

Optimization of animal production

B. K. Mathur¹, A. K. Patel², S. Kachhawa³ and R. N. Kumawat⁴

Central Arid Zone Research Institute, Jodhpur (Rajasthan) 342 003

Livestock, an important component of arid farming systems, provides sustainability and livelihood in these regions. To optimize livestock production in arid region, three major components viz. breeding, feeding and health management need to be strengthened. Other important factors which lead to higher production are proper housing and value addition of poor quality fodder. The grazing areas are progressively shrinking due to encroachment by ever growing human population. Thus there is a need to evolve economical supplementary feed resources. Studies showed that in cattle the conventional concentrates can safely be replaced by 20 to 25% by locally available feed resources like Tumba (Citrullus colocynthis) seed cake and Vilayati Babool (Prosopis juliflora) pods with no adverse effect on animal health. Improved animal shelter was found to enhance productivity of animals through minimizing thermal stress during extreme climatic conditions. The supplementary feeds such as multi-nutrient block and multi-nutrient mixture can also be provided to the bovines for improving productivity and health during periods of drought and scarcity of feed and fodder.

Key words: Climate, Fibrous crop, Improved animal shelter, Livestock, Mineral, *Prosopis juliflora*

LIVESTOCK is an adjunct farm enterprise in arid region of country as crop cultivation alone is not profitable due to harsh climatic condition. Livestock rearing provides needed buoyancy to cope situations in arid regions. The superiority of livestock farming for development of arid region is further highlighted by the fact that this region is endowed with some of the best breeds of livestock (Table 1) and drought-hardy perennial grasses. These breeds of livestock are known for their endurance making use of the meager feed resources which are perennial grasses, herbs, shrubs, tree leaves and cultivated feed and fodder crops. These acquired certain characters to withstand the arid climate that were transmitted through generations to make the present hardy breeds of animals. Availability of common grazing lands although degraded has made livestock rearing as obvious choice specially the small ruminants in these areas. However, due to lack of proper nutrition, genetic potential of these animals was not harnessed to

its maximum level.

Livestock population trends

According to livestock census, 2012, Rajasthan has 57.77 million domestic animals whereas it was 57.89 million in 2007. However, due to drought and famine conditions the population decreased by 6.22% from 54.35 million in 1997 to 57.732 million in 2017 in Rajasthan. The hot arid zone of Rajasthan is comprised of 12 districts laying in the western part and these are Barmer, Bikaner, Churu, Hanumangarh, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali, Sriganganagar and Sikar. This arid region of Rajasthan has 52.27 % of total livestock

population of Rajasthan (Census, 2012), and out of which, larger number of sheep (76%) and goats (59%) present in the arid districts. The large ruminant production system of cattle and buffalo is dominant in IGNP irrigated districts like Hanumangarh and Sriganganagar. Whereas, in all other districts of arid zone, the small ruminants' production system accounts for 65.17% of total livestock.

HUSBANDRY

To optimize livestock production in arid region, three major components viz. breeding, feeding and health management needs to be strengthen. Other important factors are proper housing and produce-marketing facilities for increasing farmers' income.

Breeding husbandry

Despite the best indigenous breeds of livestock available in Thar desert, unfortunate cross-breeding of these indigenous cattle with exotic breeds

Table 1. Major livestock breeds in hot arid zone

Livestock	Breeds
Cattle	Tharparkar, Rathi, Nagori and Kankrej
Sheep	Marwari, Jaisalmeri, Chokla, Nali, Magra and Pugal
Goat	Marwari, Kutchi and Sirohi
Camel	Bikaneri and Jaisalmeri

of *Bosau-tarus* species were used to increase the milk yield rapidly. This trend in recent years was taken place in the society without taking into account the environmental and edaphic conditions of the home tracts of exotics. Though, these cross bred progeny were good milk yielder in initial phase of life but they were often unable to cope with the harsh environmental conditions of the desert.

Consequently the reproductive performance in conception rate, service period and number of calving are influenced adversely. Moreover, crossbred animals need higher inputs of feed and water, comfortable shelter, and health coverage for their body maintenance and optimum production. Selective breeding of indigenous livestock breeds is only the way to improve the quantitative traits like milk, meat, wool, and reproductive efficiency of native animals. The genetic potential of indigenous livestock is underestimated in limited resources, which was harvested by providing better feeding management and health coverage. Thereafter, the selected high producing male animals were used in breeding to introduce high producing genes in local animal population.

Balanced feeding

The concept of balanced feeding in animal husbandry is essential for obtaining optimum production from animals. This includes proper ratio of concentrate with required digestible crude protein, total digestible nutrient and mineral-vitamins to roughages (dry and green) in daily ration. In India most of the livestock are fed on crop residues, apart of grazing with some quantity of supplementation, which include agro-industrial byproducts. Thus, in India livestock production is entirely different from the feeding management point of view is in vogue in the western countries.

Utilization of fibrous crop residues: Most of the cattle and buffaloes in India owned by farmers were underfed and suffer with malnutrition. During dry season (October–May) sheep graze forage

Table 2. Commonly used poor quality roughages in India

Crop residues and agro-industrial by products	
Wheat straw	Sorghum stover
Rice straw	Millet stover
barley straw	Cotton by products
Masoor straw	Cotton straw
Groundnut straw	Fruit canning waste
Sugarcane tops	Rice hulls
Sugarcane by products	
Corn stover	Sugarcane bagasse
Corn cobs	Cotton seed hulls
Oat straw	Coffee bean hull
Sunflower stover	Soybean straw
Cassava wastes	Banana pseudo stem
Cassava leaves	

material on agricultural and *gauchar* lands. In rainy season (June–September) sheep were commonly taken to the forest for grazing. Many efforts were made in the past to augment the feed resources through physical, chemical and biochemical means to enhance the nutritive value of poor quality fodder and crop byproducts. Additionally to increase the nutritive forage production, an application of 40 kg N/ha increased green and dry fodder yields by 10 to 12% over the control. Crude protein yield of grasses was also increased (61%) with inclusion of cowpea and fertilizer application. Water-use efficiency of grasses and cowpea was increased with nitrogen (N) application. Low quality roughages were identified in the region to determine the possibility of improving their nutritive values; some of the commonly used roughages in India were mentioned in Table 2.

Out of total available roughage sources, cereal straw due to their huge availability of about 300 million tonne annual received maximum attention for improving their palatability and nutritive value.c Despite of huge gap existing between availability and demand for dry matter, energy and protein at national level for feeding to animals, still in Punjab and Haryana cereal straws more specifically rice straw is being burnt in the fields contributing to loss of valuable energy source to the national pool and also leads to environmental pollution. Under global context wheat straw (25.3%)

is the most abundant crop residue followed by rice straw (22.8%), corn stover (15.8%), barley straw (8.3%), sugarcane tops (8.1%) and sugarcane byproducts (6.3%) being reportedby workers. Asia is producing about 46% of the world crop residues; therefore nutritionists paid more attention to improve the nutritive value and utilization of crop residues as animal feed pertaining to other regions. About 92% of rice straw and 34% of the wheat straw were produced in Asia.

Feeding material from rangelands: Rangelands are major source of feed and fodder for grazing and browsing animals. Controlled grazing should be followed for better utilization of the herbage and mixed herd comprising of cattle, sheep and goat grazing is advocated for utilization of all the rangeland herbages of high nutritive value. In arid region *Cenchrus ciliaris*, *Cenchrus biflorus*, *Cenchrus setgerus*, *Lasiurus indicus*, *Aristida* spp. and *Eleusine* spp. are dominant grasses available for grazing during monsoon. During post-monsoon some trees/shrubs having top feed value also provide green fodder for browsing of goat and camel, and the dominant species of trees/shrubs available in the rangelands are *Ziziphus nummularia*, *Prosopis cineraria*, *Acacia senagal* etc. Many other species of grasses, weeds, shrubs and trees are not dominated but also provides nutritious green forage for grazing. Some grasses, weeds and trees/shrubs found in arid region are listed with their nutritive value Table 3.

A large number of trees and shrubs were identified which are being lopped for fodder purpose. Although tree leaves are considered as emergency fodders, they serve as potential feed resources for small ruminants and provide about 50% of the total dry matter consumption. They are either utilized as freshly loped leaves or by conserving as dry fodders. Dry matter in most trees varies from 12 to 20% on dry basis. Very high calcium (Ca) and low

Table 3. Common available feeding material from natural rangelands with crude protein percentage

Botanical name	Local name	C.P.%
Grasses		
<i>Aristida funiculata</i>	Lapra	4.38
<i>Brachiaria ramosa</i>	Murat	11.37
<i>Cenchrus biflorus</i>	Bhurat	15.31
<i>Cenchrus ciliaris</i>	Dhaman	8-12
<i>Cenchrus setigerus</i>	Moda	8.77
	Dhaman	
<i>Cynodon dactylon</i>	Dob	10.10
<i>Dactyloctenium aegyptium</i>	Ganthia	10.10
<i>Eluesine comprass</i>	Tantiya	13.99
<i>Eragrostis tremula</i>	Chidi grass	6-10
<i>Lasiurus indicus</i>	Sewan	9.05
<i>Panicum antidotale</i>	Gramna	7.1
<i>Tetrapogon tenellus</i>	Kagiyo	13.36
<i>Urochloa panicoides</i>	Kuri	12.02
Weeds		
<i>Achryanthus aspera</i>	Antipada	19.9
<i>Amaranthus viridis</i>	Chandelio	4.9
<i>Celosia argentea</i>	Makhamal	12.5
<i>Cyperus rotundus</i>	Motha	9.1
<i>Digera muricata</i>	Lolru	12.07
<i>Indigofera cordifolia</i>	Bekario	18.0
<i>Trianthema portulacastrum</i>	Sathi	14.31
<i>Tribulus terrestris</i>	Kanti	18.18
Trees/shrubs		
<i>Acacia nilotica</i>	Desibabul	13.9
<i>Acacia senegal</i>	Kumat	17.48
<i>Acacia tortalis</i>	Israilbabool	14.6
<i>Azadirachta indica</i>	Neem	15.8
<i>Calotropis procera</i>	Aak	13.5
<i>Capparis deciduas</i>	Kair	2.05
<i>Cordia gharaj</i>	Gundi	15.3
<i>Euphorbia caducifolia</i>	Thor	5.61
<i>Prosopis cineraria</i>	Khejri	14.63
<i>Tecomella undulata</i>	Rohida	12.2
<i>Prosopis juliflora</i> (Pods only)	Vilayati babul	13.8
<i>Salvadora persica</i>	Metha Jal	10.5
<i>Ziziphus nummularia</i>	Jharberi	14.1

phosphorus (P) are common features in almost all tree fodders which when fed solely leads to a very wide Ca:P ratio. Dry matter intake from most of the tree leaves varies from 2.5 to 3.5 kg/100 kg body weight. Although they are rich in protein, the digestibility of crude protein is low (25 to 30%) in many cases. Tree fodder, therefore, should be fed in mixture with other feeds, specially containing high phosphorus (P), such as wheat bran, rice bran, grains etc. Although tree fodders are consumed by all livestock, but goats have special preference with higher digestibility of nutrients.

Table 4. Standard conditions for urea ammonization

Straws	Urea needed/ 100 kg straw	Quantity of water to be added (litre)	Minimum time required for incubation (days)
Wheat straw	3	50	21
barley straw	3	40	21
Paddy straw	4	85	10
Maize straw	4	50	14

Enrichment of roughages

Roughages fibrous crop residues and fibrous agricultural residues processed to enhance palatability, intake and nutrient utilization with the ultimate objective of improved performance of livestock. Many methods of treatment were exhaustively investigated. Urea treatment can be done in different ways, depending on the local conditions but some rules were made regarding concentration of urea, duration of treatment, amount of water to be used and way of stacking (Table 4).

Since the temperature of the heap affects the rate of hydrolysis of urea to ammonia (NH₃), the duration of treatment can be variable depending as the region or season where treatment is done. The type of crop residue used and its initial nutritional quality affects the effectiveness of treatment. Poor quality roughages showed higher effect of treatment, probably because of high quality straw contains more cells soluble and thus economics of ammonization reduces. Normally, fibrous agricultural residues were more than 60% dry matter in the form of either cellulose or hemicellulose.

Meeting mineral requirement of livestock in arid region: Minerals provide the essential nutrients to livestock for metabolic functions such as growth and development, immunity and reproduction. Their deficiencies can adversely impact on animal productivity. Animals' diet must contain the essential minerals and vitamins in appropriate amount and ratio. In rural areas infertile cattle and buffaloes were under fed condition and suffering with malnutrition, and their per rectum examination of genitalia revealed hypoplastic and or smooth ovaries and persistent corpus luteum. The Ca, P, Cu and Mn were significantly low in livestock of Barmer district.

The P level was observed lower than the normal levels reported for Indian livestock. The Fe and Zn were significantly higher than the normal level while Cu and Mn were significantly low. Thus there is micronutrient imbalance in the desert livestock.

The macro-minerals Na, K and Mg were observed above normal range in livestock of Jodhpur district and low level of Ca and P. Among micro-minerals, Bagaria area livestock showed deficiency of Zn and Mn while in general livestock showed deficiency of Fe, Mg and Mn. Jaisalmer district livestock showed Na, K and Mg above normal range. It is inferred that during the period of deficit biomass from November to February in Thar desert, milk yield of Rathi cattle was increased by feeding balanced concentrate mixture having 2 % mineral mixture. The nutritional deficiency of micronutrients has adverse effect on the productivity, reproduction and health of the livestock. Thus, the requirement of these nutrients should be met out by supplementation of mineral mixture.

Supplementary feeding in livestock: Desert livestock thrive mainly upon range forages, palatable weeds and crop residues which are unable to meet the nutrient requirement. The supplementary feeds such as multi-nutrient block and multi nutrient mixture were provided to the bovines for improving productivity and health. For preparing 100 kg of multinutrient block the required raw material are molasses 44.5 kg, urea 4.3 kg, common salt 4.3 kg, dolomite 4.3 kg, vitamin mineral mixture 4.3 kg, wheat bran 32.1 kg, cluster bean gum dust 1.0 kg, and cluster bean meal 5.1 kg. One block (2 kg) lasts of 7 days in a cow but 5 days in a buffalo. Feeding of the block improves digestibility of dry matter and provides essential nutrients to the animals, corrected

mineral deficiency and augment milk yield in cow and buffaloes.

The results of demonstrations of feeding of multinutrient block in bovine at farmers' field under project revealed an increase of total 22,687 liters of milk yield from 188 cows and 293 buffaloes due to feeding of multinutrient block for 3 months. The daily milk yield of cows and buffaloes increased by 12.63% and 6.9%, respectively due to supplementation with B:C ratio of 4:38 in cow and 4:6 in buffaloes.

Farm managed goats were given supplementary feeding with balanced concentrate mixture having 18% CP, 70% TDN and 1% mineral mixture. The ingredients taken were *guar korma*, *Tumba* seed-cake, wheat bran or balanced pelleted cattle feed. The above feed is provided @ 400 g/day to goat during lactation and pregnancy. Water was given *ad lib*. Additionally deworming of animal with Albendazole/ fenbendazole was done twice in a year. The study showed 35 to 40% increase in milk with increase kidding percentage and twinning increased up to 58%.

It was observed that supplementation of concentrate feed for does during late gestation and early lactation periods showed positive impact on growth performance of kids. Supplementary feeding practices were well received by the goat farmers and participatory action research might be an exemplary tool to promote scientific management practices in rural area.

Unconventional resource of desert region used as feed: *Tumba* (*Citrullus colocynthis*) seed cake is a cheaper feed resource. *Tumba* plant, an annual creeper, grows naturally in abundance in arid areas with minimum water. It grows and multiply very fast during monsoon and its fruits locally known as *Tumba* - are available between October and November. The fruits are bitter and not used as such by the human beings. *Tumba* seed are rich in fat with oil content up to 22%. The *Tumba* seed-cake (TSC) a by product of the oil extraction industry is nutritionally rich as it contains 16 to 22% CP. Presently, TSC is being used as a fuel for furnaces in factories, and its thus wasted. The feeding trials

reveled that in cattle the conventional concentrates can safely be replaced by TSC to the extent of 25% to lower the cost of animal feeding.

Villayati babool pods: This plant (*Prosopis juliflora*) spread profusely and encroached upon all types of habitats but it considered boon for the desert as its wood is used for fuel and pods for preparation of animal feed. The whole pods are ground to a fine powder and mixed with *tumba* seed-cake, *guar* (*Cyamopsis tetragonoloba*) *korma*, til (*Sesamum indicum*) seed-cake, wheat bran, maize grain, common salt, mineral mixture as per requirement. This balanced cattle feed prepared had 20% crude protein and 73% total digestible nutrient. Studies revealed that acceptability and palatability of this formulated concentrate mixture was high with no adverse effect on health. It increased milk and reduced the cost of feed.

The technology was demonstrated in the adopted villages of the Institute. It was found that milk yield of cattle increased from 8.1 to 8.6 litre with benefit: cost ratio of 3.30. The cost for processing of *P. juliflora* pod-based cattle feed was ₹ 2.75/kg less than the conventional cattle feed available in the market and reduced the cost of concentrate by ₹ 7,039/cattle/year. It saved ₹ 137.50 for per 50 kg bags than conventional feed available in the market. It can increase the employment in the society and some farmers are earning money by collecting the pods and selling in the local market.

Prosopis cineraria v/s Colophospermum mopane leaves: It was observed that the palatability of dry *Colophospermum mopane* leaves was low and decreased with progress of feeding from 15 to 5% from 1st to 5th week and the traditional local *P. cineraria* leaves were better source of supplementation even in the dry form which can support the milk production of goats.

Lani: Salty shrub Lani (*Salsola barysoma*) of arid region available at vegetative stage can be a good source of fodder to animals. Shoots consist of mainly fleshy stem, since leaves are very minute, consisting not more than 5 to 7% of the total biomass.

The acceptability and palatability of fresh cut shoots showed that Lani is palatable

Lana seeds: Lana (*Haloxylon salicornicum*) is a salty weed available in the arid region produces seeds having CP 18.60% found to be good source of protein in the concentrate part of lactating cows replacing about 25% of the conventional sesame-cake.

Hardwickia binata as a supplement feed in goats: It is available in plenty in the arid region having rainfall above 300 mm. The study showed that the fresh leaves were palatable to goats and sole feeding supports the growth of growing kids.

Thornless cactus (*Opuntia ficus indica*): A new fodder source *Opuntia ficus indica*- a thornless cactus introduced in Indian arid region was found to have the fodder value as maintenance feed and was observed to reduce the water requirement, if fed along with the dry roughages in goats, sheep and growing cattle. Besides its high mineral content may reduce the mineral requirement particularly calcium, as arid animals are suffering from mineral imbalances.

Improved shelter management for small ruminants: Environmental stress is one of the important constraints in arid region affecting the performance of livestock. In arid region, traditional housing structure is provided to the productive or lactating animals only. However, these structures are open from all sides with poor control of air movement and sunlight. Animal are directly exposed to sunlight and rains. Improved housing can reduce the impact of high temperature and other environmental factors causing stress to livestock.

An improved animal shelter was designed and developed based on the study of different factors like orientation, wind direction, sun movement, air temperature, local materials for construction etc. Orientation of shelter is essential for minimizing the adverse effect of environmental stress. The orientation of the shelter was kept east-west direction which is open from south direction and north direction. The



Fig. 1. (a-d) Villayati Babool (*Prosopis juliflora*) pods a cheaper source of concentrate mixture for lactating cattle

south facing shelter has the advantage of receiving larger solar radiation during winters than summer. It also gave protection from rains. The open space of north axis was covered by plastic curtain to minimize the entry of cold winds inside the shelter during winter. The double slope roof of the shelter was made by corrugated asbestos cement sheets (1 m × 3 m) on angle iron frame. The roof height is 10 feet (3 m) from centre and 7 feet (2.1 m) from sides. 4 inch (10 cm) thick thatched panels were fixed just below the asbestos sheets to provide roof insulation.

Microclimate of improved animal shelter: Higher values of minimum and maximum temperature were recorded in improved animal shelter during winter (from October to March) than traditional animal shelter. However, the lower values of maximum temperature were recorded in improved animal shelter during summer (from March to September) in comparison to traditional animal shelter. The higher value of minimum temperature in improved animal shelter could be due to the absence of direct entry of air temperature inside close type animal house, secondly the minimum temperature which was attained usually in absence of thermal radiation during the time beyond midnight, remained higher in closed type animal shelter, because of inadequacies in loss of absorbed heat and low ventilation also add to this effect. The lower values of maximum temperature in improved animal shelter during summer could be due to the failure of direct sunlight to reach inside closed type animal shelter and roof insulation.

Milk production and body weight

performance: Goats of traditional animal shelter produced lower milk yield (129.3 litre) during lactation than the goats of improved animal shelter group, which produced 157.6 litre of milk. The peak yield of this group was also found higher 1.46 litre as compared to 1.38 litre in traditional animal shelter (Table 5). Kids housed under improved animal shelter gained more body weight (9.52 kg) as compared to kids maintained under traditional animal shelter (7.52 kg) in 6 months. Overall the kids of 6 month age achieved 26.6% more body weight at one year age under improved animal shelter. The study showed that the livestock breeds of arid region are resistant to high and low environmental temperature, but they do suffer from extremes of summer and winter, when exposed to upper and below critical temperature. Tree shed was found to be common available shelter to the livestock, with its limitations in rainy season and winter. Closed type shelter with open space for free movement for livestock, was found to be most suitable animal shelter in arid zone.

Climate resilient sheep production: To mitigate the adverse effect of climate extremes, a study at Chandan, Jaisalmer district, maintaining sheep under continuous grazing system on sewan grass (*Lasiurus sindicus*) pasture as per the prescribed carrying

capacity. The flock at double the stocking rate i.e. 12 animals/ha was provided with supplementary feeding of concentrate @ 200 g/animal along with health care management, individual body weight gain was maintained at par with the flock grazed at a stocking rate of 6 animal/ha. There is seasonal variation in water intake. Provision of shed (natural /artificial) is one of the simplest ways to minimize heat stress. It was observed that during grazing, animals preferred tree shade rather than erected thatched shade. Sheep was a great potential to adapt the climate change in difficult areas particularly to hot arid zone. The stocking rate of animals in vast rangelands in arid zone could be increased by providing supplementary feeding and health care management. Natural shade of trees in rangeland can help in coping heat stress.

Health management

Broadly common diseases in arid region are divided in to four groups as per causative reason:

- **Viral diseases:** The viral diseases are Rinder pest, (Cattle plague), Foot-and- Mouth Disease, Rabies and Sheep pox.
- **Bacterial diseases:** The bacterial diseases are Anthrax, Tuberculosis, Mastitis, Haemorrhagic Septicaemia, Black-quarter and

Table 5. Lactation performance of Marwari goats under different housing systems

Parameters	Traditional animal shelter	Improved animal shelter
90 –days lactation yield (litre)	64.0 ± 6.2	69.3 ± 5.0
Total lactation yield (litre)	129.3 ± 10.1	157.6 ± 20.8
Lactation length (days)	180.5 ± 17.5	193.0 ± 18.8
Peak yield (litre)	1.38 ± 0.14	1.46 ± 0.16
Fat (%)	3.42 ± 0.13	3.60 ± 0.10
SNF (%)	8.18 ± 0.10	8.29 ± 0.07
TS (%)	11.69 ± 0.19	11.89 ± 0.18



Fig. 2. East-west orientation is suitable for both hot and cold weather



Fig. 3. Orientation allowed plenty of sunlight from south direction inside shelter during winter

Pneumonia.

- **Parasites and parasitic diseases:** *Ectoparasites* (ticks and mites), *Endoparasites* (Protozoan, Nematodes, Trematodes and Cestods).
- **Deworming:** Animal should be dewormed with broad spectrum anthelmintic thrice yearly. In ectoparasites, spray/dusting should be done at regular intervals with ectoparasiticide. This simple treatment will increase the availability of nutrients to livestock.
- **Miscellaneous diseases and pathological conditions:** Urinary calculi, Milk fever, Grass tetany, Cobalt deficiency, PICA, Vitamin A deficiency and paraplegia.

Preventive measure and proper timely treatment will reduce the losses.

Improving fertility in Tharparkar cattle: Higher reproductive efficiency is desirable for successful and profitable dairy farming. Calving interval and age at first calving in indigenous cattle breeds (like Tharparkar) under ideal conditions should be about 12 to 14 months and 40 to 50 months respectively. Under usual field conditions in rural areas, the calving interval and at first calving are usually higher and vary between 18–20 months and 55–60 months respectively. Efforts were

made to improve fertility in Tharparkar cattle to the desired level by adopting a package of improved practices which resulted good success rate. A package of improved management practices includes: Deworming of animals with Albendazole/ Fenbendazole @ 1.5 g tablet/2 quintal body weight thrice a year.

Balanced feeding: It is done as enumerated here.

(a) Regular feeding of balanced concentrate mixture as pelleted cattle feed to all categories of animals with following broad schedule:

- Heifers (3 month to 1 year)- ½ to 1 kg/ day
- 1 year to pregnancy- 2 kg/day
- Pregnant heifer/cow- 2.5 kg/day
- For milk production (additional)- 40% of milk yield.

(b) Supplementation of vitamin-mineral mixture in cattle feed @ 5 to 25 g/day (age-wise) for about 200 days/year.

(c) Injections of Vitamin-A @ 5-10 ml I/M route × 2 days twice a year to all categories.

(d) Injections of inorganic Phosphorus @ 5-10 ml I/M route × 2 days twice a year to all categories.

(e) Dry fodder: Chaffed *bajra*/ *Massor*

straw *ad lib*.

(f) **Grazing:** Free grazing in moderate to good pastures for 4-5 hr/day.

Regular gynecological examination of all breedable females every two months with timely treatment of infertility as per cause. It led to

- Timely identification of pregnant animals and their due care.
- Early detection of non-pregnant non-return animals.
- Cases of persistent corpus luteum.
- Early detection of endometritis in post parturient and repeat breeder animals.
- Early detection and treatment of True anoestrus cases. Ovarian and genital massage in these cases leading to increase in success rate.

SUMMARY

Regular administration of ecobolic powder/liquid from standard company (Replenta™ / Uteretone™ etc.) in prescribed doses for about a week mixed in jaggary starting immediately after -calving to hasten uterine involution. The above package of practices has led to reduction in calving interval and at first -calving by about 6 to 8 months.

¹Head; ²Principal Scientist; ³Subject Matter Specialist; Corresponding authors' e mail: mathurbasant@yahoo.co.in

Latest publications of ICAR-DKMA

- Textbook of Medicinal and Aromatic Plants
- Handbook of Integrated Pest Management
- Textbook of Livestock Breeding : From Concept to Application

For copies :

Business Manager

DKMA, KAB-I, Pusa, New Delhi 110012
e-mail: businessuniticar@gmail.com