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BACKGROUNDING MANUAL

A Guide to Preparing Cattle for the Feedlot in Pakistan

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PREFACE

Pakistan's strategic geographical location offers it numerous trade opportunities with vibrant economies in the Middle East, Central Asia, and Southeast and East Asia. Beef exports from Pakistan are hindered by inconsistent quality and lack of a uniform product, allowing it to be out-competed by other producers around the world. To counter this trend, Pakistani slaughterhouses and other processors involved in exporting beef are increasingly demanding better quality cattle to produce a higher quality, consistent carcass that can better compete in international markets and allow further value addition.

Backgrounding is an intermediate stage in beef production, between weaning and finishing at the feedlot. When done correctly, backgrounding gives a calf optimal muscle and skeletal development without putting on excess fat. This is achieved through a diet of quality forages supplemented by smaller amounts of concentrate and taking advantage of crop by-products common in Pakistan.

Feedlots prefer backgrounded animals because they are healthy, have low stress, put on weight fast, and offer consistent size and quality. This allows the feedlots to better supply the beef exporters with the carcasses they need to be more competitive in international markets.

Backgrounding requires spending money, but the returns can be high because of the more efficient feeding and the premium price paid by the feedlot for backgrounded animals (compared to animals purchased in live animal markets).

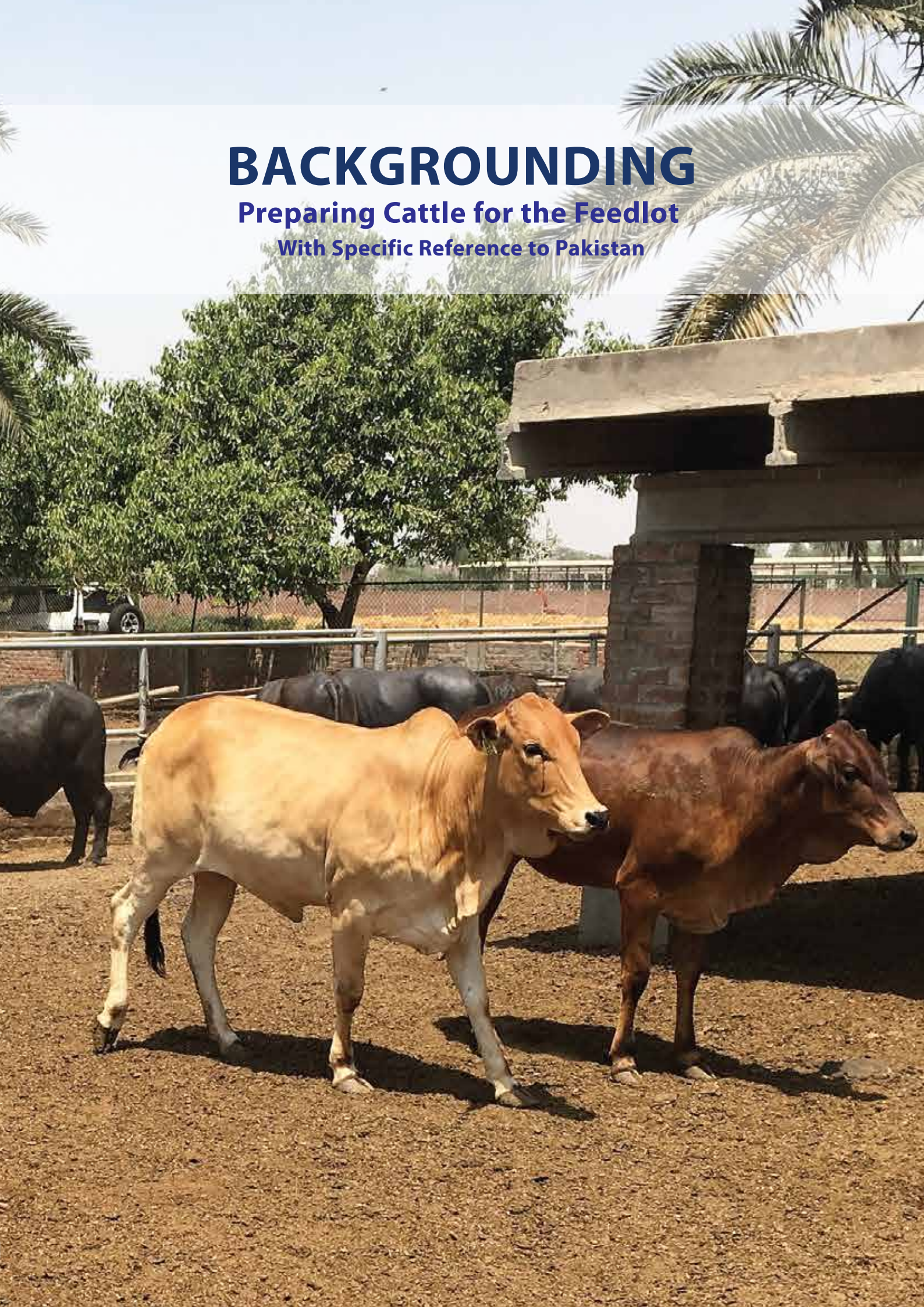
This manual aims to better inform and guide those interested in becoming backgrounders, and to help those already active in backgrounding to improve their operations.The focus of the manual is Pakistan's Punjab and Sindh Provinces, but the information also has relevance to other regions and countries. Topics of the manual include an overview of existing production systems, business models of backgrounding, economic planning, farm design, and good animal husbandry practices, including nutrition and health.

We hope this manual will encourage Pakistan's burgeoning backgrounding activities, which play an important role in support of a strong, competitive beef industry.

BACKGROUNDING

Preparing Cattle for the Feedlot

With Specific Reference to Pakistan



B. Production Technology for Summer Fodder Crops

Well established fodder crops produce better yields in terms of biomass as compared to poorly established fodder crops. Following proper production technology and integrated crop management techniques ensure availability of quality fodder for animals throughout the year.

Corn, sowing season in Punjab is from March to September whereas in Sindh is February to November. Seed rate mainly depends on soil type, germination percentage. 40 kg /acre healthy certified seed is recommended for fodder production. Sowing/planting mixtures Maize+ Guar (30 kg+5 kg/acre), Maize + Cowpeas (30 kg+ 4 kg/ha). Planting with drill in line keeping line to line distance of 30 cm. Main insects are Stem borer, Shoot fly and Jassid can be controlled by Furadan or Padan (8 kg per acre), Jassid can be controlled with 500 ml Novakran or Confidar 260 ml per acre.

Harvesting spring cultivated (March) harvested during May. Crop cultivated during July should be harvested in second week of September. Fodder maize should be harvested at 25-50% tasseling. Grain Maize is harvested when it is fully matured. Maturity can check by teeth for grain crop Green fodder yield 20-25 ton/acre under rainfed and 25-30 ton/acre in irrigated conditions.

Millet Sowing Season is in Punjab March to August and Sindh March to October. Millet can be grown on various types of soil, alluvial/loamy and well drained soils are more suitable and slightly saline soil. Before sowing, the land is ploughed 2-3 times and planking afterward. Seed Rate is 6 kg/acre of clean seed. Sowing/planting rates in mixtures is Millet+ Guar (8kg+4 kg/acre), Millet + Cowpeas (8 kg + 3 kg/ha). Irrigation can be done, 1st Irrigation 3 week after planting, afterward according to the crop requirements. 300-400 mm rainfall is suitable for successful production. Fertilizer is 1 bag DAP or 1 bag Urea/ acre. Planting Method is sowing and should be done by drill in line keeping line to line distance of 30 cm. Harvesting fodder at 10-50% heading stage and for grain is fully matured. Production for Rainfed is 20-25 ton/acre and for irrigated 30-35 t/acre.

Rhodes Grass Sowing Time: February to September. Soil Type is wide range of soils from light sandy to clays however; water-logged soils are not suitable. Seed Rate is4-8 kg/acre. Sowing is mud or dry broadcast. Irrigation is once at time of sowing then after every cut. Fertilizer per acre is dependent on soil types and requirements; general guideline is Phosphorous 50-75Kg during sowing, then 50-75Kg after every 6 months or 50Kg NP after every 3rd cut and Urea 75-100Kg till first cut, then 50-40Kg after every cut or as per need. The newly established field should be free from weeds. Weed out twice after planting at monthly intervals during establishment. Harvesting the grass and weeds together using sickle when there is vigorous growth is alternative to control weeds. Using an herbicide like 2-4-D is an effective removal of young broad leaved weeds. There are no insects observed or no diseases on Rhodes grass are observed on Rhodes grass production. Harvesting first cut 45-60 days, and then after every 25-30 days.

Mott Grass Sowing time is February and July and seed rate is11000 branches per acre. First irrigation soon after sowing and remaining according to season. Fertilize with 1 bag DAP or 1 bag urea/ acre. First harvesting after 75-90 days after sowing, afterwards every 45 days.

Sorghum is best suited in subtropical to tropical climates and temperature for growth of plant is >27 Rainfall is > 400 mm or irrigated conditions. Sorghum is grown on various types of soil; alluvial/loamy and well drained soils are more suitable and can be grown on slightly saline soil. Sowing time is Punjab March to August and Sindh, March to October. Before sowing, the land is ploughed 2-3 times and planking afterward. Fertilize with1 bag DAP or 1 bag Urea/ acre. Irrigate total 2-3 times, first Irrigation is 3 week after planting, afterward according to the crop requirements. Seed rate mainly depends on soil type, germination percentage and on sowing method. Sowing/planting rates as single species is 30 kg /acre healthy certified seed. Sowing/planting rates in mixtures is Sorghum+ Guar (20 kg+5 kg/acre) and Sorghum + Cowpeas (20 kg+ 4 kg/acre). Sowing should be done by drill in line keeping line to line distance of 30 cm. Insects are stem borer and Shoot fly, Jassid. Furadan or Padan (8 kg per acre) for stem borer and shoot fly while Jassid can be controlled with 500 ml Novakran or Confidar 260 ml per acre.

Sadabahar sowing time is February and July. Land is ploughed 3-4 times and planking afterward. Seed rate is 6 kg/acre of clean seed and fertilize with 1 bag DAP or 1 bag Urea/ acre. Irrigate total 2-3 irrigations, first Irrigation 3 weeks after planting and afterward according to the crop requirements, 400-600 mm rainfall is suitable for successful production. First Harvesting after 75-90 days after sowing and afterwards every 45 days. Yield is 80 ton/acre.

The seasonal nature of fodder availability necessitates preservation of fodder crops to feed the animals throughout year. Fodder can be conserved in three different ways, silage, hay and haylage. Fodder preservation is conserving fodder at best nutritional value. Standard protocols to make silage, hay and haylage from cropping to preservation. A number of fodder crops can be preserved either as hay, haylage or silage. All the three preservation techniques are supposed to conserve fodder at best nutritive value, therefore special consideration to nutritional profile should be given while selecting fodder for preservation. Silage requires adequate amount of fermentable carbohydrates and more than 65% moisture. Commonly used fodder crops for silage making in summer are maize, sorghum, millet and Sadabahar.

C. Common Fodder Winter Season Crop

a. Winter Fodder Crops and their Nutritive Values

These fodders are grown at the beginning of winter. They ensure provision of fodder till the beginning of the summer season. Generally the winter fodder crops are higher in protein as compared to summer season fodder crops. The fodder crops grown during winter season can be divided into Legumes; Alfalfa, Berseem, Grasses: Ryegrass, and Cereals, Oats (Table 9).

Table 9. Winter fodder crops and their nutritive values

Fodder	Time of Cultivation	Harvesting Time	Crude Protein (%)	Type
Ryegrass	October to December	First cut after 40 days, the after every 30 days till April	20-24	Grass
Oats	October to December	January to May	10-12	Cereals
Alfalfa	September to October	December cut and after 45 days for 3 years	20-24	Legume
Berseem	September to October	November to May	18-20	legume

Dry Matter Basis

b. Intercropping Consideration of Benefits and Constraints

Cropping system comprises all components required for the production of a particular crop and the interrelationships between them and environment. In the cropping systems, sometimes a number of crops are grown together or they are grown separately at short intervals in the same field. This delineates cropping patterns. Depending on the resources and technology available, different types of cropping systems are adopted on farms.

Intercropping is the growing of two or more crops together in proximity on the same land. As a result, two or more crops are managed at the same time. It differs from crop rotation in which two or more crops are grown one after the other. There are at least four types of intercropping according to spatial arrangement (Sullivan, 2003).

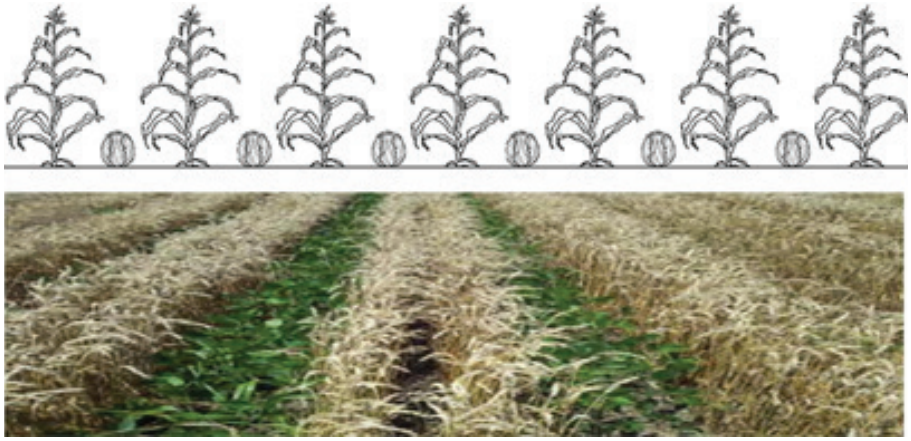


Figure 14. Intercropping

Advantages of intercropping are better use of growth resources including light, nutrients, water and suppression of weeds. Yield stability; even if one crop fails due to unforeseen situations, another crop will yield and produce income. Successful intercropping produce higher equivalent yields (yield of base crop + yield of intercrop. Intercropping reduces pest and disease incidences and Improvement of soil health.

Disadvantages of intercropping are yield decreases as the crops compete. Managing of two crops having different cultural practices is a difficult task. Improved implements cannot be used as efficiently. Higher amount of fertilizer or irrigation water cannot be utilized properly as the component crops vary in their response and harvesting is difficult

Relay intercropping is growing two or more crops simultaneously during part of the life cycle of each. A second crop is planted after the first crop has reached its reproductive stage but before it is ready for harvest (Figure 15).

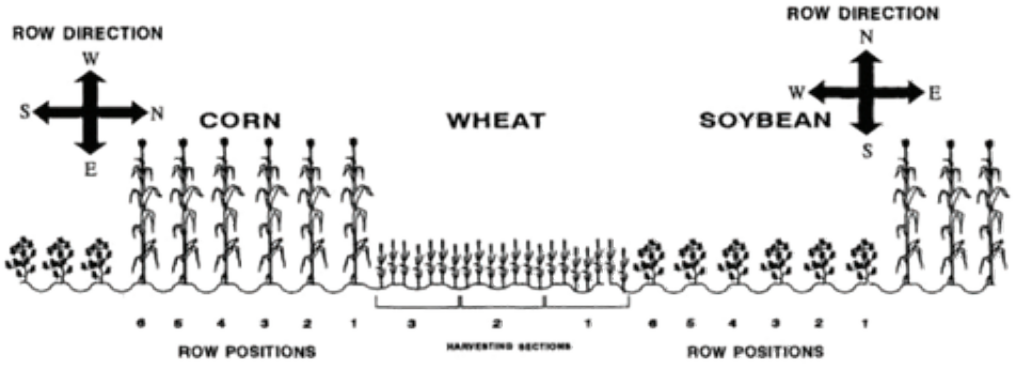


Figure 15. Relay Intercropping

Intercropping legume with cereals and grasses is an extensively applied planting pattern in crop cultivation. Intercropping exhibits a greater forage production performance than single cropping and is a feasible option for forage production. Studies have shown increased fodder yield, dry matter production and improved digestibility of fodder produced through this system (Figure 16).

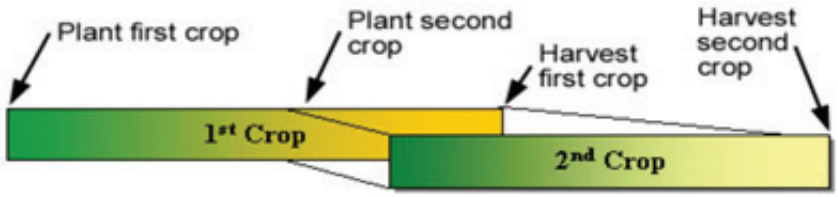


Figure 16 Intercropping Legumes with Grass

Advantages intercropping of legumes with grass as a companion crop through transfer of nitrogen by legumes, less need for fertilize and less competition for soil nitrogen by legume. Intercropping of legumes with grass improves protein yield for non-legumes and less weeds.

There are options available to enhance productivity through intercropping of different crops as example. Alfalfa and maize occupy complementary spatial and temporal niches, resulting in complementarily light interception and facilitating the circulation and diffusion of air (especially CO2). The time of sowing of cereal and legume is critical for the yield of each crop. Data so far available indicate that under sowing within 10 days of planting a fast-growing cereal such as maize does not depress cereal grain yield significantly but slow-growing, long-season crops such as photosensitive sorghum, grain yield is greatly depressed. In the case of sorghum, high grain yield is obtained if the legume is sown 3 - 4 weeks after the cereal.

A deep-rooted crop like alfalfa can be intercropped with shallow-rooted crops like oats, rye, barley or a brassica (vegetables and canola); annuals are usually sown between the rows of perennial fodder. Studies show that intercropping of alfalfa with oats produced greater dry matter yields than single crops. The grain and stover yields may suppress cereal crops production with intercropping. A farmer should be considering his local climate, before considering intercropping.

c. Oats (Non Legume/Cereals)

Oats is a winter cereal and is grown in Pakistan in the form of fresh fodder, silage and hay Figure 17. Winter cereals will produce a good yield of medium to high-quality hay silage.

Figure 17 Oats Growing, Silage and Hay

Nutrient Value of Oats at different growth stages are shown in Table 10.

Growth stage	Metabolizable MJ/kg Dry Matter	Crude Protein Percentage	Quality	Potential Yield Kg Dry Matter /Acre	
Late Vegetative 60 Cm		12 - 18	High	607	2024
Flowering	8.5 – 9.5	8 - 12	High Medium	1214	3643
Dough Stage	7.5 – 9.0	4 -10	Low Medium	1417	4048

Land is should be well ploughed for a good seed for good germination. Seeding rate is 30 – 35 kg/acre and broadcasting is practiced for fodder production, however for grains, drill seeding at 1 ft distance in rows. When sown in rows there are fewer chances for lodging. Fertilize with urea (25 Kg/acre), phosphorus (15 Kg/acre) Potassium (80 Kg/acre), calcium (Kg/acre) and Magnesium (8 Kg/acre). Oats 1/3 of nitrogen, phosphorus and half of the required potassium. The remaining fertilizer is required at 35-70 days. Irrigate 3-4 times, first irrigation after 03 weeks of sowing, second in December, third in late January or early Feb. Excess irrigation can cause the stand to fall down. Select improve multicut varieties of seeds for the best production. The seed should be free of disease and weed from certified and trusted source. Loam and clay soils are best and saline soils are not suitable for oats. Oats is sown either in first two weeks of October or early November. This is a cool dry season crop and can survive frost and sever winter. Heavy winds and rain in February can cause heavy losses. The stem of oats is weak and cannot tolerate high winds. Falling of stands (lodging) is one of major cause of production losses. However choosing right type of varieties can help to reduce the risk.

Damage from field insects is not generally a major factor for oat crops. Control red legged earth mite and alfalfa flea during the seedling stage if necessary. Aphids should be checked for and controlled from flag leaf stage and later in crops considered to be high yielding. If growing susceptible varieties in areas with moderate to high BYDV risk then spraying the crop with a synthetic pyrethoid at 4-5 weeks after sowing is advisable. Broad leaf weeds and dumbi, sitti are major weeds affecting the production of oats .Use of metribuzine 80-90 gm per acre within 30 days of sowing to kill dumbi sitti. Use of MCPA at the rate of 500 ml per acre is recommended to weed out broad leaf weeds.

Harvest early varieties for fodder first cut after 70-80 days. Timing of harvesting is an important decision as it affects the fodder yield and feeding value of the harvested corp. Fodder yield is 300-400 Munds and grain is 25 Munds. Oats as a fodder crop is available during fodder shortage season therefore has a high value in the when available at end of November or start of December.

Oats and winter cereals can be grown deliberately for storage as conserved fodder or can be grazed and then locked up for conservation. Oat hay is fine stem and leafy, free of weed and disease are considered quality parameters for oat hay. Oats are customarily harvested for hay when grain kernels are in the soft dough stage of maturity. At this stage, heads are filled with nearly mature grain and yield in tons per acre is at a maximum. Oats cut at the soft dough stage are usually close to the 60 to 70 percent moisture content desired for good silage.

d. Ryegrass (Grass-Non Legume)

Ryegrass is a winter growing, hairless, shiny leaved, palatable annual or biennial pasture grass. It has a vigorous root system tenaciously holds the soil against erosion while improving soil organic matter levels, increasing water infiltration, and reducing nitrate leaching.

Ryegrass is considered as a high quality fodder grass and is capable of producing feed over one to three years depending on climate and management and gives 5- 8 cuts. It has a rapid re-growth after cutting and the quality of the grass is very high in respect of digestibility and crude protein.

Ryegrass is adapted to a wide range of environments and is being grown in Pakistan since 2011-12 from Sakrdu to Thatta. It has good autumn early winter production and a large spring flush, ideal for fodder conservation.

Perennial Ryegrass has multiple uses in dairy and feedlots, grazing, green chop, haylage 45-50% moisture, silage at 60 t0 70% moisture and hay. Whenever excess Ryegrass intercropped with clover harvest at early head emergence emergence stage of ryegrass or early to mid flowering of clover (30 days).

Ryegrass growing months is mid October until temperature is below 35oC and areas growing from March to September until temperature are below 35oC. Soil Type is moderate to good fertile lands, however not good on saline soils. Seeding rate is 8-10 kg/acre. Sowing is by mud broadcast drilling. Irrigate once at sowing and depending on temperature, irrigate 2-3 time after every cut. Fertilize with potassium recommended by soil test and phosphorous at 50-70kgs during land preparation and 50kgs after every three cuts. Urea is 75-100kgs until first cut and 40-50kgs after very irrigation. Select tolerant variety for diseases and insect control. Weeding is important at time of sowing. Harvesting, first cut 45-60 days after sowing and there afterwards after every 25-30 days. Ryegrass expected yield as is green chop is 6 ton/acre/cut, haylage3ton/acre/cut and hay is 1.5ton/acre/cut. The expected nutrient values is shown in Table 11.

Table 11. Ryegrass Nutrient Value Dry Matter Basis

Value	Unit	Ryegrass Early Vegetative	Ryegrass Late Vegetative	Ryegrass Mid Vegetative
DM	%	17	21	18
ME	MJ	12.0	11.0	11.5
CP	%	24.0	18.0	22
NDF	%	36.0	45.0	38.0
DIGESTIBILITY (UDP)1	%	90	90	90
K	%	3.00	2.0	2.50
Cl	%	0.80	0.80	2..80
Fe	Mg/kg	280	280	280
Cu	Mg/kg	10.0	7.0	8.0
Mn	Mg/kg	85.0	74.0	54.0
Zn	Mg/kg	24.0	20.0	95.0

Silage and haylage preservation allows for cutting high quality fodders at the proper time to maintain high percent of total digestible nutrient values. Silage and ryegrass haylage is an effective preservation of high moisture fodders preserved when hay production is less than ideal conditions. Ryegrass large baled hay has a high value for export. Ryegrass in large bales and dairy cows fed green chopped Rye grass is illustrated in Figure 18.

Figure 18 Ryegrass in large bales and dairy cows consuming Ryegrass green chopped.

e. Alfalfa (Legume)

Alfalfa well drained on deep loam soils and not recommended on heavy clay and water logged soils and require uniform seed bed for good stand. Good tillage practices. Alfalfa crop can produce for 3 years. Sowing time is Oct- 15 through Nov 15. Soil testing is must before fertilization. Broad cast 10kg /acre. Spray knock down herbicides (glyphosate) before sowing and spray y pendimethaline or Stamp after emergence of weeds. Spray insecticide on field but 10-15 day before harvesting for Army worms and Aphids. Harvesting alfalfa is from 6 – 7 cuts per year. First cut is in 70-90 days and next cut is after 20-25 days or when budding start. Fresh: 6-7 tons/cut/acre. Yield of hay is expected 1to 1.5 tons per harvest and alfalfa should be cut 2-3 inches above the soil to ensure early re-growth and quality.

Alfalfa is used primarily as a protein source and is high in energy for a forage. Alfalfa hay is used extensively in dairies and when used in growing beef cattle as sole source of feed will support about 0.70 kg of gain. Protein and energies are shown in Table 12.

Value	Unit	Per Bloom	Early Bloom	Mid Bloom	Full Bloom
DM	%	21	23	24	25
CP	%	20-28	18.24	16-22	14-18
ME	Mcal/kg	2.78	2.17	2.10	1.99
Net Energy Maintenance	Mcal/kg	1.41	1.31	1.24	1.14
Net Energy of Gain	Mcal/kg	0.83	0.74	0.68	0.58

Table 12. Alfalfa Nutrient Value Dry Matter Basis

f. Berseem Clover

Berseem prefers slightly alkaline loam and silty soils but grows in all soil types except sands. Soil phosphorus can limit berseem clover growth. Fertilize with 60 to 100 lb. phosphorus/acre if soil tests below 20 ppm Boron also may limit growth, so test soil to maintain levels. Berseem tolerates saline conditions better than alfalfa and red clover. Use R-type inoculant suitable for berseem clover and crimson clovers. Broadcast or drill berseem seed alone or with spring grains onto a firm, well-prepared seedbed or closely cropped sod so that it is 1/4-inch deep with a light soil covering. To improve seed-soil contact and to maintain seed-zone moisture, cultipack or roll soil before and after broadcast seeding. Dry, loose soil will suppress germination. Recommended seeding rates are 3.5kg to 5.5kg/acre drilled or 5.5kg to 9.0kg/acre broadcast. Excessive rates will create an overly thick stand that prevents tailoring and spreading of the root crowns.

g. Preservation of Forages

Corn is the most used fodder crop for silage throughout the World. Corn silage will produce more energy per acre than any other Fodder and has corn grain, and roughage as a complete nutritional package. Nonstructural carbohydrates and consistent moisture contents of corn allow good and quick fermentation resulting in high quality silage.

h. Steps in Silage Making

Production of high quality silage requires care at each and every step from growing to ensiling and storing of corn crops. Silage quality highly depends upon following correct protocols for complete fermentation as well as good agronomic practices from seed selection to harvesting of corn. Therefore when you plan to produce corn silage consider to plant good, proven varieties having, high protein, digestibility, high yield/acre and higher grain ratio.

Harvest mature well eared corn for silage at 35% dry matter (65% moisture) for highest production and highest nutritional value. This is achieved at proper fermentation and elimination of oxygen while providing sufficient water soluble carbohydrates. Cut at least 6 inches above ground and Set knives at 6 to 15 mm theoretical length of chop to assure that 15-20% of particles remain at 4 cm length improves digestibility. Particle length is important for rumen health and proper fermentation. Silage can be stored in bunkers, pits, bales or piles. Ensiling can be done in bales or in bunkers.

Baled silage is chopping the fodder and tightly wrapped into plastic sheets with specialized balers. As fodder is tightly packed, all the oxygen is eliminated and anaerobic fermentation begins. The chopped fodder can be stored in bunkers after packing.

i. Use of inoculants

Lactobacillus bacteria based inoculants can be used to help ensuring fast, efficient and better fermentation. Inoculants improves the quality of silage by reducing dry matter losses and conserving protein, sugars and improves the storage life of silage and prevents fungus growth.

Good silage is light brown in color. There will be no petrified odor. There is good ratio of grains along with plant material in well made silage. There should be no mold or fungus in silage Figure 19.

Figure 19. Poor and Good quality silage

Physical	
Color	Light Brown
Smell	Vinegar Like
Nutrition	
Dry Matter (%)	30-35
Net Energy of Lactation (Mcal/kg DM)	1.4-1.5
Starch (% DM)	28.32
Crude Protein (%)	7.1-7.9
Acid Detergent Fiber (%)	23-30
Neutral Detergent Fiber (%)	46-50
Fermentation	
pH	<4.0
Lactic Acid (% DM)	>3.0
Acetic Acid (% DM)	<3.0
Propionic Acid (% DM)	<1.0
Butyric Acid (% DM)	<.01
Alcohol (% DM)	0
Microbial	
Yeast /Mold (cfu/gm)	<100,000
Mycotoxins	20 PPB or less Lactating Dairy cows beef cattle less than 200 PPB

Table 13. Attributes of good silage

a. Bunker and Hay Storage Location

Silage bunker and feed storage is near the feeding mixing area. Silage, hay storage and ingredients for the TMR (total mixed ration) need to be centrally located to the feedlot. Feeds need to assessable to the front loader r and feed mixers with scales.

Figure 20. Packing a Bunker Silo

Silage can be stored in open area with brick soling or concrete floor as a bunker design with sides to prevent spoilage after packing and covering. Face removal rate to remove at least 8 inches per day from the silo face to keep ahead of spoilage in warmer weather.

The minimum width is based on the packing-tractor width that can be determined by multiplying the packing tractor width by 2. The maximum bunker width is based on the amount of silage removed each day which is influenced by bunker height; face removal rate and silage density. The maximum height is determined by how high the equipment or workers can reach.

Length is primarily determined by the total quantity of forage that must be stored. To calculate the silo size; use amount of silage that will be fed each day, for which following equation can be applied.

Total Silage (Kg) = Silage per head per day x number of heads x number of days.

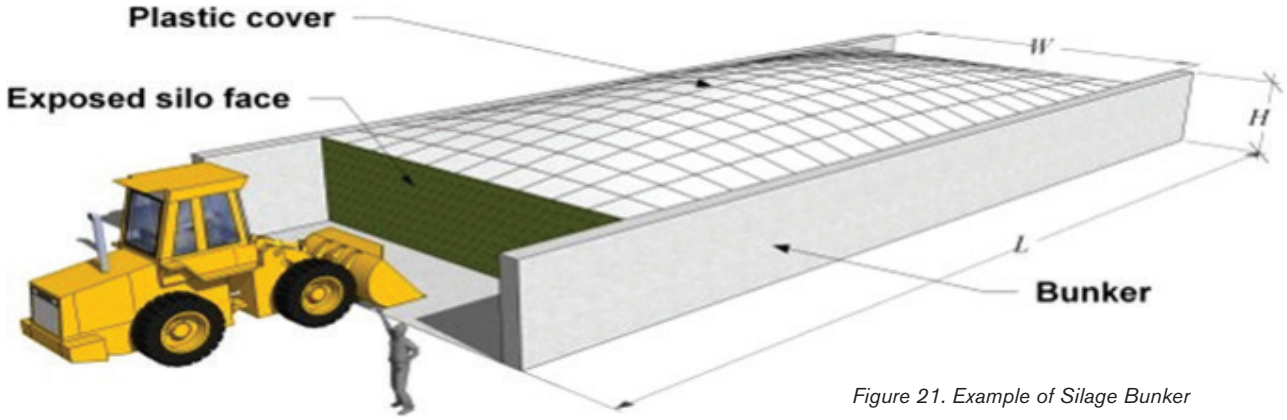


Figure 21. Example of Silage Bunker

The volume of silage depends upon the silage density which is related to moisture contents of the fodder. The average density of silage depends on the moisture content of the fodder. Less the moisture content, lower the density per cubic feet. The density of corn silage in varies between 17 to 23 kg/cubic ft that depends on the weight of tractor and pressing time. Following equation can be applied to calculate the bunker volume; Volume of bunker = Total silage required ÷ Silage Density.

Bunker Width (Ft) = Total Volume required per day (Kg) ÷ (Face Removal Rate (Feet per day) x Wall height)
Length (Ft) = Face Removal Rate (ft/day) x Feeding Period (days)

b. Hay Making

Hay is fodder sun dried. Moisture content reduced to 15% by wilting. A fodder crop for best quality has more leaves to stems ratio has the higher nutritional value. Almost all fodders can be made into hay. The best time of mowing is when half the fodder has started to flower. It is best to consider weather forecasts to allow hay to cure for three days.

Second step is tedding fluffs up hay to promote curing. This practice helps the under surfaces to dry properly by allowing them to contact with air and sun. Wilting of hay is very important to ensure good quality hay. Fluffers are used for proper and uniform sun drying and must be done once or twice depending upon weather conditions and crop density. First fluffing should be done 1 hour later after harvesting and second fluffing should be done in evening or in the morning to secure whole plant

Third step is raking and gathered in linear line. Proper lining is important to have smooth and uniform bales and baling operations.

Fourth step is Baling after raking or after some time depending upon condition of hay for quality. Baling should be done at 10 to 12 % moisture. In summers when temperature is high baling must be done in morning or evening hours to avoid breaking of the grass.

Figure 21. Hay Steps from Left to Right

c. Haylage Making

Haylage is made with same equipment as hay difference is type of baler. Haylage can be made from all fodders that have 40 to 60 percentage moisture. The first step in haymaking is mowing the hay. The maturity of the grass is the determining factor for starting the first field of the season. The best time of mowing is when half the fodder has started to flower (grasses) or early bud (legumes). It is best to consider weather forecasts so that rain or irrigation allows hay to cure for three days.

Haylage, also known as Baleage or round bale silage, is produced by baling forage at relatively high moisture levels and wrapping the bales with plastic. The practice excludes oxygen, resulting in fermented forage that can be excellent quality feed. However, haylage can also turn into a "deadly, worthless mess." If best management practices for haylage are not followed. Make haylage from high quality/early growth forage (late boot to early head) since it has higher sugar content that is needed to produce good haylage fermentation. Mow forage without conditioning once the dew has dried so that the moisture in the haylage is within the plant and not on the surface. Mow forage into a wide swath for rapid and uniform wilting to 50-60% moisture for best fermentation, which takes about 4 to 6 hours. The forage should not be tedded since tedding leaves the stems oriented at random while parallel stems will allow baling denser bales. Rake the forage into a windrow and bale in a tight, dense bale to reduce air (oxygen) inside the bale. Pre-cutters in the baler increase bale density and improve fermentation. Bale to a uniform bale diameter needed to exclude air where bales come together when using in-line tube wrappers. Also, bale size and weight need to be compatible with tractor and loader capacity. Wrap bales in plastic within 2 hours to exclude air using at least 6 mils of plastic and 50% overlap and 50% to 55% stretch. Wrap in dry weather for plastic to stick. Store bales in an area that is relatively level with no sharp stones. Stack bales to reduce sunlight exposure to save plastic and reduce sweating, north-south orientation of bales evens out sunlight on both sides of the bale. Inspect bales weekly, repair tears and holes to prevent spoilage and secondary fermentation using tape made for plastic, not duct tape (Figure 22).

Figure 22. Haylage and Baled Haylage

d. Irrigation Management for Efficient Fodder Production

Agriculture is often greatly hampered due to irregular, insufficient or uncertain rain. Proper irrigation systems can secure uninterrupted agriculture. The productivity of irrigated land is more than the un-irrigated land. Seeds cannot grow in dry soil as moisture is necessary for the germination of seeds. With the help of irrigation supply, the required moisture content of soil for the growth of seed can be ensured. Multiple cropping in a year is possible through irrigation. This will enhance production and productivity. In many areas, two or three crops in a year are cultivated with irrigation facilities. Through the irrigation, it is possible to supply the required amount of hydrogen and oxygen, which is important for the proper

A plant can absorb mineral nutrients from the irrigated soil. Thus irrigation is essential for the general growth of the plant. Bringing more land under cultivation is possible through irrigation. Insufficient rain may also cause drought and famines. Irrigation can play a protective role during the period of drought and famines. Irrigation contributes to the economic growth and poverty reduction. As income and employment are closely related to output and irrigation increases production, substantial increase in income is achieved in the countryside.

Precipitation, and in particular its effective portion, provides part of the water crops need to satisfy their transpiration requirements. The soil, acting as a buffer, stores part of the precipitation water and returns it to the crops in times of deficit. In humid climates, this mechanism is sufficient to ensure satisfactory growth in rainfed agriculture. In arid climates or during extended dry seasons, irrigation is necessary to compensate for the evapo-transpiration (crop transpiration and soil evaporation) deficit due to insufficient or erratic precipitation. Irrigation consumptive water use is defined as the volume of water needed to compensate for the deficit between potential evapo-transpiration on the one side and effective precipitation over the crop growing period and change in soil moisture content on the other side. It varies considerably with climatic conditions, seasons, crops and soil types.

Both overwatering and under watering will result in lower yields. Overwatering will also result in higher operating costs. Irrigation scheduling is the key to achieving optimal yields.

Flood systems has extensive land leveling, high runoff, leaching of Nitrate and other nutrients, Increase labor, promote weeds, low germination rates that will lead to lower yields.



Pivot/lateral/rain gun Sprinkler have less waste and energy, water, labor and time saved with application precision and downtime minimized. Flexibility of planting time; high germination rates and yields are increased.

Traveling irrigation systems are low initial costs, lower operational costs, irrigates, ideal for soil/ground preparation wide range of crops, with zero field hindrance and low labor requirement. Performs at a high degree of uniformity and has high degree of portability with low maintenance, irrigate corners and for emergency irrigations. Adoptability to irregular field conditions and recovers initial investment quickly.

VI. Improved Feedlot Management Practices

Efficient feedlot farming practices are critical for optimal beef production. There are a range of processes which need to be thoroughly and regularly administered to ensure the desired business output and objectives met. As the feedlot business deals with living beings, the animals require focused attention to their feed requirements, health and safety measures. Being the business owners, farmers must stipulate defined metrics which are measured at defined stages. Farmers must be enabled and made aware of the need to recalibrate their processes when needed to overcome deficiencies over the fattening duration. A feedlot farm's management must further ensure its labor force is capable of taking preemptive measures in terms of both animal concerns such as stress management, performance monitoring, and maintaining hygiene and inventory supplies. A skilled labor force cognizant of required output in terms of healthy animals goes a long way to meet objectives of feedlot farmers.

A. Feeding of Newly Bought Animals In Feedlot

Animals for feedlot are. Animals purchased from local Mandi or directly from farmers are in poor body condition, high load of parasites and feeding history is unknown. Cattle have been grazing or fed green chopped forages. After arrival at feedlot feed and water should be available. Cattle entering into the feedlot should be adapted to a total mixed ration (TMR) starter diet. Starter feed should have high roughage and ingredients that will be fed in subsequent diets. Cattle 250 kg to 350 kg recommended 3 step up ration program; first a starter ration, secondly an intermediate ration fed and then a finisher ration. This is a period of time for cattle adapt to feed and water troughs and learning to eat aggressively (Table 14).

Table 14. Feeding Schedule for Newly arrived cattle

Day-1	1.5 % of body weight hay or 2.0% green forage
Day-2	If all feed is not consume do not feed until cleaned 1.5 % of body weight forage or 2.0% green forage
Day-3	Cattle should consume 1.5 % of body weight hay or 2.0% green forage trough should be completely cleaned before moving forward. If cleaned up feed 1.0 percent body weight plus 0.5% of body weight of Starter Ration.
Day-4	1.0 % of body weight hay or 2.0% green forage before moving forward must have a clean trough. This trains the calf to eat aggressively. 1.0 % of body weight starter on top of the forage
Day-5	0.5 % of body weight hay or 1.0% green forage before moving forward must have a clean trough. 1.0% % of body weight Starter on top of the forage
Day-6	0.5 % of body weight hay or 1.0% green forage before moving forward must have a clean trough. 1.% % of body weight Starter on top of the forage
Day-7	1.5 % of body weight TMR on top of the forage
Day-8	2.0 % of body weight Starter
Day-9	Begin feeding Starter to Appetite
Day-10	Begin feeding Intermeiate Ration to appetite
Day-11	Continue feeding Intermeiate Ration to appetite
Day-12	Continue feeding Intermeiate Ration to appetite
Day-13	Continue feeding Intermeiate Ration to appetite
Day-14	Begin feeding finisher ration to appetite using trough reading to feed to appetite and continue until finish

If cattle are received over a 5 day period all cattle be fed through day 3 and last cattle arrive fed 3 days before moving to day 4. Newly purchased animals are fed once a day in first 7 days then twice a day. The quantity shall be based on previous day feed consumed. The starter ration is fed through processing.

B. Feed Intake and Water

Feed intake is expressed as DM however, diets are consumed as fed which includes moisture and intakes are expressed as kg of feed daily (as fed) and dry matter is calculated and expressed as dry matter. Dry matter feed Intake is controlled in finishing cattle by energy requirements for growth. When high roughage moisture ration are fed the intake is controlled by rumen fill. The three step program the newly arrive cattle will consume in the first 7 days from 1.0% to 2% of body weight dry matter except if they become sick consumption will be 0.5% to 0.75%. The starter ration should be 75% dry matter ration. As the Intermeiate and finish ration is fed after 30 days the expected dry matter is 2.25% to 2.75% as cattle starting feed do not meet expected dry matter intake then Starter (TMR) should be fed longer until target dry matter is consumed.

There are many factors affecting dry matter intake however, major factors that reduce dry matter intakes are health status particularly virus such as FMD, hot and humid and cold wet weather. Minor affects are due to species age, weight, sex and breed. Feed characteristics such as; palatability and physical form determine can influence the level of feed intake. The ideal moisture for Feedlot fattening is 60% to 75 % to insure the proper consumption of dry matter. Feed is best fed twice per day, however can be fed once a day.

Free access to clean drinking water all the time is important to support feed consumption in animals. Lack of drinking water reduces feed intake. Water quality is important in maintaining water consumption of cattle. Physio-chemical (pH, total dissolved solids, hardness, and total dissolved oxygen), organoleptic (odor and taste), compounds present in excess (nitrates, iron, sodium, sulfates, and fluorine), toxic compounds (arsenic, cyanide, lead, mercury, hydrocarbons, organochlorides and organophosphates) and bacteria are criteria for evaluating drink water for humans and livestock. Cattle consume water from surface water sources and ground water sources such as ponds, lakes, streams, and wells.

Water need of feedlot cattle recommended by NRC Nutrient Requirement of Beef Cattle-2000 and further modified by Hutcheson 2017 (Table 15).

Table 15. Estimated Feedlot Water Intake

Body Weight Kg	Ambient Temperature		
	10°C	20°C	30°C
180	9-16 liters	11-22 liters	18-36 liters
270	11-22 liters	15-30 liters	23-45 liters
360	14-29 liters	18-39 liters	29-64 liters

NRC (2000) has also developed water intake equation as below;

Water Intake (liters/day) = −18.67 + (0.3937xMT) + (2.432xDMI) − (1.52xPP) − (4.437xDS)

MT is maximum air temperature in degree Fahrenheit; DMI is daily dry matter intake in pounds;

PP is precipitation in inches per day and DS is percent salt in the ration.

Salinity refers to the amount of dissolved salts in water and is measured by total dissolved solids. These dissolved salts are sodium chloride primarily but may include carbonates, nitrates, sulfates, calcium, magnesium and potassium (Table 16).

Table 16. Guide to use of saline water

Total Dissolved Solids (TDS) mg/l or ppm	
Less than 1,000 ppm fresh water	Presents no serious burden to livestock
1,000 - 2,999 ppm slightly saline	Should not affect health or performance but may cause temporary mild diarrhea
3,000 - 4,999 ppm moderately saline	Generally satisfactory, but may cause diarrhea, especially on initial consumption
5,000 - 6,999 ppm saline	Can be used for reasonable safety for adult ruminants but should be avoided for pregnant cattle and baby calves..
7,000 - 10,000 ppm very saline	Should be avoided if possible. Pregnant, lactating, stressed or young animals can be affected.
Greater than 10,000 ppm brine	Unsafe, should not be used under any conditions

Salinity is part of the total dissolved solids but is not hardness. For an example high saline waters may contain high degree of salt and yet not be hard due to the lack of magnesium and calcium. Concentration of calcium and magnesium contributes to hardness. Hardness, calcium plus magnesium classification is defined in Table17.

Table 17. Calcium and Magnesium concentrations and hardness

Hardness	Calcium plus Magnesium ppm
Soft	0-60 ppm
Moderate	61-120 ppm
Hard	121-180 ppm
Very Hard	181 ppm and greater

The degree of hardness does not affect livestock production. Laboratory analysis sometimes reports hardness as grains of hardness. One grain per gallon is equal to .0058 ppm.

Cattle performance and reproduction is affected by nitrates in the water. Nitrate (NO3) is reduced to nitrite (NO2) which creates the toxicity. A nitrate level in water in excess of 0.3 mg of nitrate nitrogen per liter contributes to excessive algae growth. Table 15 is a guide to levels of nitrate and nitrate nitrogen and precautions (Table 18).

Table 18. Nitrates in water

Nitrate (NO_3) ppm	Nitrate (NO_3-N) ppm	
0-44 ppm	0-10 ppm	No harmful effects
45-132 ppm	10-20 ppm	Safe if diet is low in nitrates and nutritionally balanced
133-220 ppm	20-40 ppm	Could be harmful if consumed over long periods of time
221-660 ppm	40-100 ppm	Cattle at risk; possible death losses
661-800 ppm	100-200 ppm	Unsafe; high probability of death losses
Over 800 ppm	Over 200 ppm	Unsafe; do not use

Table 19 has been adapted from Mineral Tolerance Domestic Animals, NAS, 1980 and Nutrients and toxic substances in water for livestock and poultry, NAS, 1974 as a guide line for water quality for cattle.

Table 19. Water quality guidelines

Item	Desired Upper Limits ppm	Maximum Upper Limits ppm
Aluminum	5	10
Arsenic	0.2	0.2
Bicarbonate	Unk	<1000
Boron	5	30
Cadmium	0.01	0.05
Calcium	100	150
Chloride	100	300
Chromium	1	1
Cobalt	1	1
Copper	0.2	0.5
Fluoride	2	2
Lead	0.05	0.1
Magnesium	50	100
Manganese	0.05	.5
Mercury	0.01	0.01
Nickel	0.25	1
Selenium	0.05	.10
Sodium	50	300
Sulfate (S from SO4)	20	100
Sulfate (SO4)	50	300
Vanadium	0	0.1
Zinc	25	50
Nitrate (NO3) ppm	45	130
Nitrate (NO3-N) N from NO3	10	20
Total Dissolved Solids (TDS)	960	5000

C. Calling Feed and Feed Trough Reading

Feed trough management is matching the amount of feed delivered to the amount of feed the cattle can handle. Cattle are self propelled fermentation vats and like everything to stay constant. Cattle like a consistent diet and consistent amounts at consistent times. Feed trough management influence feed intake and weight gains of the animals. The right quantity of feed added to trough need understanding the amount consumed by group of animals in 24 hour and is referred as “Feed call”. As it affect subsequent day feed intake, is quite tricky. If ration is increased too much the animals may eat all but loose appetite and crash day or two due to acidosis (drop in rumen pH) and may take time return to normal pH and so feed intake.

Calling feed is an art that can be developed with practice. Most feed callers score the feed troughs each morning before feeding and then determine the amount to be fed that day. The feed amount is divided into two feedings or more. Reading the feed bunk at the same time every day is important, and then calling the feed for the day is more accurately accomplished. Feed trough reading can be done between feeding as well and adjustments can be done for the second feeding. The guidelines and notes are aids for bunk reading and calling feed Table 20.

Table 20. Bunk Reading and Calling Feed Guidelines

Bunk Score	Observation of Feed in Bunk	Description	Call
1.	Empty - Slick	No feed remaining in the bunk	Consider increasing no more than 10 % of dry matter. Approximately 400 to 500 gms or less on an as fed basis
2.	Crumbs	Scattered feed present. Most of bunk is exposed.	Consider increasing no more than 5 % of dry matter. Approximately 200 to 300 gms or less on an as fed basis
3.	Small Amount Less than 0.5 inch of feed	Uniform layer of feed across bottom of the bunk.	No change in previous amount of feed
4.	Too Much more than 0.5 to 1.0 inch of feed	10 to 25 % of previous feed remaining.	Consider decreasing no more than 5 % of dry matter. Approximately 200 to 300 gms or less on an as fed basis
5.	Excessive More than 1inch of feed	More than 25 % remaining in the bunk.	Consider decreasing no more than 10 % of dry matter. Approximately 400 to 500 gms or less on an as fed basis

Slick – 1

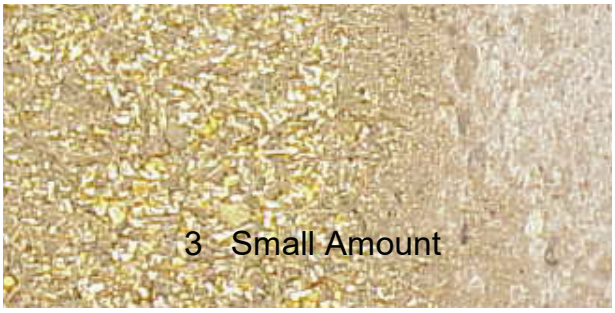
- Behind cattle not fed enough fed the day before.
- Increase dry matter 7 to 10 %.
- If slick 3 or 4 days do not increase 4 or 5 day.

Crumbs – 2

- Cattle fed about right.
- Increase the call 3 to 5 %.
- If crumbs for 3 or 4 days in a row then do not increase.

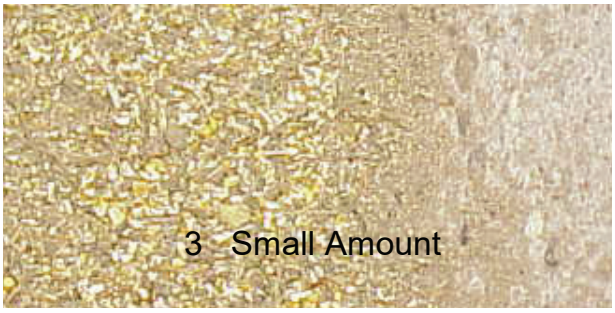
Good – 3

- The cattle should be cleaned up by the time they are fed.
- No change in feed call for the next day.



Small Amount - 4

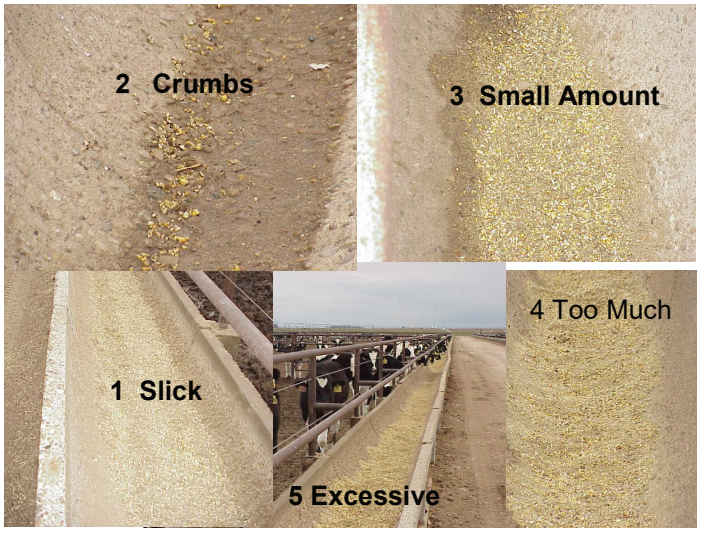
- Slightly overfed the day before.
- Reduce feed call for next day 3 to 5 %.
- Reduce feed call no more than 3 or 4 days.
- If reduced 3 or 4 days in a row then reduce feed call 7%.



Too Much – 5

- Excessive over feeding the day before.
- May need to scoop out depending on moisture.
- Allow cattle to clean up the feed before feeding.
- Reduce feed 5 to 10% next feeding.
- If too much for 2 or 3 days in a row then reduce the call 10 % next day.

Summary



When making the feed call, take into account:

- The previous four days' feed deliveries,
- The previous four days' trough conditions (what have the feed calls been the last four days?)
- The number of days the cattle have been on feed
- Any other information which may be pertinent, such as processing schedules.
- When feed has been increased or decreased 3 days in a row consider not making a change the fourth day. Use dry matter intake as percent of body weight for past 3 to 5 days to make call.
- Try not to increase or decrease too rapidly.
- Feeding cattle over or under feeding a few kgs can be a large fluctuation of available feed for that day.
- 10 kgs delivered to the bunk more or less than the call for two days will accumulate to 20 kg over or under. (50 head in the pen 400 grams per head over or under).
- Check intakes by pens for previous 3 to 7 days to determine if a pen is developing a pattern of being under fed or over fed.
- Feed should be deliver as close to the call as possible.

D. Manure Evaluation as a Diagnostic Tool for Feeding Program

Evaluation of feces has some potential as a nutrition and health tool. Feces evaluation can be described by color, consistency and content. Fecal color is influenced by feed type and passage rate of digesta. If an animal undergoing medical treatment may excrete colored feces. Dark or bloody manure may indicate hemorrhaging in the gastro intestinal tract from watery dysentery, mycotoxins, or coccidiosis.

Feces can give an indication of rumen is functioning and where and how well feeds are being digested. Rumination and digestion by microbes in the rumen break down fiber and feed particles to small size. If the animal does not eat enough fiber (chewable and total) to maintain rumination and rumen function, feed can pass out of the rumen more quickly and in larger particle size than it should be. When this happens, ingested feed is not well digested and find its way in the manure. With adequate fiber in the diet a mat of fiber is maintained on top of liquid compartment in the rumen which retains feed for more complete digestion by microbes and prevents rumen acidosis. If rumen is working well then only few particles not more than 0.5 inches long can be seen in the feces. The feed particles escaped from rumen some may be digested in the small intestine and some in the hind gut (cecum and large intestine). The extent to which feed ferments in large intestine alters the consistency, color and physical appearance of feces excreted.

To assess how feces indicates digestion in the rumen, fecal scores varying from 1 to 5 from a dairy score card are suggested and used as quick tool for diagnosis the problem and rectifying by adjustment in the ration. A pen incidence of score 1 or 2 of more than 3 on any given pen may require action.

Animals ruminating (6-8 hrs a day) is a sign of good rumen functioning. Undigested grains indicate grains are not ground to a fine enough particle size or fed large amount at one time. Fecal evaluation is subjective but yet is a tool for the nutritionist can determine the best cost for the feeding program for Dairy or Feedlot Fattening. The dairy score card is slightly different from the Feedlot Fattening score card differences are noted in Table 21.

Table 21. Dairy Fecal Scores and Causes

Scores	Apperance	Possible Cause
Score-1 Loose & watery manure.		• Insufficient fiber in ration • High soluble protein. • Infectious disease. • (E coli, Salmonella etc)
Score-2 Diarrhea, custard type consistency, splatter far when drop on ground.		• Spoiled, moldy feed. • Rumen acidosis. • Increased hindgut fermentation. • Ration imbalance.
Score-3 Foamy manure with mucin casts. Mucin casts are shed out of large intestine Dairy No Mucin Feedlot.		• Rumen acidosis Dairy. • Increased hindgut fermentation Dairy. • Feedlot Good not acidosis in Feedlot no mucin cast.
Score-4 Thick heavy onsistency, stack & make sound when dropped, small depression or temple in middle.		Almost acceptable if no undigested feed particles
Score-5 Stiff dung almost forming balls		• Constipation • Inadequate water intake • Only dry forage possibly sorting diet feedlot

E. Health Management of Feedlots

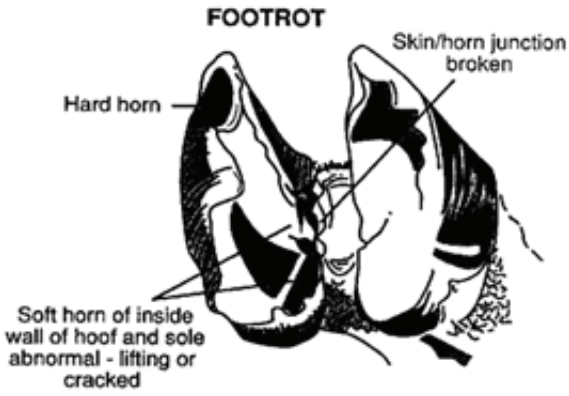
There is an increasing animal disease burden which is causing poor productivity thereby decreasing the sustainability of feedlot farmers. If an effective animal health management system is implemented at farm level, these losses can be minimized. Health management improves animal welfare by providing comfort to the animals including safe environment and ample nutrition that meet national and international requirements. Diseases cause economic losses in feedlots through mortality, treatment cost and low productivity. The production losses due to clinical and subclinical diseases may be higher than the mortality losses. Feedlot managers should understand the impact of disease on cost production. Animals suffering from incurable diseases or genetic deformities including chronic laminitis, foot rot, chronic bloat, chronic pneumonia, acute and chronic pulmonary abscess and bovine viral diarrhea should be culled from the farm. An animal should be sold for slaughter if this is a viable option or euthanized. Early and accurate diagnosis of infectious diseases is a key to sustainable production of beef. This can be achieved by good surveillance and appropriate facilities for examination and treatment at the farm. A herd-health "calendar" in which health events are coordinated with major operational events of feedlot farm should be planned. The major disease risks for a given herd, along with appropriate preventive measures, should be established in consultation with herd owners and a protocol for treatment. Herd health managers should focus on diseases that reduce productivity considering biosecurity, nutrition, and the judicious use of medicines.

The feedlot veterinarian should make regular scheduled visits to the feedlot, deal emergencies, perform necropsies, follow established treatments, vaccinate animals on time, discuss overall animal health and production performance with the feedlot managers and other consultants to achieve animal health and production goals. In many cases, feedlot personnel can be trained to recognize common postmortem lesions, take digital photographs of such lesions and send them to the consulting veterinarian, and collect samples for laboratory analysis. Feedlot managers should maintain record of individual animal identification, serial/lot number of medicine, weight of animal, diagnosis, and drug dosage used, route of administration and withdrawal period for two years. The veterinarian should provide a treatment protocol book specific to the feedlot operation. It should be reviewed regularly and updated at least every 90 days. One copy should be kept at the treatment facility and another copy should be maintained in the feedlot office.

Feedlot employees should be trained for early detection of sick animals in their pens and treatment. The common sickness observed in animals are anorexia, depression, lameness or abnormal gait, stiff movement, coughing, nasal and ocular discharge, increased breathing rate, crusted muzzle, sunken eyes, rough hair coat, loose or very firm feces, abnormal abdominal fill, and straining. At feedlot farm, record of complete history of the disease outbreak (including details and date of index case, total number of sick animals, treatments, case fatality rate, population mortality rate, and vaccination history), and clinical examination of several affected animals (with appropriate samples) as well as necropsies should be maintained.

An important component of feedlot health programs is the planning of vaccination programs. If outbreak of an infectious disease is encountered, the intensity of surveillance must be increased to detect new cases in the early stages of disease when response to treatment is usually good. Vaccination schedules vary depending on the prevalence of disease both in the feedlot area and in the area from which the cattle originated. The vaccines used and the vaccination schedule should be based on the expected incidence of the disease, the cost of the disease when it is seen, the cost of the preventive procedure (vaccine plus labor), the field efficacy of the vaccine, and other available control procedures. It should be ensured by farmers that calves purchased for feedlot purposes are vaccinated against foot and mouth disease, bovine viral diarrhea, bovine ephemeral fever, hemorrhagic septicemia, black quarters, anthrax and brucellosis. Before purchasing animals, farmers should be sure that herds have tested negative for these diseases.

Foot and mouth disease (FMD) is a viral disease that mainly infects buffaloes and cattle. The symptoms mainly include high rise in body temperature, lesions on muzzle, hooves and udder. Most of the young animals infected with FMD leads to death. Moreover, FMD leads to irreversible pathological changes in udder that result in reduced milk production from lactating animals. FMD can transmit to other animals through physical contact. So the separation of diseased animals from healthy animals is good strategy to control the spread of the disease. Mostly, the oil based vaccines are to control the FMD at buffaloes and cattle farms. This vaccine can protect the animals up to one year.



Bovine Viral Diarrhea (BVD) is the main viral disease of buffaloes and cattle throughout the world. Mostly, it infects animals of all ages but the young animals of 6 to 24 months of age are more prone to this disease. Even after cure of this disease, the infected animals can remain the source of diseases transmission throughout its life. The virus shed through the urine and excretion of the infected and carrier animals. This disease mainly leads to high rise in body temperature, reduced milk production, diarrhea and high rise in eye secretions. This disease mainly leads to abortions in pregnant animals. So to control this disease, it is important to purchase BVD free animals.

Hemorrhagic Septicemia (HS) is a main bacterial disease of buffaloes and cattle. This mainly infects the immune compromised animals, especially due to weather and humidity stress. This pathogen mainly resides and grows in oral tonsils and the toxins spread throughout the body. After infection within 8-24 hours, the infected animal shows signs and symptoms of the disease. During initial course of the disease, there is high rise in body temperature, high rise in reluctant to move.

The main sign of this disease is the swelling of the throat that spreads with the course of the disease. The swell throat put pressure on trachea region (Breathing tube) and it became very difficult for the infected animal to breath. The infected animal may leads to death due to breathing failure. The animals should be vaccinated with oil based HS vaccine, which protects the animals 9-12 months from this disease.

Black Quarters is a disease cause due to bacterial pathogen, which mainly survives in the soil for years in the form of spores. The fodder raised in the contaminated soil may become a source of infection. After the ingestion of spore contaminated fodder, the spore absorb in the blood through intestine. In favorable conditions, these spores turned to vegetative form in heavy muscles. The summer provide favorable environment to spread this disease. The symptoms mainly include in high rise of body temperature, swelling of back muscles and air bubbles can be found beneath the skin. There will be crepitating sound after you press the air bubbles. This disease can leads to death within 12-48 hours. The animals should be vaccinated to protect the animals from this disease.

Anthrax is a disease infects both animals and humans worldwide. This disease is caused due to bacteria. The global environmental changes mainly, heavy rainfall and drought mainly helps to spread this disease. Mostly the animals got infection from the ingestion of fodder that rose in anthrax spore contaminated soil. Usually, these spore leads to productive infection, 3-7 days after spore ingestion. Usually it is an acute disease that leads to death shortly. The symptoms include high rise in body temperature, difficult breathing, shivering, trembling gate, blood ooze out from natural orifices that ultimately leads to death. This disease leads to decrease milk production and abortion in pregnant animals. The postmortem of dead animal due to this disease is not recommended. The animals can be protected from this disease by using anthrax vaccination.

Bovine ephemeral fever (BEF) is an important vector-born disease of farm animals. The pathogen of the disease is transfer through vector. This disease may lead to fever, lameness, stiffness, nasal and ocular discharge. This disease may lead to decrease body calcium level that ultimately results depression, muscle tremors and constipation. The vaccine should be used to control this disease.

Brucellosis is a bacterial disease that leads to abortion in almost 7th month pregnant animals. The disease animal excretions are a source of bacterial spread that leads to the spread of the disease in healthy animals. This pathogen transfer through disease animal mating and disease male animal semen, that leads to metritis that ultimately leads to abortion. The pathogen is also secret in disease animal's milk. So the raw milk can be a source of disease spread in humans. The best way to control this disease is the proper and regular screening of the farm for this test using RBPT and ELISA.

Hemoparasite are the single cell organisms that found in animal blood. These may transfer due to vectors. Hemoparasites including Theileria and Babesia are important domestic animal pathogens causing Theileriosis and Babesiosis. Theleria transfer to the healthy animals through ticks. This parasite propagates successfully in white blood cells (WBC) and red blood cells (RBC). Theleria leads to high rise in body temperature, tonsillitis, difficult breathing that ultimately leads to death. As the tick increases during the summer season that ultimately increase the disease.

. This disease also leads to death if leave the animals untreated. Babesiosis is also an important tick born disease of animals. This parasite mainly affects the red blood cells (RBC). This disease leads to high rise in body temperature, difficult breathing, weight loss, and anemia and blood urine. After proper diagnosis and treatment the diseased animals can be cured for Theileriosis and Babesiosis.

Ectoparasites are potential source to spread many diseases in farm animals. This includes ticks, mites, flies and etc. The type of the ectoparasite is important to treat the ectoparasite. Endoparasites are parasites present inside the animal body. Due to these endoparasites animals cannot benefit the diet because these parasites take major part of the disease. Due to the presence of these endoparasites, most of the vaccines cannot produce the immunity to its potential. So, the costly vaccines usually become less effective. For the diagnosis of endoparasites, the feces should be sent to the laboratory. After the diagnosis, proper treatment should be done in the animals.

Health management at feedlot farms depends on purchasing healthy animals, comfortable pen environment, and good surveillance of diseases, proper medication and vaccination and culling of animals suffering from incurable diseases. A deworming schedule is presented in feedlot farmers (Table 22).

Table 22. Farmer deworming Schedule

Type of Worm	Deworming Schedule
1. Roundworms	First dose at 10 days of age and thereafter at monthly interval up to 6 months Thrice a year in animals above 6 months of age
2. LIver Flukes	Twice in a year in endemic areas (before and after monsoon)
3. Tape Worms	Twice a year i.e. in January and June in calves in problem herds

Purchasing power of the public has increased and intake of protein of animal origin has significantly increased. This demand has put heavy burden on supply chain of milk, meat and eggs, especially in big cities of Pakistan. Moreover, escalated general prices of meat products have attracted many potential investors to feedlot farming in Pakistan. Although the feedlot farming is somewhat profitable for farmers yet is facing many limiting factors like disease issues e.g., foot and mouth disease, hemorrhagic septicemia, etc. These diseases not only decrease their profit margin but sometimes cause heavy economic losses to them in the form of poor productivity, heavy mortalities, and cost of diagnosis, treatment, vaccinations and surveillance. It is pivotal to take effective measures which help protect feedlot farms for entry of infectious agents. Strict implementation of farm biosecurity plans and provision of comfort to animals keeping in view animal welfare recommendations may aid individual farmer in having sustainable feedlot beef production. Consumers are willing to buy beef at higher price from feedlot farms which have proper health record of deworming, vaccination, disinfection, etc.

Farm workers, veterinary doctors, vaccinators and other farm visitors may breach farm biosecurity and become a source of infectious disease transmission. Entry of service and consumers should restrict. Persons desiring entry requiring performing any procedure, please provide them clean gum boots and dungarees. Similarly, arrange such restrictions as stop the entry of any dog, cat, rabbit, rat or any wild animal.

Spray disinfectants on the tires of vehicles which are used to transport visitors, farm staff, animals, feed and fodder. Restrict use of mobile phones at the farm premises because it is also a potential source of spread of pathogens from one farm to another.

Newly purchased/ replacement animals must be screened for important infectious diseases like brucellosis, tuberculosis, hemoparasites and endoparasites. It is advisable that final payment of the replacement animals may be paid, once they are found healthy by lab based disease diagnosis. Wherever, such diagnostic facilities are not accessible, keep these animals in strict quarantine for two weeks before their entry into existing herd. During this period, animals must be kept under strict observation for appearance of any unusual animal behavior or symptomology. Routine vaccination must be administered to the animals as per prevalent livestock diseases of the area.

It should be ensured that animal feed must be toxin free and brought from the land which is irrigated by clean sources of water and not by sewerage water. Similarly, drinking water tested for coliform counts from such reputable water testing lab as providing proper interpretation of recommendations. Water pumps having less than 100 feet of bore depth are generally having high contamination with pathogens which cause enteric diseases like calf diarrhea so it is recommended that at least over two hundred of bore depth may be drilled for having safe source of water for your animals.

Complete record of individual animal health should be maintained to predict any outbreak at the farm before time. There should be strict implementation of biosecurity plan on the farm to control animal diseases. Many international organizations like FAO, OIE, Global Animal Partnership (GAP), have developed comprehensive protocols / procedures to control infectious diseases, these protocols should be strictly implemented at farm in true spirit.

Ensure weekly spray of antimicrobial iodine solution like Pyodine (1-2%; commercially available on every medical store and is very cost effective) which significantly decreases the microbial load especially of common bacterial and viral pathogens. Quarterly whitewash (using lime) the walls, floors (especially fill the crevices), feed troughs, water troughs, and entry points for removing organic matter/biofilms which harbor some resistant pathogens keeping chain of disease cycle perpetuate.

Infectious diseases can be prevented by proper vaccination, safe feed, ample water and space and strict implementation of biosecurity measures. Infectious diseases can be prevented by proper vaccination, safe feed, ample water and space and strict implementation of biosecurity measures. The vaccines used and the vaccination schedule should be based on the expected incidence of the disease, the cost of the disease when it is seen, the cost of the preventive procedure (vaccine plus labor), the field efficacy of the vaccine, and other available control procedures.

After thorough consultations with the local veterinarian, following vaccination schedule can be used for feedlot animals with modifications Table 23.

Table 23. Vaccines, Vaccinations, Dose, Route of administration, Booster Time and Immunity

Vaccine	Dose	Route	Time of Vaccination	Booster Time	Immunity Duration
FMD (O, A and Asia 1)	2-3 mL	S/C, I/M	February and September	Six months/ yearly	9-12 months
BEF (Bovine Ephemeral fever)	2 mL	I/M	1 month before summer	Yearly	12 Months
HS (P. multocida Robert type B)	3-5 mL	S/C, I/M	May & November	Six months	4-6 Months
Black quarters	5 mL	S/C	May to September	Four months to Yearly	12 Months
Anthrax	1 mL	S/C	Recommended in endemic areas	Yearly	12 Months

Note: Vaccination schedule as per specific management system may be prepared in consultation with the local veterinarian keeping in view the disease burden of the area.

Checking Dose and Removing Air before Injection

F. Effect of Stress on Performance of Animals In Feedlot Fattening

Stress is defined as a nonspecific response of the animal to any demand. Stress in Feedlot cattle has 2 major components: 1) The stressor, the environment and 2) the physiological changes in the animal. Nutrition and stress in at least two different ways: 1) can produce or aggravate nutrient deficiencies 2) nutritional deficiencies can prevent the animal's ability to respond to stress, the management of cattle from the market Mandi results in many stresses. The major stressors created are deprivation of feed and water, weaning, crowding and infectious diseases. Other stresses encountered either before or after arrival at the feedlot include environmental changes castrations, dehorning, vaccination, deworming and other processing procedures. All of this stressor may be involved in altering nutrient requirements of animals. Market – Transportation stressors cause at least two effects: 1) loss of appetite or willingness to consume feed is depressed during the first three weeks after arrival at the feedlot. Erratic and low feed consumptions are affected by previous management, environment and other stressors. Nutrition, stress and environment interrelate and all must be considering in selecting the best combinations of management practices for optimum animal performance.

Heat stress can be devastating to feedlot cattle performance. Heat stress can occur when temperature and humidity is high day and night with little or no wind movements.

The heat index is a reliable index that is a useful tool in determining periods of heat stress. Table 24 is the environmental livestock weather safety index.

Table 24. Livestock Weather Safety Index

Dry Bulb Temp C°	Relative Humidity %																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
24							70	70	70	71	72	72	72	73	74	74	74	75	76	76
25						70	70	71	71	72	72	73	73	74	74	75	75	76	76	77
26				70	70	71	72	72	73	73	74	74	75	76	76	77	77	78	78	79
27		70	70	71	71	72	73	73	74	75	75	76	77	78	78	78	79	80	80	81
28	70	71	71	72	73	73	74	75	75	76	77	77	78	80	80	80	81	82	82	83
29	71	72	72	73	74	75	75	76	77	78	78	79	79	81	81	82	83	84	84	85
30	71	72	73	74	74	75	76	77	78	78	79	80	80	82	82	83	84	84	85	86
31	72	73	74	75	76	76	77	78	79	80	81	81	81	84	84	85	86	86	87	88
32	73	74	74	75	76	77	78	79	80	80	81	82	82	85	85	86	86	87	88	89
32	73	74	75	76	77	78	79	79	80	81	82	83	83	86	86	87	87	88	89	90
33	74	75	76	77	78	79	80	81	82	83	84	84	85	87	88	88	89	90		
34	75	76	77	78	79	80	81	82	83	84	85	86	87	89	90	90				
35	76	77	78	79	80	81	82	83	84	85	86	87	87	90	91					
36	77	78	79	80	81	82	83	84	85	86	87	88	89							
37	78	79	80	81	82	83	84	86	87	88	89	90	90							
38	78	79	80	82	83	84	85	86	87	89	90	91								
41	80	82	83	84	86	87	89	90	91											

Alert

Danger

Emergency

The basic challenge is the ambient temperature is higher than the body core temperature. Heat stress occurs when cattle are outside of their thermal neutral zone (TMZ). The thermal neutral zone is that environmental period that does not affect the cattle ability to perform at the maximum expectation. During episodes of heat stress, feed intakes decrease markedly and net energy of maintenance (NEM) requirements increase. The maintenance energy is required to remove heat from the body to cool the body. When the environmental temperature increases above, the TMZ maintenance energy is required to increase the movement of body heat by radiation, convection, conduction and/or vaporization of water. During heat stress, a majority of the dry matter intake is required for maintenance energy and less is available for gain. Many times feed intake is not enough to meet maintenance needs to remove the heat. The figure below describes the thermal neutral zone for cattle. When cattle are outside the thermal neutral zone TMZ either cold or heat stress can occur. Dry matter intakes and maintenance requirements during heat stress is illustrated in Figure 23.

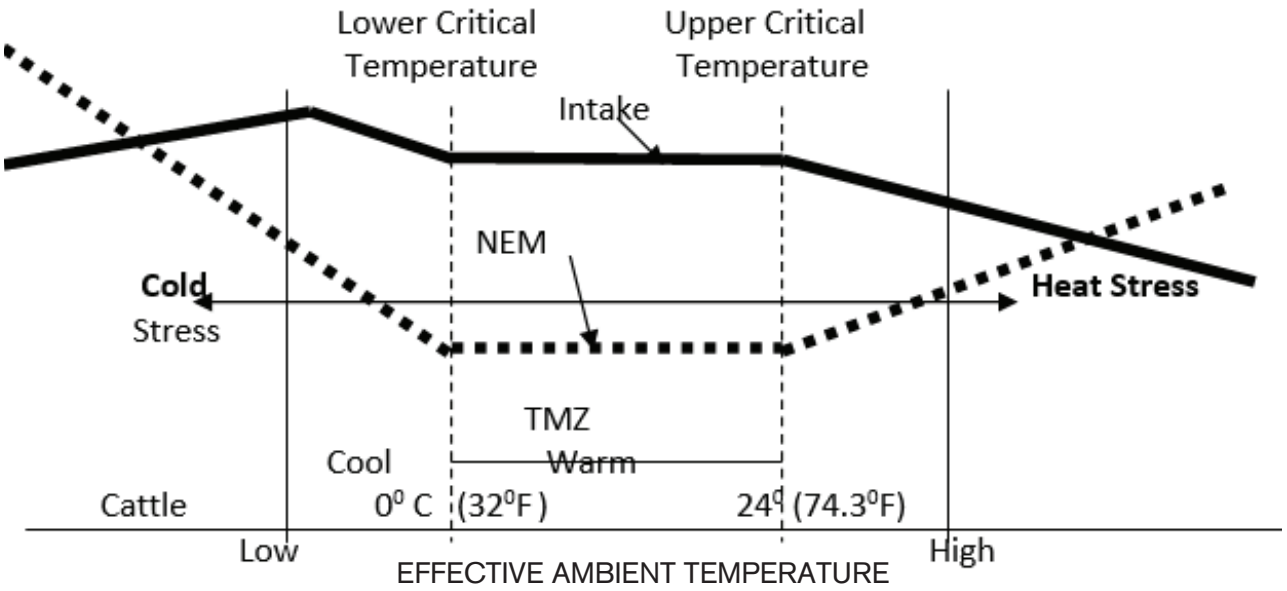


Figure 23. Dry Matter Intake and Maintenance requirements in Heat stress,

Energy needs increasing and energy from fat and higher neutral detergent fiber feeds tend to allow some relief during heat stress. The heat increment, heat that the rumen generates during ruminal digestion is highest with high fiber feeds. The increase in by pass protein tends to reduce heat stress since less microbial protein is synthesized.

Minerals that are involved in electrolyte balance should be evaluated in the ration during heat stress. Potassium has been shown effective in the diet at 1.2 % to 1.5 % of the dry matter during heat stress periods. Salt should be considered to be in the diet during heat stress periods, salt should be between 0.15 and 0.35 percentage of the dry matter. Magnesium should be considered to be between 0.25 and 0.35 % of the diet dry matter. Other products such as yeast and bicarbonates have played a role in aiding the animal to cope with heat stresses.

The loss of production from heat stress is not just during the period of heat stress but continues with a reduced production long after the heat stress episode. The recovery period can be 5 to 10 times as long as the heat episode.

Heat stress can be determined by monitoring the physiological functions of the cattle. The physiological functions increase, as an animal becomes heat stressed. Respiration can be monitored and be an indications of heat stress. The physiological functions during heat stress are shown in Table 25.

Table 25. Physiological Functions to heat stress

	700(F) 21.20 (C)	900(F) 32.20(C)
Respiration per min	26	115
Heart Rate per min	82	69
Rectal Temperature	102 38.9	104 40.0
Rumen Retention	37	43
Dry Matter Digestibility	62	68

Summary

Heat stress affects the cattle in the following ways:

1. Increase Energy for Maintenance
2. Decrease Intake
3. Alters Digestion
4. Alters Nutrient Absorption
5. Alters Metabolism
6. Alters Acid Base Regulation
7. Alters Physiological Functions
8. Dehydration particularly in very young animals

Considerations for heat stress feedlot episodes.

1. Heavier and fattest cattle are greatest risk
2. The cattle closes to finish should receive the first priority for cooling strategies
3. Extra water space is necessary
4. Fans for movement of air may be necessary
5. Cattle tend to find coolest place in pen
6. Many times this is over the water trough
7. Shade can be effective during this heat stress

Open mouth labored breathing with excessive salivation and tongues hanging out typically when ambient temperatures are close to cattle body temperatures and high humidity limits evaporative cooling, maintenance requirements can be 11 to 25 % higher. Dry matter intakes decrease by 1/3 or more when outside temperatures are greater than the body, temperature it is difficult for the animal to remove the heat load.

During Heat Stress Periods

1. Provide Shade.
2. Shade can be an effective during heat stress periods snow either fence type or solid. Arrange shades to shade a maximum area and high enough to allow heat removal.
3. Provide plenty of clean fresh water.
4. Water should be available at all times and water space may have to be increased during times of heat stress.
5. Water is critical at all times both amount and availability.
6. Cooler the drinking water is the more effective is the cooling effect.
7. Manage feeding schedule so cattle are not full during peak daytime temperatures.
8. Increase energy density with additional fat (7 to 8 percent dry matter basis)
9. Maximize formula to maximum Neutral Detergent Fiber (NDF)
10. Cool cattle with sprinklers more effective with fans to move air
11. During high humidity episodes, this may not be effective.
12. Water can aid in cooling with hot dry temperatures and good air movement.

Workers

1. Consider having available an electrolytes in a drink
2. Dry electrolytes can be added to water
3. Pre mixed electrolytes are available
4. Consider shade during critical times
5. Hats rather than caps
6. When no air movement consider fans

G. Feedlot Performance Monitoring Importance of Good Records

"One can only improve what is measured." Therefore, good (i.e., complete and accurate) record keeping is crucial to the sustainability of Feedlot Fattening. Good records are essential to monitor measures of production and allow for informed management decisions and planning. Cattle feeders use feedlot close-out information for economic evaluation of groups of cattle. However, frequently monitoring feedlot performance and costs as cattle are still being fed not only tells you where the feedlot is currently, but also allows managers to make fast mid-course corrections as feed costs or cattle prices change. Knowing the current cost of production is essential for making timely marketing decisions and decreasing corn and high cost feeds.

Good records help feedlot owners and managers to answer important questions about the operation's financial health, and effective management will depend on accurate measurement of production and financial variables. This allows for management decisions and plans based on good historical data.

Information in today's world is generated quickly. Therefore, it can be challenging to manage the volume of information available in ways that make the information understandable and manageable. However, once collected, information is of little value unless it is used to monitor progress, make decisions, and evaluate alternatives. Feedlot owners should continue to invest in methods of managing information. The owners and managers should also communicate the critical importance of accurate information from various input points in the feedlot.

Records to record date of purchase, number purchased (group or pen), pen number to feed, purchase price, purchase weight market and feedlot arrival, transportation cost, daily feed fed to pen, feed cost per ton processing cost, hospital cost, sale weight live and carcass, and sale price. Software program to calculate output are available or develop an data management to calculate reports.

Cost of gain and breakeven should be continually monitored. Feedlots should work with projected breakeven and marketing date/weight. Employees should be trained and should make decisions based on management input provided weekly. Inventory analysis should be conducted daily or weekly. Feed mixing and weighing of ingredients should be monitored. Cattle intake should be evaluated daily, and ration feed trough samples should be analyzed frequently. Feed waste should be measured, and adjustments should be made. Cattle gain and performance should be estimated with the use of software. Previous closeouts and records on cattle from a specific source could be used to estimate future performance. Feed purchases and waste should be monitored monthly for billing or cost of feed adjustments. Health management program effectiveness should be evaluated annually. Non-feed costs should be monitored and adjusted annually using feedlot figures. The charge of feed costs should be based on updated fixed and variable costs. Databases should be maintained and reviewed regularly. It is important to evaluate the database of selling prices by the type of cattle and feeding programs.

When facing difficult economic times all aspects of the operation should be evaluated. Sound economical decisions are made based on what we can measure and identify as not profitable.

Accurate evaluation of all processes and reevaluation of current practices is the way progress can be achieved for an individual feedlot, and because of this, good records are essential to maximizing productivity.

H. Biosecurity

Biosecurity on the feedlot refers to the measures put in place to protect livestock against exposure to endemic and emergency diseases. It also aims to limit the spread of these diseases within livestock and, in the case of zoonotic diseases, human populations. Infectious diseases, whether they cause clinical (obvious) or subclinical (hidden) disease, significantly reduce the productivity, profitability and long term financial viability of a feedlot. Biosecurity on the feedlot also includes preventing the spread of diseases, pests and weeds to or from other primary industries. Bio security is an important part of farm management which helps to avoid entry of all the unwanted agents which are not part of normal farm operation. Most of this refers to a dairies however should be considered biosecurity for feedlot farming where applicable.

Bio Security Requirement

1. Farm should have boundary wall to keep away the animals which could bring disease to the farm.
2. The farm should have a proper gate for entry and exit from the farm.
3. The farm staff should stay within farm boundary to avoid contact with other animals.
4. The farm staff should be working in specific uniform and proper safety shoes.
5. The farm staff must be aware of bio security measure within their work place

Farm Operations includes

1. Daily spraying and dipping system.
2. Regular disinfection plan.
3. Vaccination and de worming program.

Daily spraying and dipping system should be a regular spraying protocol in place at farm. The dipping protocol should be followed at the main gates of the dairy or feedlot farm to avoid the risk of entry of any unwanted agent. For this purpose formalin and white phenol can be used either for dipping or spraying the vehicles. The same could also be used for foot dipping at the entrance of animals housing or sheds. The foot dipping of animals is also being done by copper sulphate solution to control foot problems like interdigital dermatitis for dairies.

Regular disinfection plan for animal housing and open yards should also be followed by removing the bedding material after every 6 months and before putting new sand live lime stone should spread in open

yards 1 cubic meter of lime stone for 300 square meter surface area and then put new sand on top of the lime stone and sand layer thickness should be 12 inches. The top layer of sand could be sprayed by 5% formalin of commercial 40% concentration (Dairy). For sand bunkers animals sitting area inside the sheds should be disinfected with KMno4 with 5% solution and broad spectrum disinfectants solution 4% solution.

Eradication Program for dairies should be a regular examination of herd to detect the disease such as Brucella, Tuberculosis and Jhon's disease if any animals found positive that animals must be culled from the farm and such examination should repeated every 6 months for the negative herd and for positive it should repeated every 21 days for Brucella and after every 2 months for Tuberculosis.

Other Measure for Bio security also includes the Behavior of staff and visitor control. The staff should be reminded for their responsibility of infection control at farm. This should include sessions regarding following:

- Entry Exit in the farm and between sheds.
- Milk parlor hygiene in dairy section.
- Veterinary procedure.
- Insemination..
- Movement between the groups i.e. sick animals and calf housing.
- Personal hygiene.

I. Backgrounding

tBackgrounding beef calves is the growing of bulls, steers and heifers from weaning until they enter the feedlot. It is a beef cattle production system that uses pasture and other forages. Calves generally gain from 50k to 100 kilograms, depending on the available forages, ration fed and length of time involved. The weight gain comes primarily from muscle and frame development, with little fattening.

Proper health management is a vital part of any successful backgrounding program. The investment in disease prevention is less than the cost of disease treatment. Management of newly received or weaned calves during the first three to four weeks may very well determine the profit or loss of a backgrounding program. It is very desirable for all calves to be delivered during a short period of time (one day to a few days). Do not mix new calves with calves that have been at the backgrounding facility. If new calves are purchased, keep them separate and handle them as a different group. Assume that all incoming calves of unknown history need complete processing.

Calves should be placed in a clean pen or small pasture directly off the truck and be given free access to good-quality grass hay and fresh, clean water. Provide eighteen inches of feed trough space per calf. Process calves within a few hours of their arrival; however, if the cattle have traveled a great distance, a good rule of thumb is to wait one hour for every hour they were on the truck before processing.

Purchasing cattle from the market many have been weaned and are older. Bulls weighting 150 to 250 kg can be backgrounded and should be fed to gain 1.0 to 1.25 kg per day and will develop muscle and some fattening. Gains are accomplished as economically as possible by making maximum use of forages such as hay and silage in addition to non-conventional feeds. Little, if any, grain is used in most back grounding programs.

Holstein dairy bulls or steers produce more bone to muscle ratio due to large frame size. Backgrounding should be from weaning 80 kg to 150kg at least gaining 1kg per day. The objective is to have muscle and some fat to outgrow the bone development. This allows more muscle to bone ratio to increase the dressing percentage and boneless yield. During this period of growth is extremely efficient and can be moved directly to a finishing ration to produce desired carcass weights. They do require more protein than beef calves being backgrounded. A marketing plan should be developed to your advantage as example; the backgrounded animals could be sold as feeders to a Feedlot Fattening farm or could be retained for the market.

Advantages of Backgrounding is can be done on small or large farms that can produce large tonnage of forages or crop residuals, returns can be quickly 4 to 6 months, calves can utilize large quantities of harvested forages and residuals (concentrate to receive target gains) and thus produce best cost of gains and the program is flexible because adjustment in numbers is easily made.

Disadvantages of Backgrounding is the amount of capital required, buying and selling skills are important, may have labor requirements with other farm duties, need to be skilled with identifying and treating sick calves, risk of drastic market changes, equipment for forage harvesting and handling equipment as well processing area, supplement mixing and understanding the economics of backgrounding.

J. Total Mixed Rations (TMR)

Total mixed ration refers to a complete ration produced by blending all the feed ingredients, including roughages, concentrates as well as mineral and vitamin supplements. It is a ration that provides adequate nourishment to meet the nutrient requirements of animals. Because of complete mixing of all feed ingredients, each bite of feed consumed by an animal contains the same proportion of roughages and concentrates and the required level of nutrients (energy, protein, minerals and vitamins) needed by the animal. Feeding total mixed ration also creates a consistent rumen environment that helps improve feed utilization and productivity of animals.

a. Advantages of using total mixed ration

1. It eliminates animal selectivity of individual feeds. All forages, protein and energy supplements as well as minerals and vitamins are thoroughly mixed. If the roughages and concentrates are fed separately some animals may select the roughages only or consume only very little of the concentrate. Such animals cannot attain the desired level of body weight gain. On the other hand, some animals may selectively consume only the grain or concentrate and disregard the roughage.

Such animals could suffer from stomach upset such as acidosis due to over consumption of grain and grain by-products and lack of structural carbohydrates in the diet. When total mixed ration is used, the animal has very little chance of sorting for individual feed ingredients.

2. Total mixed ration enables more accurate determination of dry matter (DM) and nutrient intake of animals. Completely mixed feeds, coupled with grouping of animals according to age and/or weight and feeding them to appetite allows greater flexibility in feeding exact amount of nutrients (energy, protein, minerals and vitamins) to more nearly nourish the animals according the desired level of performance (body weight gain).

3. When thoroughly mixed with the roughage component, concentrate mixtures can be liberally fed to feedlot animals resulting in more efficient use of feeds. It allows the animals to consume as close to their nutrient requirements as possible, and at the same time maintains the physical structure or roughage characteristics required for optimum rumen function.

4. It allows overall better control of feed offered and consumed by animals and, thus, better control of feed costs.

5. It enables use of a wide variety of feedstuffs including less palatable ones.

b. Challenges of using total mixed ration

To be an efficient and effective feeding program, the TMR has to be managed correctly. Critical management factors include the following.

1. There is a need for correct grouping of animals according age and body weight.

2. The dry matter intake has to be closely monitored and there is a need for good feed trough management. Correct ration formulation and knowing the amount of DM consumed by the animals is very important to optimize productivity of the animals. Without good DM intake information, it is difficult to correctly formulate rations to meet the nutrient requirements of animals for maximum genetic body weight gain. Underfeeding of nutrients results in reduced performance of animals and overfeeding increases feed costs.

3. Thorough and consistent mixing of the ingredients is very important. A chopper is needed to cut (chop) the roughage feeds intto small pieces to facilitate mixing with the concentrate.

4. Even after chopping, the roughages and molasses pose difficulty of mixing well with the concentrate mix. Thus, a special type of mixer (vertical mixer) is required to mix the chopped roughages and molasses with the concentrate mix.

K. HACCP (Hazard Analysis and Critical Control Points)

Hazard Analysis and Critical Control Points (HACCP) is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. The finish point for the Feedlot is the carcass delivered to the abattoir. HACCP is a systematic approach to the identification, evaluation, and control of food safety hazards based on the following seven principles:

1. Conduct a hazard analysis
2. Determine critical control points (CCPs) in the process
3. Establish critical limits.
4. Establish CCP monitoring procedures.
5. Establish corrective actions
6. Establish verification procedures
7. Establish record keeping and documentation procedures

Feedlot cattle must meet the requirements of beef processors for health, carcass characteristics and food safety. A beef quality assurance program could be developed as a HACCP example.

Care and Husbandry Practices (CCPs)

1. Follow a Quality Herd Health Plan that conforms to good veterinary and husbandry Practice
2. Handle/transport all cattle in such a fashion to minimize stress, injury and bruising
3. Regularly inspect facilities (fences, corrals, load-outs, stations, freestall areas, alleys, etc.) to help ensure proper care and ease of handling
4. Keep feed and water handling equipment clean
5. Provide appropriate nutritional and feedstuffs management
6. Maintain an environment appropriate to the production setting
7. Evaluate and enforce biosecurity
8. Keep records for a minimum of 2 years or longer as required by laws/regulations (ie. 3 years for Restricted Use Pesticides)

Feedstuffs (CCPs)

1. Maintain records of any pesticide use on pasture or crops that could potentially lead to residue in cattle
2. A quality control program is in place for incoming feedstuffs that is designed to help eliminate contamination from molds, mycotoxins or chemicals in incoming feed ingredients. Supplier assurance of feed ingredient quality is recommended
3. Analyze suspect feedstuffs prior to use
4. Records are to be kept a minimum of two years, or longer as required by laws/regulations

Processing/Treatment and Records

1. Follow all label directions for each product
2. Strict adherence to extended withdrawal periods as determined by a veterinarian shall be employed
3. Individual animal or group identification

When cattle are treated/processed individually, treatment records will be maintained with the following recorded:

a. Individual animal identification
b. Date treated
c. Product administered and manufacturer's lot/serial number
d. Dosage
e. Route and location of administration
f. Earliest date animal will have cleared the withdrawal period
g. Name of individual administering the treatment
h. All cattle (fed beef bulls and dairy beef) shipped to harvest will be checked by appropriate personnel to ensure that animals that have been treated have met label or prescription withdrawal times for all animal health products administrated
i. Records are to be kept a minimum of two years, or longer as required by laws/regulations

This is an example that would assure the carcass was delivered to processor as a quality carcass, other could develop HACCP programs. There are records that can be to verified what has been administered to the animal

L. Common Routes of Drug Administration

a. Parenteral Administration Methods

Intravenous Route (IV) method of drug administration provides instant, effective and highly predictable blood concentration of medicine given, which allows its rapid metabolism and utilization by the body, required for the treatment of diseases. In most domestic of the animals (i.e. Horses, Cattle, Sheep and Goats) the IV medication is given through Jugular vein.

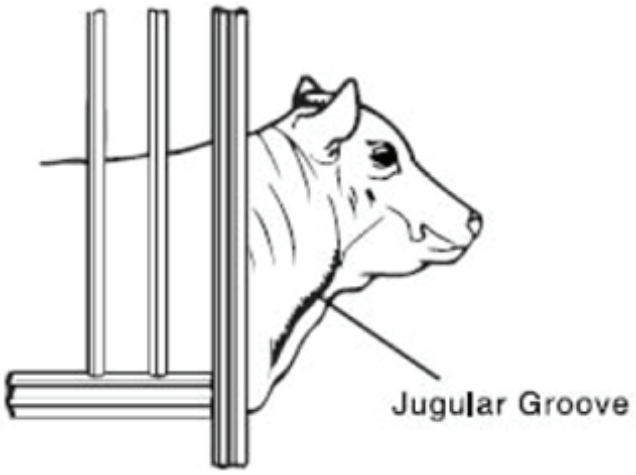


Figure 24. Jugular Groove for Intravenous Injection Site

b. Intramuscular (IM), Sub-cutaneous (SC or SQ)

(IM) Route: IM injection is the 2nd best, quick and most common method of drug administration in the body. In this the medicine is readily absorbed from muscle into the blood for utilization in the body. The IM injection is given where there is good muscle mass in the body. The preference site, in large animals, is neck muscle. Subcutaneous (SC/SQ) Route: SC injection is given when there is need to continuous and slow absorption of drug is required. The injection can be given at any site where the skin is slightly loose. In this case, the injected medicine is very slowly absorbed into surrounding tissues and then goes into the main circulation

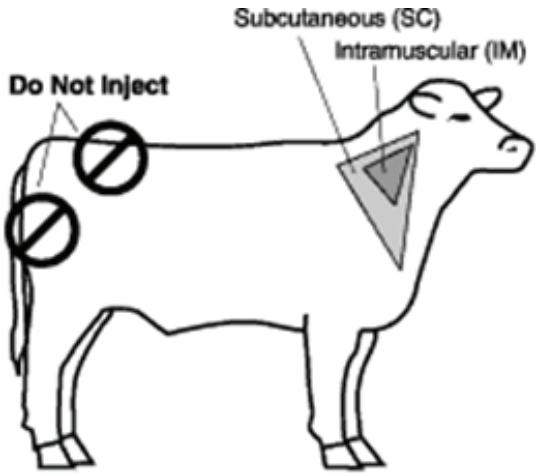


Figure 25. Intramuscular and Subcutaneous Injection Sites

c. Per-Oral or Per-Os (PO)

Per-Oral administration (PO): Per-Oral is the most common route of drug administration, i.e. directly into the rumen. The drugs for PO administration are either solid forms (as Powders, Tablet, Capsules, Pills, etc.) or liquid forms (as Syrups, Emulsions, Mixtures, or Drench). PO administering of medicaments are usually large in volume and is commonly called as 'Drenching'. The drenching of medicine is given through a Drenching Gun, Drenching Bamboo or Bottle. A small volume of liquid or solid forms of drug can also be administered with a large Dosing Syringes or Dosing Gun, specially designed for the purpose. Use of Stomach Tube is for larger volumes of fluid medications of electrolytes can directly pumped into the cow's rumen through a long Stomach Tube (and Pump). The Stomach tube is passed directly into the rumen through mouth/esophagus. This procedure is very useful when there is large volume of medicament in the form of liquid that is required to be administered directly into the rumen. This method is very effective in treating variety of conditions including severe dehydration and electrolyte imbalances in ruminants. The drenching equipment needed for the purpose, consists of a metal pump, attached with long stomach tube. The stomach tube is passed mouth into the rumen through a metal director, which can be kept in the mouth by a nose holder. The nose holder is necessary to keep the stomach tube in position and to avoid sliding out of the cow's mouth, while the medication is being pumped into the rumen. Once the stomach tube is advanced via the metal director in the mouth, esophagus, into the rumen, it meets no resistance. To confirm the stomach tube into the rumen, one can blow the air into rumen via the external end of tube and simultaneously, an assistant can auscultate the air blow sounds with a stethoscope on the rumen. Once the entry of stomach tube is confirm into the rumen and the metal director is fixed with nose holder, the medicine can be pumped into the rumen with pump (or funnel) without any resistance or complication.

Figure 26. Equipment for Drenching, Tubing, Pump and Nose holder

M. Human Resources

Human Resource Management (HRM or HR) is the management of human resources. It is designed to maximize employee performance in service of an employer's strategic objectives. HR is primarily concerned with the management of people within organizations, focusing on policies and on systems. Human Resource Management (HRM) is a relatively new approach to managing people in any organization. People are considered the key resource in this approach. Since an organization is a body of people, their acquisition, development of skills, motivation for higher levels of attainments, as well as ensuring maintenance of their level of commitment are all significant activities.

These activities fall in the domain of HRM. Human Resource Management is a process, which consists of four main activities, namely, acquisition, development, motivation, as well as maintenance of human resources. Human Resource Management is responsible for maintaining good human relations in the organization. It is also concerned with development of individuals and achieving integration of goals of the organization and those of the individuals.

a) The basic objective of human resource management is to contribute to the realization of the organizational goals. However, the specific objectives of human resource management are as follows :

1. To ensure effective utilization of human resources, all other organizational resources will be efficiently utilized by the human resources.
2. To establish and maintain an adequate organizational structure of relationship among all the members of an organization by dividing of organization tasks into functions, positions and jobs, and by defining clearly the responsibility, accountability, authority for each job and its relation with other jobs in the organization.
3. To generate maximum development of human resources within the organization by offering opportunities for advancement to employees through training and education.
4. To ensure respect for human beings by providing various services and welfare facilities to the personnel.
5. To ensure reconciliation of individual/group goals with those of the organization in such a manner that the personnel feel a sense of commitment and loyalty towards it.
6. To identify and satisfy the needs of individuals by offering various monetary and non-monetary rewards.

VII. Least Cost Formulation for Feedlot

Least cost ration formulation using linear program (LP) is an ideal approach to optimizing cost of feed without compromising the quality of feed using local available feedstuffs. Obtaining genetic potential maximum daily gain using lowest cost feed options that provide the required level of nutrients to promote this gain can be accomplish by linear programming. Pakistan regional feeds variation is a primary objective using Least Cost Ration formulation. There are rising demands for beef in the neighboring countries of Pakistan. At the same time, low consumption of beef within the country, ability to locally grow feed and fodder and a large population of livestock all combine to provide an incentive for investors to competitively grow and export beef thereby incentivizing a sustainable and profitable value chain. This manual aims to elaborate on and assist farmers so they can build capacity and secure the optimal least costs for feed, which of itself compromises 60-80% of costs for the livestock operation.

The first step is to develop data base of regional feeds and nutrient composition. Evaluation of Nutritive Profile Data of Ruminant Feedstuffs in Pakistan is presently developing the Data Base, in the meantime local resources for feedstuffs is available and can be used for developing Least Cost rations.

A. Local Feed Resources for Feedlot Rations in Pakistan

a. Energy sources grains and fat sources

Cereal grains such as maize, sorghum, wheat are often added as source of energy in feedlot rations. Wheat is a staple food for human and its use in animal ration is minimal. Most of the maize and sorghum produced in the country are used in poultry rations and available to feeding to large animals is limited. Prices of grains are relatively high and should be formulate to allow the best performance. All grains are not equal in energy density and starch and their quality vary. In fattening and finishing feedlot rations grains serve as important source of energy and constitute an integral part of the feedlot rations. Their inclusion rate varies depending on other energy feeds such as grain byproducts in the ration or Agro-Industries by products. Rumen digestion of grain starch depends on grain type and its physical form. It is important that grains to cattle and buffaloes can be fed as ground, cracked or coarsely ground mixed with forage properly allows optimum fermentation in the rumen.

i. Maize or Corn

Maize is the most popular animal feed grain in the world as it is used in all livestock and poultry rations. Maize as silage produces the most energy per acre that any other cereal grain. Maize is high in starch dry matter basis DMB) (60-75%) and fat (4%) and low in fiber (2.5%). It contains DMB 8-10% CP and 2.9-3.2 Mcal/kg ME. Yellow maize has higher vitamin A content than white maize. Whole grain corn is poorly digested in cattle and buffaloes making it necessary to break the waxy external shell of the kernel to permit its degradation in the rumen.

Potential Constraints: Unlike most feedstuffs, corn does not contain significant levels of toxic or deleterious compounds. However, it is often contaminated with mycotoxins, which are of concern in animal feeding. Grain quality must be assessed before feeding livestock, and tested for mycotoxins contamination. Mold infection occurs during pre harvest drying, handling and storage does alleviate mycotoxins.

Recommended Levels: Maize grains up to 40% can be added in feedlot rations. The ultimate rate of inclusion depend on other energy feed ingredients in the diet

ii. Sorghum

Sorghum is mostly cultivated in barani regions both for fodder and grain production. Sorghum grains are mainly used for animal feeding in Pakistan. Sorghum contain DMB 73% starch and or slightly lower, than maize as an energy source. For ruminants, it requires more vigorous processing to achieve optimal digestibility. However, there is considerable variability in feeding value among sorghum cultivars and types, mainly because of variations in tannin contents. Brown, high-tannin bird resistant sorghums result in poorer animal performances and lower digestibility than lower tannin types. Sorghum is a poor source of DMB CP (7-10% DM), is low in fiber (3.0% DM) and high in energy (ME 3.2 Mcal/kg DM).

Potential Constraints: Different varieties of sorghum grains contain varying amount of tannins. In ruminants, high tannin contents in bird-resistant sorghum greatly reduce protein availability in both the rumen and small intestine. Various processing methods and treatments can be used to partially overcome adverse effects of tannins in sorghum.

Recommended Levels: Price of sorghum grain is generally higher than other grains in Pakistan and would limit its use in feedlot diets. Local varieties of sorghum are also high in tannins. It can be included 10 to 20% in feedlot rations provided the price is lower than maize.

iii. Millet

Millet is a native crop to barani regions and cultivated for both fodder and grains. Millet grains are seldom used in feeding of large animals and instead make important part of diets for birds, quails and chickens. In large animal diets millet can partially replace maize. Millet contains DMB 67% starch and about 4% oil in . It is low in DMB CP (8-10%), low in fiber (2.5 -3.2%) and high in energy (ME 3.1 Mcal/kg).

Potential Constraints: Millet grains are free of any anti-nutritional factors and is a safe feed

Recommended Levels: Due to limited availability, high price and its alternative uses, millet is not an attractive feed ingredient for large animals. Nevertheless it can be included 10-15% as partial replacement of maize grains if prices are relatively lower.

iv. Wheat

Wheat is a staple food for human and has limited use as feed grain in Pakistan. Wheat is not considered superior to maize grains as energy source. Its starch content is lower than maize about DMB 60% in and is rapidly fermented in the rumen. CP contents is higher than maize and varies from DMB 10 to 13 %. The starch and CP contents highly vary in wheat depending on variety, cultivars, growing location, climate, soil fertility, etc. The energy contents are slightly less than maize and contain DMB ME 2.8-3.1 Mcal/kg. Its fiber and oil contents are quite lower (DMB 2.6% and 1.7%, respectively). Damaged wheat not infected with mold can be used as energy source in feedlot rations.

Potential Constraints: Due to rapid fermentation of wheat starch in the rumen may causes digestive disturbances in ruminants including acidosis, bloat, laminitis and reduced or erratic intake pattern. There are no significant toxins in wheat, and is less prone to mycotoxins producing fungi although occasionally may be infected with ergot.

Recommended Levels: Wheat grains can be included up to 25% in feedlot rations as a partial substitute of maize if the cost is relatively lower than maize or other grains.

v. Grams (Chickpea)

These leguminous grains have DMB 20-28% CP and are also good source of energy but are 3- 4 times costly than cereal grains because Grams are mainly used in human diets. Different types of grams are available and these have variable quantity of some anti-nutritional factors.

B. Fats and oils as Energy Source

Fat and vegetable oils are high in energy, fat is 2.5 times higher than carbohydrates. Animal fat is expensive energy source however high fat ration can be helpful during heat stress. Calf milk replacers require high fat additions. Fats increase palatability, eliminate dustiness in compounded feeds. Major fat sources are animal fat, vegetable oils, and whole oilseeds such as whole cottonseeds. The digestibility of animal fat is about 85% in ruminants. The energy value on a dry matter basis for ruminants is DMB 177% TDN or ME 7.3 Mcal/kg. Animal fat contains no protein, minerals or vitamins. As a part of traditional practice vegetable oils are often used by local farmers periodically to enhance performance of cattle and buffaloes.

Potential constraints: Rancidity is a major problem in fats. Rancid fats are unpalatable to animals and may even be toxic. This is usually manifested in the form of diarrhea, liver problems or brain damage. Vegetable fats and oils are usually extracted with antioxidants which occur naturally in plants. It is necessary to add an antioxidant to animal fats, such as BHA (butyrate hydroxyanisole), BHT (butyrate hydroxytoluene) or ethoxyquin; the usual amount is 125-200 g per ton of fat. Secondly feeding large quantity of fats/oils reduces fiber digestion and may disturbs rumen fermentation

C. Oilseed Cakes and Oilseed Meals

Oilseeds are processed for oil extractions using cold pressing (mechanical extraction) or solvent extraction processes and residue obtained in the form of cakes from mechanical extraction and as meal (powder form) from solvent extraction. Oilseed cakes have higher residual oils (10-30%) depending on the efficiency of the mechanical process and their protein contents are relatively lower and are highly degradable in the rumen with high fiber. Oilseed meals have little residual oils (less than 10%), low fiber and high protein contents and are less degradable in the rumen, thus high bypass value. Prices of the two byproducts are highly variable and on commodity basis oilseed meals are relatively expensive. However, when cost is calculated on the basis of protein contents, oilseed meals may be less expensive than oilseed cakes

a. Cottonseed Cake

Cottonseed cake is a byproduct of oil extraction from cotton seed. It is high in protein and common protein sources for cattle and buffaloes in Pakistan. Oil from cottonseed is mechanically extracted and the cake is left with residual oil up to 20% fat. Before processing hulls are not removed from the seeds and the cake is referred as undecorticated having up to DMB 38% crude fiber. Cottonseed cake has DMB 20-23% CP and ME 2.26 to 2.84 Mcal/kg.

Potential Constraints: In the local market cottonseed cake is often adulterated with non-feed ingredients such as saw dust which can be deducted from change in the color of cake from normal greenish to brown and can be also assessed from texture and visible adulterants when pieces are broken. Quality of low price cottonseed cakes is always questionable. Cottonseeds contain an anti-nutritional factor called gossypol. Young ruminants because of their incomplete rumen development are highly susceptible to gossypol toxicity in cottonseed cake. Mature cattle and buffaloes do not suffer but may affect their reproductive performance, in the diet of breeding bulls, as may affect gossypol negatively for semen quality. Cottonseed cake available in the local market have been reported containing high levels of mycotoxins (aflatoxins) and pesticide residues which affect animal performance, animal health and also serve as threat to human health consuming milk and meat of these animals.

Recommended Levels: Although high in protein and fats but because of anti-nutritional factors in cottonseed cake it can be restricted to 20% in feedlot diet and may not exceed 10-15% in the dietof young calves below 6 months age.

b. Cottonseed Meal

Cottonseed meal is residue after solvent extraction of oil from dehulled cottonseeds. Cotton seed meal is high in protein DMB (34 to 46%), low in fiber DMB (16 -24%) and residual oil DMB (1-5%). Protein in cottonseed meal is of better quality due to higher bypass value. Its mean energy value is DMB 2.4 Mcal/Kg. Due to its higher CP content, its cost per unit of protein is less than cottonseed cake with additional benefits of supplying bypass protein. It is not used in poultry rations due to anti nutritional property and the price in the local market is lower than other protein meals.

Potential Constraints: Nutritional limitations of cottonseed meal with respect to gossypol, aflatoxins and pesticide residues are same as described above for cotton seed cake.

Recommended Levels: Cottonseed meal can be used up to 25% in feedlot ration as replacement of other protein meals such as canola meal and soybean meal.

c. Rapeseed Cake/ Mustard Seed Cake

Mustard seed cake is produced after mechanical extraction of oil from mustard (sarson) seeds. Two extraction processes are used. In villages animal driven oil extraction called “ghani” is used which produce mustard seed cake in large pieces of bucket shape with high residual oils (20-30%) and is relatively more expensive. The other extraction is expeller type that produces cakes in small pieces (crumbs) with less oil residues (7-10%). Mustard seed cake is low in fiber and rich in protein DMB (33-38%) which is readily fermentable in the rumen. It makes good combination with feeding poor quality forages. Its ME contents ranges from DMB 2.56 to 2.88 Mcal/kg.

Potential Constraints: Mustard seed cake has bitter taste due to glucosinolates contents and is therefore not very palatable. However, when mixed with other feeds it is readily consumed by animals. Over the last decade improved varieties of rapeseed “canola “are cultivated which produce oilseed cake with no glucosinolates or erucic acid.

Recommended Levels: Rapeseed cake from bitter varieties should not be used more than 15% in the feedlot rations. Canola seed cake can be used up to 20% in place of other protein feeds.

d. Sunflower Cake

Sunflower cake is the by-product of the mechanical extraction of oil from sunflower seeds. The extraction process apply screw-presses (expellers), resulting in a "cake" containing 15-20% of oils depending on the pressing and this oil content impart higher energy value to the cake . Sunflower cake on DMB has 22 to 37 % CP, 17 to 34% crude fiber and 2.60 Mcal/Kg ME. Proteins in sunflower cake are highly degradable (80-90%) with almost no bypass value. Presently mechanical extraction of oil from sunflower seeds is performed to limited extent and most of the seeds are processed through solvent extraction. Therefore, sunflower cake availability in the local market may be limited.

Potential Constraints: A major benefit of sunflower cake is that it does not have anti-nutritional factors such as those found in cottonseed and rapeseed cakes. For that reason, it is considered to be a safe feed for all classes of ruminant livestock. Sunflower cake may be contaminated during crop harvest and post-harvest operations and risk factors are pesticides residues and mycotoxins.

Recommended Levels: Sunflower cake can be included up to 25% in feedlot diets without any deleterious effect and effectively replaces other oilseed cakes.

e. Sunflower Meal

Solvent extraction of oil from sunflower seeds produces sunflower meal as a byproduct. Sunflower meal is one of the major protein meals used for livestock feeding, particularly for ruminants all over the world. Its protein content ranges from 23 to 44% in DM. Its residual oil contents are low (2-3%) and the metabolizable energy value is around 2.3 Mcal/kg DM. As compared to other protein meals its bypass protein value is low (20-25%). Unlike other protein meals its fiber contents are on higher side (27% in DM)

Potential Constraint: One particularly interesting trait of sunflower meal is the absence of intrinsic anti-nutritional factors unlike other oil meals, including those of soybean, rapeseed or cottonseed, The high fiber and lignin content of sunflower meal tends to reduce nutrient digestibility, and its energy value is lower than those of soybean meal. The risk of potential contaminants is those described for sunflower cake.

Recommended Levels: Sunflower meal can be included in feedlot rations up to 30% as partial replacement of expensive protein feeds. Sunflower meal is a highly variable ingredient where protein, fiber and fat cover a much larger range than in many common feeds. When formulating diets with sunflower meal, one should always take into account the actual analytical composition of the batch used rather than using the table values.

f. Palm Kernel Cake/Meal

Palm kernel cake/meal is the main by-product of the palm kernel oil extraction process. It is a highly fibrous and medium grade protein feed and most suited to ruminant livestock feeding. Palm kernel cake resulting from mechanical extraction contains DMB 5-12% oil in and solvent-extracted palm kernel meal contains DMB 0.5-3% oil. Palm Kernel cake/meal is not produced in Pakistan and is mostly imported from Malaysia and Indonesia. Average CP content in palm kernel cake is DMB16.7% in DM and that of meal is DMB 18.7% in. The fiber content in both cake and meal is about DMB 19.0%. ME contents varies from DMB 2.5 to 2.7 Mcal/Kg in the two byproducts.

Potential Constraint: Palm kernel meal contains 20-30 ppm of copper. Sheep are very sensitive to copper and levels as low as 25 ppm in the diet can be toxic to them if fed in large quantity. It is safe for feeding to cattle and buffaloes.

Recommended Levels: Depending on the price, palm kernel cake/meal can serve as major source of protein in feedlot rations up to the level of 30%. Palm kernel cake/meal is widely used for feeding growing cattle. It is considered as a reasonably profitable feed for cattle, both for fattening and supplementary feeding. In Malaysia, feedlot cattle are normally fed up to DMB 80% palm kernel meal in the diet.

g. Soybean meal

Soybean meal is the by-product of the extraction of soybean oil. Soybean meal is the most important protein source used to feed farm animals globally. Soybean meal is a highly palatable feedstuff and characterized by high protein content (43 to 53% DM) and a low crude fiber content (less than 3% DM). Soybean meal is usually classified for marketing by its crude protein content. There are two main categories of soybean meal, the “high-protein” soybean meal with DMB 49-51% protein and 3% crude fiber, obtained from de-hulled seeds, and the “conventional" soybean meal, with DMB 43-44% protein, that contain the hulls. In solvent-extracted soybean meals, the oil content is typically lower than 2% while it exceeds 3% in mechanically-extracted meals. The Metabolizable energy content is appreciably high and varies from DMB 3.2 in solvent extracted meal to DMB 3.5 in expeller soybean meal. About one third of its protein escapes rumen fermentation and serves as bypass protein. Soybean is not cultivated in Pakistan and both soybean seeds for oil extraction and soybean meal are imported mainly from US and India. The product is choice protein source in poultry rations in competition with dairy and feedlot animals.

Potential Constraint: Soybean seeds contain anti-nutritional factors such as trypsin inhibitors and lectins. Ruminant animals can tolerate and are not affected by these factors. Poultry and monogastric animals are sensitive to these and depress performance. However, soybean meal usually undergoes several heat treatments that destroy heat-labile anti-nutritional factors and make it safe. Soybean meal may also contain goitrogenic and estrogenic substances that affect health and growth in poultry and monogastric animals but cattle and buffalo are affected to a lesser extent. Though soybean meal is relatively high in phosphorus, much of it is present in the form of phosphorus-phytate, a poorly digestible complex especially for monogastric animals. Most of phosphorus is thus excreted in manure.

Recommended Levels: Depending on the price and availability, large quantity of soybean meal up to 30% can be included in feedlot diets. With the prevailing market price soybean meal can be an attractive feed on the basis of cost per unit protein comparable to canola meal and sunflower meal and much less expensive than oilseed cakes. Soybean is high in protein DMB (43-53%). Moreover high quality protein in soybean meal also make it attractive for feeding to both young growing, fattening and dairy animals. In the local market prices and availability of soybean meal fluctuates due to its large use in poultry rations. It is recommended that part of the protein requirements in feedlot may be met from soybean meal by including 10-15% in the rations.

h. Peanut Cake

Peanut cake also named as groundnut cake is available in South Punjab and other barani regions where the crop is grown for peanuts. Peanut cake is a byproduct of the local oil extraction process and available as light gray to brownish pieces flakes of variable size with a smooth, slightly curved surface. It is a protein rich ingredient that is widely used to feed all classes of livestock around the world. Its protein degradability is high 70 to 90%. Peanut cake is generally considered as an excellent feed ingredient due to its high protein content DMB (50-55% in), high oil (5 to 10%) and relative absence of ant-nutritional elements. The fiber contents are lower 7-10% in Dry matter depending on skin and shell fragments. The energy value is quite high with a mean ME content of DMB 3.31 Mcal/kg.

Potential Constraint: Peanut cake is particularly vulnerable to contamination by fungi that produces aflatoxins. Aflatoxins contamination may occur in the field, after peanuts are lifted but before harvest, during transport, and during storage when temperature is high. Drought stress alone increase aflatoxins production. Like other legume seeds, peanuts contain substances with potentially anti-nutritional effects, such as tannins which are present in the seed coats, lectins and trypsin inhibitors but have received little attention because these elements in peanut cake seem less deleterious than those of other legume cakes or meals. However heat treatment considerably reduces the anti-nutritional property of the cake. Peanut cake due to its high oil contents may become rancid if stored for long time.

Recommended Levels: Peanut meal is a good source of protein for ruminants and there are no restrictions on its use, provided that it is not contaminated by aflatoxins. Considering its limited availability in the local market it can be used 15-20% in feedlot rations when available. It can effectively replace soybean meal in the feedlot diet. Experiment elsewhere has shown that finishing beef heifers fed a diet containing 21% peanut cake had daily live weight gains and carcass results similar to those obtained with a diet containing 17% soybean meal.

i. Maize gluten feed/meal

Maize gluten feed is the by-product of oil extraction from maize germs obtained from maize processing. It is a product of moderate to good nutritive value suitable for all classes of livestock but its composition is highly variable. Maize gluten is available in four forms and ranked according to its protein contents; maize gluten feed 20%, 30%, 40% and 60%. Maize gluten 20 and 30% are mainly used in cattle feed for milk and meat production. Maize gluten is less expensive than other protein sources while maize gluten meal 40 and 60% are relatively expensive and mostly used in poultry rations. The crude fiber content is moderate DMB (10%). Residual oil ranges from less than DMB 3% to more than 10%, reflecting differences in oil extraction efficiency. Metabolizable energy content varies from DMB 2.2 to 2.8 Mcal/kg.

Potential Constraint: The oil in oil-rich maize gluten feed/meal can oxidize and become rancid when the products are stored for long periods. The products are particularly rich in phytic acid and limit availability of phosphorus to animals. It is vulnerable to mold attack and may contain varying levels of mycotoxins. The mold can develop in maize grains before processing or in the byproduct feed Protein content in the feed is often lower and do not match with the labeled information on the bag. It is therefore suggested that the batch purchased shall be tested for CP contents before ration formulation.

Recommended Levels: Recommended inclusion rate in feedlot ration vary from 15 to 25%.

j. Maize germ cake

This is a product of the Rafhan Maize Company and contains DMB 17% CP. Residual oil is DMB 6 to 12% depending on the processing. It is available in the form of large to small pieces that are easily breakable and is yellow to brown in color. It is exclusively used in cattle and buffalo feeding as part of the home mixed concentrate. ME contents in maize germ cake is around DMB 2.8 Mcal/kg.

Potential Constraint: Maize germ cake available in the local market was found high in mycotoxins. When fed in large quantity would depress growth rate, feed consumption and create health problems in the animals. The other constraints are those described under maize gluten feed/meal.

Recommended Levels: Maize germ cake can be fed 15 to 25% can be added along other oilseed cakes or meals to feedlot rations as a source protein and energy.

D. Urea as Source of Nitrogen

Ruminant animals such as cattle, buffalo, sheep and goats have the unique capability of utilizing urea as a source of nitrogen and convert it to useful microbial protein of high biological value for animal metabolism. This is accomplished by the microbial population in the rumen who need ammonia for cell synthesis. Urea contains 46% N equivalent to DMB 288% CP when ingested is readily soluble and produces ammonia. The ammonia release from urea must be controlled so that it do not exceed microbial requirement and avoid toxicity. Therefore, it is important that urea in right quantity must be included in the ration and the daily dose shall be calculated in relation to quantity and quality of feed protein and forages offered to the animal.

Potential Constraint: Urea feeding can create toxicity. If animals consume excessive amount of urea at one time without being adapted properly or if urea is not mixed properly, it can be toxic and may lead to death of the animal. Toxicity symptoms include staggering, excessive salivation, tympani and falling over. If such symptoms develop, one gallon of acetic acid (sirka) diluted with one gallon of water should be immediately drenched. It is most important that urea shall be thoroughly mixed with other ingredients in the ration and the animals shall be gradually adapted to increasing levels of urea over a minimum period of seven days starting from 1/10th of the calculated target dose on the first day.

Recommended Levels: Urea (fertilizer grade) can be added to ration to replace protein feeds and supply up to 33% of the total dietary CP. Urea can be added up to DMB 2% DM in concentrate mixture or up to DMB 1% in total ration. When urea is included in the rations the amount of fermentable protein such as

oilseed cakes shall be reduced to avoid overburdening of animals with ammonia in the rumen. Urea feeding is not beneficial when ration contain large quantity of berseem, alfalfa or rye grass and protein feeds. Urea in feedlot rations in the presence of grains and molasses is efficiently utilized.

E. Grain Byproducts as Protein and Energy Source

Wheat bran, a by-product of the dry milling of wheat grain into flour, is one of the major agro-industrial by-products used in animal feeding in Pakistan. It consists of the outer layers (cuticle, pericarp and seed coat) combined with small amounts of starchy endosperm of the wheat kernel. Wheat bran is suitable for livestock feeding and is very palatable to most classes of animals. Wheat bran is a bulky feed that can be used to lighten dense, heavy feed mixtures. It can be readily incorporated into concentrate mixture or spread over forages at the time of feeding. Protein, minerals, oil and fiber are mainly found in the outer layers of the grain, and wheat bran is richer in these nutrients than the whole grain. Wheat bran is relatively rich in protein (14-19% DM) and minerals (4-7% DM), notably rich in phosphorus (0.9-1.5% DM) but low in calcium (0.14% DM). Its oil content (3-5% DM) is higher than that of the whole grain. Because of fiber contents (6 to 14% in DM) and variable starch contents (23% in DM) its metabolizable energy value (2.8 Mcal/kg DM) is slightly lower than wheat grains. The feed value of wheat bran is better than rice bran.

Potential Constraints: Wheat bran contains a very heat-stable lipase that causes hydrolytic rancidity and is more active if the bran is finely ground. However, wheat bran contains low amounts of fat and no health problems due to rancidity have been reported in livestock. It is ten times higher in phosphorus than its calcium contents and this imbalance ratio affect bio-availability phosphorus and shall require calcium supplement such as lime stone. Wheat bran is often adulterated with saw dust which could be deducted from the texture and fiber analysis. Good bran should have a fair coating of flour and be in the form of large, dry and non-adherent flakes. It is advised that batch purchased shall be tested for contamination.

Recommended Levels: Wheat bran is relatively cheap and supply both protein and energy, it can be included in feedlot rations 10 to 20% in combination with other protein feeds. The quantity can be increased in background ration to 25%. Wheat bran is relatively less expensive and makes good combination with poor quality forages and stimulates feed consumption.

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b. Rice Polish

Rice polish is a by-product of rice milling representing the soft covering of rice grains and available as fine soft powder. It may also contain bran and germ of rice with some fragments of hulls and broken rice. Rice polishing is rich in fat DMB (11-17%), low in fiber DMB (less than 4% in) and high in DMB CP (12-17%). Due to high oil and starch contents DMB (42% in DM) its energy value is quite high DMB (ME 3.0-3.8 Mcal kg). Most of the starch in rice polishing bypasses rumen and absorbed as source of glucose in the small intestine. Wheat bran it is rich in phosphorus DMB (1.7%) and low in calcium DMB (0.07%).

Potential Constraints: The oil in rice polish can become rancid during storage due to the presence of a lipolytic enzyme. Apart from extraction of the oils, the rancidity process can be delayed by heating or drying immediately after milling. Prolonged storage of full fat rice polish shall be avoided and shall be tested for rancid at the time of purchase. Adulteration of rice polishing with rice bran is practiced in the local market. Defatted rice polish is also available in the local market.

Recommended Levels: Rice polish beside good source of energy and protein is palatable and can be included up to 30% in feedlot rations depending on total fat in Ration.

c. Rice Bran

Rice bran is by-product of rice milling. After de-hulling the rice grains, the outer part bran is separated from during milling. The bran fraction is high in fiber DMB (around 15%) low in CP DMB (8.8 %) and contains DMB 5 to 14 % oil. Defatted rice bran is also available in the local market. Rice bran is often adulterated with rice hulls which increases its fiber contents above DMB 28% and reduce its feed value. Rice bran contains DMB 0.47% calcium and 0.74 % phosphorus in DM. The ME contents in full fat rice bran is in the lower range of DMB 1.6 to 2.4 Mcal/kg.

Potential Constraints: Rancidity on storage and high fiber content especially when supplied mixed with rice hulls limit its use as feed in feedlot rations.

Recommended Levels: Research has shown that fattening animals do not perform well when supplemented with rice bran. Although inexpensive, the quality of rice bran in the local market is low and may be avoided or kept to minimum level (below 10%) in feedlot rations.

F. Corn Steep Liquor (CSL)

Corn steep liquor is one of the main byproducts of industrial processing of corn for food, sweetener and ethanol production. Corn steep liquor is a liquid by-product containing condensed steep water and condensed distillers solubles from a wet corn milling. It is a brownish appearing material with a pudding like consistency and lower viscosity. This feed typically contains 43 to 55% dry matter and DMB 33% crude protein (can be higher as 50%) and its energy value DMB (ME 2.89 Mcal/kg) is 65 to 70% of that of corn grains. It is rich in phosphorus DMB (3.2%) and potassium DMB (2.25%). So it has potential value as a protein and energy feed for fattening and finishing feedlot. Notably its price is close to molasses with a much higher feed value. The product can be obtained from corn processing industry and may not be available open in the local market.

Potential Constraints: Except that high ash contents (about 20% DM) that limit its high inclusion in ration, there is no other potential risk of feeding corn steep liquor to livestock.

Recommended Levels: Corn steep liquor can economically replace a portion of the corn, molasses and urea in the fattening and finishing rations for beef cattle and can be included up to 12% in the diet dry matter.

G. Dried Distillers Grains with Solubles (DDGS)

Corn distillers' grain is the main by-product of the distillation of alcohol from maize grain. Varying amount of soluble are blended back to the distillers' grain to create DDGS. Corn distillers' grain is rich in protein, moderately rich in fat and relatively poor in fiber, and can be fed to all classes of livestock. Corn distillers' grain is palatable and contains variable amounts of oil DMB (7-15%), crude fiber content in dry matter range from 5.3-14.8% which is highly digestible. Crude protein in dry matter vary from 25 to 35% and the DDGS available in local market has reportedly DMB 29.5% CP. Residual starch is low and range from DMB 3.9 to 15.2 %. Metabolizable energy content is quite high DMB (3.39 Mcal/kg). Most of the protein in corn DDGS is zein, which has a high rumen escape value. Reportedly DDGS has 1.8 times greater protein value than soybean meal and has more energy per kg of dry matter than corn grains. DDGS is therefore, used as a high energy and protein source in diets for feedlot finishing cattle. Feeding of diets containing DDGS reduces acidosis in feedlot cattle fed high grain diets.

Potential Constraints: Mycotoxin concentrations may be about three-fold higher in DDGS corn. Sometime high Sulphur contents in the product may cause health problems in the animals.

Recommended Levels: Corn DDGS is an excellent energy and protein source for beef cattle in all phases of production. It can be effectively used as an energy source and be fed up to 40% of ration dry matter intake for finishing cattle with excellent growth performance and carcass and meat quality. It is relatively inexpensive and the price may vary from Rs.28 to 32 per kg.

It can effectively replace a part if not all of soybean meal, canola meal and maize grains in beef cattle diets. For growing heifers (backgrounding), adding urea to meet the degradable protein intake requirement is not necessary when DDGS is used. DDGS can be an effective forage supplement to increase growth at times when availability of forage may be limited, and DDGS has 18 to 30% higher energy value than corn for growing heifers.

H. Pulses Chuni

Pulses chuni is a waste product obtained during industrial processing of various pulses such as Gram, Moong, Moth, Masoor etc for producing edible product (dal) for human consumption. The byproduct consists of husk and broken pieces of pulse grains and valued as potential concentrate feed due to low in fiber and more in energy and protein. The nutritive value of chunies varies depending on the type of pulse grains from which it is originated and processing technology. Generally it is high in CP (15-20% DM), has crude fiber contents of 21-30% DM and ME value around 2.0 Mcal/kg DM. Depending on the prices, chunies can be included about 10% in feedlot rations. Higher levels up to 20% in ration DM can be incorporated for growing calves in backgrounding phase.

Potential Constraints: Some pulses have anti-nutritional factors such as trypsin inhibitors, lectins and tannins that may be also present in the chunies and limit its feed use for monogastric animals but reportedly not injurious to ruminant livestock.

I. Sugar Industry Byproducts

a. Sugar Beet Pulp

Sugar beet pulp is a byproduct of sugar industry obtained after sugar extraction from sugar beet roots. The residue after juice extraction, known as wet sugar beet pulps has 10-15% dry matter (85-90% water). Its high water content, both from the point of view of transport and storage, limits its use to the vicinity of the sugar mill. The wet pulp can be pressed to remove the excess water, thereby raising the dry matter content to 20%. Pressed pulp, though easier to transport, has the same poor keeping qualities. If wet beet pulp heaped and covered to exclude air, it can be stored up to two weeks. For longer storage it should be properly ensiled in airtight conditions. Beet pulp can be dried and sold as dried sugar beet pulp or mixed with molasses to form dried molasses beet pulp. In Pakistan pressed beet pulp is available in sugar beet growing region (presently in D.I.Khan and Peshawar division) for a limited period of about 45 days starting early May. Drying of beet pulp under open sun is labor intensive and not cost effective and practiced to a small extent. Industrial drying of beet pulp in Pakistan does not exist. Ensiling wet beet pulp is a good method to make it available for year-round feeding. Wheat straw or hay in layers may be added at time of ensiling to reduce the water contents in the pulp and reduce effluent from the silo. It can be also converted to baled silage wrapped in polythene. Silage bales of beet pulp are produced by one of the sugar mill in D.I.Khan for sale. Only small quantity of about 1000 tons is converted to silage bales weighing 700 kg per bale at the mill.

The energy value of beet pulp on DM basis is equal to maize grains for ruminant livestock. The high energy value of beet pulp is due to highly digestible (80%) fiber contents DMB (19-24%) that support efficient rumen fermentation and do not cause acidosis unlike grains. Beet pulp is low in DMB CP (8-10%) and low in phosphorus DMB (0.12%) and high in calcium DMB (1.3%).

Potential Constraints: The high water contents in fresh beet pulp limit its storage and cannot be stored in open longer than two weeks. When left open, toxin producing molds develop that causes several health problems when consumed. Conservation as silage requires water to be reduced to 70%. Low phosphorus content causes red water disease (hemoglobinurea) when beet pulp is consumed in large quantity.

Recommended Levels: Sugar beet pulp is an excellent feed for fattening and can be fed 25 kg wet beet pulp containing 20% dry matter (equivalent to 5 kg dry matter)/animal/day or offered free choice. Since it is low in CP and phosphorus, it is recommended that protein meal and dicalcium phosphate preferably with a product high in phosphorus shall be supplemented. Urea as a source of nitrogen makes good combination with beet pulp. On dry matter basis urea DMB 2% or 0.4% in as fed can be added to overcome protein deficiency in the total diet. Urea can be mixed with wet beet pulp before feeding or added at the time of ensiling.

b. Molasses

Molasses is a viscous, dark and sugar-rich by-product of sugar extraction from the sugarcane or sugar beet. It is a common feed ingredient, used as an energy source and as a binder in compound feeds. Molasses is difficult to handle and transport because of its viscosity and is not fed directly in its liquid form but instead mixed with other feed ingredients. Molasses also reduces dustiness in fine-particle feeds. Molasses is a valuable additive for silage making when ensiling conditions are difficult, or when the forage is of poor quality (low is sugars) such as maize plants after removing ears. It provides readily fermentable energy that promotes lactic acid bacteria development, subsequently reduces pH and improves silage quality. Molasses is used in making multi-nutrient molasses urea blocks for livestock feeding as a supplement to poor quality roughages. Molasses has around 70% dry matter and contains DMB 5-9% CP. It is good source of several minerals but is low in phosphorus DMB (0.07%), relatively high in calcium DMB (0.9%) and very high in potassium DMB (5.0%). Its ME value is DMB 2.2 to 2.8 Mcal/kg.

Potential Constraints: Molasses on mill site is often stored in ponds open to contamination with rain water and dead rodents and birds etc. that contaminate and reduce quality of molasses. Diluted molasses will rapidly ferment into alcohol and may fatally poison the cattle. Feeding large amounts of molasses is toxic to livestock causing nerve disorders. Excess intake of potassium from molasses can damage kidneys and causes diarrhea. High potassium and sulphur contents may cause mineral imbalances.

Recommended Levels: When used as an energy feed, for example to replace grains, moderate amounts of molasses are usually recommended (10-20%) of the diet dry matter). Higher levels may be detrimental to animals.

Molasses is deficient in nitrogen and, therefore, nitrogen supplementation is often required to optimize rumen fermentation. Adding urea to molasses is a common method to improve its nitrogen status and utilization as cattle feed. Quality of molasses shall always be checked before buying. Although the quality is tested by measuring "Brix", knowing the dry matter contents can be also used as an indicator.

J. Fruits and Vegetable Waste

a. Citrus Pulp Fresh

Citrus pulp is the solid residue that remains after fresh orange fruits are squeezed into juice. It amounts to 50-70% of the fresh weight of the original fruit and contains the peel (60-65%), internal tissues (30-35%) and seeds (0-10%). Large amounts of fresh citrus pulp are available in the harvest season during winter when green fodders are scarce. Fresh citrus pulp has a natural acidity but is still quite perishable due to its high content of water and soluble sugars. It ferments and sours quickly when it is in contact with the air, and can attract flies if allowed to spoil. It is also quite bulky and, for all those reasons, fresh citrus pulp is usually fed to animals in the vicinity of the processing plants. However, it can accumulate too rapidly for immediately local consumption, but can be preserved as silage.

Like sugar beet pulp, ensiling citrus pulp is a good method to make it available for year-round feeding. The silage has a pleasant odor and is readily eaten by cattle. The process can take less than 50 days. In order to obtain firm silage, the pulp can be pressed before ensiling or mixed with straw or hay. Citrus pulp enhances overall silage quantity and quality (more sugars, more acidic bacteria, lower pH) and reduces the need for acid additives. Citrus pulp silage has a much higher weight per volume than that of maize silage. Fresh citrus pulp has about 20% dry matter and is highly digestible (90%). It contains up to 40% soluble fiber (pectins) and carbohydrates 5-10% on DMB. It has lower calcium content DMB (0.5-0.8%) and phosphorus DMB (0.1-0.2%). CP content is also in the lower range of DMB 4.8-8.0% and has DMB 10% crude fiber. Its metabolizable energy value is high DMB (around 3.0 Mcal/kg).

Potential Constraints: Citrus pulp has an unbalanced Ca:P ratio that may affect bone development. High levels of citrus pulp in ruminant diets can result in rumen parakeratosis, a digestive condition that retards nutrients absorption in the rumen. Without ensiling or drying fresh citrus pulp can become moldy leading to the formation of mycotoxins. Citrus pulp contains limonin present in the seeds and skins that imparts a bitter taste to citrus pulp and reduce palatability. Pesticide residues in citrus pulp may also occur depending on the pre-harvest pesticide application.

Recommended Levels: Fresh citrus pulp can be fed to beef cattle 15-20 kg/day (3-4 kg dry matter) and can be used as substitute of maize silage. It can be fed mixed with cereal straws or other dried forages.

b. Mango Seed Kernels

It is a waste product of mango processing and canning industry. It is obtained when juice is extracted from mango fruit.. The kernels inside the seeds represent 45-75% of the whole seed. Mango seeds have a hard fibrous shell containing a kernel rich in fat DMB (6-16% of the kernel) and starch DMB (40-50%). The kernels can be considered as energy feed for cattle despite low in protein (less than 10% dry matter). The kernels are low in crude fiber DMB (3 %) and low in calcium and phosphorus. Its energy contents DMB (ME 2.5 Mcal/kg).

Potential Constraints: Mango kernels are fairly rich in tannins, which progressively lead to reduced growth rates and less efficient feed utilization when large quantity is included in the ration. The deleterious effect is more marked in simple stomach animals than ruminants. It also contains cyanogenic glucosides, oxalates and trypsin inhibitors. Several chemical and physical treatments may remove tannins and HCN but the most effective method proved to be soaking as it removed 61% of the tannins and 84% of Hydrogen Cyanide (HCN) or prussic acid.

Recommended Levels: Mango kernels are palatable to animals and can be dried and ground and incorporated up to 10% in concentrate mixture for fattening animals. Higher levels up to 20% in ration can be fed to growing cattle and buffaloes.

c. Mango Peels Fresh

Mango peels are also abundantly available as waste of mango processing industry. Mango peels can be fed fresh, dried or ensiled. Due to their high sugar content, they are palatable to ruminants and can be considered as an energy feed, but the high moisture (85%) and acidity of fresh peels may limit their use. Because of their low protein content DMB (6%), the addition of a source of nitrogen or protein is necessary to allow an efficient utilization of the energy in the diet. In order to produce good silage, mango peels have to be mixed with dry materials (straw for example) and a nitrogen source (a legume or urea for example) to increase moisture and protein content to facilitate fermentation. Mango peels are low in crude fiber DMB (7.7% DM) and dry matter digestibility is about 70% giving ME contents close to DMB 2.5 Mcal/kg. Mango waste comprising the fresh by-product of mango juice extraction (mixture of peels, seeds and culled fruits) may be also available on the site of mango processing industry. The waste has been reported to have a higher energy value than maize silage and could partly replace energy concentrates in diets for ruminants. It has been reported that a mixture of mango peels and seed kernels gave a higher intake than peels and kernels fed separately.

Potential Constraints: Mango peels if consumed in large quantity may sometime cause dermatitis (itching of skin) due to presence of a chemical “urushiol” in the peels. Some of the anti-nutritional factors of mango kernels may be also present in the mango peels but ruminants have relatively better tolerance to these elements.

Recommended Levels: Fresh mango peels can be mixed with wheat straw chaff or legume/pulses straw in 70: 30 ratios and fed 5-10 kg/animal/day or can be fed as silage.

d. Dates

Date by-products include culled dates, immature dates, date pedicels, date seeds, date press cake and date molasses. In Pakistan culled dates (fresh and dried) and its fleshy part unfit for human consumption are available and can be fed to livestock. Cull dates are fruits that are too hard, too small, blemished and of poor appearance. Dates are rich in sugar and the total sugar content; have a low protein concentration DMB (1.5-4%). Dry matter content is between 75 and 95%. Whole dates have about 15% pits and contain about DMB 2-10 % fiber. Pitted dates and date pulp have a similar content, except for a lower fiber contents. The high sugar content of dates and date pulp make them good energy feed. Due to their high carbohydrate content and relatively low fiber, dates have an energy value as high as that of most of the cereal grains.

Potential Constraints: Pesticides are often used to kill insects, including carbamates and organosphosphates, which may leave residues. However, the main limitation of dates is their low protein value, and protein supplementation is required when dates are included at high levels in the feedlot diet.

Recommended Levels: Dates have been fed to feed ruminants, due to local availability and low purchase costs.. They have been used in sheep and cattle feed for both milk production and fattening. The nutritional potential of dates in ruminant diets has been studied in areas of production, where they can be an inexpensive alternative energy source to cereal grains. Part of the concentrate ration may be replaced by including dated up to 20% level.

e. Potato

Surplus and cull potatoes can be fed as energy feed to beef cattle. Small size potatoes “goals” are often available at inexpensive price and can be used as livestock feed. Potatoes contain 20% dry matter, DMB 9-12% CP and DMB 2.5% crude fiber. It is rich in starch (65%DM) imparting DMB ME 2.9 Mcal/kg. Chopped potato can be fed as raw or ensiled with forage.

Potential Constraints: Potato sprouts contain an alkaloid, solacing, so it is advisable to remove the sprouts before the potatoes are fed to animals. Potatoes may get stuck in the food pipe, but this risk can be minimized if the potatoes are fed from low troughs or mashed or cut into pieces.

Recommended Levels: Beef cattle can receive raw potato up to 20 kg a day. Raw potatoes are not very palatable and have a laxative effect. They should therefore be introduced gradually. To get the most value from the starch, the potatoes should be boiled or steamed.

f. Turnips

Turnips or white turnips are grown as vegetable root. Small tender varieties are grown for human consumption and large size varieties are cultivated for livestock feeding. The leaves of vegetable turnips after harvesting are mostly fed to animals.

Sometime it may be more economical to use turnip as animal feed instead of marketing as vegetable. The dry matter, CP and fiber contents in dry matter of whole turnips are 8 to12%, 9 to 10% and 18 to 20%, respectively. It is highly digestible and has ME contents of DMB 2.70 Mcal/kg which is greater than that of good quality forages. There is little or no difference in ME and CP contents of leaves and roots parts of turnips.

Potential Constraints: No deleterious factors are present in turnips except that feeding whole non chopped turnip may cause choking of food pipe in animals.

Recommended Levels: whole turnips can be fed to growing and fattening cattle and buffalo in place of green fodder varying from 10-15 kg per day. Sheep and goats are equally benefited.

K. Green Fodders

Fodders also referred as forages constitute important part of livestock rations. Fodders are cheap source of critical nutrients and provide fiber for supporting proper rumen function. Fodders are often offered at the rate 6 to 9% body weight to animals or given free choice depending on availability. In beef cattle forages alone cannot support rapid weight gain and are therefore included to a minimum level of 20-40% in diet DM along concentrates during fattening and finishing phases. Growing cattle during backgrounding phase can be raised on free access to good quality forages with limited concentrate allowance.

There are two main classes of forages leguminous and non-leguminous. The later include cereal and grass forages. Leguminous forages such as berseem, alfalfa, cowpeas and guar and mustard are rich in protein and calcium than non-legume fodders (maize, sorghum, millet, oats, mott grass, Rhode grass). Fodders can be offered fresh or after conserving as silage or hay. The nutritive value of forages depends on stage of growth and decline with advancement of maturity. It is therefore important that fodders shall be harvested at optimum stage for maximum nutrients yield.

a. Maize Fodder

Maize fodder is a crop of irrigated regions. It is low in protein content DMB (8 -12%) and is high in crude fiber DMB (19-36%). Depending on the stage of harvesting and fertilizer application, it can be rich in starch (up to 30% DMB or more). ME is 2.3 Mcal/kg DMB. Calcium and phosphorus is (0.4 and 0.3 % DMB, respectively). Locally it is reported to have higher nutritional quality than sorghum and millet. Maize plants shows a constant DM digestibility (71-75%), because the increasing proportion of maize ears, which has a high and constant digestibility (83%) by maturity. Because of its relatively high carbohydrate contents maize fodder is ranked excellent for silage making. In Pakistan new imported hybrid varieties of maize were introduced during 90's and are now increasingly cultivated for green fodder and silage making.

Potential Constraints: There are no potential constraints to using maize fodder as animal feed except that for better performance it shall be supplemented for CP and mineral correction

b. Sorghum Fodder

Sorghum is an annual fodder mostly cultivated in barani regions because of its drought tolerant. Forage sorghum can be fed fresh or made into hay or ensiled. Multicut high yielding hybrid fodder variety of sorghum x Sudan grass (Sadabahar) The composition of sorghum forage depends on its stage of maturity, variety, climate, harvest conditions and many other factors. Average nutrients contents on dry matter basis are as follow; 28-35%, CP 8%, crude fiber 34%, calcium 0.4% and phosphorus 0.2%. Dry matter digestibility is 60-65% and ME content is 2.1 Mcal/kg DMB. The overall nutritive value of sorghum fodder is lower than maize fodder.

Potential Constraints: Sorghum contains hydrogen cyanide (HCN) and nitrates/nitrites, which may be toxic for animals if they are ingested at a high level. There are varietal differences between sorghum strains and also influenced by growing conditions. In the plant, HCN levels usually decline with maturity, reaching non-toxic levels 45-50 days after planting. The HCN is partly destroyed when the fodder is made into hay or silage. Sorghum is nitrate accumulating plant and nitrate levels ranging from 0.5 to 1% DM in the plant are considered potentially toxic to ruminants. Nitrate levels higher than 1% DM are considered dangerous. Nitrates are more concentrated in the stems than in the leaves. Several environmental conditions such as drought stress and high applications of N fertilizer result in nitrate accumulation in the sorghum plant.

c. Berseem (Egyptian Clover)

Berseem is winter leguminous forages in Pakistan cultivated in irrigated zones. Berseem is an annual multicut forage legume. It is a fast growing, high quality forage that is mainly cut and fed as green chopped forage mixed with wheat straw. Berseem can also be made into silage mixed with oats. Drying of berseem for hay making is also practiced but easy shredding of leaves during drying causes nutrient losses. Berseem can be harvested after every 30-40 days and 5 to 6 cuttings can be obtained under proper irrigation. Berseem is high-quality forage characterized, by protein (15-25% DMB), minerals (11-19%DMB). It is rich in calcium (1.93%DMB) and has 22% crude fiber in DMB. Being succulent in nature its dry mater is low 15-20% fresh . Metabolizable energy value is 2.3 Mcal/kg DMB.

Potential Constraints: Fresh Berseem when fed alone may cause bloat in animals and is therefore fed mixed with wheat straw chaff. The imbalance ratio of Ca:P in berseem requires phosphorus supplementation for maximum benefits. Though berseem is high in nitrogen content, it is also highly soluble and about 70% of the nitrogen ingested is excreted as waste.

d. Alfalfa (Lucerne)

Alfalfa (Lucerne) is a perennial herbaceous legume forage and high nutritional quality, high yields and high adaptability. Improved varieties of alfalfa have been introduced that give higher yields and are non-winter dormant. Annually it provides six cuts at interval of 4 to 5 weeks. Alfalfa hay is a popular

in both dairy and beef animal nutrition. Alfalfa fiber helps to prevent acidosis due to its intrinsic buffering effect and stimulate rumination, chewing and salivation. Alfalfa hay may be chopped, or fed as is. Mostly it is marketed in the form of bales of variable sizes and weights. Alfalfa is considered "Queen of forages" and has outstanding protein content (21%DMB) and a well-balanced amino acids profile for ruminants that compares favorably with that of soybean. Alfalfa provides higher amounts of minerals (mainly calcium 1.9%DMB, and also magnesium, potassium, sulfur, iron, cobalt, manganese, and zinc) and vitamins (beta-carotene) than other fodders. Crude fiber contents vary from 16 to 38% DMB. The energy content of alfalfa (ME 2.2 Mcal/kg DMB), though slightly lower than that of some grasses, should not be underestimated. Generally alfalfa is less commonly used for beef cattle than for dairy cows, as its lower energy availability does not allow it to sustain the same average daily gains as maize and grass forages. Alfalfa hay may be mixed with maize silage as partial replacement of protein meals and oilseed cakes. Research in US has demonstrated that alfalfa is an important transition feed for nursing and weaned calves. During the finishing period, diets may contain 15% alfalfa hay and up to 85% cereals, with average daily gains of 1.3-1.4 kg/day. Alfalfa fresh or hay is equally good for fattening sheep and goats. In summary the high dry matter yield, protein and calcium content of alfalfa make it suitable forage for all classes of ruminant livestock.

Potential Constraints: Fresh alfalfa at vegetative stage may cause bloat in sheep and cattle. Saponins content in alfalfa forage may have adverse haemolytic effects on livestock and reduce growth. Although not relevant to fattening, alfalfa contains phytoestrogens that are reported to reduce conception rates in cattle and sheep fed alfalfa prior to mating.

e. Rye Grass

Rye grass is a cool season grass which can be grown in climatic conditions of subtropical and wet temperate areas of Pakistan. There are two types of rye grass; annual ryegrass and perennial ryegrass. Both varieties are easy to establish, versatile in how they can be used and adapted on a wide range of soil types. They are leafy grasses that produce highly palatable forage that often exceeds 70% digestible dry matter and 20% crude protein DMB. These characteristics enable animals to maintain exceptionally high dry matter intake levels and result in outstanding animal performance. Seeds of improved varieties of ryegrass were recently introduced in Pakistan by some commercial seed companies and field trials have revealed promising results in term of yield and quality and adaptability. Rye grass can be grazed, fed as fresh or converted to hay.

Potential Constraints: There is no specific constraint in using rye grass as ruminant feed.

f. Oat Fodder

Oat is an annual grass grown for fodder and grains during winter season. It is harvested and fed as fresh and can be conserved as silage or hay. Oat forage is often sown in mixture with a legume such as vetch or berseem. Oat fodder has CP varying from 6.3 to 9.0 % DMB and crude fiber ranging from 22.15 to 27.48% in DMB. Oat fodder has ME 2.2 Mcal/kg DMB.

Potential Constraints: The oat plant is prone to accumulate nitrogen as nitrate and may cause nitrate poisoning in livestock, especially when it is harvested at the flowering stage, or if the plant has been stressed by frost or drought. However this problem is not common and may seldom occur.

g. Rhode Grass

Rhodes grass is a perennial or annual tropical grass suited to both rain-fed and irrigated conditions. It is grazed, cut for fresh feeding or made into hay. Commercial bales of Rhode grass hay of varying sizes are available in Pakistan both for local use and export. Rhodes grass is a persistent, drought resistant and highly productive species. It supply 4 to 5 cuts and the average yield is 10-16 tons dry matter/ha. Rhode grass contains DMB crude protein 8-10%, DMB crude fiber 28-43%. Dry matter digestibility ranges from 60 to 65% with DMB ME value of 2.0 Mcal/kg.

Potential Constraints: No constituent in Rhode grass constrains its feed value except that it is deficient in protein and minerals and needs correction for these nutrients when fed in large quantity to animals.

h. Sugarcane Tops

In sugar cane growing areas of Pakistan, sugar cane tops are abundantly available during cane harvesting season and is used fresh for feeding to cattle and buffaloes. The cane harvesting season coincides with fodder scarcity period during winter and therefore sugar cane tops are used to fill the fodder gap.. Sugarcane tops represent 15 to 25% of the aerial part of the plant. They generally consist of green leaves, bundle sheath and variable amounts of immature cane (top portion). Generally used as fresh but chopped sugarcane tops can also be ensiled to increase its availability year round as low cost forage. Addition of urea and molasses at the time of ensiling improves its feed value. The nutritive value of sugar cane tops is low CP (5% DMB), low dry matter digestibility (55-60%) and low ME contents (1.2-1.9 Mcal/kg DMB). Research elsewhere has shown that feeding sugar cane tops 20% with protein meal, cereal bran, rice polishing and molasses supported 500 to 800 g weight gain/day in fattening calve.

L. Cereal Straw/Stover

Straws are plant residues (stem and leaves) left after removing grains from mature crops. Common cereal straws/stovers that are commonly used for livestock feeding include wheat straw, rice straw, maize stovers and sorghum stovers. All of these have common feed value characterized by low CP (3-5%DMB), high crude fiber (above 42%DMB) and low dry matter digestibility varying from 30 to 40%. The ME value is less than 1.5 Mcal/kg DMB. The fibers are highly lignified (8-12%) and poorly digested. Maize stover has a slightly higher nutrient with about 6% crude protein DMB and 40-45% dry matter digestibility. In Pakistan under traditional feeding system cereal straw are important as feed for cattle and buffalo especially during feed scarcity periods. When animals have access to legume forages such as berseem and alfalfa, straws can be used as roughage for ration for dairy and fattening animals. Cereal straws have very low net energy of gain (.13 to 0.30 Mcal/kg DMB).

a. Pulses straws

Pulses straws are crushed plant material left after threshing the main crop for separation of pulses. Common pulses that are used in livestock feeding are gram straw (chick pea straw), moong straw, moth straw, masoor straw, cowpeas straw and arhar straw. After harvesting the pulse seeds are threshed out and the remaining residue consist of stem, leaves, husk and pod coverings and together referred as pulse straw.

Pulses straws have better palatability and better nutritive value than cereal straws/stovers and are relatively expensive. Pulses straw is particularly relished by sheep and goats. On DMB pulses straw contain DMB CP 7 to 10%, crude fiber DMB 26 to 30% and DMB ME 1.8 to 2.1Mcal/kg. Dry matter digestibility varies from 50 to 60% . Pulses straw is also good source of calcium (1.5 to 2.7%DM).

Potential Constraints: There are nutritional constraints except variable quality influenced by processing, handling and storage.

b. Ground/Peanut straw

Groundnut (peanut) is a major crops cultivated in barani regions. At the time of harvesting large quantity of aerial part (stem, leaves and residual pods) are available that can be fed fresh or dried. It is called as haulms, vines, tops, stover, hay or straw of peanut. Like other legume hays/straws, peanut straw is subject to leaf shattering, which increases the proportion of stems and diminishes its nutritional value Peanut straw has a very variable composition, which is influenced by the relative proportion of leaves, stems and residual pods. Protein content is relatively high on average about 10-12% DMB. Fiber content is high, with crude fiber ranging from 15 to 51% DMB. Dry matter digestibility is about 59% and ME contents is around 2.0 Mcal/kg DMB. Calcium content is high (1.2%DM).

Potential Constraints: Peanut crop residues can be contaminated by aflatoxins.

Table 23. Nutrients Composition of Feeds Available in Pakistan for Livestock

S. No.	Feed Stuffs	Dry Matter (DM) %	Crude Protein (CP)	Fats (Ether Extract)	Crude Fiber (CF)	NDF	ADF	Ash	TDN	ME	NE maint.	NE gain	Ca	P
		As percent in dry matter								Mcal/kg DM			% in DM	
A	**Grains**													
1	Barley (Joe)	91.40	10.21	2.68	7.26	20.80	7.20	2.67	77.20	2.79	1.86	1.43	0.06	0.39
2	Gram Black (Chick pea)	94.40	20.35	3.17	7.33	22.80	13.80	2.62	75.20	2.72	1.80	1.37	0.20	0.4
3	Maize yellow	89.00	11.80	4.07	3.03	12.70	2.90	1.71	80.60	2.91	1.96	1.54	0.04	0.3
4	Maize white	89.36	11.25	4.80	2.98	13.10	2.60	1.69	81.30	2.94	1.98	1.56	0.06	0.28
5	Millet (Bajra)	90.90	10.55	4.67	10.00	29.15	25.73	3.11	77.20	2.79	1.86	1.43	0.04	0.3
6	Oats (Jai)	91.94	9.52	6.31	14.68	30.00	14.60	4.45	75.10	2.71	1.79	1.36	0.11	0.4
7	Paddy Rice (rough rice)	91.20	8.40	2.19	11.10	21.50	13.30	5.40	66.80	2.41	1.53	1.09	0.06	0.29
8	Sorghum (juar)	90.20	15.75	2.62	2.47	11.00	4.30	2.66	78.50	2.84	1.90	1.48	0.03	0.3
9	Wheat	91.77	10.67	1.73	2.48	13.40	4.40	2.53	79.00	2.86	1.92	1.49	0.05	0.43
B	**Oilseed cakes and Oilseed meals**													
10	Almond cake	93.02	39.68	11.29	5.47	36.80	28.70	8.52	89.50	3.24	2.22	1.81	0.28	0.13
11	Canola meal/Rapseed meal	90.12	35.00	2.70	14.10	31,1	20.40	7.80	74.00	2.67	1.75	1.33	0.85	1.33
12	Corn gluten feed 20%	92.90	21.85	7.00	21.85	45.00	12.20	7.00	54.14	2.88	1.93	1.51	0.07	0.55
13	Corn gluten feed 30%	93.00	30.70	4.84	6.56	44.00	12.00	3.44	83.60	3.02	2.05	1.63	0.03	0.63
14	Corn gluten meal 60%	91.80	64.70	8.17	3.48	29.00	7.80	2.61	94.60	3.42	2.37	1.98	0.04	0.93
15	Caster seed cake	93.10	28.12	80.50	21.16	41.50	32.00	6.23	68.50	2.47	1.58	1.14	0.84	0.98
16	Cotton seed cake (undec)	93.50	23.04	9.52	26.20	50.30	40.10	6.52	63.40	2.29	1.42	0.98	0.17	0.60
17	Groundnut/ Peanut cake	91.70	24.75	5.78	18.43	26.60	16.60	5.89	68.50	2.48	1.59	1.15	0.16	0.61
18	Guar meal	91.30	47.86	6.57	7.78	20.70	10.10	6.90	83.80	3.03	2.05	1.64	0.70	0.64
19	Linseed cake	92.50	32.22	7.35	10.70	36.10	22.10	7.03	79.70	2.88	1.93	1.51	0.43	0.90
20	Maize germ cake	95.80	15.97	8.14	0.29	45.00	12.20	2.82	88.40	2.98	2.01	1.60	0.07	0.55
21	Palm Kernel cake	91.00	16.70	9.20	19.80	73.00	44.80	4.70	76.67	2.73	1.81	1.38	0.28	0.60
22	Poppyseed cake	92.80	32.48	11.00	12.82	34.10	23.30	9.75	83.60	3.02	2.05	1.63	3.04	1.40
23	Rape seed cake	93.00	37.10	8.17	11.61	29.90	19.70	8.39	79.80	2.88	1.93	1.51	0.79	1.19
24	Sesame cake	93.14	36.07	8.70	6.66	24.60	13.50	9.34	84.70	3.06	2.08	1.67	1.97	1.26
25	Sunflower cake	91.90	30.47	16.20	26.66	40.30	30.00	7.40	69.70	2.52	1.62	1.19	0.48	1.00
26	Sunflower meal	89.00	32.40	2.20	27.90	45.00	32.00	7.10	60.14	2.17	1.31	0.86	0.44	1.16
27	Soybean meal	88.10	53.00	1.80	11.00	5.90	0.50	7.20	90.08	3.25	2.24	1.83	0.36	0.79

S. No.	Feed Stuffs	Dry Matter (DM) %	Crude Protein (CP)	Fats (Ether Extract)	Crude Fiber (CF)	NDF	ADF	Ash	TDN	ME	NE maint.	NE gain	Ca
		----------As percent in dry matter----------								---Mcal/kg DM--		% in DM	
C	**Grain and Sugar Industry Byproducts**												
28	Corn Steep Liquor	48.00	**33.00**	1.30	5.30	19.00	6.70	19.48	80.00	2.89	1.94	1.52	0.01	0.32
29	Dried Distillers Grains with Solubles (DDGS)	88.00	29.50	11.10	7.90	34.20	13.60	5.40	92.57	3.34	2.31	1.91	0.16	0.79
30	Maize bran	93.10	9.88	3.76	11.71	44.20	14.50	3.65	71.60	2.59	1.69	1.29	0.47	0.37
31	Molasses	82.30	8.00	0.00	0.10	0.80	0.50	10.33	64.02	2.31	1.44	1.00	0.90	0.07
32	Rice bran	92.60	9.99	15.12	14.25	34.40	19.60	15.44	77.40	2.80	1.86	1.44	0.07	1.38
33	Rice bran (defatted)	92.00	15.40	2.54	14.80	32.60	18.00	14.20	64.02	2.31	1.44	1.00	0.25	1.92
34	Rice polishing	92.60	12.36	15.82	4.16	51.99	18.32	11.66	89.90	3.25	2.24	1.83	0.06	1.39
35	Sugar Beet Pulp (wet)	90.30	12.21	2.04	19.93	45.80	23.10	2.77	74.00	2.67	1.75	1.33	1.30	0.10
36	Wheat bran	91.40	14.99	4.27	12.47	42.50	15.50	5.69	71.00	2.57	1.67	1.24	0.13	1.18
D	**Fruit byproducts**													
37	Citrus pulp Fresh	23.00	6.00	4.60	10.40	25.60	16.90	3.60	89.80	3.25	2.24	1.83	0.70	0.16
38	Mango seed Kernels Fresh	53.50	6.40	7.90	2.90	23.40	5.80	3.50	70.68	2.55	1.66	1.22	0.44	0.28
39	Mango Peels Fresh	15.60	6.10	2.20	15.60	24.80	16.60	4.50	70.50	2.54	1.64	1.21	0.80	0.30
40	Dates whole	84.40	4.00	2.00	6.00	24.00	19.50	3.70	78.50	2.84	1.90	1.48	0.39	0.27
41	Dates Depitted	84.00	4.90	0.60	3.20	5.6	2.1	2.50	84.00	3.03	2.05	1.64	0.74	0.08
E	**Animal Source Byproducts**													
42	Blood meal	91.80	72.98	1.98	1.74	12.80	0.80	6.21	88.90	3.21	2.20	1.80	0.30	0.30
43	Bone meal	94.00	0.0	0	0	0	0.00	84.50	0	0	0	0	30.30	14.00
44	Dicalciul Phosphate (DCP) Bone origin	90.00	0.0	0	0	0	0.00	95.00	0	0	0	0	22.00	17.00
45	Feather meal	95.30	83.84	1.89	1.11	55.00	6.80	7.97	89.80	3.24	2.23	1.82	1.30	0.80
46	Fish meal	93.20	53.86	7.19	1.18	0.00	0.00	22.10	85.80	2.95	1.99	1.57	4.06	2.69
F	**Green Forages**													
47	Barley, dough stage	29.20	**7.13**	2.09	29.49	57.6	34.6	10.45	52.00	1.88	1.04	0.58	0.48	0.17
48	Berseem, full bloom	22.77	18.90	2.24	19.06	44.34	27.32	15.40	62.92	2.27	1.40	0.96	1.91	0.27
49	Guara, milk/dough stage	25.00	17.35	2.44	30.97	56.5	30.55	11.90	59.59	2.15	1.29	0.84	1.78	0.1
50	Maize milk stage	28.49	9.93	2.30	30.40	52.66	32.61	7.00	69.29	2.50	1.61	1.17	0.2	0.18
51	Maize silage with ears	32.17	7.93	2.97	31.50	52.66	32.61	7.00	70.68	2.55	1.65	1.22	0.2	0.18
52	Lucerne, full bloom	27.16	21.20	2.37	20.62	41.6	32.48	9.02	62.60	2.26	1.39	0.95	1.92	0.25
53	Millet, milk/dough stage	29.50	6.08	1.73	30.40	69.97	40.33	8.20	52.90	1.91	1.07	0.61	0.54	0.28

S. No.	Feed Stuffs	Dry Matter (DM) %	Crude Protein (CP)	Fats (Ether Extract)	Crude Fiber (CF)	NDF	ADF	Ash	TDN	ME	NE maint.	NE gain	Ca	P
		----------As percent in dry matter----------									---Mcal/kg DM--		% in DM	
54	Mott grass	25.20	9.70	2.00	36.00	71.5	42.5	13.80	53.22	1.92	1.08	0.62	0.36	0.29
55	Moth, milk/dough stage	21.50	17.39	1.91	28.50	32.56	25.5	15.20	55.20	2.00	1.15	0.70	2.21	0.3
56	Mongi, early/full bloom	17.35	18.27	1.21	19.98	28.11	20.1	13.24	65.41	2.36	1.48	1.04	2.44	0.34
57	Oats Full bloom	26.13	8.72	2.50	29.89	58.20	33.65	9.60	59.59	2.15	1.29	0.84	0.37	0.23
58	Oats silage	29.89	8.90	5.74	32.00	53.25	36.62	9.11	57.65	2.08	1.23	0.78	0.46	0.31
59	Rhode grass fresh	24.75	8.81	2.18	37.03	71.88	43.05	8.81	54.88	1.98	1.13	0.68	0.38	0.29
60	Rye grass	12.80	20.39	2.97	24.15	53.09	28.02	7.80	70.45	2.54	1.64	1.21	0.57	0.27
61	Sorghum milk/dough	30.00	7.54	1.67	31.67	46.75	31.11	9.20	51.54	1.86	1.02	0.56	0.41	0.20
62	Sorghum silage	28.11	6.63	2.57	32.47	65.33	41.38	8.71	55.20	2.00	1.15	0.70	0.41	0.30
63	Swank, milk/dough stage	12.30	7.97	2.34	31.42	66.20	31.73	14.77	48.60	1.75	0.91	0.45	1.50	0.26
64	Sarsoon, early/full bloom	15.30	20.26	2.16	18.75	21.68	19.30	16.08	56.80	2.05	1.20	0.75	2.70	0.36
65	Sugarcane tops	33.50	6.20	1.60	29.50	67.01	38.80	9.10	52.38	1.89	1.05	0.59	0.28	0.12
66	Sugarcane tops silage	30.59	6.63	1.58	34.64	68.89	39.89	7.92	51.00	1.84	1.00	0.54	0.40	0.37
67	Turnips whole plant	11.90	9.66	1.60	18.99	33.14	20.82	9.36	75.00	2.71	1.78	1.36	0.59	0.29
68	Turnip tops, full bloom	16.50	13.88	3.82	15.45	21.50	23.00	12.36	61.00	2.20	1.34	0.89	0.30	0.20
G	**Dry Roughages**													
69	Barley straw	90.00	4.22	1.78	41.67	72.40	42.21	9.44	46.84	1.69	0.85	0.39	0.30	0.07
70	Berseem hay	85.60	18.46	2.45	31.31	39.60	31.20	12.27	54.88	1.98	1.13	0.68	0.58	0.30
71	Cottonseed hulls	90.20	4.66	1.23	51.55	85.30	63.00	3.88	43.79	1.58	0.74	0.27	0.13	0.10
72	Groundnut/Peanut Straw	91.20	9.20	1.70	33.70	51.80	43.90	9.90	49.89	1.80	0.96	0.50	1.10	0.15
73	Lucerne hay	87.50	18.86	2.28	33.14	44.80	34.40	11.43	54.60	2.00	1.15	0.70	1.70	0.27
74	Maize stovers	82.50	5.45	1.45	34.06	73.90	48.16	8.24	50.60	1.81	0.97	0.51	0.29	0.07
75	Millet stovers	85.00	4.00	1.41	36.23	75.74	44.14	10.29	47.40	1.71	0.87	0.41	0.25	0.14
76	Oats straw	89.80	4.90	2.45	39.51	76.00	44.60	10.27	49.10	1.77	0.93	0.47	0.25	0.12
77	Potato vines dried	90.00	7.90	4.30	27.00	48.76	39.34	13.50	43.61	1.57	0.73	0.26	0.04	0.27
78	Pulses Straw	88.20	8.50	2.30	28.00	63.20	39.60	9.90	60.14	2.17	1.31	0.86	2.70	0.20
79	Rye grass hay	87.00	15.20	1.82	28.50	55.09	30.02	6.80	60.00	2.16	1.31	0.86	0.50	0.20
80	Rice straw	92.82	3.06	1.18	35.55	79.06	54.11	11.79	38.25	1.38	0.85	0.31	0.29	0.09
81	Rhode grass hay	86.50	7.80	2.18	35.30	75.40	41.20	9.70	54.70	1.94	1.12	0.67	0.31	0.26
82	Sorghum stovers	85.50	3.74	1.29	34.03	77.74	49.95	11.11	47.30	1.71	0.54	0.06	0.30	0.07
83	Wheat straw	92.75	2.59	1.18	41.31	80.45	52.42	12.18	44.90	1.62	0.78	0.32	0.48	0.07
84	Sorghum Hay	90.00	7.50	1.40	32.30	68.70	44.00	8.80	54.60	2.00	1.15	0.70	0.18	0.17

S. No.	Feed Stuffs	Dry Matter (DM) %	Crude Protein (CP)	Fats (Ether Extract)	Crude Fiber (CF)	NDF	ADF	Ash	TDN	ME	NE maint.	NE gain	Ca	P
		----------As percent in dry matter----------									---Mcal/kg DM--		% in DM	
H	**Other Feeds**													
85	Vegetable oil	100	0	99.9	0	0	0	0	177	7.3	2.65	2.65	0	0
86	Animal Fats	99	0	99.5	0	0	0	0	177	7.3	2.65	2.65	0	0
87	Potato raw	25	10.8	0.5	2.5	7.1	3.9	7	81.2	2.93	1.97	1.56	0.07	0.22
88	Potato chips cake	90.4	9.84	14.41	1.53	-	-	3.06	81.4	2.94	1.98	1.56	0.8	2.6
89	Bakery waste/slanty waste	89	6.56	7.03	1.06	-	-	10.72	66.65	2.4	1.52	1.08	-	-

NDF= Neutral Detergent Fiber; ADF= Acid Detergent Fiber; TDN= Total Digestible Nutrients; ME= Metabolizable Energy; NE= Net Energy
Ca= Calcium; P= Phosphorus

M. Least Cost Formulation

Least Cost formulations work the best in set feeding amounts for consumption such as a concentrate fed with forage and dairy both cow and buffalo. However, it can work as well in feedlot fattening by developing the least cost rations for the stage of production, feedlots use a Starter ration fed during the first 2 to 4 weeks after arrival. After the starter ration an Intermeiate ration is formulate to have step up energy to the final finishing ration. There are three stages in Feedlot Fattening to successfully feed cattle from a beginning weight of 250 to 300 kg until finished weight of 360 to kg 400. Each step will use a separate ration that can be formulated with least cost formulation. During the growing finishing phase the cattle increases dry matter intake to account for the needed protein and energy to reach the finish weight.

a. Winfeed 2.8

i. Method

Winfeed 2.8 is a Trial Version can formulate 20 ingredients and 20 nutrients. The software has two modes:

1. Inear mode suitable for conventional feed formulation

Simple diets can be formulated either by the Pearson Square method or simulations equation methods. Both methods are unable to handle inequalities or ranges and both are independent of price. . Feed ingredients nutrient composition is variable. Variation is associated with many factors ingredients from different sources and to laboratory procedures. The linear program method uses a mean value or a table value.

2. Stochastic mode specifically for probability based cost formulation.

The purpose in feed formulation is to balance nutrients in diets to meet the nutritional requirements at least cost. Feed formulators want to minimize the risk of not meeting the optimum nutrient requirements. A proposed method is to use linear formulation with a safety margin through linear programming and use the stochastic model. Winfeed 2.8 uses both methods to arrive at a least cost formulation. The least cost linear method use matrix theory to determine least cost feed formulations. The program has two matrixes. The two matrixes are one has ingredients with nutrients and the other has ingredients cost and through simultaneous solve the mix for least cost.

b. Ration Formulation for Feedlot Fattening

Summer Fodders (Nutrient analysis Table 23 Page 78)

1. Maize
2. Sorghum
3. Sadabahar
4. Millet

5. Mott Grass
6. Rhodes Grass
7. Guara

ii. Winter Fodders (Nutrient analysis Table 23 Page 78)

1. Berseem
2. Alfalfa (Lucerne)
3. Sarson
4. Ryegrass
5. Oats

iii. Common ingredients for feed formulation (Nutrient analysis Table 23 page 7)

1. Rice Polishing
2. Wheat Bran
3. Maize Grain
4. Sorghum Grain
5. Millet Grain
6. Oat grain
7. Grams (black)
8. Oil
9. Molasses

A ration formula is made up of Protein Sources (cottonseed cake, cottonseed meal, rape seed cake, canola meal, soybean meal, Maize gluten 30, urea and etc), Energy sources (Rice Polishings, molasses, wheat bran, maize grain and etc) and Minerals (salt, bone meal, DCP, mineral mixes and etc, Vitamins (Vitamin A, D and E).

For making concentrate ration, the formulation uses protein, energy, minerals and vitamins. The nutrient categories are mixed thoroughly with the help of a mixer or by hand. Concentrate feeds are given with fodder and the fodder remains the major part of diet. The concentrate formulation will change with different fodders.The amount of forage fed daily will be the same amount and the concentrate will increase over time to optimize the daily gain of the animals. A TMR can be fed with

fodder by mixing the fodder with all nutrient categories. An example of a concentrate fed with Ryegrass and Alfalfa fodder is in Table 27.

Table 27. Concentrate fed with Ryegrass and Alfalfa Fodder and Estimated Nutrients

Concentrate Feed	%
Rice Polishings	20.0
Maize Gluten 30	25.0
Wheat Bran	27.0
Maize Cracked Rolled Ground	26.0
Minerals and Vitamins	2.0
Total	100
Nutrient Calculations	
	AS FED	**Dry Matter**
Dry Matter %	87.61	100.00
NEM MCAL/kg	1.70	1.94
NEG MCAL/kg	1.12	1.28
Crude Protein %	15.14	1.28

Another technique which is being introduced is Total Mixed Ration or TMR. In this method the concentrate items are mixed with roughages hay, silage, wheat straw and sometimes green fodder. These are mixed thoroughly either manually, or using TMR mixing wagon. TMR formulated with same ingredients with Ryegrass silage and Alfalfa fodder Table 28.

Table 28. TMR fed with Ryegrass and Alfalfa Fodder and Estimated Nutrients

Ingredients	%
Rice Polishings	26.0
Maize Gluten 30	17.0
Wheat Bran	12.5
Maize Cracked	20.0
Rye Grass Silage	10.0
Alfalfa (Lucerne) fresh Fodder	12.0
Trace Mineral Vitamin Mix	0.25
Salt	0.25
Limestone Ground (Finely)Marble	2.00
Total	100.00
Estimated Nutrient in TMR	

	AS FED	Dry Matter
Dry Matter %	75.23	100.00
NEM MCAL/kg	1.43	1.90
NEG MCAL/kg	0.95	1.26
Crude Protein %	12.06	16.03
Crude Fiber %	4.30	5.72
Crude Fat	5.38	7.15
Calcium %	0.84	1.11
Phosphorus %	0.59	0.79

Starter ration fed during the first 2 to 4 weeks after arrival. After the starter ration an Intermeiate ration is formulate to have step up energy to the final finishing ration. There are three stages in Feedlot Fattening to successfully feed cattle from a beginning weight of 275 kg until finished weight of 375kg. Table 29 TMR ration formulated with straw and other ingredients for Feedlot Fattening for export market.

Table 29. TMR Ration Starter Grower (Intermeiate) and Finisher with Straw Formulate and Nutrients

Ingredient	Starter %	Grower %	Finisher %
Rice Polishings	18.0	22.0	24
Maize Gluten 30	21.0	19.0	21
Maize Cracked	9.0	17.0	20
Wheat Bran	24.0	19.0	16
Wheat Straw	18.0	13.0	9
Cane Molasses	8.0	8.0	8
Ground Limestone	1.50	1.50	1.5
Salt	0.25	0.25	0.25
Mineral Vitamin	0.25	0.25	0.25
Total	100.0	100.0	100.0

	Starter		Grower		Finisher	
	AS FED	D.M.	AS FED	D.M.	AS FED	D.M.
Dry Matter %	89.36	100.00	89.14	100.00	89.01	100.00
NEM MCAL/kg	1.47	1.64	1.56	1.76	1.62	1.82
NEG MCAL/kg	0.94	1.05	1.02	1.15	1.11	1.25
Crude Protein %	13.04	14.60	12.78	14.34	13.17	14.79
Crude Fiber %	11.18	12.51	8.86	9.74	7.12	8.0
Crude Fat	4.28	4.78	4.90	5.50	5.31	5.97
Calcium %	0.86	0.97	0.83	0.93	0.81	0.91
Phosphorus	0.58	0.65	0.60	0.67	0.61	0.68

Note:

Rations are drier that ideal so molasses is to increase palatability. The rations as they go through steps energy density increases.

Starter ration fed during the first 2 to 4 weeks after arrival. After the starter ration an Intermeiate ration is formulate to have step up energy to the final finishing ration. There are three stages in Feedlot Fattening to successfully feed cattle from a beginning weight of 275 kg until finished weight of 375kg. Table 30 TMR ration formulated with silage and straw other ingredients for Feedlot Fattening for export market.

Table 30. TMR Ration Starter Grower (Intermeiate) and Finisher with Silage Formulate and Nutrients

Ingredient	Starter	Grower %	Finisher %
Rice Polishings		20.0	31.0
Maize G luten 30	10.0	19.0	14.0
Wheat Bran	31.0	19.0	
Maize Cracked Rolled Ground	6.0	9.0	9.0
Wheat Straw	11.0	9.0	3.0
Patty Rice	14.0	4.0	26.0
Salt	0.25	13.0	0.25
Urea		0.25	0.5
Vitamin Mineral	0.25	0.25	14.0
Ground Limestone	1.5	0.25	2.0
Maize Silage		23	14
Total	100	100	100

	Starter		Grower		Finisher	
Dry Matter %	AS FED	D.M	AS.FED	D,M	AS.FED	D.M
NEM MCAL/kg	75.43	100.00	77.32	100.00	83.27	100.00
NEG MCAL/kg	1.19	1.58	1.36	1.76	1.56	100.00
Crude Protein %	0.75	1.00	0.89	1.15	1.04	1.25
NPN Protein %	9.99	13.24	12.54	16.22	12.06	14.49
Crude Fiber %			1.43	1.84	1.43	1.71
Crude Fat	11.68	15.48	7.48	9.68	6.10	7.32
	1.87	2.49	4.63	5.99	6.00	7.20
Calcium %	0.74	0.98	0.80	1.03	0.76	0.91
Phosphorus	0.40	0.53	0.51	0.65	0.59	0.71

Note:

In the starter Ration there is no silage and no urea. There could be Urea but was not need. The silage was left out because silage is not an ingredient likely used. Cattle adapt to a non silage ration. The rations as they go through steps energy density increases.

N. Dairy Beef Production

Commercial Dairies produce Holstein male caves while smaller dairies are producing dairy cross male calves. The dairy industry produces replacement heifers, however, the bull calves are traditionally viewed as an un-wanted by product of the Dairy industry. These bull calves represent an opportunity for producers to generate income to supplemental total farm income. There is not a consistent market presently for dairy and dairy cross bull calves. The dairy and dairy cross bull calves are under utilized for beef presently and can be an excellent source of high quality beef to enter into the export market. Dairy and dairy cross beef calves intensively managed, using aggressive feeding strategies to achieve high levels of efficiency, increase the opportunity to produce high quality beef profitable for domestic and export markets.

a. MANAGEMENT of the DAIRY COW

The dairy cow is the source of both the dairy heifer and the dairy bull calf. The heifer calf is retained and special care is given to the heifer calf so that she can be returned as a milk cow. The bull calf is sold as soon as possible so that the milk can be sold. Proper care and management of the cow is important to produce a healthy calf either a heifer or a bull calf.

Prepartum Management

1. It is suggested to vaccinate the cow prior to birth with E. coli and Salmonella bacterins.
2. The cow should be housed individual in a clean dry pen with a minimum space of 1002 feet.

3. The pen should have bedding that is comfortable and clean (long dry straw bedding is desirable)
4. When the cow is observed (attended) during parturitions prenatal mortalities will remain low.
5. Knowledgeable intervention during parturition will minimize fetal and maternal stress.
6. Good hygienic practices are essential for successful calving management.
7. The calving area should be cleaned and disinfected as thoroughly as possible prior to parturition.

Figure 27 shows a cow in a calving pen that has adequate space and comfortable bedding with clean long dry straw.

Figure 27 Cow in calving Pen

THE SINGLE MOST IMPORTANT MANAGEMENT FACTOR THAT DETERMINES CALF HEALTH AND SURVIVAL IS ADEQUATE COLOSTRUM INTAKE WITHIN THE FIRST 24 HOURS.

The colostrum contains antibodies that provide the overall disease resistance of the calf during the first few weeks of life. Colostrum, the first milking, contains large quantities of the protective antibodies (quality of the colostrum). Table 31 shows the colostrum (first milk) is high in solids. Adequate and timely consumption of colostrum by the calf is a key factor that controls early calf hood diseases and death loss. Table 1 shows the major constituents of colostrum changing to milk. By 48 to 72 hours, 2-3 days after the calf is born the colostrum is transitioned to milk.

Table 31 Transition of colostrum to milk.

Time after Calving hr	Total Protein %	Casein %	Albumin %	Fat %	Lactose %	Ash %	Total Solids %
0	17.6	5.1	11.3	5.1	2.2	1.0	27.0
6	10.0	3.5	5.3	5.8	2.7	.9	20.5
12	6.0	3.0	3.0	3.8	3.7	.9	14.5
24	4.5	2.8	1.5	3.4	4.0	.9	12.8
30	4.0	2.6	1.2	4.9	4.3	.8	13.6
36	40	2.8	1.0	3.6	4.0	.8	12.2
48	3.7	2.6	1.0	2.8	4.0	.8	11.5
72	3.9	2.7	1.0	3.1	4.4	.8	11.9
96	3.8	2.7	0.8	2.8	4.7	.8	11.9
120	3.8	2.7	0.9	3.8	4.8	.8	12.7
168	3.3	2.4	0.7	3.4	5.0	.8	12.1

The calf ability to absorb colostrum is limited, the gut's ability to absorb the antibodies diminishes rapidly after birth thus the quicker the colostrum is fed to the calf the better protection the calf will have against diseases. Table 2 shows the period of time that percentage of calves that absorb colostrum. Twenty four hours after birth a small percentage of calves can absorb the antibodies in colostrum. Therefore feeding 2 liters of colostrum with the first hour is important and feeding a total of 6 liters in the first 24 hours is desirable.

Table 32 Absorption of Colostrum by Calf

Hours after Birth	Percent of calves absorbing colostrum
0	100
12	95
16	82
20	70
24	42

TIMING OF THE FIRST FEEDING OF COLOSTRUM IS CRITICAL AND SHOULD BE DONE IDEALLY WITHIN THE FIRST HOUR OR AS SOON AS POSSIBLE AFTER BIRTH.

a. 2 liters colostrum within the first hour of birth and 2 liters colostrum 6 to 8 hours after birth and 2 liters within 24 hours after birth, total of 6 liters of colostrum within 24 hours after birth.

b. Feed the cow's milk, 4 to 5liters 2 times per day during the first 5 to 7 days.

c. Calf can be moved to the calf nursery for feeding and weaning after 5 to 7 days

The livability of the calf is dependent on the intake of good quality colostrum. .

Table 33 Colostrum Intake and Mortality

Colostrum Fed	Calf Mortality 1 weeks to 6 months
Liters per day	Percentage
1-2	15.3
2-3	9.9
4-5	6.5

b. Sanitation

Birth of a new calf means a rapid adjustment for the new calf to a new external environment. The respiratory tract, the digestive system, and the umbilical stump (navel cord) are all highly receptive to disease organisms in the first hour after birth. During the first 2 to 4 weeks of life, calf management should strive for maximum sanitation.

Sanitation is especially important when feeding calves liquid diets. Equipment must be spotless clean and sanitized after each feeding. Feeding buckets or nipple bottles should be washed with disinfectant soap and rinse with a disinfectant and dried

Health problems that can occur at the calf Nursery

1. Diseases that can occur from contaminated water
   a. Cryptosporidiosis
   b. Giardia
   c. E. coli
   d. Salmonella spp.
   e. Campylobacter
   f. Other Bacteria
   g. Viral
   h. Provide Veterinary care if observed
2. Coccidosis
   i. Occurs after the calf is 21 days old
   j. Initiated by stress
   k. Diarrhea with blood is sometimes observed.
   l. Provide Veterinary care if observed

3. Mycoplasma

   m. Bacteria from Mycoplasma

   n. Contained in mastitis milk

   o. Antibiotics not real useful

   p. Signs droopy ears

   q. Sanitation is helpful to control Mycoplasma infections.

   r. Provide Veterinary care if observed.

4. Parasites external and internal should be controlled recommend parasite control begins after 30 days at the calf Nursery.

   a. Flies should be controlled every 10 day.

   b. Lice should be controlled.

c. Scours

Calf scours or calf diarrhea causes more financial loss to calf producers than any other disease-related problem encountered. Calf scours is not a disease; it is a clinical sign of a disease which can have many causes. In diarrhea, the intestine fails to absorb fluids and/or fluid secretion into the intestine is increased. There are two main causes of scours in neonatal calves:

Nutritional Scours

Nutritional scours are related to stress, the most susceptible time for the calf is during the first 4 weeks of life, however the calf will becomes more resilient to stress with age. Causes of nutritional scours can include:

i. Changing types of milk or milk replacer or feed

ii. Changing from milk or waste milk to milk replacer

iii. Weather, particularly heat stress but both heat and cold stress are contributors

vi. Vaccinations

v. Dehorning

vi. Transportation

vii. Any type of stress

Nutritional Scours can cause as much water loss as dehydration from pathogenic causes

2. Pathogenic Scours

   a. Causes of pathogenic scours can include

      i. Bacteria found on premises

      ii. Virus found on premises

   b. Infection can be caused by

      i. Calf to calf contact

      ii. Workers while feeding or handling the calves

      iii. Through the environment

   c. Common pathogens that cause enteric infections are

      i. Rotavirus

      ii. Coronavirus

      iii. E Coli

      iv. Salmonella

      v. Cryptosporidia

      vi. Others

Sanitation is the Key to controlling enteric bacterial scours. The calves are babies and have to be feed and handled as babies.

After birth, passive immunity is obtained through colostral ingestion however colostral immunity decreases while the calf slowly develops a functional immune system. The baby calf at birth has an immature immune system and must develop a functional immune system.

Results of Dehydration

- Calves can lose 5% to 10% of their body weight within 1 day of scouring.
- Fluid loss of 8% requires IV treatment
- Over 14 % of body water loss death normally occurs

Clinical Signs that aid to evaluate amount of dehydration in calves (Table 34).

Table 34 Clinical Signs of Dehydration

Dehydration	Signs
5-6%	Diarrhea and strong suckling reflex
6-8%	Mild depression, skin tenting 2-6 seconds, still suckling, sunken eyes and weak
8-10%	Calf depressed, laying down, eyes very sunken, dry gums, skin tenting more than 6 seconds
10-14%	Calf will not stand, cool extremities, comatose
14%	Death

Calves may show no symptoms of dehydration but if they need encouragement to drink, monitor the calves closely for scouring or illnesses. Calves 1-7 days old may or may not know how to drink out of bucket, it is important for the calf to learn to drink from buckets. Milk and water may be fed from buckets. During rehydration calves need enough energy to maintain weight and the immune system when sick. Oral rehydration solutions cannot provide enough energy because they are limited to the amount of glucose in the solution. Therefore feeding milk or milk replacer should be fed with oral rehydration solutions when calf is dehydrated. The important ingredient in oral rehydration is water. Nutritional calf scours should use oral rehydration solutions the rehydration of the calf is important. If the directions for mixing are a small amount of powder in gallons of water this is not an oral rehydration solution, this is an electrolyte solution meant for calves over 6 weeks of age. Check labels and use the correct product for the calf scours.

Calculating the amount of oral rehydration solution to feed

Feeding to much of an oral hydration solution is not a detriment but feed to small amount may not alleviate dehydration and may prolong scours. Multiply weight of calf before dehydration by the percent of dehydration. This will be the liters the calf needs to drink in addition to its milk or milk replacer. Then divide by 2 to get liters of liquid required. Table 35 shows the additional oral rehydration solution needed in addition to the milk or milk replacer for treatment of scours. If fever exists calves may need an antibiotic, consult a veterinarian.

Table 35 Liters of oral rehydration needed to rehydrate calves

Dehydration Percentage	Weight, Kg					
	35	36	39	41	43	45
6.00%	2.25	2.40	2.55	2.70	2.85	3.00
7.00%	2.63	2.80	2.98	3.15	3.33	3.50
8.00%	3.00	3.20	3.40	3.60	3.80	4.00
9.00%	3.38	3.60	3.83	4.05	4.28	4.50
10.00%	3.75	4.00	4.25	4.50	4.75	5.00
11.00%	4.13	4.40	4.68	4.95	5.23	6.50
12.00%	4.50	4.80	5.10	5.40	5.70	6.00
13.00%	4.88	5.20	5.53	5.85	6.18	6.50
14.00%	5.25	5.60	5.95	6.30	6.65	7.00

d. Vaccinations

Vaccines are designed to stimulate specific cells within the immune system, thus stimulating immune cell memory. When disease strikes the immune system is then able to respond strongly and quickly to eliminate or minimize the effects of the disease when properly vaccinated. Programs for the control of infectious diseases are an important component of good managerial practices directed toward maximizing the health and productivity of dairy calves. Thus programs for the control of infectious disease should be directed toward:

- Reducing the exposure (challenge) to infectious agents in the dairy animal's environment. Minimizing factors that diminish resistance.

Nursery Phase

The calf can be moved to the individual pen or hutch after 6 liters of colostrum has been fed in the first 24 hours and the mother's milk for 5 to 7 days.

1. The pen or hutch that the calf is moved into should have been thoroughly cleaned, walls disinfected,
2. Enhancing resistance to those diseases through vaccination

The incidence of infectious diseases in populations of dairy calves tends to increase with increased numbers and concentration of susceptible calves in the nursery. Good hygienic practices are essential for successful calving management including thoroughly cleaning of nurse bottles, nipples, buckets and feeding utensils.

Before moving the calf to a clean, dry, well-ventilated individual calf pen or hutch, ear tag the calf for identification.

1. Manure and bedding from previous calves removed and a liberal layer of dry, fresh bedding added.
2. During this early period, closely monitor calf health and ensure that it is consuming the allotted liquid diet. Veterinary care should be administered if required.
3. Calves that are housed in individual pens and are removed daily for exercise, feeding and water.
4. Should remain in the individual pen for 7 to 14 days before exposure to other calves.
5. If calves are sick and/or have diarrhea (scours) should not be co-mingled with other calves
6. Calves in hutches should be arranged such that calves do not touch each other so as not to pass disease from calf to calf.
7. Bull calves should consider to be dehorned during the nursery period or at weaning
8. Calves should receive needed vaccinations by the veterinary care recommendations
9. The ideal temperature for the milk or milk replacer is 380 to 430 C to be fed to nursery calves. Fresh milk from the cow will be 360 to 390 C.
    - All container using milk or milk replacer should be sanitized after each feeding of milk every day.
    - Water should be fresh daily.
    - Feed should be available the day after the calf arrives at the nursery and fresh feed should be replaced daily.
    - Fresh water should be available daily.

Admitting the calf to the Calf nursery

The calf is inspected for health and any physical problems and is accepted if health is good and no physical problems exist. The calf is logged into the calf nursery admission record. The calf nursery should record the dairy of origin, the calf nursery identification a unique number, date of birth. An example admission form is shown in table 36. The comments section can record date of death if calf dies or any other comment about the individual calf is necessary. The date that the calf leaves the Calf Nursery is recorded to complete the record of the calf. The form should be kept in a record book and can be recorded into a computer file for reference and management evaluation

Table 36 Calf Nursery Admission Form

Day	Amount of liquid diet	Feed to Appetite
5-35	2 liters fed per calf milk 2x per day	Starter Ration
35-42	2 liters fed per calf per day milk 1x day	Starter Ration
	Moved to weaning pens and feed starter feed toappetite. Out weight 90 Kg	Starter Ration

Nurseries are designed units to provide semi-isolation to minimize contact with disease organisms shed by older animals. The facilities should be well ventilated and easy to clean and be disinfected between calves.

Calves need clean, well lighted, properly ventilated quarters. Damp stalls, drafts, and wet bedding may lower the calf's resistance to certain diseases, especially pneumonia. Poorly ventilated quarters usually lead to strong undesirable odors. Young calves should be placed in individual pens until 8 to 12 weeks of age. There are two basic types of facilities:

1. Individual pens inside barns
    a. The units have places that the milk, feed and water can be fed. Exception, if calves are co-mingled during the day then feed and water should be available where co-mingled. Co-mingling should not occur until calf is 7 to 14 days of age.
    b. The units require 2.5 to 3 meters 2 for each animal.
2. Individual pens outside.
    a. The units have places that the milk, feed and water can be fed.
    b. The units require 3 to 4 meters 2 for each animal.

Table 37 Feeding schedule at the nursery

Day	Amount of liquid diet	Feed to Appetite
5-35	2 liters fed per calf milk 2x per day	Starter Ration
35-42	2 liters fed per calf per day milk 1x day	Starter Ration
	Moved to weaning pens and feed starter feed toappetite. Out weight 90 Kg	Starter Ration

1. Calves should be fed a complete mixed ration (Starter Ration, Table 6) beginning when they arrive at the nursery. Early starter feed consumption is necessary to stimulate the development of the rumen. The calves should be fed to appetite with fresh feed daily.
    a. The starter ration should be a coarse textured mixed feed.
    b. The starter feed should be fresh daily and fed in a trough or bucket.
2. The starter feed nutrient guidelines are shown in table 6. The calcium to phosphorus (Ca: P) ratio should be between (1.2 to 1.4) to 1.0. Vitamin A and Vitamin E needs to be considered to be added to the ration if Vitamin A and E are not available green feed or feeds high in Vitamin A and E should be fed.

Clean fresh water should be available at all times for the calf. Free water consumption is necessary to develop the rumen. Free water improves feed intake as shown in Table 38. Feed intake was improved by 129 grams per day a 44 percent improvement and resulted in 127 grams of extra growth (70 percent improvement).

Table 38 the effect of free water on feed intake of calves in the nursery.

	With Free Water	Without Free Water
Starter feed intake grams/day	421	292
Starter feed intake grams/day	308	181

Water quality guidelines are shown in table 9. Water quality can affect the calf's growth and development of the immune system and good quality water should be available at all times.

Table 39 Water guidelines for sulfate and nitrate

	Desired Upper Limits PPM	Maximum Upper Limits PPM
Sulfate (S from SO4)	20	100
Sulfate (SO4)	50	300
Nitrate (NO3-N) N from NO3	10	20

Nursery Phase Calves weaned and fed the Starter ration until 80-90kg. Recommended Starter Ration Nutrient Guidelines Dry Matter Basis (Table 40).

Table 40 Recommended Starter Ration Nutrient Guidelines Dry Matter Basis

Nutrient	Range Dry Matter Basis
Protein, %	22 to 24%
Net Energy of Maintenance (NEM) Mcal/kg	1.80-2.10
Net Energy of Gain (NEG) Mcal/kg	1.10-1.35
Moisture, %	80-85
Calcium, %	0.7-1.4
Phosphorus, %	0.5-0.6
Vitamin A	+
Vitamin E	+

Example Starter feed and Nutrients Calculated is in Table 41.

Table 41 Example Starter Feed with Nutrients Calculated

Ingredient	Percentage	Cost Rs/kg
Wheat Cracked	22.0	24.00
Corn Cracked	27.5	62.70
Corn Silage	14.0	6.00
Cane Molasses	8.0	12.00
Corn Gluten 30		28.00
Rice Polishings	0.5	29.00
Urea	1.0	140.00
Vito Mineral	1.0	7.50
Salt	1.0	112.00
Lithovial	1.0	
Total	100.0	

Ingredient	AS FED	D.M.
Dry Matter %	80.5	100
NEM MCAL/kg	1.47	1.83
NEG MCAL/kg	1.04	1.29
Crude Protein %	13.8	17.1
Crude Fat	3.0	3.0
Crude Fiber %	2.9	3.6
NPN Protein %	1.4	1.8
Calcium %	0.62	0.78
Phosphorus %	0.50	0.62

Note that these young dairy calves are very efficient and as they move forward to a desired weight they can produce an excellent carcass. The feed to gain dry matter basis (1.78) due to the rapid grow of muscle. The expected gain is 0.8 kg per day with average feed intake of 1.75 kg (dry matter intake was 1.4 kg per day). These young dairy bull calves are nearly as efficient as chicken during this period in their life.

Expected Performance is in Table 42

Table 42 Expected Performance

Items	
Intake kg/day	1.75
Days	69
Expected gain	0.8
Feed/Gain, As Fed	2.01
Feed/gain, Dry Matter Basis	1.78
Cost/per gain Rps	64.48
Birth Weight, Kg	30
End Weight. kg	90

B. Growing Phase Dairy Bull Calves

The growing phase is growing the bull calf from weaned bull calf (90 kg) to bull calf (190 kg). This is a critical phase of rapid growth to produce muscle and bone Figure 28 is newly calves from arrived from Nursery.

Figure 28 Dairy Calves in Feedlot from Nursery

Nutrient guidelines for the nutrients need in the ration during growing phase (90 kg to 190 kg) are in Table 43.

a. The calcium to phosphorus (Ca:P) ratio for maximum growth Ca:P ratio for optimum genetic growth is (1.2 to 1.5):1 bone and muscle growth

b. Vitamin A and Vitamin E needs to be added to the ration if Vitamin A and E are not available green feed needs to be fed

Table 43 Grow Ration 90 kg to 190 kg Nutrient Guidelines Dry Matter Basis

Nutrient	Range Dry Matter Basis
Protein, %	16.0 – 18.0
Net Energy of Maintenance (NEM) Mcal/kg 1.70 – 1.90	1.70-1.90
Net Energy of Gain (NEG) Mcal/kg	1.20 – 1.30
Moisture, %	75% – 85 %
Calcium, %	0.7 – 1.4
Phosphorus, %	0.4 – 0.5
Vitamin A	+
Vitamin E	+

A grow ration was calculated and cost was applied when this ration was calculated Table 44.

Table 44 Example of grow ration with Cost and Nutrients Calculated

Ingredient	Percentage	Cost Rs/kg
Wheat Cracked	22.0	24.00
Corn Cracked	27.5	62.70
Corn Silage	14.0	6.00
Cane Molasses	8.0	12.00
Corn Gluten 30		28.00
Rice Polishings	0.5	29.00
Urea		140.00
Vito Mineral	1.0	7.50
Salt	1.0	112.00
Lithovial	1.0	
Total	100.0	

Ingredient	AS FED	D.M.
Dry Matter %	80.5	100
NEM MCAL/kg	1.47	1.83
NEG MCAL/kg	1.04	1.29
Crude Protein %	13.8	17.1
Crude Fat	3.0	3.0
Crude Fiber %	2.9	3.6
NPN Protein %	1.4	1.8
Calcium %	0.62	0.78
Phosphorus %	0.50	0.62

Note crude protein is less than starter ration but energy remains similar.

The expected performance is shown in Table 45.

Table 45 Average Expected Performance

Cost Rs/Kg	25.84
Intake kg/day	4
Days	84
Expected Gain	1.20
Dry matter Feed/Gain	2.86
Cost/per gain	86.41
Begining Weight, Kg	90
End Weight, Kg	190
Ration Cost Rs/Kg	25.84

Note the dry matter feed to gain is increasing however, cost of gain increased from starter feed

C. FINISHING PHASE DAIRY BEEF BULL

The finishing phase is the longest phase and use one ration. The ration is a complete mixed ration that is fed to appetite. The calcium to phosphorus ratio for maximum growth should be between (1.2 to 1.4) to 1.0. Vitamin A and Vitamin E needs to be added to the ration if Vitamin A and E are not available green feed needs to be fed. The Nutrient guidelines for finishing dairy beef bulls are in Table 46.

Table 46 Finishing Ration 190 to 400 - 450kg Nutrient Guidelines Dry Matter Basis

Nutrient	Range Dry Matter Basis
Protein, %	15.0-16.0
Net Energy of Maintenance (NEM) Mcal/kg	1.70-1.90
Net Energy of Gain (NEG) Mcal/kg	1.25-1.35
Moisture, %	75%-80%
Calcium, %	0.70-1.0
Phosphorus, %	0.3-0.4
Vitamin A	+
Vitamin E	+

Table 47 Example Finishing Ration for Dairy Bulls

Ingredient	Percentage	Cost Rs/kg
Wheat Cracked	21.0	24.00
Corn Cracked	28.5	62.70
Corn Gulten 30	5.0	6.00
Rice Polishings	15.0	12.00
Corn Silage	18.0	27.50
Cane Molasses	9.0	28.00
Urea	0.5	29.00
lithovial	1.0	112.00
Vito Mineral	1.0	140.00
Salt	1.0	7.50
Total	100.0	

Table 48 Finisher Ration Nutrients Calculated

Ingredient	AS FED	D.M.
Dry Matter %	78.1	100
NEM MCAL/kg	1.43	1.83
NEG MCAL/kg	1.01	1.30
Crude Protein %	12.8	16.3
Crude Fat	2.9	3.7
Crude Fiber %	2.7	3.5
NPN Protein %	1.4	1.8
Calcium %	0.64	0.81
Phosphorus %	0.48	0.62

Table 49 Average Expected Performance

Ingredient	AS FED	D.M.
Dry Matter %	78.1	100
NEM MCAL/kg	1.43	1.83
NEG MCAL/kg	1.01	1.30
Crude Protein %	12.8	16.3
Crude Fat	2.9	3.7
Crude Fiber %	2.7	3.5
NPN Protein %	1.4	1.8
Calcium %	0.64	0.81
Phosphorus %	0.48	0.62

Table 50 Total Feed Cost for Dairy Beef from Birth to 400 kg

Period	Total Feed	Cost Rs/kg	Total Cost of Feed
Milk or Milk Replacer	67	Rs. 100.00	Rs. 67.00
Nursery Period	121	Rs. 32.07	Rs.3,880.47
Growing	336	Rs. 25.84	Rs.28,244.00
Finishing	1170	Rs. 23.32	Rs. 27,284.40
Total			Rs.59.455.87

Table 51 Cost per kg gain for Dairy Beef

Item	Amount
In Weight, Kg	30
Out Weight, Kg	400
Total Gain, Kg	370
Total Feed cost, Rs	Rs.59,455.87
Cost per kg/Gain	Rs.160.70

Summary

The single most important factor to the success of a dairy beef program is for the newborn calf to receive colostrum with 1 hour after birth and 4-6 liters in the first 24 hours. Dairy beef programs are designed to utilize concentrate feeding to produce a high quality carcass at the earliest possible age. The dairy bull is a relative large frame animal and can be grown at a rapid rate without over fattening. The carcasses are consistent in size of muscle for deboning beef for export.

The manual describes the management and nutritional guidelines from the management of the cow and birth of the dairy bull calf until live weight that produces a high value beef product. There is a nursery phase which calf is fed milk and is grown to 90 kg. The growing phase grows the dairy bull calf to 190 kg and the finishing phase produces the dairy beef for export or domestic market at 400kg.