TECHNICAL BULLETIN NO. 2

TECHNOLOGY PACKAGE

FOR

MEAT RABBIT PRODUCTION

भाकृअनुप
ICAR

ICAR RESEARCH COMPLEX FOR GOA
(Indian Council of Agricultural Research)
ELA, OLD GOA - 403 402
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Newzealand White rabbit showing large litter size

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CONTENTS

I. Introduction

Per capita consumption of meat in India is only 14 g per day as against the actual requirement of 125 g. Non availability of quality meat and its exorbitant price have restricted meat consumption. Increasing the meat production through intensive rearing of various meat animals will help to meet the demand. Rabbit is one among them which can contribute substantially to enhance the meat production. Rabbit meat is tasty and contain 20 per cent protein. In tropical countries like Ghana and Egypt, back yard rearing of rabbit is popular, as it is a source of nutritious food for the family and additional income generating enterprise to the farmer.

Goa with its moderate climatic conditions along with plenty of natural forages and tree leaves, offers a favorable environment for rearing this species.

II. Advantages of rabbit rearing

1. Rabbit meat is nutritious and delicious like chicken meat.
2. It multiplies rapidly and grows faster. In a year, a doe can produce around 18 to 24 kits in three to four kindlings.
3. Feeding rabbit is simple and less expensive. Vegetable leaves, grain and kitchen waste would be sufficient for maintaining this animal.
4. Since it is a small animal, it can be slaughtered as and when meat is required for the family. There is no need to store the excess meat in the refrigerator. Hence, rabbit is also called 'Biological refrigerator'.
5. Initial capital investment required for a rabbitry is minimum. One can even start the rabbitry with borrowed animals and return the live animal within 6 to 9 months.
6. Rabbits are docile. Women and children can handle the animal and maintain the rabbitry. They do not make noise and cause disturbance to the neighbours.
7. The manure does not have offensive smell and it can be used for the kitchen garden.
8. The skin can be processed and used for making fancy goods like cap, peticoat, etc.
9. They produce offsprings regularly and throughout the year. Therefore, it provides regular income for the farmer through disposal of surplus stock.
10. According to the financial need of the farmer, animals can be sold in small numbers from time to time. It does not compel large scale disposal at a time.

III. Breeds of rabbit

There are more than fifty breeds of domestic rabbits. They can be broadly classified under two groups viz., 1) fur breeds and 2) meat breeds.

1. Fur breeds : They are grown for wool and as fancy animal. Angora, Flemish Giant, Argente and Havana are popular wool breeds. Among them, Angora is the most famous breed especially for its white and soft hair. It performs well under cold climate with temperature ranging from 10 to 15°C although it is not a good source of meat.

2. Meat breeds : They are raised for flesh and pelt production. Soviet Chinchilla (Fig. 1), Newzealand White, Grey Giant, White Giant and Carlifornian White (Fig. 2) are the meat breeds introduced in India. Soviet Chinchilla and Newzealand White multiply faster and can be reared in tropical climate. An adult Soviet Chinchilla weighs about 3.5 to 4.5 kg and Newzealand White weighs about 3 to 4 kg. Grey Giant weighs about 4 to 4.5 kg. Selection of breed depends upon the local climatic conditions and the purpose for which rabbit is reared. Meat breeds can be reared under the temperature ranging form 20°C to 30°C.

IV. Selection of breeding stock

1. Adult rabbit for breeding should be selected from a reputed rabbit breeder, maintaining a clean and hygienic rabbitry.

2. Selection of good animal as foundation stock is necessary. Healthy skin, erected ears and bright eyes are the symptoms of good rabbit. Overgrown nails, unhealthy skin, defective walk and dirty paws are indicative of sick rabbits. After considering the physical appearance, selection can be made based on genetic make up for economic traits such as faster growth rate, early maturity, better feed efficiency and litter size. These can be identified from the production records of rabbitry.

3. After purchasing the breeding stock, keep the animal under observation for about two weeks to identify the presence of contagious disease, if any.

V. Housing

Housing arrangement depends upon the type of rearing adopted. Rabbit rearing can be classified into two systems.

1. Backyard rabbit farming.
2. Intensive rabbit production or commercial rabbit rearing.

1. Backyard rabbit farming

The animals can be reared on floor. An open area can be covered with 90 cm high wall and over that, wire mesh can be fixed to about 120 cm height. The ceiling can be made of asbestos sheet with bamboo and coconut leaves. Cement concrete flooring should be provided for easy cleaning and disinfection. Under this system, about 20 to 30 animals can be reared and the space requirement will be about one m^2 for six rabbits. Proper record keeping and controlled breeding will not be possible in this system.

Alternatively, 'Hutches' can also be used for backyard rearing. Hutches of 90 cm width, 75 cm depth and 60 cm height are required for an adult rabbit. This can be made with split bamboo or wooden reapers and wire mesh. The hutches should be arranged in a row on both sides of the shed leaving a walking space of one metre. The bottom of the hutch should be 90 cm above the ground level. A thatched shed of 5 m x 3 m can accommodate 10 adult rabbits.

2. Commercial rabbitry

Commercial rabbitry should be well designed to provide the following facilities:

1. It should have enough space for the animals and for workers to clean and feed.
2. The rabbitry should maintain an optimum temperature (20°C - 30° C) and humidity (70 to 80%) so that the animals are comfortable.
3. Cages should be arranged and equipped properly to minimize the loss of feed and fodder.
4. The rabbitry should have proper enclosures to prevent the animals from escaping and to protect them from natural enemies such as dogs and wild animals.
5. It should be constructed with sturdy materials which will minimise the maintenance expenditure.
6. Housing arrangement should facilitate easy cleaning and feeding operations which will minimise the labour requirement.
7. It should have proper ventilation and drainage to keep the rabbitry hygienic and disease free.

Although there are specific designs for rabbitry, these can be suitably modified as per the requirements of the local climatic conditions to provide a convenient shelter for the animal.

a) Selection of site

In tropical climate, protection against the sun and rain is more important. The temperature of the rabbitry should be between 15 to 30°C for optimum production. Higher temperature affects reproduction. Under better care and management, they will perform well even in temperature of 30°C. Proper ventilation is necessary to clear the stale air in the shed and to reduce the temperature inside the rabbitry. The shed has to be located under tree shade. False ceiling should be provided when asbestos is used. In tropical region, ideal roof for rabbitry can be made with coconut leaves and wooden rafters. This will be cheaper and keep the temperature inside the house lower than the atmospheric temperature. In high rainfall areas, the shed has to be constructed in an elevated place to avoid water stagnation during the monsoon. The humidity of the shed should be between 70 to 80 per cent.

b) Cage for rabbit

In commercial rabbitry, cages can be made of sturdy materials like iron angles and welded mesh. The size of the cage depends upon the stage of the animal. An adult rabbit requires a floor space of $0.3m^2$. A cage size of 45 cm x 60 cm x 45 cm will be required for an animal.

Kindling cage : For a doe, the floor requirement is more. A cage size of 90 cm x 60 cm x 45 cm is necessary. A kindling box of 45 cm x 30 cm x 15 cm (Fig. 3) is also to be kept inside this cage at the time of kindling. The floor of the cage should be made of 6 x 6 mm welded mesh and the sides with 12 x 12 mm mesh to avoid the escape of young one and to protect them against rats and other predators.

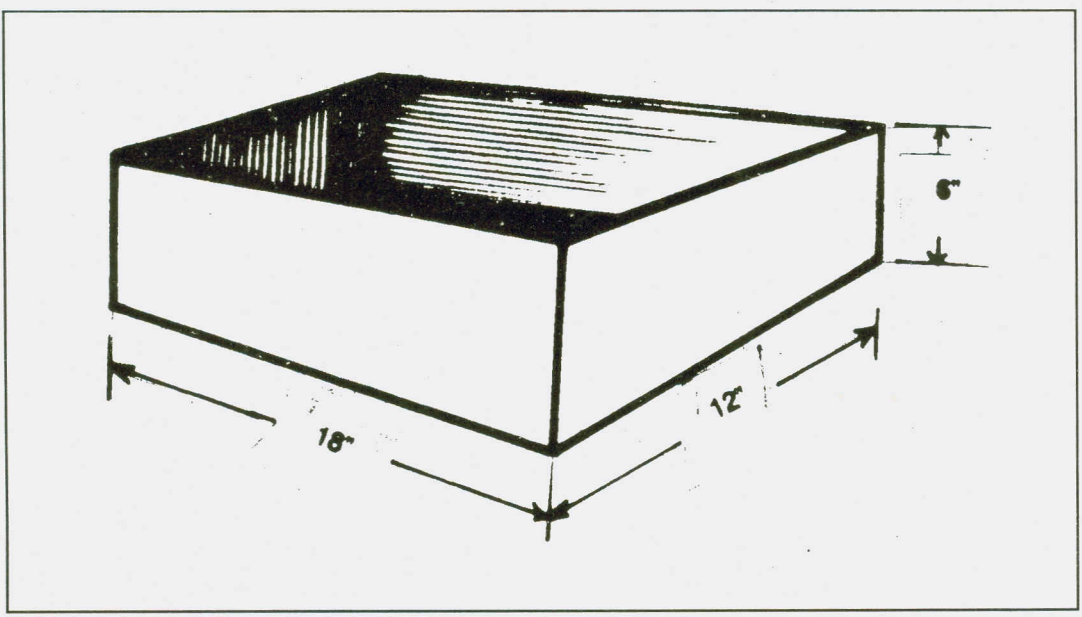

Fig. 3. Kindling box

Cage for buck : The floor space requirement for a buck is about 0.36m^2. A circular cage will be ideal for mating. The feeders and waterers should be well placed so that they are not disturbed during mating.

Arrangement of doors : Doors can be fixed to the cage with a hinge or similar ring. Sliding doors can also be fixed. But this is advisible only in places where the other arrangements are inconvenient. The door should be preferably on the top side of the cage. It can also be provided on the sides. However, side doors may open accidentally and the escape of animal from the cage is possible at times. Further, side doors when open, may hinder easy movement of workers.

Cages can be fabricated with wooden reapers of 24 x 18 cm size and welded mesh (16 G) of 6 x 6 mm at the bottom and 18 x 12 mm at the sides. Iron angles may be used in place of wooden reapers which will be more durable. Split bamboo can also be used for making pens.

Arrangement of cages : Rabbit cages should be kept 30 cm away from the wall of the rabbit house. The cages can be arranged in single tier called the "flat deck system" or in two tiers like the Californian cages or in three tiers. Most preferable arrangement among them will be the single tier or flat deck system. The cages can be arranged in rows on both sides leaving a walking space of one metre in between. This helps to feed and water the animals on both the sides at a time and reduce the labour. Two tier and three tier cages can be used in areas where the space availability for the rabbitry is limited.

c) Construction of floor

The floor of the rabbitry should be made of cement concrete to facilitate easy cleaning and washing. Although mud floor will be advantageous for absorption of urine and cleaning of dung, it will not be possible to disinfect the floor properly. The cemented floor should be smooth and slopy, to facilitate easy drainage of water at the time of cleaning.

d) Roof

Thatched house with coconut leaves and rafters will be cheaper and will provide the right atmosphere for the animal. However, in high rainfall areas this may not be suitable. A permanant structure with RCC roofing or tiles with false ceiling can be erected. All the sides of the rabbit house are to be covered with wire mesh fencing leaving only an entrance to protect the animal against stray dogs and other wild animals. The sides may also be covered with bamboo pole or wooden reapers. However, this arrangement should provide cross ventilation inside the house.

VI. Reproduction and breeding

Ability of the animal to reproduce is an important factor in livestock rearing. This is particularly true in rabbits because, commercial rabbit rearing depends upon faster multiplication and rapid growth rate. Hence, it is worthwhile for a rabbit farmer to know about the various aspects of reproduction and breeding in rabbits.

Rabbits attain maturity at three months of age. However, successful mating and delivery takes place in five to six months old ones in local rabbits and seven to eight months in exotic rabbits. Body weight of the animal rather than age is the criteria for breeding. The female should weigh at least 2.5 to 3 kg at the time of mating. The doe has to be taken to the cage of the buck for mating. If the buck is taken to the doe, the male will be less active and in some occassions, the female may attack the buck. After successful mating, the male will fall on its back or on the side with a cry. Mating should be done preferably in the morning hours. It is also practicable to leave the female with the buck for a day or two.

The gestation period ranges from 30 to 34 days. Local rabbits will deliver in about 30 days. Exotic animals will take 31 to 34 days for kindling. During the last week of pregnancy, mammary glands develop prominently. From the 29th day, the doe starts plucking her own hair to make a soft lining for the nest. At this stage, a nest box is to be kept inside the cage (Fig. 4). Making a fur-lined bed is an indication of good mothering ability of the doe. An adult doe may give birth to four to eleven young ones. The litter size depends upon the breed and condition of the doe. Each kit will weigh around 40 to 70 g. Birth weight of the young one depends upon the litter size, breed and condition of the doe.

Immediately after kindling, the doe eats the placenta. During this period, it will consume more water and feed. The doe may eat the young one if enough water is not provided (cannibalism). Proper care and management is necessary at the time of kindling to avoid cannibalism. The doe in which this practice is observed consecutively for two to three kindlings, should be culled.

Milk secretion in the doe starts on the 29th day of gestation and increases upto third week after kindling. In some animals, particularly in the exotic meat rabbits, there may be lack of milk secretion after kindling. Under such condition, foster mother feeding can be followed. Animals delivered at the same time, may allow the young one to feed milk provided the placenta of the foster mother is rubbed over the young ones. Artificial feeding of cow's milk with the help of cotton swab may also be tried to save the young one. Milk secretion of doe depends upon the nutritional status of the animal. Pregnant animals which receive a good diet containing the required amount of protein, energy, vitamins and minerals, will have normal growth and development of udder and milk secretion.

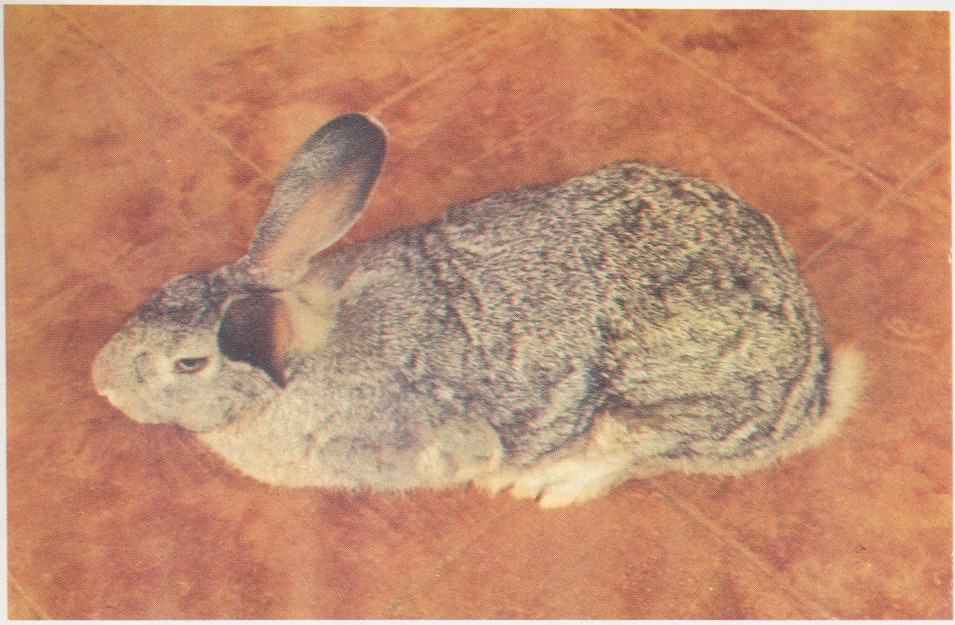

Fig. 1. Soviet Chinchilla - an exotic meat type rabbit

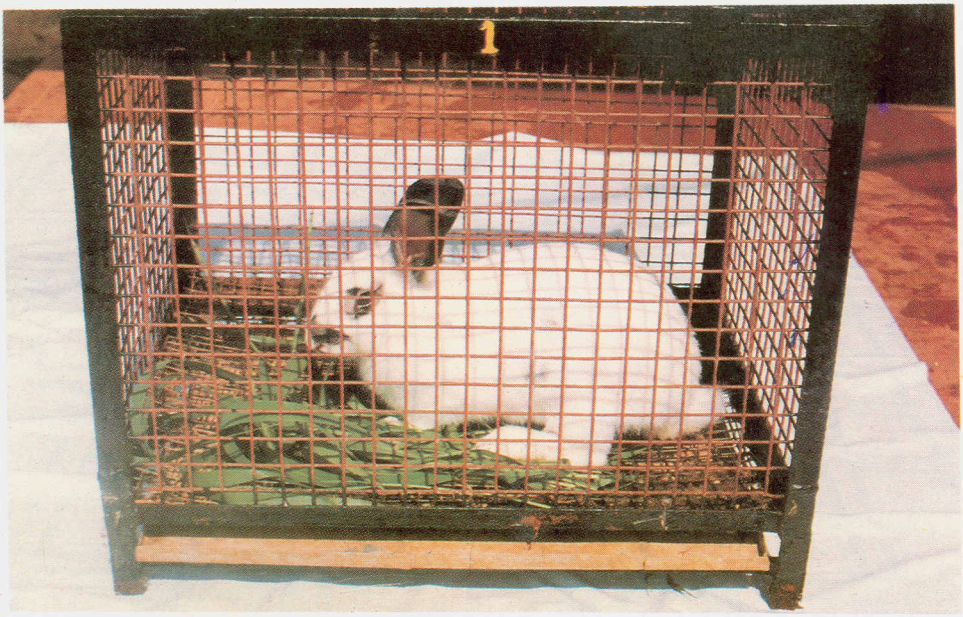

Fig. 2. Californian White rabbit in a cage

In exotic rabbits maintained under tropical climatic conditions (with temperature above 30°C), there will be lack of milk secretion. Higher environmental temperature affects the secretion of posterior pituitary hormones and inhibits lactation. Local rabbits and cross breeds can withstand the climatic stress and produce enough milk and therefore, under higher environmental temperature also, they can rear the young ones successfully. At the peak of lactation, the doe gives about 150 to 250 g of milk every day. Unlike cow's milk, rabbit milk is rich in fat and protein. The doe suckles the young ones only once a day usually in the morning hours. Since there are only six teats, the chances of a newborn rabbit getting the milk is limited when the litter size is more than six. This is one of the reasons for higher mortality in young rabbits. Milk secretion of the doe gradually reduces from fourth week of kindling and stops at eighth week. If the young ones do not suckle a particular teat, milk secretion will stop from that teat.

Since eyelids of the kit are closed at the time of birth, they will remain inside the nest box. On 14th day when the eyelids are opened, they start moving outside the box. At this stage proper care should be taken in arranging the feeders and waterers, to avoid mortality. A wide and shallow aluminium plate can be used for keeping water. Crushed wheat can be kept in shallow bowls for the kits. From third week onwards, the kits will start nibbling green grass. After 42 days, the doe can be separated and shifted to a new cage. The kits are to be reared in the same cage.

The doe can be rebred even 24 hours after kindling. During this period, it will be highly fertile. However, it is not advisable to rebreed the animal within 60 days after kindling. In a year, three to four kindling will be ideal to maintain the health of the animal.

VII. Feeding and nutrition

Among the various livestock species, rabbit is the smallest animal which can use roughage and convert it into good quality protein for human consumption. It is an efficient converter of food energy into edible meat. For successful rabbit farming, it is essential for a breeder to know some of the basic principles of feeding. Even a good rabbit will exhibit poor production performance if proper feed is not given. A poor rabbit can also exhibit greater production under good nutritional management. Further, in any livestock enterprise, feeding claims 70 per cent of the total maintenance expenditure. Therefore, a basic knowledge of the digestive physiology of rabbit and its nutrient requirement is essential to formulate balanced diet.

Rabbits have two pairs of incisors, one pair on the upper jaw and one pair of incisors on the lower jaw. These are called cutting teeth. In addition to this, there are molars and premolars which are called grinding teeth. The food reaches the stomach and stays there for about four hours. Partly digested food moves to the small intestine, where simple carbohydrates and protein are further digested and absorbed. Remaining food materials, which mainly consist of structural carbohydrate (crude fibre), reach the caecum and stay there for about six hours. During this period, the food is subjected to microbial action and fermentation.

Volatile fatty acids such as acetic, propionic and butyric acids are produced due to bacterial action and absorbed through the wall of the caecum into blood. These volatile acids provide energy for the animal. In addition, bacterial population available in the caecum increases utilizing the food energy and protein. These organisms are utilized partly by the rabbit as a source of essential amino acids and vitamins. The undigested food leaves the caecum as a semisolid mass and passes out as soft faeces, which is again eaten by the animal. This practice is termed coprophagy. Generally, the coprophagy activity can be observed during night time. This habbit develops when the kits are three or four weeks old. Undigested food passes out as hard pellet. Details of the digestive system of rabbit is illustrated in figure 6.

a) Nutrients in the feed

To formulate an ideal feeding practice, one should know the nutritive value of various feed ingredients. A wide range of feeding stuff are available in the local market for rabbit feeding. Green forages, vegetable leaves, kitchen wastes, cereal grains, straw and by products such as brewery waste, can also be fed to rabbits.

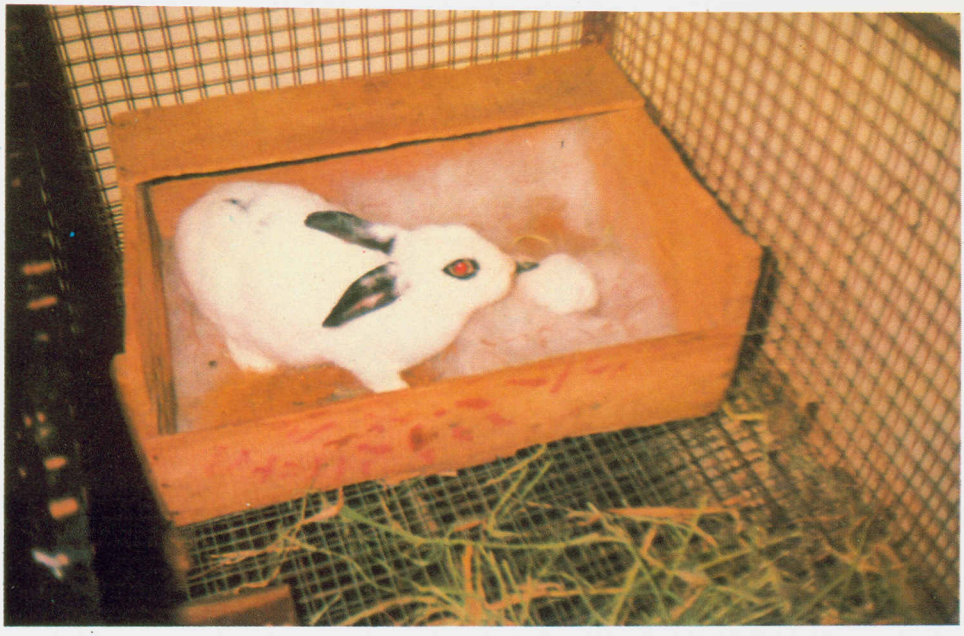

Fig. 4. Nest box with doe, kid and fur inside a cage

Fig. 5. Pelleting machine for preparation of small feed pellets

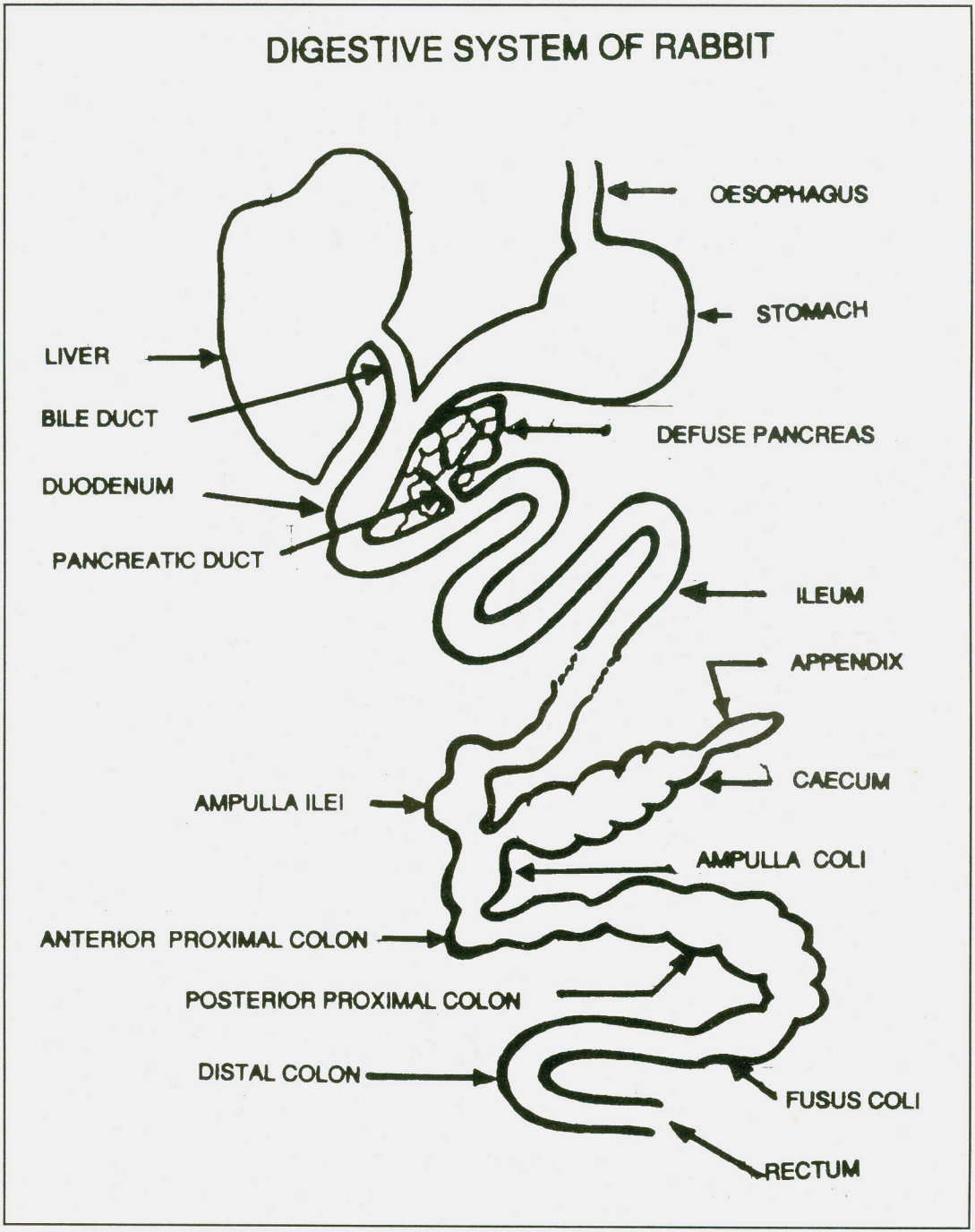

Fig. 6. Digestive system of rabbit

The nutrients present in these feeds can be classified into five proximate principles viz, crude fibre, crude protein, fat, vitamins and minerals.

Crude fibre : Roughages such as grass and straw contain a poorly digestible fraction of the plant material called crude fibre. It includes cellulose, hemicellulose and lignin which are present in the cell wall. Cellulose and hemicellulose are digested by microbial fermentation and lignin mostly remains undigested. Although crude fibre is poorly digested, it plays an important role in rabbit feeding. It helps in the proper movement of digested materials in the intestine. It is also a source of volatile fatty acids. Certain amount of crude fibre is necessary for the formation of hard faeces. A ration for adult rabbit should contain 12 to 14 per cent crude fibre. Young and growing rabbits should be provided 8 to 9 per cent crude fibre in the diet.

Crude protein : It is essential for growth and development of muscles and various organs in young rabbit. In adult animal, protein is essential for the development of udder and milk secretion. Oil cakes, green fodders and fishmeal are the important source of protein, althrough protein available in these sources are not of the same quality.

Protein quality depends upon the available essential amino acids in the feed. Good quality protein should provide all the essential amino acids in required quantity for the animal. Lysine, methionine, cystiene and arginine are the essential amino acids required for the rabbit. Protein from soyabean cake, fishmeal and lucerne are easily digested and absorbed. Groundnut cake, maize, etc., are the next choice for protein. The requirements of essential amine acids for growing rabbits are detailed in table 1.

Table 1 : Requirement of essential amino acids for growing rabbits (g/kg feed)

Arginine	6.0	Lysine	9.0
Glycine	5.0	Methionine/Cystinc	5.5
Histidine	2.8	Phenylalanine	10.6
Isoleucine	5.6	Tryptophan	1.7
Leucine	10.4	Valine	7.1

Energy : For maintenance of body health and production, sufficient energy is very much essential. The energy present in the feeding stuff is expressed as gross energy. All the energy present in the feed is not utilized by the annimal. Only a portion of it is digested and absorbed by the rabbit and that is known as digestible energy. Each feed ingredient has certain amount of digestible energy (DE). Cereal grains such as maize, sorghum, wheat etc., are good sources of DE. By - products such as molasses and rice bran are other sources. An adult rabbit weighing 2.5kg requires 290 K cal of D.E/day. A pregnant rabbit needs twice the normal requirement during the last 10 days of pregnancy. During lactation, the doe requires maximum energy which is about three to four times that of the maintenance requirement (800 K cal/day). Rabbit gives about 150 to 200 g of milk/day. One kg of rabbit milk contains 1,400 K cal of energy. Hence, to maintain the milk production in a lactating doe, sufficient amount of energy rich feed (about 400 g/day) should be provided. Young rabbits grow much faster between three to ten weeks of age. During this period, they should be provided more energy rich feed. Growing rabbit with a daily body weight gain of 20 g will require 350 K cal of D.E. every day. Vegetable oil can also be incorporated in the feed at one or two per cent level as a source of energy and fat.

Vitamins : These are essential nutrients required in small quantities for the maintenance of health and body functions.

1) **Vitamin A :** Vitamin A is present in plants as carotene. It is required for regulating the reproductive cycle in adult doe and to avoid premature birth. Young rabbit requires 28 iu Vitamin A/kg body weight. Adult rabbit requires 58 iu of Vitamin A/kg body weight every day for body maintenance. Blindness, sore eye, ataxia and skin lesions are other symptoms of Vitamin A deficiency. In case of severe deficiency, Vitamin A therapy is necessary. About 600 iu/kg body weight is to be administered every day for about three to five days. Fish meal, carrot and green leaves are good sources of vitamin A.

2) **Vitamin B complex :** All the B complex vitamins are synthesised by the bacteria present in the caecum of rabbit. However, Vitamin B_6, and B_{12} are not produced in required quantity. These two vitamins are required for the formation of blood cells and enzyme activity. Fresh green vegetable leaves are good sources of B Vitamin. Tablets of yeast and vitamin feed supplements can also be added to the feed and water.

3) **Vitamin C :** There is no specific requirement for this vitamin. The conventional feed materials which are provided for the rabbit will supply required amount of this vitamin.

4) Vitamin D : Deficiency of this vitamin causes Rickets. Providing good sunlight and a balanced feed containing calcium and phosphorus will help the normal growth and development of bones. In tropical climatic conditions, deficiency of this vitamin does not occur usually.

5) Vitamin E and K : These two vitamins are required for reproduction and health. Green forages will provide the required amount of these vitamins.

Minerals : Calcium and phosphorus are the two major minerals required for the development of bones and other body functions like milk secretion. An adult doe requires 1.1 g of calcium and 0.8 g of phosphorous every day. The two minerals should be available in the diet at 2:1 or 1:1 ratio for proper utilisation.

Other minerals such as zinc, copper, cobalt and iron are also required for the maintenance of various body functions. The nutritive values of feeds and forages are presented in table 2.

Table 2 : Chemical composition and nutritive value of feeds/forages

	C.P.	C.F.	E.E.	T.N.	NFE	TDN	DE
Maize	11.1	1.9	4.4	1.9	80.7	94.3	3.5
Wheat	10.4	2.0	2.6	2.4	82.6	92.3	4.1
Sorghum	15.2	2.6	2.5	2.8	79.5	85.7	3.8
Ragi	10.3	3.7	1.2	3.9	81.0	-	-
Groundnut cake	47.0	6.1	6.6	7.5	33.1	46.4	3.5
Cotton seed cake	27.5	18.4	9.4	6.4	38.4	19.4	3.5
Soyabean cake	40.9	6.1	14.4	7.3	31.3	-	-
Sesame cake	34.6	6.7	7.8	13.2	37.7	-	- -
Coconut oil cake	23.4	12.9	13.0	8.4	42.3	21.1	4.0
Horse gram	24.0	5.7	1.0	5.5	63.3	-	-
Bengal gram	20.0	9.8	4.1	3.5	62.6	13.5	3.8
NB - 21 grass	10.2	30.5	2.1	16.2	41.0		
Lucerne	20.2	30.1	2.3	10.7	36.6	13.5	2.6
Subabul	16.7	12.6	7.1	12.5	51.1	-	- -
Cabbage leaves	18.2	8.4	2.8	15.0	55.6	11.7	2.19

C.P - Crude protein
C.F - Crude fibre
E.E - Ether extract
TN - Total nutrients
NFE - Nitrogen free extract
TDN - Total digestible nutrients
DE - Digessible energy

b) Nutrient requirements

For body maintenance : An adult rabbit weighing 2.5 to 3 kg requires 120 g of feed (dry matter) every day. About 60 g of concentrate and 300 g of green grass will provide all the nutrients required. About 280 K cal of DE, 14 to 16 g of crude protein and 12 to 14 g crude fibre are the minimum levels of nutrients required for maintenance.

For pregnant doe : In pregnant doe, nearly 80 per cent of the mammary gland development and foetal growth takes place during the last 10 days of pregnancy. During this period, the nutrient requirement of the doe will be nearly twice that of maintenance. A diet with 2,800 K cal energy and 18 per cent crude protein should be provided ad libitum. The nutrient requirement for fattening and breeding rabbit is given in table 3.

Table 3 : Nutrient requirement of rabbit (weight/kg feed)

	Fattening	Breeding
Digestible engery (K cal)	2900	2600
TDN (g)	650	600
Crude protein (%)	16-18	15-17
Ether extract (%)	3-5	2-4
Crude fibre (%)	9-12	10-14
Minerals :		
Calcium (%)	1.0	1.0
Phosphorus (%)	0.5	0.5
Magnesium (mg)	300	300
Copper (mg)	20	10
Iron (mg)	100	50
Zinc (mg)	50	50
Vitamins :		
Vitamin A (iu)	8000	8000
Vitamin D (iu)	1000	800
Vitamin E (mg)	40	40

For lactating doe : Milk secretion starts on 29th day of pregnancy. It increases upto third week and declines there after. During lactation, the doe requires three times more energy than the maintenance level. A diet with 18 per cent crude protein and 2,800 K cal energy should be given for maintaining the milk production.

c) Feeding methods

Depending upon the availability of feed stuff and according to the convenience of farmer, feeding system can be formulated. Forage and concentrate can be given separately or in the form of compounded feed. The feed can be prepared in the form of mash or as pellet. Rabbits prefer pellet feed. This will help to avoid wastage. Certain by products, minerals and vitamins, which will be otherwise rejected by the animal, can be incorporated into the pellets. A low cost small animal feed pelleting machine with a capacity to produce 70 kg pellets per hour, can be used (Fig. 5). Rabbits have a tendency of biting wood and hard materials. Providing a pellet feed gives good exercise for their teeth and prevents over growth of teeth. Animals with over grown teeth will not consume feed properly. Handling, measuring and feeding will be easy with pelleted feed. Wastage during handling can be minimised. Diseases such as pneumonia which occur due to inhalation of dusty feed, can be avoided. However, concentrate feed prepared in the form of mash will be cheaper. The feed should be moistened with water just before feeding to avoid dustiness.

Fresh green leaves of subabul, erythrina, lucerne, tender grass and vegetable leaves are liked by the rabbit. During rainy season, the leaves are to be dried for about six hours before feeding to avoid digestive disorders.

Feeders : Aluminium or galvanized iron feeders can be used as container for rabbit feed.

d) Computation of ration

The daily feed requirement for a rabbit consists green fodder and concentrate feed.

Green fodder : An adult rabbit will consume about 350 g of green forage per day. Leaves of vegetables, subabul, *Erythrina indica*, *Sesbania grandiflora*, etc., can be given. Young animals will start nibbling green grass from third week of age. Bunnies of one to three months age should be provided 50 to 200 g of green forage/day.

Concentrate feed : Young and lactating rabbits require a concentrate feed containing 18 per cent crude protein and 2,800 K cal DE/kg of feed. For other animals, a

concentrate feed with 15 per cent protein and 2,100 K cal energy/kg feed is to be formulated. The feed formulae given at table 4 can be adopted for lactating young animals.

Table 4. Feed formulae for lactating young rabbit.

Ingredient	Per cent part in concentrate		
	I	II	III
Jowar	-	-	25
Maize	30	30	-
Wheat	-	20	10
Groundnut cake	30	15	-
Cocount oil cake	-	10	-
Wheat bran	18	-	18
Rice bran	-	18	-
Ragi	20	-	15
Fish meal	-	5	-
Mineral mixture	2	2	2
Soyabean cake	-	-	30
Total	100	100	100

The feed should be given at the rate of 60 g/adult rabbit/day or 30 to 40 g/young animal /day. Feed formulae for adult maintenance are given in table 5.

Table 5. Feed formulae for adult rabbit maintenance.

Ingredient	Per cent part in concentrate		
	I	II	III
Maize	25	30	25
Jowar	25	10	-
Ragi	-	20	-
Wheat	10	-	20
Groundnut cake	20	-	25
Soyabean cake	-	20	-
Wheat bran	18	18	28
Mineral mixture/vitamin supplement	2	2	2
Total	100	100	100

VIII. Management

As in any other enterprise, effective management is necessary for successful rabbit farming. Selection of the right type of breeding stock, identification of animals and maintaining breeding, feeding and production records of the rabbitry will help farmer to identify the defective steps in management.

a) Selection

Select the animal from a well recognized rabbitry. Breeding records of individual animal can be checked through litter size at weaning, feed efficiency and growth rate. Litter weight at three weeks indicates the milk production capacity of the doe. Average litter size should be six to eight. The buck should be heavier and aged. Number of successful mating should be verified from the hutch card (Buck register).

b) Identification mark

To maintain breeding and production records of individual rabbits, identification mark is necessary. This can be done by tattooing, ear tagging or by applying rings. Tattoing should be done at the age of three to four months. With the help of tattoing forceps, puncture the ear and apply the tattoing ink by rubbing well on the punctured area. This will form a permanent mark of identification. The marking is done on the right ear for male and left ear for female rabbit.

Eartags made of aluminium strips can also be fixed on the tip of the ear for identification. Serial number, month and year of birth of the animal can be printed in these tags, e.g. 587/103 indicates the month of May, 1987 and serial number 103. This will help to identify the age of the animal without referring to the records.

Rings can also be fixed on the hind leg just above the hock joint. This has to be done when the animal is about six to nine weeks old. The rings will bear the serial number and it will not be a disturbance for the movement of the animal. The rings can be removed only at the time of destruction of the animal.

c) Handling of rabbits : Make yourself familiar with the animal before handling them. Do not lift the rabbit by holding its ears. Catch the animal with a firm grip on the loose skin just above the shoulders and lift it. Support the weight of the animal with the other hand, by holding its back. Young rabbits should be lifted by holding the loins (Fig. 7).

d) Identification of sex : Adult male rabbit can be easily identified by seeing the pair of testicles. In young rabbits, identification of sex is difficult. The following procedure can be adopted to find out the sex of young rabbits (below 6 months):

Fig. 7. Right way of handling rabbit

Hold the rabbit with its back on your left arm. Press the genital organ with the thumb and index fingers of the right arm. In male, a small projection will be noticed, where as in female a long slit can be observed (Fig. 8).

e) Record keeping : Maintenance of breeding, feeding and production records is very essential to monitor the profit and loss in commercial rabbitry. It also helps in selection and improvement of breeding stock.

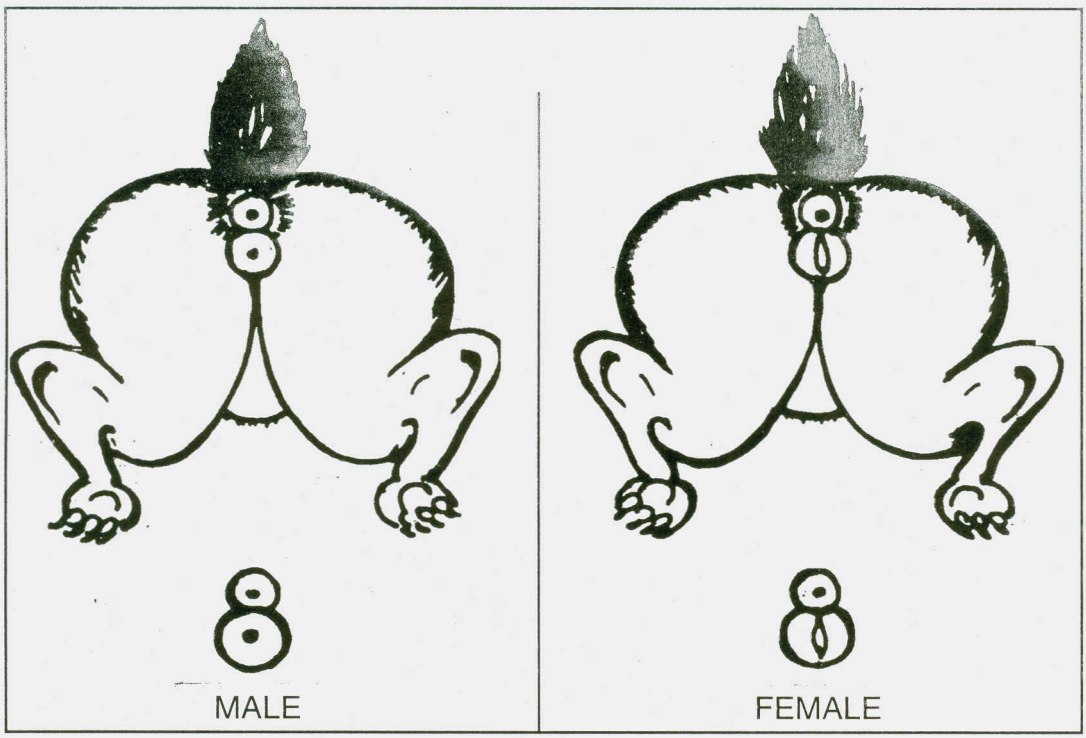

Fig. 8. Sex idensification in rabbits

IX. Diseases of rabbits

The following diseases are commonly noticed in the rabbitry under the tropical climatic conditions.

1. Coccidiosis : Affected animal will sit on its back and appear dull. Symptoms of diarrhoea and spongy feeling of the abdomen can be observed. Soiled fur on the hind leg and around the anus can also be noticed.

It is caused by the intestinal Coccidia (*Eimeria sp*). Moist and dirty cage floor, unclean water, sudden change of diet and humid atmosphere will influence coccidiosis. Cages should be cleaned with 5 per cent caustic soda solution, washed with water once in a fortnight and disinfected with Savlon solution. Feeders and waterers are to be cleaned every day. Affected animals are to be given bifuran in drinking water. Sulpha quinoxiline can be added in feed @ 200g/ton.

2. Pneumonia : Sneezing, discharge from the nostrils, dull looking, dirty paws on the front legs and loss of apetite are the common symptoms of pneumonia. It is caused by bacterial infection. Inclement weather and poor ventilation are the predisposing factors for the disease. Penicillin 4,00,000 i.u and Streptomycin 0.5 g as intramuscular injection once in 3 days for four times, will be helpful to save the animal.

3. Ear mite : This causes scabs on the ear. Affected ear is completely filled with scabs which disturbs the balaning power of the animal. In severe cases, the animal develops wry neck, a condition in which the neck is turned to one side. Such animals cannot take feed and drink water properly. The ear crusts are to be removed with cotton swab and ascabial lotion has to be applied, once in two days. Three to four applications will cure the disease.

4. Sore hock : It is caused by wiremesh, cage floor and nails on the sides of cages. The wound is infected due to unclean floor. Cleaning and application of antiseptic ointment will heal the wound. In severe cases, destruction of the animal is advised.

5. Conjunctivitis : Inflammation of the eyelid and water discharge may be noticed. Bacterial infection on the eye, pricking of straw or other roughage on the eye, dust and smoke may cause inflammation of the eye lid. Cleaning the eye with wet cotton swab and applying antibiotic eye ointment for four to six days will cure the eye.

6. Wry neck : The head will be twisted to one side. There will be loss of equilibrium and the animal will not be able to walk properly. Ear mites which causes canker, sometime affect the inner ear and causes this condition. The animal should be treated in the early stage for ear canker. Once the wry neck condition is developed, it cannot be cured.

7. Pasteurellosis : Loss of body weight, discharge from the nostrils and eyes, dirty paws in the front leg and a dull appearance are the common symptoms. The disease is caused by the bacterium *Pasteurella multocida*. Affected animal should be separated from healthy one. In the early stage, intra muscular injection of 0.5 g Streptomycin and 4,00,000 i.u. of Penicillin on alternate days for four days, will cure the disease. In advanced stages, the affected animal is to be destroyed and disposed hygienically to avoid further infection in the herd.

X. Processing

In addition to meat, rabbits also provide valuable fur which can be used for making fancy bags, caps, etc. The quality of the fur depends upon selection of the prime skin and proper processing. Processed skin with hair is called pelt. Good quality pelt can be obtained when the animals are slaughtered above six months of age. Rabbits maintained under good nutrition will provide ideal skin. Certain husbandry practices such as tattoing and dying will reduce the value of skin. Fighting among the rabbits sometimes causes injury and scar on the skin. Certain rabbits will be chewing the fur when kept isolated and this affects the quality of the fur. Improper flaying and cutting will spoil the fur. Therefore, it is necessary to know some of the basic principles of processing rabbit skin.

a) Slaughtering of rabbit

A blow with a hard wooden stick in between the two ears or behind them, will be sufficient to kill the animal. The other method is to hold the two hind legs of the rabbit with the left hand and to hold the head of the animal with the right hand. The head should be turned upwards so that it is at right angle to the body. Then the body should be straightened with force. Due to this sudden jerk the animal will die.

The two hind limbs of the animals are tied over a bar and the body is hung upside down. Circular incision is made around the hook in both the limbs, followed by a longitudinal cut from the anus to the hook. The tail has to be cut with the help of scissors. Strip the skin from upside down. When it reaches the neck, make a circular incision around the head and also around the knee joints of the front leg. The entire skin can be striped off like a shirt. As soon as it is removed, the inner surface of the skin has to be treated with common salt and stretched well over an iron rod bent in the shape of an inverted 'V' (Fig. 9)

Dry the skin under shade for three to four days to remove the moisture completely. The dried skin can be stored until processing.

b) Pelt production : Cut the skin in the mid line and spread on a smooth surface with the flesh portion on the upper side. Scrape the excess flesh and fat with a blunt knife. Prepare the following solution.

(a) Dissolve 115 g of sodium carbonate in 2 litres of water.

(b) Dissolve 450 g ammonium aluminium sulphate or potassium aluminium sulphate in 4 litres of water.

(c) Add slowly solution (a) to (b) and stir vigorously.

Stretch the skin on a flat surface and apply a thick coat of this solution over the skin. It should be allowed to work for 24 hours and then removed. The same application is to be repeated twice. The last application should be left on the skin for a least 3 to 4 days. The skin is to be washed with borax solution. Treated skin is to be stretched and dried. The dried skin is to be softened by working on the smooth edge of a table or around a wooden pole.

Olive oil or glycerine should be applied on their skin portion of the pelts. The pelt can be used for making fancy goods.

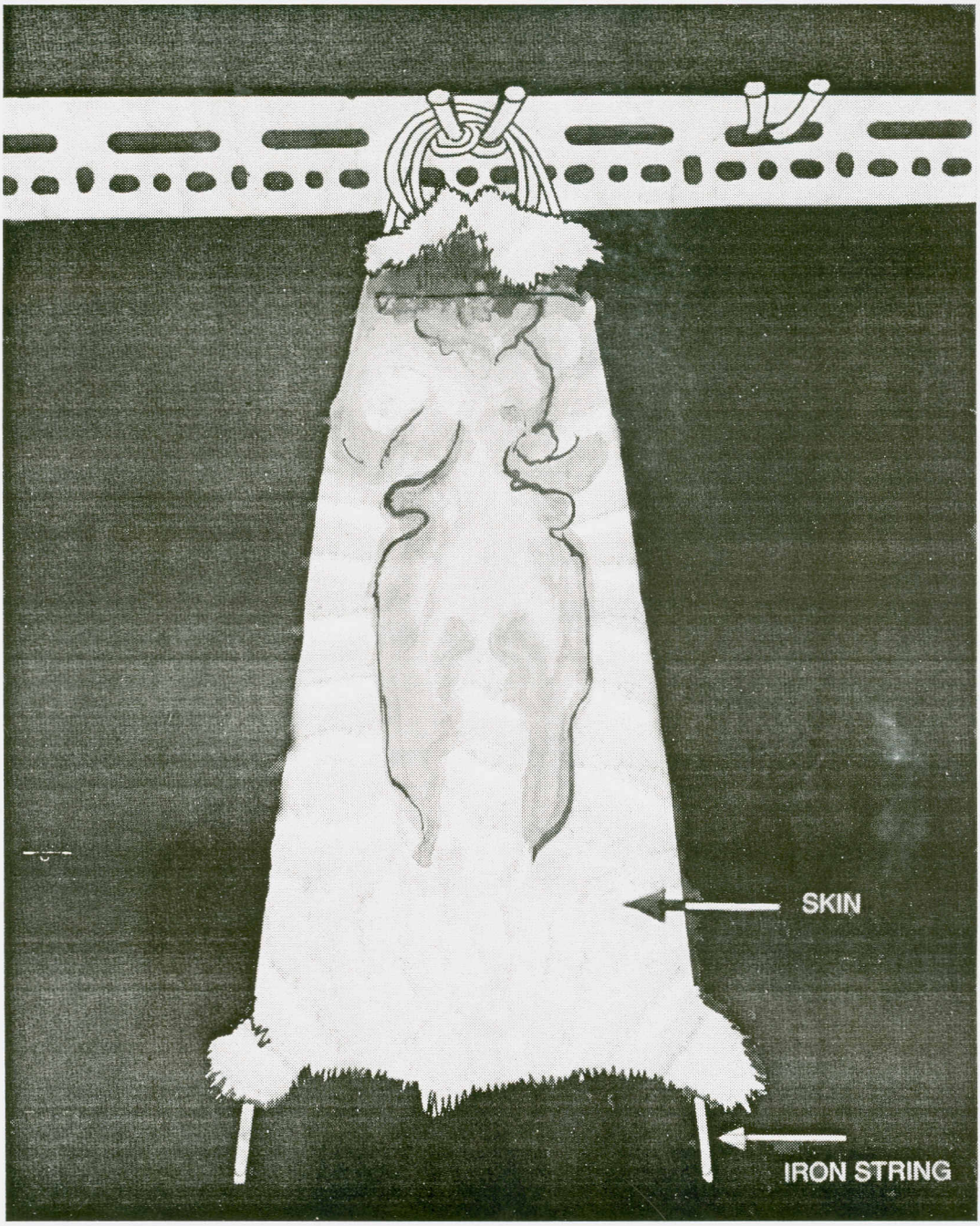

Fig. 9. Pelt strectcher for drying rabbit skin

XI. Economics of rabbit production (for 100 rabbits)

(In Rupees)

1)	**Capital investment**		
a)	Housing		
	i) Housing for breeding stock 12 x 6 m @ Rs. 800/m^2		57,600
	ii) Kindling does and young ones 20 x 8 m @ Rs. 800/m^2		1,28,000
b)	Cages		
	i) For 4 adult rabbits one cage of 2.4 x 0.45 m		12,500
	ii) For does and kits 130 cages of size 0.1 x 0.6 x 0.6 m @ Rs. 400/cage		52,000
c)	Breeding Stock 100 rabbits @ Rs. 120/rabbit		12,000
		Total (Rs.)	2,62,100
2)	**Working capital**		
a)	Feeding cost for adult rabbits (for one year)		
	i) Concentrate 22kg/rabbit @ Rs. 5/kg for 100 Rabbits		11,000
	ii) Green grass + fodder - 110 kg per rabbit @ Rs. 0.25/kg		2,750
b)	Feeding cost for young ones (on an average 24 youngones from each doe will be available and will be maintained for 3 months.)		
	i) Concentrate - 2.5kg per youngone @ Rs. 5/kg		25,500
	ii) Green grass and fodder - 13 kg per animal @ Rs. 0.25/kg.		6,630
c)	Labour charges and others		
	i) Labour, Rs. 1,500/month		18,000
	ii) Medicine and others (Rs. 500/month)		6,000
		Total (Rs)	69,880

Contd.

3)	**Income**		
a)	Through sale of meat - 1.3kg/animal @ Rs. 60/kg for 2,040 rabbits		1,59,120
b)	By sale of skin @ Rs. 10/skin		20,400
c)	Manure		3,000
		Total income (Rs)	1,82,520
4)	**Expenditure**		
a)	Interest on capital investment (Rs. 2,62,100) at the rate of 15%		39,315
b)	Depreciation on housing (Rs. 1,85,600) at the rate of 5%		9,280
c)	Depreciation for cages (Rs. 64,500) at the rate of 1%		645
d)	Expenditure (working)		69,880
		Total expenditure (Rs.)	1,19,120
5)	**Profit**		
a)	Total income (Rs.)		1,82,520
b)	Total expenditure (Rs.)		1,19,120
		Net profit (Rs.)	63,400