must be a primary consideration.

Proper ventilation of the buildings, dry, clean pens, sanitary handling of the ewes and lambs, adequate and clean water, clean feed supplies and feeding facilities and the feeding of balanced rations, together with a vaccination and a parasite control programme are sound prophylactic measures for disease prevention and control in sheep flocks. Information on housing, construction of pens and feeding and watering facilities is given in Chapter 3.

Disease and health problems of sheep cannot be controlled or prevented if they are not identified. Every effort should be made therefore to determine the exact cause of death when animals die. Correct diagnosis of the condition causing the death will help to save many animals in the flock. If, for example, symptoms of diarrhoea appear in lambs, faecal samples (rectal swabs) are obtained for laboratory diagnosis in order to identify whether the condition is of bacterial, coccidial, parasitic or nutritional origin so that proper treatment against the causal agent can be applied. All ewes which abort must be separated from other ewes and the placentae and dead lambs removed and buried or burnt. Samples of placentae, the embryo and of dead lambs should be taken for laboratory examination in order to determine the cause of the abortions.

Disease may be carried from flock to flock by visitors, friendly farmers or sheep shearers. A disinfectant should be applied to injuries and in warm weather a fly repellent should be used. Sick animals should be removed from the flock to a separate or isolated pen where feeding and treatment can be done more easily.

There are many vaccines, antibiotic injections and other pharmaceutical products (as, for example, vitamins) available to producers that should be used when the need arises. Good care and the necessary sanitary measures should be applied when vaccinating or giving injections. Improperly administered vaccines and injections may cause infection, loss of weight and condition and lameness. Needles and syringes must be sterilized. Manufacturers' recommendations should be followed as to the dosage and means of injection. The rules of hygiene must always be observed. Cleanliness and disinfection are the only means of preventing and controlling the spread of infectious agents.

Subcutaneous injections are given just beneath the skin. These are administered most easily on the side of the neck, just behind the shoulders or on the wool-free area under the forelegs. Intramuscular injections are given directly into the muscle of the animal and in sheep are normally administered in the muscle of the shoulder or forearm. The needle should be inserted into the muscle and the syringe plunger pulled slightly backward to ensure that the needle point is not in a blood vessel. If it is in a blood vessel, blood will enter the syringe. The needle should then he pulled back slightly and the injection completed. Intravenous injections are made directly into the jugular vein along the neck.

The knowledge of existing disease problems in a particular area will help in outlining a programme of vaccination and control of internal and external parasites in that area.

Vaccines are used to develop prolonged immunity to specific diseases. Vaccines should only be given to healthy animals and in accordance with the manufacturers' directions. The instructions for the reconstitution, storage, administration and dosage should be closely followed. Expiration date should be noted and vaccines

should not be used after this date. If vaccines are used improperly they may be completely ineffective. Active immunity is not established until at least 10 days following vaccination. Some vaccinations may require annual injections (booster doses) to maintain effective immunity.

Different vaccines and types of vaccines are available which can be used depending on the diseases present within a country, in districts within a country or in neighbouring countries. The vaccine against enterotoxaemia, for example, is given every year to breeding stock, suckling lambs (15-20 days) and again at weaning and in feeder lambs before transportation and when in the feedlot. Johne's disease vaccine is given to lambs at 7-10 days old. Foot and mouth vaccine is given after the sixth month of age and is repeated every year. Virus abortion vaccine (Chlamydiosis) is given to yearlings at least 15 days before mating and every two or three years thereafter. Sheep pox, anthrax and other vaccines may be given in areas where such diseases are present.

First aid materials for the personnel working on the farm and other pharmaceutical products for animal use are stored in a medical cabinet. A refrigerator is required for certain drugs or vaccines.

An isolation pen equipped with feeding and water facilities should be built in a corner of the farm. In this sick animals can be isolated to prevent the spread of disease from other animals and in this pen treatment is applied.

4.10 Control of parasites

The damage from internal parasites is normally greatest in lambs, yearlings and very old sheep. Proper nutrition is of extreme importance in the control of internal parasites. Parasitic disease problems increase with intensification of production and lack of attention to strict sanitation. A regular parasite control programme is necessary to prevent loss of condition of the animals and loss of production.

The main categories of internal parasites are the nematodes (stomach and intestinal roundworms, such as Ostertagia and Trichostrongyle,and lungworms), cestodes and trematodes. In all cases of parasitism more than one species of worm is present but usually the disease is due to one or two species. Laboratory examination is, therefore, required for the identification of the causal parasite(s) in order that the correct treatment can be applied.

The objective of seasonal plans of control is to reduce the number of worms at certain critical periods. Treatment at these periods aims at preventing the build-up of heavy infections in the animal and at reducing the contamination of pastures and sheds with worm eggs. Control of parasitism is accomplished through sound management and the use of drugs. Leakages of water supplied to reservoirs, tanks or troughs should be avoided. Overstocking for long periods should also be avoided. Strip grazing and clean rested pastures for lambs and drenched sheep should be used. The use of feed bunks and proper nutrition is essential in controlling parasitism.

Drenching is the most effective and least expensive method if proper equipment (Photograph 21) and techniques are used. Without adequate precautions being taken, sheep may be lost from injury, crowding in the drenching chute or from over-dosage. Pneumonia may result from drench in the lungs. Drenching should be done if possible during the coolest part of the day. If drenching must be done during the heat of the day it will be beneficial to sheep and labour if temporary shade is provided. A chute (race) for drenching should be about 50 cm wide and 12m - 15m long and the sides should be solid. The operator moves along beside the sheep inside the chute and stands just behind the shoulder of the sheep being drenched. The free hand should be placed under the jaw and the nozzle of the drench gun is inserted into the side of the mouth and over the tongue. The head should be held in a normal position. Different nozzle lengths are available for most drench guns depending on the breed of the sheep. The end of the nozzle should be just opposite the middle molar teeth and directed slightly toward the side of the mouth.

21. Drenching gun (top), multidose syringe (bottom)

Ewes in late pregnancy are not drenched. There are a number of dose syringes and drench guns that may be used satisfactorily. There is a variety of anthelmintics which is very effective. Manufacturers'recommendations as to dosage and instructions for their use should be strictly followed.

Infestation of sheep with ticks, lice and other ectoparasites may be widespread and cause considerable loss in condition and production and reduce the quality of the wool.

Ticks and lice are easily controlled by dipping, spraying or dusting with a suitable acaricide/insecticide. Permanent dipping tanks may be used for dipping (Figure 24). The application of an acaricide/insecticide, if possible, soon after shearing, can be done with the least effort and expense, the results being very satisfactory. Normally two applications a year will control ticks effectively.

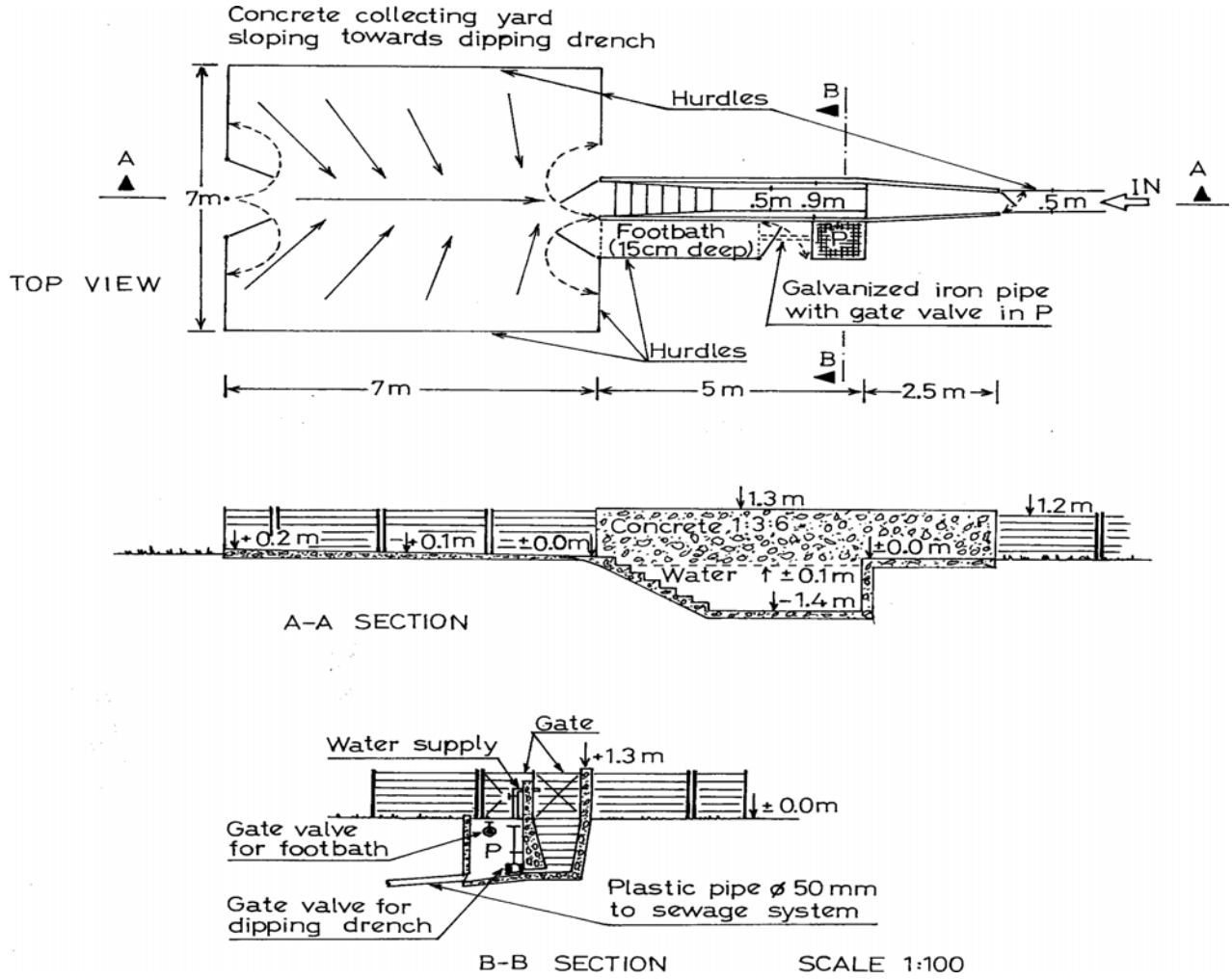


Figure 24 - Dipping tank. Permanent dipping vat and footbath. Hurdles for fencing collecting yards.

Dipping is not recommended for sick animals, thirsty animals or animals after exercise and animals should not be over driven after dipping. Dipping is also not recommended for ewes in late pregnancy or within a short time before slaughter. Sheep are kept in the swim bath for half a minute and one minute if fleeces are over two months. Spraying isalso not recommended for ewes in late pregnancy or within a short time before slaughter. Sheep are kept in the swim bath for half a minute and one minute if fleeces are over two months. Spraying is not recommended in a confined, non-ventilated area. There are many commercial acaricides and insecticides suitable for the effective control of ectoparasites. A veterinarian's advice should be sought to choose the right preparation. Manufacturers' recommendations as to dosage, formulation and strength, the amount for each animal and where and when to apply them must be strictly followed.

4.11 Major diseases in sheep

There are many types of pneumonia in sheep such as parasitic, aspiration, viral and bacterial. Sheep of all ages are affected. Stress factors influence the severity of pneumonia. Some of the predisposing factors are extreme climatic conditions (excess moisture, faulty ventilation, draughts, and temperature extremes particularly at lambing and weaning), transportation, shearing and housing. Reducing the factors responsible for stress may reduce the incidence of pneumonia. Favourable conditions under which stress is reduced are:

- clean, dry and well ventilated premises;
- culling of ewes with chronic pneumonia;
- the correct concentration of animals in the buildings;
- provision of shelter against storms and shade from sun; and
- the gradual introduction of diets.

If pneumonia is an annual problem with lambs, tetracycline antibiotics may be added to the concentrate ration. The broad spectrum antibiotics are usually effective as a treatment for pneumonia.

Enterotoxaemia affects sheep of all ages but it is most common in lambs under 6 weeks of age and weaned lambs in feedlots. The most obvious predisposing factors are digestive disturbances due to diet, lack of exercise and sudden changes in the diet. The disease may be prevented through good management and by vaccination. Lambs coming from pastures should be gradually adapted to feedlot conditions. Hay is fed the first few days and gradually concentrates are introduced. Feed must be available at all times.

Parasite control should first be implemented and then vaccination before transportation. Antibiotics may be added in the ration at 20 mg/kg feed. Providing the lambs are in good body condition booster doses should be given 2-4 weeks later after the arrival of the lambs in the feedlot. Intensively reared lambs require one vaccination during suckling and a booster dose at weaning or soon after weaning. Losses may be prevented in young lambs by vaccination of the ewe 2-4 weeks before lambing. If enterotoxaemia appears late in the feeding period concentrates are reduced by 50 percent for one week or longer after which they are increased gradually. Lambs in market condition are sold and those remaining vaccinated.

Polyarthritis is an infectious disease of nursing lambs, recently weaned lambs and feedlot lambs. Clinically the disease is characterized mainly by stiffness and swollen joints which lead to reduced weight gains. Antibiotics have proved to be effective for the control of the disease.

White muscle disease is a condition due to a selenium or vitamin E deficiency and is more common in lambs 3-8 weeks of age; it may, however, be seen in older lambs. When experience indicates that white muscle disease is an annual problem,the best results are obtained by injecting ewes with selenium and vitamin E one to four weeks before lambing and preferably by injecting lambs 2-4 days after birth and again at 20-22 days of age.

Coccidiosis, if not controlled, causes loss of appetite, unthriftiness, diarrhoea and high mortality. It is primarily a disease of young and feedlot lambs. Outbreaks may occur 2-3 weeks after lambs have arrived in the feedlot. Feeding low levels of coccidiostats is of great value in preventing an outbreak. Feed and water troughs should be designed to allow the minimum of faecal contamination. Troughs should always be clean. Sulphonamides are used for treatment.

The occurrence of urinary calculi may be widespread in sheep and particularly in rams or lambs in feedlots or on high concentrate diets. The condition is associated with a high phosphorus content in the diet, rations with a phosphorus-calcium imbalance and those with low water and a high mineral intake. Preventive measures are the provision of a clean, constant supply of water and a normal phosphorus content in the diet. When concentrate rations high in phosphorus are fed.it is advisable to add limestone (1-2 percent) to correct the calcium:phosphorus ratio.If the diet is alkaline lOg of ammonium chloride is added.

Staphylococci, streptococci, pasteurella and other organisms are implicated as causes of mastitis in suckling or milking sheep. The gangrenous type of mastitis is more severe and in those ewes which survive the udder is non-functional or severely damaged. Ewes affected with mastitis should be immediately separated from the flock and treated with a wide spectrum antibiotic. Sulphamezathine is particularly effective. All affected ewes are culled. Strict hygiene measures such as cleanliness, good milking and udder washing and dipping in appropriate disinfectant can prevent the outbreak of the disease. Injuries of the udder or the teats should be treated so as to prevent the transfer of infection during milking through the teat canal. When ewes are dried off milking is gradually discontinued. About seven weeks before the next lambing intramammary ointment (similar to that used for "dry cow") is inserted in each teat to reduce the incidence of mastitis in the following lactation.

4.12 Health problems of young lambs

Some of the most important causes of death in lambs during the first weeks of life are pneumonia, starvation and diarrhoea. The survival rate of lambs can be increased when:

- healthy ewes and rams are used in the breeding programme; ewes are properly fed during breeding and gestation and ewes and rams are vaccinated when particular problems exist requiring the provision of parental immunity to newborn lambs;
- as far as possible supervision is given at lambing;
- ewes have sound and functional udders and a well developed maternal instinct;
- ewes immediately after lambing are cleaned and sheared around the udder and hindquarters;
- lambing sheds are cleaned and slacked lime is spread over the floor of the shed;
- ewes are allowed to lamb in lambing sheds and are then moved to lambing pens;
- the navel of the lamb is disinfected with an iodine solution or other disinfectant;
- lambs suffering from chill are provided with heat and
- lambs are provided with an adequate quantity of colostrum and an adequate amount of milk thereafter.

The incidence of disease increases as the lambing season progresses, because there is an accumulation of infection in the lambing areas. Sound sanitary conditions must always be ensured in these areas in order to reduce the incidence of disease.

4.13 Nutritional disorders

A condition called hypocalcaemia, because the affected animals have a low blood calcium level, occurs normally within the first three days after lambing, during late pregnancy and occasionally in other periods. Affected animals stagger from side to side when walking, lie down on the sternum, show muscle tremors, fall into a coma and die. Predisposing causes may be the physiological upset at lambing, sudden starvation and bad

weather conditions. With increasing age the calcium resorption from the bone is reduced and a continuous absorption of calcium from the digestive tract is required. In the early stages of the disorder the intravenous injection of calcium borogluconate alleviates the symptoms.

Pregnancy toxaemia or twin lamb disease occurs usually in twin bearing ewes during late pregnancy and is due to an imbalance between the energy demand of the foetuses and the energy intake of the ewe. It can be induced by undernutrition, impaired liver function and endocrine disorders. Prevention of the disease may be successful with the maintenance of a high level of feed intake by the ewe, no sudden changes in the diet and no sudden changes of the conditions under which the ewes are kept.

The clinical designation 'rumen acidosis' has to be considered as a collective term for several digestive disturbances which result in depression of the pH of the rumen contents. Acidosis may develop under the following circumstances:

- when sheep unaccustomed to concentrate feed (barley, wheat, sorghum, maize, sugar beet, potatoes) suddenly consume a large quantity of such feed;

- when potentially dangerous feed has already been eaten for several weeks and the ration is then moderately increased;

- when the roughage component of the diet is low in relation to the concentrates;

- when the proportion of roughage is lowered with an unchanged concentrate intake;

- when there is a sudden change of the diet from straw or hay to green pasture (high in soluble carbohydrate and low in crude fibre).

In order to prevent losses from acidosis the following preventive measures are suggested:

- gradual adaptation to concentrate diets over a period of at least two weeks. This change over a period should be applied whenever increases in energy intake are required because of increasing energy requirements (late pregnancy, or early lactation), or during changes of the grains in the diet;

- there must always be a balance between the roughage and concentrate components of the diet. A general recommendation is that the roughage component of the diet should constitute 40 percent of the dry matter of the total diet. If the availability of roughage is low it is advisable that roughage should be stored for feeding at periods of increased energy demands, when increased quantities of concentrates have to be fed;

- feeding more than once daily;

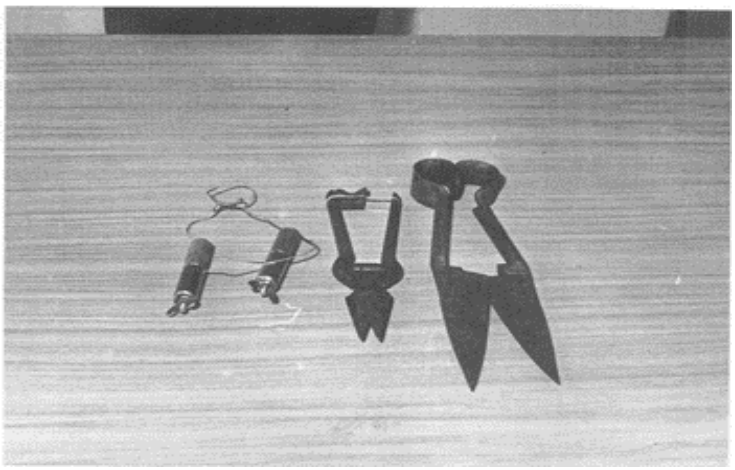
- when group feeding is practised enough space for all animals in the feeding trough should be provided. More aggressive animals or animals with higher energy requirements should be fed separately.

The feeding of sheep with diets high in copper (over 25 ppm) over an extended period causes haemolytic jaundice and death due to copper poisoning. Excess of copper accumulates in the liver until at a critical level and affected by stress factors, it induces liver cell necrosis and liberation of copper into the blood stream. The disease may also occur when the copper content in the diet is 10-20 ppm and there are also extremely low levels

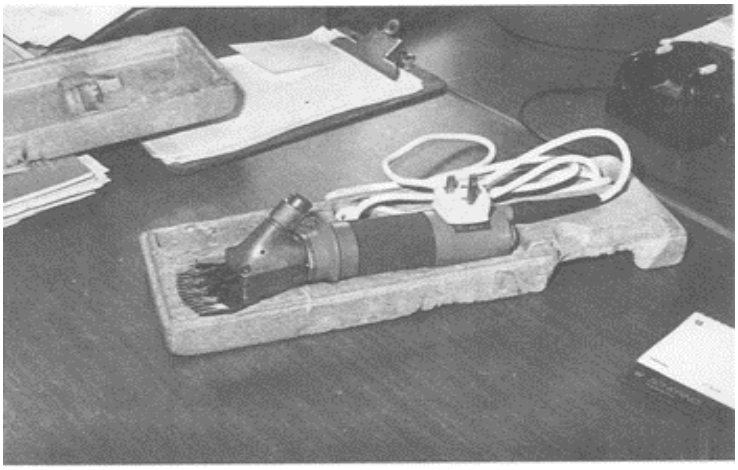
of molybdenum (0.1-0.2 ppm). Copper poisoning may arise from the increased use of copper compounds by the veterinary services, the increased use of copper fungicides, mistakes in compounding (the preparation, for example, of sheep diets after the preparation of poultry diets high in copper or the use of a trace element mixture containing copper, more suitable for other types of animals). In cases of copper poisoning of sheep the recommended therapy is drenching daily for five days with 100 mg of ammonium molybdate and 1 g of sodium sulphate. Due to interaction in the metabolism of copper, molybdenum and sulphur, it is recommended that a daily intake of 10 mg of copper, 2-2.5 mg of molybdenum and 2-2.5 g of sulphur should be given as a preventive measure against copper poisoning.

4.14 Trimming of hooves, castration, docking and dehorning

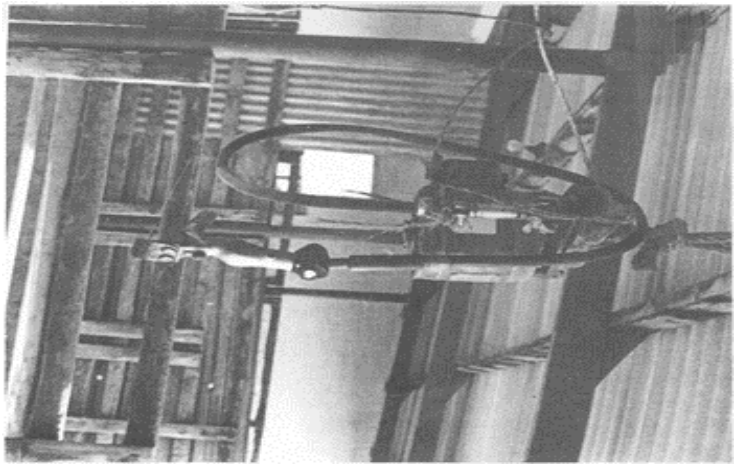
Twice a year hooves should be trimmed using a special pair of scissors (Photographs 22 and 23). Trimming takes place immediately after lambing and later at least two months before the next lambing. A permanent foot bath should be constructed (Figure 24) to treat the feet of the sheep.



22. Dehorning wire (left), hand shears (right) and hoof trimming scissors (middle)



24. Electricshearing machine



24. Electric shearing machine

Castration of males is carried out before the lambs are 6 weeks of age using the elastrators, the knife or the Burdizzo method. However, castration is not recommended under intensive conditions of fattening where slaughtering takes place a relatively short time before sexual maturity. Castration reduces the rate of gain and feed efficiency and the carcass contains more fat compared to intact male lambs. Moreover, in most countries of the Near East, slaughter animals with intact testicles are preferred.

Docking of the tail should take place during the first days of life (2-4) using a knife or elastrators. However, there is no definite advantage to be gained from this operation (a better quality of carcass of males is claimed) since losses of lambs may occur from shock or infection. If instruments for docking and castration are not used properly and strict sanitation is not observed, loss of weight and condition, and death may occur.

There is no need to dehorn lambs which are to be slaughtered. In rams kept for breeding it is better to leave the horns and cut them using a dehorning wire (Photograph 22) as the need arises.

23. Trimming of hooves

25. Shearing after lambing

4.15 Fleece and shearing

In a sheep production system where the main objectives are the production of meat and milk the contribution of wool to the annual income is very small, wool being considered a by-product.

The wool yield and quality is affected by genetic and nutritional factors. Considerable breed differences in fleece characters exist mainly in the weight of the fleece and in its composition. Chronic undernutrition can reduce the growth of the wool and the thickness of the fibre. Feeding practices which do not restrict the birth weight or the early postnatal growth of lambs will help positively in the initiation and maturation of follicles. This development is necessary if maximum wool production is to be achieved. Increased feed intake results in higher quantity and quality of wool. The quality of wool is lower as a result of sudden and severe reduction in feed consumption brought about by drought, illness or lack of water. Adequate protein intake is also necessary. Infestation of sheep with ectoparasites reduces the quality, appearance and value of wool. Dipping or spraying against ectoparasites will, however, improve wool quality.

A sheep is usually shorn for the first time at about 10-15 months of age. Shearing takes place normally once a year in early spring.

Shearing of ewes and rams usually takes place after 15 March when temperatures begin to rise. Lambs should be sheared in June. Shearing can be done using either a special pair of hand shears (Photograph 7), or an electric shearing machine (Photographs 8 and 9). Combs and cutters or hand shears should be disinfected before use. A disinfectant should be applied to cuts occurring during shearing.

The wool is first cleaned by hand or dipping is scheduled a few days before shearing so that the wool is clean. Sheep are sheared by cutting the wool just above skin level using a pair of shears. Hand shears have been traditionally employed for this purpose, but the use of mechanically operated shears, particularly those powered by electricity, is becoming widespread. Machinery should be checked for damaged and worn parts and replacements, if necessary, ordered well before the scheduled shearing time. The shearing shed should be cleaned before shearing and skin cuts disinfected. Hand shears or electrical shears should also be disinfected. After shearing the animals should not be exposed to severe climatic conditions and should not be driven long distances. It is customary at shearing to separate the soiled wool and the floor sweepings from the main fleece which is preferably packed in hessian bags.

4.16 Record keeping

The overall efficiency of an intensive sheep operation depends on the improvement of the breeding efficiency of the flock (prolificacy, frequency of lambing, weaning percentage); proper nutrition of all animals (ewes, rams and lambs) and maintaining good health of the flock. The key to genetic improvement, balanced feeding and health control programmes is record keeping.

Productive traits such as prolificacy, milk production, growth rate, fleece weight, time and duration of the breeding season, adaptability and the results of selection or crossbreeding can best be evaluated when records are kept for each animal. The measurement of these characters demands the individual identification of all animals in the flock. The individual identification of the lambs requires the correct assignment of lambs to ewes at lambing time and the correct assignment of ewes to rams at mating time. Eartags of different types are available for individual identification. When ewe lambs or ram lambs have been selected to join the breeding flock larger eartags may be used. The simultaneous identification by tattooing the inside of the ear will help to keep the identification of the individual when eartags are lost.

Various books are kept on the farm for record keeping purposes:

Mating book. The following data is recorded: ewe number, first, second, third service, date of service and sire.

Lambing book should record: ewe number, lambing date, lamb number, sex of lambs, birth weight, sire, weaning weight, age at weaning and liveweight of lambs at 105 days.

All the progeny and production records are transferred to an individual sheep record card on which milk production, fat content of milk and lactation period are recorded.

Veterinary diary. This is a diary in which all cases of death, disease and treatment of animals are recorded daily. Date of vaccination, dipping and veterinary diagnostic tests are also included. Specimens for laboratory diagnosis (rectal swabs, milk, blood, placenta and embryo) and the veterinary results are also recorded.

Mortality book. All dead animals are recorded together with the results of the post-mortem examinations.

Records of feeding. The rationing of each category of ewe (dry, lactating, pregnant, ewe lambs and fattening lambs) is recorded on special forms so that personnel responsible for the feeding of the animals is aware of any changes in the rations (quantity and type of roughage or of concentrate mixture).

Milk records. The individual milk yield of ewes is recorded on special forms once monthly after weaning until the end of the lactation.

Records must be used effectively if they are to repay the trouble and expense of keeping them. They can help, for example, in the selection of replacements, the culling of unproductive animals and identification of health problems in the flock.

4.17 Feeding of the ewe

Feeding, in most intensive production systems, is responsible for over 50 percent of the total production costs. It constitutes therefore the most important factor governing the success of any intensive operation. Rations must be formulated which support optimum production, and are efficient and economical to feed. Energy intake is the most important factor in production. In practice the nutrient requirements are based on the performance of a group of animals. Feed allowance therefore must be adequate for all animals. It is also not possible to have one ration for each class of animal. Farmers may have one or two concentrate mixtures or supplements and offer different proportions of concentrates to roughage and/or roughage of varying quality, under different situations.

When ewes lamb once each year the time between weaning and mating should enable ewes to be brought up and maintained in good body condition for mating. More frequent lambing, or when ewes are milked by hand, may require the use of concentrate feeds or good quality roughage for such practices. Usually the onset of oestrus is delayed when ewes are lactating. Milking of first lambing ewes is stopped earlier than older ewes even at higher milk yields, because the onset of oestrus in this class of ewes is delayed. The condition of the ewe at mating has an important influence on the number of lambs born. There is a static effect of body size with heavier ewes producing more lambs and a smaller dynamic effect of improving body condition in ewes of similar weight.

Flushing is the practice of improving ewe body condition prior to mating by increasing the plane of nutrition. Flushing is usually accomplished by providing animals with fresh pasture, good quality hay or up to 0.25 kg concentrates per day. This feeding begins 2-3 weeks before breeding and continues through the mating season. Flushing is generally not profitable when supplemental feed is fed to ewes in normal body condition. Excessively fat ewes or those in very poor condition will perform at a reduced rate compared to ewes in normal body condition. The shepherd or the manager of the sheep flock usually is in a better position to judge the body condition of the ewes and decide whether flushing is necessary.

Pregnancy adds to the nutritional requirements of the ewes. After the ewes are mated and pregnancy is established it is sufficient to feed them for maintenance until the third month of pregnancy. Thereafter, and until lambing, the requirements increase because of the additional requirements of the lamb(s), udder growth and initiation of milk secretion. Pregnant ewes are fed separately from dry ewes. The plane of nutrition is gradually increased after the third month of pregnancy so that at six weeks before lambing the ewes are offered the full diet until lambing. It is advisable that changes of diet during this critical period are avoided. Grazing for 1-2 hours daily is necessary even if feed is not available in adequate quantities. Dry roughage should be offered first in the barn, before turning the ewes out for grazing. Roughage should always be offered first followed by the concentrate mixture. Usually diets of higher energy concentration (good quality roughage and concentrates) and of good palatability are fed.

Appetite declines at the latter stage of pregnancy and during this period the ewe may suffer a severe negative energy balance and pregnancy toxaemia may result. It is also advisable during the last stages of pregnancy for diets to be given similar to those used immediately after lambing, to avoid sudden changes of diet. The level of different nutrients in late pregnancy depends on the liveweight of the ewe, the number of foetuses and the type of feedstuffs used in the formulation of the diets.

Maintaining the required plane of nutrition in early lactation is important to increase total milk yield. There is no effect of the level of feeding during the last stages of pregnancy on the milk yield of the ewes unless the feed deficit is very large. Single bearing ewes only suffer from underfeeding when extreme weather conditions (drought) lead to a prolonged period of semi-starvation. Under good conditions undernutrition is likely to be evident in ewes carrying more than one lamb. Milk production can be severely affected by the level of feeding after lambing. The intake of ewes immediately after lambing is low and increases gradually. However, maximum feed intake does not occur until after peak milk yield and animals with high milk yields are in negative energy balance. For this reason diets high in energy concentrates are fed during this period. Better nutrition in early lactation will result in higher peak milk yield which is highly correlated with total lactation milk yield.

The diet of ewes should gradually increase from lambing to ten days post partum when controlled ad libitum feeding is practised. The increase in energy intake during this period and until weaning is mainly achieved by increasing the concentrate component of the diet. Roughage of good quality is offered (lucerne hay or other legume hay) but the proportion of concentrates to roughage should remain between 60:40 or 70:30 to avoid

digestive disturbances. This high level of feeding continues for about one week after weaning.

Milk yield is reduced immediately after weaning. The feeding of ewes ten days after weaning to the end of lactation depends on the level of milk production of the flock and the fat content of milk, the liveweight of the ewes, the desired liveweight change, and the feedstuffs available. Feeding level is adjusted at *2* or 4 week intervals. The loss of liveweight occurs during the first 50 days of lactation and is more efficiently- restored during the lactating period than during the dry period. The flock may be divided into two groups according to the level of production and are fed accordingly. For each kilogramme of milk produced, with fat ranging from 6-7 percent, about 700-750 g of concentrates are fed. In mid and late lactation when milk yield is low feedstuffs of lower quality may be used.

Dry ewes have low requirements for the different nutrients, and roughages of low quality supplemented with nitrogen, phosphorus and vitamin A are adequate. Ewes in poor condition during this period must be fed extra feed to restore good body condition until mating. The requirements depend on the liveweight of the ewe and its activity during grazing. The energy cost of walking is about 2.6 Joules/kg liveweight horizontal metre and 28 Joules/kg liveweight vertical metre.

Ewes are fed roughages and concentrates either in fenceline feeders or are hand fed in hay or grain bunks. Sheep diets are balanced first for energy. Other nutrients in deficit are then supplemented.

In intensive sheep operations feeding systems are based on the concept of the determination of the nutrient requirements of the animal and the nutritive value of feeds, and then on the formulation of a ration which meets the daily requirements of the animals. However, grazing can play an important economic role in meeting part of the nutrient requirements of the sheep particularly when natural vegetation, stubble or crop residues are available over certain periods of the year. It is important to schedule breeding and weaning so as to obtain an optimum combination of the animal's nutrient requirements and forage availability and quality.

Production response of grazing animals is related to both quality and availability of feed. Sheep grazing on good quality pasture may obtain adequate levels of most nutrients, but deficiencies may be expected when grazing is inadequate and of poor quality. Supplementary feeding of low-quality roughages, mainly with nitrogen, energy, phosphorus and vitamin A, is necessary. Generally the amount and kind of supplement varies. The operator must be able to assess the condition of grazing, the condition of the sheep and be able to determine what supplements can be supplied at least cost to ensure adequate production.

Feed grade urea contains 45 percent N or 281 percent crude protein (NX 6.25). The amount of protein equivalent in 13 kg of urea plus 87 kg of maize is the same as in 100 kgof soyabean meal. Urea can be efficiently utilized in rations containing high levels of easily fermentable carbohydrates (grains, molasses), when the degradability of protein inthe rumen is low and the level of protein in the diet after supplementation is not higher than 12 percent crude protein (dry matter). It is not however efficiently utilized in moderate to high roughage diets. Good mixing of urea with the other ingredients is necessary to avoid possible toxic effects.

4.18 Water intake

Water is essential to successful sheep production and producers must plan for an adequate supply of clean water when designing their sheep operations. Water quality is of great importance to sheep. Sheep will not consume adequate amounts of stagnant, poor quality water or water that has an objectionable odour. If sheep are forced to drink poor quality water, production will be greatly reduced.

Water intake increases as dry matter intake increases. Water intake is about twice the weight of the air dry feed intake. Intake of excessive nitrogenous compounds results in considerable water loss in the elimination of the nitrogen-end products. Excessive mineral intake will significantly increase water consumption.

Sheep can tolerate water containing 1 percent salt over a relatively long period of time but cannot tolerate water containing 1.5 or 2.0 percent salt. Sheep apparently can use water containing 1.3 percent salt without ill effect., but water consumption increases up to 100 percent.

Sharp increases in water requirements can be expected when environmental temperatures rise above 21° C and water intake decreases with low environmental temperatures. The temperature of the water will have a great effect on water intake during periods of extreme heat or cold. Water located in the shade will be accepted more readily on extremely hot days. Water requirements and water intake of the ewe increase greatly during late gestation and during lactation. For greatest production during these periods ewes must have an unlimited water supply available from which they can drink frequently.

Adequate watering facilities to prevent crowding and to ensure that each animal receives ample water is essential.

Chapter 5 MANAGEMENT OF FATTENING

5.1 Lamb fattening from weaning to 35-40 kg liveweight

After weaning suckling lambs or artificially reared lambs are moved to the growing unit for fattening. The whole area and the facilities should be cleaned and disinfected. Lambs are vaccinated against enterotoxaemia at weaning. The limiting factor to performance is usually the level of feed intake. The diet available for early weaned lambs should supply the essential nutrients in suitable proportions, but it must also ensure maximum voluntary intake.

With the restriction of milk intake, during the last two weeks of weaning, solid feed intake increases and there is only a slight reduction in growth. Good quality hay (alfalfa or other leguminous hay) and a concentrate mixture, containing 16 percent crude protein (as fed) with barley grain and soyabean meal as basic ingredients should be offered from two weeks of age. The same concentrate mixture should be offered after weaning. Hay should be offered in hayracks or hay bunks (100 g daily) and the concentrate mixture in pelleted form in self-feeders. Feed should always be available in the self-feeders.

Automatic waterers should be used but lambs should be trained to drink from this type of waterer, before weaning. Feeding and watering facilities should be inspected daily and cleaned. Sheltered areas and open yards should be regularly cleaned and lime spread over the floor.

Adequate nitrogen intake in relation to energy intake Is crucial on the optimum growth of lambs. It is therefore essential under intensive conditions of fattening where lambs are expected to reach marketable size quickly to feed lamb diets high in energy concentrates and a minimum amount of roughage to maintain the normal functioning of the digestive tract (8-10 percent of the total diet or 80-100 g daily). The protein concentrate of diets varies from 16 to 12 percent (as fed) according to the increasing liveweight-(from 15 to 40 kg). However, in order to avoid frequent changes of the diet which may affect intake, two levels are used, i.e. 16 percent until 90 days of age and 14 percent from 90 days until slaughter (35-40 kg liveweight). Protein content for male lambs above 40 kg liveweight is reduced to 12 percent. The requirements of female lambs are about 2 percentage units lower.

The higher the feed intake by lambs, the higher the rate of gain and the efficiency of feed conversion. Maximum

feed intake can be achieved with a balanced diet in terms of all nutrients (energy, protein, vitamins and trace elements) being present. Supplementation of the diets with a vitamin-trace-element mixture will improve performance considerably. Vitamin A (5 000 I.U./kg feed) is essential. The cost of supplementation is insignificant compared to the total cost of the ration. Because of the high level of phosphorus in grains and cakes, supplementation with limestone is also essential for a correct balance between calcium and phosphorus and protection against the incidence of urinary calculi.

Pelleting the concentrate mixtures (5 mm pellets) improves palatability, prevents the selection of feed ingredients and reduces wastage. The overall advantage of pelleting in the performance of lambs is about 7 percent and, if the cost of pelleting is lower than the achieved increase in performance, feeds should be pelleted. Otherwise grains should be offered coarsely ground or rolled together with oil cakes and the vitamin-mineral mixture.

Under intensive feeding and managerial practices sexes are separated after weaning. Female lambs are fed ad libitum with a concentrate mixture containing 16 percent crude protein until 2 months of age, changing to 14 percent thereafter until they reach 3 to 3 1/2 months of age. Should all female lambs be used as replacements or for selling as breeders, the lambs should be fed the amount of feed required to reach the desired weight at mating. If, for example, the liveweight at 3 to 3 1/2 months of age is 25 kg and the desired liveweight at mating is 40 kg at the age of 12 months, then the expected total gain of 15 kg liveweight should be obtained in 260 days or about 60 g daily. When the energy content of the available feeds is known, together with the daily allowance of energy for maintenance and growth, then the daily amount of feed can be calculated. The diet is then balanced for other nutrients.

Female lambs available for fattening and slaughter will continue on diets containing 14 percent crude protein and will be slaughtered at an earlier age than males of the same breed. If males, for example, are slaughtered at 35 to 40 kg liveweight, females should be slaughtered between 28-33 kg liveweight.

5.2 Slaughter weight

The yield of usable meat increases with increasing slaughter weight because of increasing dressing percentage and decreasing bone content. Many of the costs of handling and processing lamb carcasses are related to the carcass as a unit and thus the cost per unit meat increases for small carcasses. In the earlier stages of growth the effect of spreading the overhead costs of the breeding flock or the initial price of lambs lead to marked decreases in cost per kg of carcass and, in spite of the deterioration in feed conversion efficiency, costs per kg of carcass begin to rise when the lamb carcass weight exceeds 25 kg. However, carcass fat increases with increasing slaughter weight. This factor limits the extent to which carcass weights can be increased in order to increase the yield of usable meat. The choice of genotype is crucial because of the effect on fatness at a given carcass weight.

Hygienic rules for disease prevention, proper housing and feeding and watering facilities, described in other chapters, together with proper nutrition will result in high feed intake, increased efficiency of feed conversion and generally high efficiency of meat production.

5.3 Fattening of older lambs

When lambs on the range are late weaned or older lambs are imported and have to be transported in fattening operations certain measures should be taken to avoid losses and better adaptation in the feedlot. Such lambs undergo considerable stress in the move to the feedlot. They are gathered, sorted, often stand for a long time without feed and water before being loaded or unloaded, and move in strange surroundings.

Whenever facilities are available preconditioning before moving the lambs to the feedlot would be very helpful in reducing death loss and loss of weight. This would involve starting on feed, vaccination, and drenching. The lambs should be rested and fed two to three hours before loading. Transportation to the fattening operations should be done as rapidly as possible. Before their arrival all yards, sheds and facilities should be cleaned and disinfected. On arrival the lambs should be kept separately from other animals. They should be allowed to rest and should be offered water and hay of medium quality for two-three days.

After a rest lambs are sorted according to size, sick and weak lambs being isolated. All lambs are treated for internal and external parasites and vaccinated against entero-toxaemia. Highly stressed lambs should not be drenched or vaccinated. The starter ration should contain a high proportion of hay and the concentrate mixture a high proportion of fibrous materials (wheat bran, cottonseed hulls or peanut hulls). There is a gradual adaptation to the rations and quantities are gradually increased so that the full ration is introduced in two to three weeks. The concentrate mixture should also contain an antibiotic (25-35 mg of aureomycin per kg feed) which can be removed at the final stage of fattening.

The rations used for fattening can be classified in three categories, starter, intermediate and finishing. The starter contains higher levels of roughage, 14 percent crude protein and antibiotic at the rate of 40 mg/kg feed. The ration is hand-fed in order to control feed consumption and identify any sick animals or animals going off-feed. From the starter ration, which is fed for 1 week, the lambs are gradually changed to the intermediate ration containing a lesser proportion of roughage to the total ration, 13 percent crude protein and 30 mg of antibiotic per kilogramme of feed. The intermediate ration is hand-fed for one week. Trough space is about 25-30 cm for the starter and intermediate rations and total feed intake is about 1 kg daily. In one week lambs are gradually changed from the intermediate to the finishing ration, which contains even less roughage, with a protein content initially of 13 percent, declining to 12 percent when successful adjustment on the rations has been achieved. Finishing rations are self-fed. The finishing ration should contain about 10 percent roughage which is fed in a separate feeding trough, concentrates being self-fed. Chopped straw can be included in the concentrate mixture and self-fed.

Feeding and watering facilities and sheds should always be clean. Vaccination and parasite control programmes should be followed.

Urea can be used in the finishing rations to minimize production costs. The urea should be well mixed with the concentrate mixture. Urea utilization is improved with small supplements of alfalfa meal (5 percent). Heavy lambs must be finished more rapidly with a high concentrate ration, while lighter lambs can be fed rations containing more roughage. However, because forage is limited and costly, minimum roughage should be included in the rations. Cottonseed hulls, peanut hulls, wheat bran and chopped straw can be used in lamb rations to help prevent digestive disturbances.

Late weaned lambs taken off the range or imported should not exceed three months of age. Because there is an initial growth check of these lambs (transporation stress) full feed intake is delayed for three weeks and, when feed intake rises to promote high growth rates, feed conversion efficiency starts to decline. However, the prices of feeds and of lamb meat may be such that, despite the deterioration of the feed efficiency, fattening of older lambs will continue to be profitable.

An abundant supply of clean water is essential in intensive lamb fattening. Throughout the feeding period lambs that are able to drink frequently will consume more water, have less digestive disturbances, have a lower incidence of urinary calculi and will make better gains than lambs that are only offered water once or twice daily.

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