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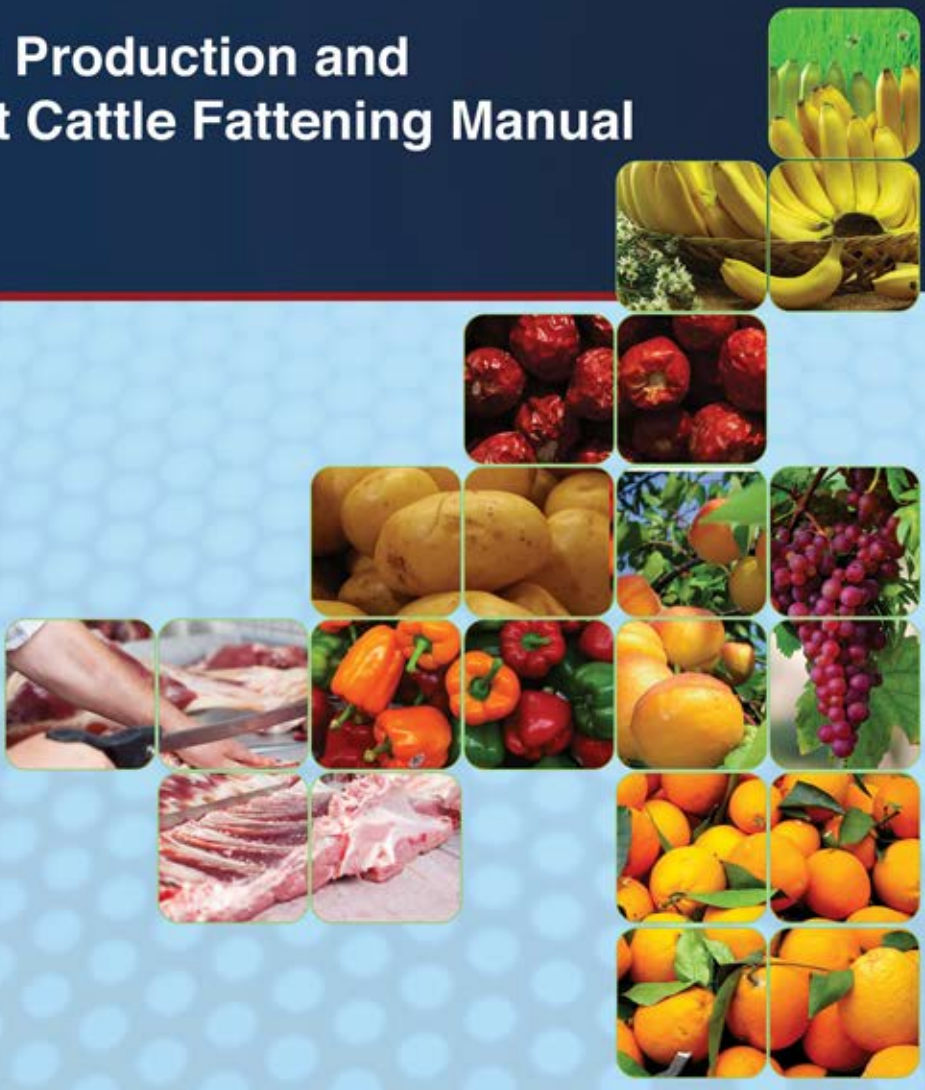
Animal Production and Feedlot Cattle Fattening Manual



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Animal Production and Feedlot Cattle Fattening Manual

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This manual is a live document which can be changed/updated as the project progresses. Any suggestions for further improvement are most welcome.

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The time spent in Lahore proved invaluable. We were able to have meetings at the PAMCO offices and visited PAMCO fattening facilities. However, it was the design of the model breeding program and business model that forms the backbone of this report. It was truly a team effort by a number of producers and industry role players and it essentially took two full days to put in place the structure of the breeding and business model.

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Finally, the day to day activities, reports and pictures have been made available on the web using "evernote".

FOREWORD

A series of Training manuals , Guide Books and Reports have been developed by The Agribusiness Project (TAP) to facilitate the capacity building of farmers involved in TAP's targeted value chains, thereby enabling them to make the requisite transformation from 'subsistence farming' to 'farming as a business enterprise'. The Agribusiness Project is funded by USAID|Pakistan, with the overall goal of supporting improved conditions for broad-based economic growth, enhance profitability and employment opportunities and contributing to poverty alleviation through product and process transformation of selected value chains in horticulture and livestock sub-sectors." The strategy of TAP focuses on:

1. strengthening capacities in horticultural and livestock value chains to increase sales to domestic and foreign markets;

2. strengthening the capacity of smallholders (through farmer enterprise groups-FEGs), individual farmers and agribusinesses to operate effectively and efficiently; and,

3. increasing productivity and profitability through adoption of new techniques and technological innovations (among farmers, agribusinesses and business development services providers).

Through TAP, farmers have been organized as Farmer Enterprise Groups (FEGs) for cultivating the benefits of scale, through optimized production and marketing, and serving as a vehicle for transferring of the benefits of TAP interventions to its stakeholders - the farmers. TAP is providing active support to the FEGs and farmers for improving small producers' positioning in a value chain through support in incorporating producers and their product into stable, profitable market channels, and provision of necessary services and assistance in business development, planning and marketing through inter-linkages. This requires intensive capacity building of the stakeholders placing capacity building at the heart of all interventions.

This report/Manual can be used by anyone involved with the production, cultivation, harvesting and enterprise development training of and for farmers/farmer business groups. The contents have been finalized with the consultation of stakeholders engaged with the value chains.

While these Reports/Manuals/Guide Books are project specific and for a farmer audience, they can also be used for the capacity building of government and non-government agency representatives, processors and exporters who are involved in implementing production/cultivation, enterprise development and value chain programs, through the communities. Finally, I want to thank USAID|Pakistan for funding The Agribusiness Project under which this intellectual capital has been prepared. I would also like to thank ASF for successfully implementing these manuals/guide books across Pakistan for the benefits accrued to the farmers.

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THE AGRIBUSINESS SUPPORT FUND

ASF is a 'not-for-profit' company registered under Section 42 of the Companies' Ordinance 1984 with Securities & Exchange Commission of Pakistan (SECP). ASF has extensive experience in strengthening and supporting demand-driven private sector service delivery mechanisms throughout the agribusiness value chain this includes supply inputs, production and export markets ASF aims to achieve this objective by mobilizing angel investment grant provision and technical assistance support of farmer and agribusiness enterprises. The company supports start-ups as well as existing enterprises, enabling them to employ modern technique and practices and build expertise and markets understanding required by a fast-changing economic environment and to improve their productivity, profitability, competitiveness and creditworthiness

THE AGRIBUSINESS PROJECT

The Agribusiness Project is an initiative of the United States Agency for International Development (USAID) and the Agribusiness Support Fund (ASF) Pakistan .the project aims at enhancing competitiveness of agricultural value chains in Pakistan, with a focus on Horticulture and Livestock including dairy, meat and fisheries. The objective of The Agricultural Project is to support and create improved conditions for poverty alleviation. Since Pakistan's economy is agrarian in nature, The Agribusiness Project aims to invest in interventions at the primary, secondary and tertiary levels of production. Under the International Market Access Program (IMAP), the project supports the creations of linkages between exporters and importers. The objective is to facilitate market access and enable trading linkages which translates into agribusiness through trade.

ABOUT THIS MANUAL

This Manual is a brief guide to:

1-Background of the feedlot sector in Pakistan Current Animal Production Principles
2-Cattle Nutrition and Feeding
3-Financial model of a Feedlot/Fattening farm Animal Health Management
4-General recommendations regarding:
- Planning a Feedlot
- Bunker management
- Making Corn Silage

The Author(s) of this document has based much of the contents of this Manual on reports previously done for ASF. These reports include:

!-A Meat Value Chain report;
2-Business Plan for the Meat Retail Sector in Pakistan;
3-Breeding program for the large animal livestock sector and business plan model for the cattle fattening farms.

Both new and experienced users have been considered in preparing this Manual. Experienced users can go directly to the chapters they are specifically interested in.

References to the articles are provided via the website link in the references.

This Manual has been designed specifically for the Pakistan Meat and Livestock Industry. The Meat Industry is undergoing significant changes as corporates become involved in the value chain. The process is being driven by a buoyant Export Market and the development of retail stores. Historically, the Meat Industry has simply been a by-product of the Dairy Industry but this is changing with the Meat Industry now becoming its own, separate value chain.

PREREQUISITES FOR DEVELOPING A FEEDLOT

Location: A feedlot must not be located in an urban area,but rather at least 100km outside the periphery. A feedlot should also be close to the source of feed and have easy road access to the source animals that are suitable for feedlot fattening. Additionally, a feedlot:

Must have environmental clearance from the local authorities;
Must have access to land and a good source of water;
Should have an easily accessible feed source, especially the source of roughage such as silage or hay;
Have access to good sources of grain and other nutrients.

A feedlot owner must have good knowledge of:
- o Sound business principles;
- o The production characteristics of animals to be fed; o The nutritional requirements of an animal.

Economy of scale: Modern feedlots survive only because of economies of scale. In good times, (low cost of grains and high prices for animals) many small feedlots will enter the market. In tough times it is only the larger feedlots that survive.

Feedlots are capital intensive. There needs to be a far higher throughput of animals entering these facilities. Depending on the production system, many feedlots have up to three intakes of animals going through the facilities per annum. In Pakistan, many feedlots will have only one intake of animals per annum. This is unsustainable given the capital investment required to successfully run a feedlot.

Ensure that animals entering the feedlot have the ability to efficiently convert feed to meat. Animals stunted from birth are not efficient. Younger animals convert feed more efficiently than older animals.

NEED FOR FEEDLOTS IN PAKISTAN

Halal meat is one of the fastest growing segments within the global food trade:
Between 2001 and 2009, the global beef trade grew at an average of 10.4 percent to reach just over $30 billion, according to data available from the UN Food and Agriculture Organization (FAO);

The market for halal beef imports in the Middle East and Southeast Asia grew by over 18.2 percent to reach just under $2 billion a year during that same period.
The demand for meat and milk requirements is expected to double by the year 2050. Now is an opportune time to expand and invest in the livestock sector.

The Meat Sector requires similar interventions as have happened in the Dairy Sector, including:
Promotion of cattle breeds that are faster growing, more efficient and bred for higher value carcasses;
Establishment of feedlots that can deliver a higher value and more consistent product which have economic efficiencies of scale to support the retail and export sector and can promote and sell higher value products;
Support for introduction of high value crops such as corn/corn silage. Corn silage is high in energy, protein and roughage. A hectare of corn can produce up to 60 tons of feed and will be a game changer for both the dairy and meat industries in Pakistan.
Many countries, including developing countries, are starting to use manure and effluents from feedlots as a source of renewable energy. Manure and effluents are excellent sources of compost.

COMMON TERMS

As Fed Basis: Average Daily Gain (ADG): the weight gain, per day, of an animal averaged over time.
Backgrounding: The growing of heifer and bull calves from weaning until they enter the feedlot for finishing.
Balanced Ration: A feed formulated to provide an animal with appropriate amounts of nutrients required for maintenance for a given level of performance.
Carbohydrates: sugar units, such as glucose. They are considered to be the "energy reserves" for the body that are available for a rapid supply of energy.
Concentrates: animal feeds that are rich in energy, but low in fiber, such as wheat, corn, soybean and oats.
Creep Feeding: a system used to feed the younger calves before weaning. A high quality digestible fiber is provided to animals, often in a mixed ration formulae that contains a diet with both protein and starch.
Crude Fat: estimated using ether extraction and is an estimate of the total fat content of a feed.
Crude Fiber: an estimate of the fiber in grains and is still commonly used for analysis of grains and finished feeds. Fiber adds bulk to the animal⊠s diet and also keeps its digestive tract working properly because it has a laxative effect. Diets that are high in fiber tend to increase butterfat content. Most roughages are forages, i.e., they come from the green vegetative parts of the plant.
Dry Matter Basis: DM is often expressed as a percentage of body weight, for example, a 200kg animal eating 7kg of dry matter has an intake of 3.5% of body weight. Feed should always be compared on a dry matter basis. Dry matter is obtained after the moisture has been removed in the feed sample.

Energy: the first substance considered in the diet formulation, and to some extent, can determine the ability of an animal to utilize other nutrients. The major components that contribute to energy content are carbohydrates, and then fat and protein:
Gross Energy (GE): includes all the energy available in a feed.
Digestible Energy (DE): represents energy absorbed by the animal and explains how much energy does not end up in the feces.
Metabolisable Energy (ME): determined by subtracting the energy lost in urine and rumen gases from the DE consumed.
Net energy for Gain (NEG) (and fattening): an estimate of the energy value of a feed used for body weight gain above that required for maintenance nalytical results of a feed sample based on its natural state including water.

Feedlot (Fattening farm): An area or building where livestock are fed and fattened

Food Conversion Ratio (FCR): a measure of the feed to gain ratio; it measures the intake of the animal and uses the ADG to provide a measure of efficiency. For example, if an animal eats 5kgs of feed per day and grows at 1kg, the FCR would be 1:5
Net Feed Intake (NFI): In a commercial cow-calf enterprise, an animal with a good FCR also tends to be the fast growing animal and is also the animal with the highest mature body weight. Modern animal practitioners measure NFI in a breeding enterprise so that slaughter oxen remain efficient but are smaller in stature, like breeding cows.

Growth curve: the most common equation used is the Gompertz growth function. It arises from the assumption that the relative growth rate of an animal declines linearly with the weight of an animal on a logarithmic scale. Furthermore, an animal will prioritize the partition of nutrients according to the metabolic process, where the brain will have top priority, followed by bone, muscle, and fat. As the protein content of the diet increases, growth rate increases until an optimal level of protein is reached, after which the growth rate declines.
Ionophores: feed additives that alter the rumen fermentation patterns and are used in cattle diets to increase the feed efficiency and body weight gain. Ionophores are different to implants and the Ionophore feeding should be standard practice in a feedlot.
Implants: delivered through a pellet that is placed under the skin in the animal⊠s ear. Implants enhance the reproductive hormones that occur naturally in the animal. In oxen, implants replace some of the hormones that were removed when the animal was castrated.
Lipids (i.e. fats and oils): often added to ruminant diets as an extra source of energy. Lipids also help make feed more palatable when dusty or when it is very finely processed. Fats and oils contain more than double the amount of digestible energy as the carbohydrates in grain. They are a very concentrated source of energy.
Marginal versus Total Cost: The common model followed with livestock production is to balance the different energy sources in order to let an animal grow to its full potential and achieve a maximum slaughter weight. In order to ensure profitable production, however, the production methods of the enterprise should be to maximize profit and not to maximize output.
Nutrients: substances that provide nourishment essential for the maintenance of life and growth of an animal; these are divided into six broad categories: Water, Energy, Protein, Minerals and Vitamins.
Total Digestible Nutrients (TDN): a measure of the energy value of a feed. TDN is an old method used for many years to estimate the energy content of a feed, on a carbohydrate equivalent basis, and sums all the fractions that are digestible. Though not as accurate as Net Energy (NE), it is much cheaper to determine.
PH: a measure of acidity or alkalinity ranging from 0 (most acidic) to 14 (most alkaline). A value of 7 is neutral.
Protein: the proportion of protein that has a slow rate of degradability and is usually digested directly in the small intestine (similar to non-ruminants).
Protein: the proportion of protein that has a slow rate of degradability and is usually digested directly in the small intestine (similar to non-ruminants).
True Protein: substances that are chemically pure, such as amino acids, but do not include compounds such as urea, ammonia and nitrates.
Crude Protein (also called total protein): the most useful indication of the nutritional value in feed because it accounts for all the amino acids in feed.
Roughages: high in fiber (18% crude fiber or more).
Scours: occur when calves get diarrhea from a lack of colostrum (essential for at least the first two feedings), or purchasing animals that are unable to adapt to confined spaces. Scours are caused by pathogens.
Stunted Calf: a calf weaned from its mother that has not received adequate nutrition. These calves are unable to reach their full potential and are not viable for feedlot fattening.
Weaner: an animal weaned from its mother, usually at 4-7 months of age. Calves from dairy cows can be weaned from a very early age, i.e. one week, but must then be put onto a Milk Replacer.

1. BACKGROUND

The Meat Industry in Pakistan has enormous potential:

The demand for halal meat is very strong for both domestic consumption and for exports;

Exports have increased by over 30% between July 2011 and July 2014, providing much needed foreign currency to Pakistan;

This upward trend is not a "once off" and has been recurring over the last decade;

Global outlook is positive with demand for meat and milk requirements expected to double by the year 2050. Now is an opportune time to expand and invest in the livestock sector;

Pakistan has some of largest livestock numbers in the world. Until recently, the livestock sector has been undervalued, however this is beginning to change.

A Separate Value Chain:

The Meat Sector is beginning to split from the Dairy Industry and will soon become its own separate value chain. The Dairy Sector recently experienced large investments from the private sector. Companies such as Nestle heavily promoted the safety of pasteurized milk and assisted large "mega farms" to become established. They also spent significant resources training small-holder producers on the value of good management practices and how to produce a better product. Full-time consultants and other employees have been employed to assist writing business plans and training throughout the Dairy Sector. The Dairy Sector also promoted use of high value dairy cows with the potential to produce large volumes of milk. Many of the animals are Holstein cattle and mainly imported from Australia and the United States of America.

Figure 1: Holstein cattle are not bred for meat

The Dairy Sector has reached an economy of scale that needs to be emulated by the Meat Sector. The Holstein animal, however, is not bred for meat production and will ultimately have a negative effect on the meat value chain (Figure 1).

The Meat Sector requires similar interventions as those that have taken place in the Dairy Sector. The Meat Sector will need to promote the use of cattle breeds which are bred for higher value carcasses, i.e. produce more meat and milk. The Meat Sector will also need to establish cattle fattening farms that can deliver a higher value product as well as a retail and export sector to promote and sell these products. All sectors of the value chain need to work together. The private businesses in Pakistan entering the meat value chain require economies of scale and the technical support to make their businesses financially viable.

1.1. Potential for Exports

The International Regional Halal Market has more than 360 million consumers, and global halal trade is worth is more than $440billion. The value of Pakistani exports is approximately $114million, less than 2.26% of the total world's production, despite Pakistan having one of the largest herds in the world.

Halal meat is one of the fastest growing segments within the global food trade. Between 2001 and 2009, the global beef trade grew at an average of 10.4 percent to reach just over $30billion, according to data available from the UN Food and Agriculture Organization (FAO). The market for halal beef imports in the Middle East and Southeast Asia grew by over 18.2 percent to reach just under $2billion a year during that same period.

From 2003-2009, Pakistani red meat exports rose by an average 10-20 percent a year, but this is from a very low base. The single biggest advantage for Pakistan compared to other countries is its close proximity to the Middle East market.

To be competitive, Pakistan will need to adhere to the following requirements to both expand the domestic market and grow the Middle Eastern Market:

1-Move to a cuts and specialist products;
2-Ensure product safety and traceability in the supply chain;
3-Address the concerns regarding animal welfare;
4-Work on certification to ensure that the product is halal;
5-Work on increasing the production of the meat sector by investing in breeding farms and developing feedlot farms that can ensure a superior product in the value chain.

1.2. Domestic Market

Below, Error! Reference source not found. and Figure 2 provide numbers of animals by region in Pakistan and the combined value traded in the Meat Sector. The challenge for Pakistan, in its attempt to formalize its domestic and export market, is that over 80% of small- holder producers have fewer than 1-6 animals. These producers struggle to gain means of entry for their products into the formal retail market.

Table 1: Numbers of animals in Pakistan by Region: Dr Afzal (Economic Survey, 2009-2010, Millon)

	Cattle	Buffalo	Camel	Goat	Sheep	TOTAL
Pakistan	34.3	30.8	1.0	59.9	27.8	153.8
Province						
Punjab	16.8 (49%)	20.0 (65%)	0.22 (37%)	22.10 (37%)	6.67 (24%)	62.33
Sindh	7.89 (23%)	8.32 (27%)	0.30(30%)	13.77 (23%)	4.17 (15%)	34.45
NWFP	6.86 (20%)	2.16 (7%)	0.07(7%)	10.80 (18%)	3.36 (13%)	23.25
Balochistan	2.74 (8%)	0.31 (1.0%)	0.41% (41%)	13.18 (22%)	13.34 (48%)	29.98

Figure 2: The total numbers of livestock animals traded per annum within Pakistan and the value of the products to the industry (Dr. Asif Idrees; values are for the 2008/2009 season). A total of 24.5million animals are traded within Pakistan for a total value of $2.8billion.

Largestock Producers	Total Producers	Smallstock producers
7.6 million animals Rs173 ($1.8) billion 4 million cattle – Rs173 ($1.8) billion 3.6 million buffalo – Rs76 ($.8) billion	24.5 million animals Rs266 ($2.8) billion	16.8 million animals Rs93 ($.97) billion 16.8 million sheep – Rs93 ($1.0) billion 11.9 million goats – Rs57 ($)billion

1.3. Current Production Systems

Pakistan has essentially three cattle fattening production systems, namely: EID, export and the local high end retail market. Some informal trade also takes place, but these figures do not exist.

EID: (80% of market) Fattening for EID requires an older animal with at least 2 permanent teeth. Animals enter a feedlot at 16-18 months of age, weigh between 150-200 kgs, are fed for 6- 7 months (but often longer), and are marketed with a weight between 200 and 300kgs.

Retail Sector: (5-10% of market) Animals entering the formal retail sector are essentially the by- products of the Dairy Sector. The product is old, of low quality and often diseased. They enter the feedlot from one day old up to 18 months, are fed for 6-7 months and sold at an average weight between 200 and 300kgs.

Export Sector: (5-10% of market) Animals enter the feedlot at approximately one year old, are fed for 6-7 months and sold at an average weight between 200 and 300kgs.

.4. Market Requirements

Currently no pricing differentiation exists (i.e. there are no Meat Standards) that allows the market to differentiate between good or poor quality carcasses. Animals are also not purchased on a live weight basis and are simply visually assessed at the Mandi (sale yard). For EID purposes, older animals are preferred and a premium price is paid. Unfortunately feeding animals only for EID does not allow a sustainable feedlot industry to be established.

1.5. Current Feeding Regimes and Production Cycles

Animals entering the Meat Sector are essentially a by-product of the Dairy Sector. Most calves, especially male calves, hardly get an opportunity to suckle the cow and are thus stunted from birth. The result is a permanently handicapped calf which will never make a true come-back. These calves should not enter a feedlot as they will never allow a feedlot to realize a viable financial return. Calves that are stunted from birth consume useful feed and occupy the space of an animal that could yield the required financial return. A small percentage of calves are put onto milk replacers and are then fed in feedlot systems. It is commonly assumed that there is a 50% mortality rate, especially of male calves.

1.6. Current Health practices

Animal Production and Feedlot Cattle Fattening Manual for Pakistan 16Animals are generally given vaccinations for Foot and Mouth Disease, Hemorrhagic Septicemia (HS), Rinderpest, Anthrax and PPR and feed mills generally include antibiotics into the diet.
A complete vaccination schedule applicable to Pakistan is provided in Chapter 5.

1.7. Current Cost of Meat Compared to Other Countries

- In many countries, the monthly price paid for animals is provided on the website of their respective umbrella bodies;
- The price below (Error! Reference source not found.) of $1.50 per kg has been obtained from stakeholder workshops and gives an average price paid for an animal purchased at the Mandis;
- For comparative purposes, the meat prices in South Africa, Botswana, Australia and the USA is provided. The price below is the price for a weaner calf to be fattened in a feedlot;
- The perception in Pakistan is often that cattle owners do not get a fair value for their product, that feedlotters charge too much and that the industry undervalues the product. Given the comparisons in Error! Reference source not found. below, this perception is incorrect;
- The profit in many meat value enterprises is made from selling higher quality products.

The value chain is changing and moving to selling "boxed meat" i.e. selling individual cuts rather than carcasses. Meat Standards and Traceability are mechanisms used to add value to the product.

Table 2 Average Price paid for 200-260kg weaners (liveweight) in USA dollars (July 2013)

Pakistan	South Africa	Botswana	Australia	USA
$1.50	$1.56	$1.30	$1.50	1.58

Figure 3. Monthly prices for live and carcass weights are provided by many countries. Examples for Botswana, South Africa, USA and Australia.

htto://www.mla.com.au/Prices-and-markets/Market-reports-and-prices/Eastern-young-cattle-indicator
http://www.safeedlot.co.za/index.asp?Content=151
http://www.ers.usda.gov/data-products/meat-price-spreads.aspx
http://www.bmc.bw/download/cat/9/subcat//datepicker//

In all countries, a premium is paid for young animals above 200kgs and older; lighter animals demand a significant discount. Below, in Figure 4, are the prices paid in Botswana:
Figure 4. Pricing for weaner cattle paid by the Botswana Meat Commission in August 2014.
10 Pula = 1 US dollar. Note the significant discount for cattle that weigh below 200kg's

LOBATSE			
MALE CATTLE			
Live Weight (kg)	DENTITION		
	0	2	3 & 4
180-200	10.00	6.00	5.00
200.5 - 260	12.50	11.00	7.50
260.5 - 300	12.50	10.50	8.50
300.5 - 340	12.50	10.50	8.50
340.5 - 380	11.50	10.50	8.50
380.5 - 410	10.75	10.00	8.50
410.5 - 450	10.75	10.00	8.50
450.5 - 490	10.75	10.00	8.50
490.5 - 520	10.75	10.00	8.50
520.5 - 999	10.75	10.00	8.50
LOBATSE - Males ONLY up to 4 - tooth			

1.8. Increase wealth by controlling the value chain

THE WAY FORWARD:
Feedlot fattening is about economies of scale. The cost of running a feedlot enterprise drops significantly as the size of the operation increases;

Brazil is doubling its feedlot capacity to 4.5 million head in the next decade. Not only is it a lucrative export earner, it will also free up valuable pastureland;

Ethiopia, also a developing country, exports approximately 600,000 bulls out of feedlots to mostly Middle Eastern countries. The emphasis is now shifting to export deboned meat products from abattoirs. Ethiopia is currently implementing a comprehensive traceability system for all exported animals;

The Botswana model is also applicable to Pakistan in that 90% of producers are small- holder producers. In this model, a few large feedlotters, holding between 500-5,000 head of cattle, were established in the last two decades and purchase most of their animals directly from small- holder producers;

Pakistan feedlots must provide a price incentive for younger animals that are of a certain weight and discriminate against animals that are light and old

As in the illustration in Figure 4 taken from the Botswana Meat Commission (BMC) website, 3-4 tooth cattle are purchased at less than half the price (10 Pula = 1 dollar) i.e. $0.50 compared to weaner cattle that have no teeth and weigh between 200-260kgs, purchased at $1.20;

Assist small-holder producers to supply you with quality animals. Start with the feeding of the calf until the animal arrives at the feedlot;

Weigh animals purchased, and purchase on price. This will assure the seller that you are paying fair value and give you the confidence as the buyer that you are also getting fair value;

The figure below shows a proposed integrated value chain model. Link the feedlot (fattening farm) with at least 100 small-holder farmers whom you directly source your product from. Provide them with information on breeding, feeding, management and show that the feedlot adds value to their product if they are prepared to produce a better quality product. Also influence the processors to purchase on quality and push for them to pay higher prices for quality carcasses.

2. ANIMAL PRODUCTION PRINCIPLES

2.1. Breed and Breed Types

The animal must have the required nutrition to perform optimally but must also be genetically capable of optimizing the allocated feed resources;

Most breeding programs will measure the growth, carcass, reproduction and efficiency of each animal as breeding stock to ensure that they perform optimally in the feedlot;

A comparison of the production potential of the local Pakistani breeds was provided in both the Meat Value Chain report and the report on developing Seedstock farms, referenced in the front of this Manual;
Cattle breeds have evolved over time from cattle required as draught, milk and meat to specialist roles.
Breed types can basically be categorized into the following:
o Dairy;
o Dual purpose;
o Beef.

Modern dairy cattle are, for example, the Holstein or the Jersey cow;

Examples of dual purpose cattle are the Sahiwal, Shorthorn (beef and milk) and Simmental/Fleckvieh. These animals are bred for both milk and beef production;

Beef cattle includes breeds such as the Angus, Hereford, Brahman, Limousin and Charolais.

2.1.1. Purpose of the different meat breeds

2.1.1.1.Dual Purpose
The Sahiwal, dairy/beef Shorthorn and Simmental/Flechvieh are good examples of animals bred for both dairy and beef production. Simmental cattle have been bred over the last 100 years for increased milk production and meat yields. Recent advances in animal breeding have ensured that cows become more efficient, for example, the amount of feed consumed relative to the growth of the animal has improved. Animals are also bred to ensure that cow weights remain constant, and cows are therefore more efficient.

Figure 5. Cattle have evolved from draught animals to production animal

Figure 6. Simmental/Vleckvieh is a good example of an animal bred for both milk and meat production

2.1.1.2. Beef breeds
Beef breeds fall into two main types called Bos Indicus and Bos Taurus.

Bos Indicus are humped cattle that originate from South Asia and are specifically bred to be able to perform in tough environments. The Sahiwal is considered to be a Bos Indicus breed and in countries such as Australia and Kenya is used only for beef production. The Brahman breed is also an example of a Bos Indicus animal.

Bos Taurus are European breeds of cattle and are specifically bred for meat production. These can be divided into the British breeds (i.e. Angus and Hereford) and the European Breeds (i.e. Charolais and Limousin).

Terminal Sire Breeds are European breeds of cattle are specifically bred for cross breeding over smaller female breeds and produce progeny for meat production. Examples include the Belgium Blue. While Terminal breeds are ideal as meat breeds in cross breeding programs, all progeny from Belgium Blue Cattle, for example, should be slaughtered in a country such as Pakistan and the females should not be kept because of calving difficulties.

The ideal animals for feedlots are the crosses between the Bos Indicus and Bos Taurus breeds. Not only do these animals have better growth and the required adaptability in hot, dry climates, the hybrid vigor between these crosses means they perform 10-20% better on average than the pure breeds.

Most cattle in feedlots in hot and dry climates (i.e. Australia, Brazil, Southern USA and Southern Africa) originate from crosses. In Botswana for example, the majority of animals in feedlots are crosses between Brahman and Simmental. These crosses weigh over 200kgs at weaning from grass based pastures.

Research conducted in Pakistan has shown that the feed cost per kg gain for Cholistani calves was higher than those for the other breeds such as Sahiwal, Dhanni and crossbred calves. Results published in a paper by Sajjad Khan showed that value can be added through producing crossbreds, especially the Bos Taurus breeds, such as the Simmental, with local breeds.

Figure 7. Brahman and Sahiwal are Bos Indicus that are bred for hot, dry climates.

Figure 8. Crossbred animals derived from Bos Indicus/Taurus crosses are ideally suited to the feedlot because of adaptability, growth and hybrid vigor

Table 3. Performance of Simmental x Dajal crosses compared to Brown Swiss

Parameters	Simmental x Dajal		Brown Swiss x Dajal	
	Male (1)	Female (2)	Male (3)	Female (4)
Average initial weight (kg)	215	229	162	156
Average final weigh (kg)	360	369	272	270
Average Daily weight gain (kg)	1.21 +- 0.10	1.17 +- 0.10	0.92 +- 0.10	0.95 +- 0.10
Average daily ration intake(kg)	8.56 +- 0.60	8.58 +- 0.67	7.22 +- 0.60	6.67 +- 0.60
Feed conversion ratio	7.14+- 0.46	7.36+- 0.52	7.80+- 0.46	7.02+- 0.46
Meat bone ration	62:38	61:39	64:36	63:37

Pakistan must retain its indigenous breeds of cattle (i.e. Sahiwal, Dani and Cholistani).

They are excellent breeds, and if used correctly in structured breeding programs, can add a lot of value.

Indigenous breeds should be used as "mother" or "cow" lines and used in crossbreeding programs with Bos Taurus bulls (i.e. Angus, Simmental or Limousin).

This will result in animals with higher growth rates and hybrid vigor. This means animals will be more adaptable in feedlots, more efficient, have higher growth rates and better quality of meat.

2.2. Matching Feed Resources with the Production Cycle

Feedlot farms add value to the livestock sector if they are able to match the scarcity of resources, such as feed, when prices of animals are lowest with the time when there are plenty of feed resources and the price of animals are highest. This scenario becomes a win-win situation for both the livestock keepers and feedlotters and is commonly practiced in all countries where there are also distinct periods of fodder availability. The feedlot operation essentially becomes a "fodder bank" and is able to harvest high quality feed, such as silage during the summer months, and use it in the winter and spring to fatten calves.

SUMMER	AUTUMN	WINTER	SPRING
Increased supply of fodder Prices usually higher	Fodder supply starts decreasing Usually a quieter time for feedlots	Scarcity of fodder Prices lower Time for feedlots to start purchasing	Fodder supply starts increasing feedlots fatten animals

Most countries, including Pakistan, have variable seasons in different regions. As mentioned elsewhere, the ideal scenario is to have at least two or three cycles of animals coming through the feedlot per annum. It will take a decade or two before the livestock sector matures to the extent that there are distinct breeding seasons. Feedlots should, however, take advantage of the cyclical supply of fodder and pricing differences.

2.3. The Stunted Calf

One of the biggest challenges for the Pakistani livestock industry is that the resources of the cow in terms of milk production need to be shared between the family and the calf. The indigenous dairy breeds (including Sahiwal) milk production varies considerably. The statistics provided by various research papers gives an annual yield of 5-12 kgs per day, depending on the environment and feeding regimen. Beef cattle in both the adapted and indigenous breeds in Southern Africa, using the weigh-suckle-weigh method, have also been shown to produce 7-10 liters of milk per day. We can reasonably assume that the calf receives about half of the total milk production in Pakistan, i.e. 4kg of milk, resulting in a calf that is stunted from birth. Even the colostrum is often used for the household. Chapter 2.6 describes the requirement of the calf for feedlots. The calf should be provided at least two teats of milk, if milk production is low, and at the very least one teat if the milk production is at least above 8kgs per day (assuming the calf receives at least four liters of milk).

Some practitioners claim that by severely limiting the amount of milk the calf receives from birth, the concept of compensatory growth will allow the animal to "catch up" and reach a reasonable weight. This concept is not applicable when an animal is stunted.

2.4. Matching Cattle Type, Feed Regime and Feedlot Performance

As mentioned above, a good understanding of the production cycle, feeding regime and breed type is important to ensure that the correct animals are sent to feedlot for fattening and that a thorough understanding exists of the type of cattle that will perform in the feedlot environment. Also important is a good understanding of the growth patterns of animals under different feeding regimens.

2.4.1. Understanding Concepts of Cattle Growth

An animal's physiology is described in Figure 9. An animal will prioritize the partition of nutrients according to the metabolic process, where the brain will have top priority, followed by bone, muscle, and fat. Studies have demonstrated that increasing the level of dietary protein from suboptimal levels results not only in faster growth but in carcasses containing less fat and becoming leaner. As the protein content of the diet increases, growth rate increases until an optimal level of protein is reached, after which growth rate declines.

Graph A in Figure 10 describes a pasture based system that has non-descript breeds. Over 85% of the feed simply goes to maintenance and the Food Conversion Ratio (FCR) is 39 units of feed for 1kg of carcass. Graph A1 also describes a pasture based system with non- descript breeds but in this system the animals enter the feedlot at the age of 2.5 years.

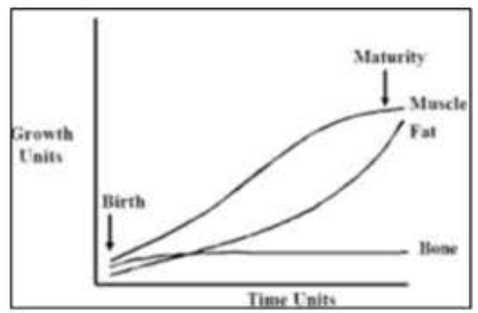


Figure 9 describes the physiology of the growth curve of an animal in terms of bone, muscle and fat

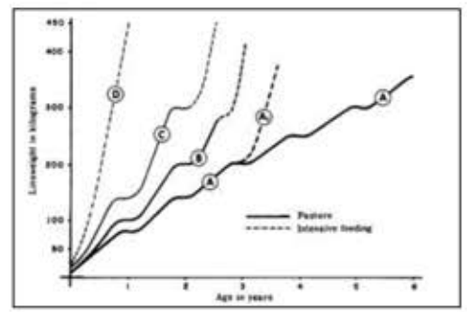


Figure 10 Effects of feedlot feeding on growth pattern and feed conversion efficiency

Graph B is also a pasture based system with non-descript animals but in this system animals are feedlot fed for 150 days and are slaughtered at 2.5 years. The maintenance requirements are 66% of the feed production requirements and 16 units of feed are used to produce a kilogram of carcass.

Graph C describes the scenario where animals are fed on improved pastures, are still non-descript breeds and are feedlot fed for 150 days. The age at slaughter is 30 months. Nearly 60% of feed is required for maintenance requirements and 13 units of feed are required for 1 unit of carcass in this regimen.

Graph D is an intensive production system. Animals are weaned at 5-6 months, enter the feedlot for 150 days and the age of slaughter is 13- 14 months. In this scenario 50% of the feed required is for maintenance and the food required for one kilogram of carcass is 7 kilograms.

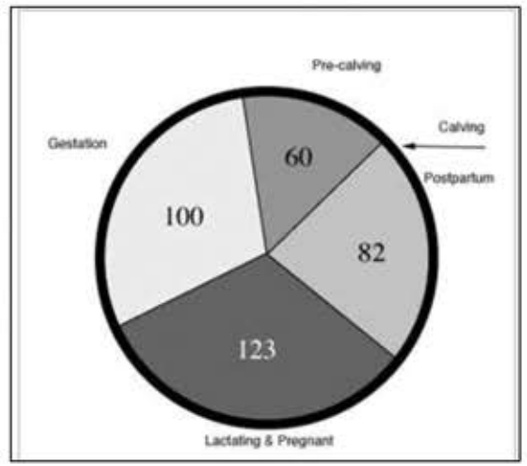
The feed efficiency of an animal improves vastly if the calf is feedlot fed, compared to natural grazing, thus freeing up valuable resources for the cow.

Younger animals are also more efficient to feed than older animals. While the growth rate between an older and younger animal may be the same, a

The concept of a frame score is also important for a feedlot owner to understand. The ideal animal in a feedlot is very dependent on the market requirements. In general, most prominent cattle markets have a grading system that differentiates the product in terms of meat quality. The most important factors in a meat grading system are age of the animal (younger is preferable) and an animal with a reasonable fat cover at slaughter. Feedlot owners tend to prefer medium framed animals.

2.5. Beef Cow Production Cycle

Feeding strategies can only be developed if there is an understanding of the production cycle of the cow and the cow's changing nutritional requirements. This allows cattle keepers to plan their feeding programs and lower the costs. The figure below and discussion forms part of the Virginia Tech Education publications that can be found at the website: http://pubs.ext.vt.edu/400/400-012/400-012.html.



2.5.1. Post-Partum

Starts after the calf is born and last for 80-90 days;
This is the period when the nutritional demands of the cow are greatest because the cow must produce milk, recover from the calving process and re-breed;
If not adequately fed, she will lose weight to the point that re-breeding will be delayed.

2.5.2. Lactation and Pregnancy

A period of about 120-130 days;
Energy requirements decrease by about 15% and protein requirements about 10%;
Cows reach peak lactation and then milk production decreases;
When pregnant, fetal growth adds very little to nutritional requirements;
Cows usually lose weight during this period.

2.5.3. Gestation

A period after the calf is weaned about 200 days after from birth of the calf;
Energy needs are 25% less and protein requirements drop nearly 40%;
This is the best time to put weight back onto animals;
Fetal growth still does not add much to nutritional requirements.

2.5.4. Pre calving

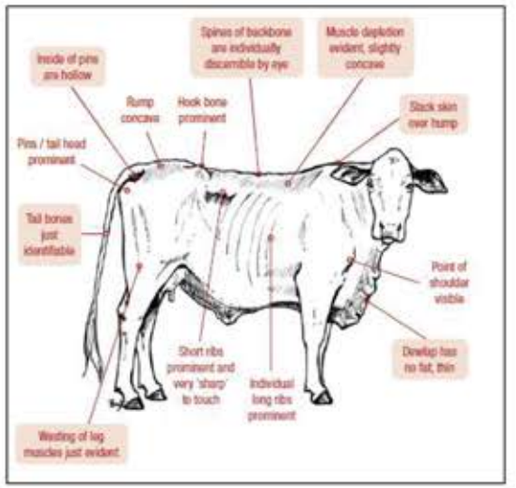
The period 50-60 days before calving;
Is a critical period because the reserves of an animals are stored (similar to putting money into the bank);
Cows must be in condition score 5 or greater;
Cow needs to gain at least 0.5-0.7 kgs per day.

2.5.5. Body condition scoring (BCS)

A body condition score describes the relative fatness or body condition of a cow through the use of a nine-point scale. A body condition score of five is the average. A BCS 1 cow is extremely thin and a score of 9 is extremely fat. Body condition scores of animals are a universal measure and visibly describe the nutrition requirements in the beef cow cycle.

The scores are usually taken at each point of the cycle mentioned in Chapter 2.5. Aim for a score of 5. The website below, provided by the MLA in Australia, provides details of feeding animals that are maintained in drought or limited feed conditions such as that found in Pakistan and the daily maintenance requirements.

http://www.alpa.net.au/UserFiles/File/Documents/MLA%20Low%20Score%20cattle%20Sept%202013.pdf



2.6. Requirements of the calf for feedlot

New born calves must receive 2 to 3 liters of new colostrum within 12-24 hours of birth, preferably within the first six hours. By one month of age, calves should be eating grass and some concentrate, both of which should be available to the calf from birth.

For the first two weeks, feed calves twice daily. Thereafter, they can be fed once daily – best in the afternoon so they get to sleepwith a full stomach.

Calves will need about 7-8 liters of full cream milk per calf daily until weaning at 7 to 8 weeks of age. They should be putting on about 500-700 grams of body weight daily up to weaning.

Weaning, in beef cattle, usually occurs at approximately six months of age because this is usually the stage when an animal obtains more nutrients from feed than from milk. In dairy animals, weaning can occur as early as 4 – 6 weeks, within an intensive production system where animals are very carefully managed to ensure adequate rumen development. It is suggested, for conditions in Pakistan, the optimal weaning time is four months of age, with the stipulation that animals are able to suckle at least one or two teats as described in Chapter 2.3.

A well-nourished animal will continue to perform at a later stage and as shown in Chapter 3.1, will make up the financial difference because of an increase in performance. Early weaning of animals at four months could be acceptable if animals were not stunted from birth, as described in Chapter 2.3, and given an adequate diet.

Figure 11. This animal weighs between 100-120 kgs and was 26 probably not given the milk required for adequate growth.

2.7. Raising Bottled Calves

Some producers or feedlotters purchase small calves and bottle feed them. Some advice for this management practice is as follows:

Try and ensure that you purchase the calf directly from the owner. Calves purchased from auction (Mandi) are very risky;

Run your hands over the calf and ensure that there is no swelling, enlarged bones or deformities. Also check the calves navel for possible deformities;

A healthy calf will usually suck your finger. A too docile calf is usually sick;

Hot calves are animals that have been fed a very high protein diet too quickly. They never recover and usually die;

Check the Navel for signs of infection. It quickly spreads to other parts and creates a sick animal;

Use a two liter bottle for feeding. Use a milk bucket, or box, with multiple teats if you have more than a five calves. Feed the calves twice a day, early morning and late evening;

To make artificial colostrum (essential for at least the first two feedings), mix together 1 egg, one spoon of cod liver oil and stir into 700ml of cow's milk;

It is very important to give a shot of vitamin A, D and E after the second feed. Also administer an antibiotic. These may be expensive but are critical as they save money in the long term;

Feed a good quality milk replacer at 8% of body weight. The milk replacer should have over 20% protein. The newer formulae's are called 25/25 i.e. 25% protein and 25% fat
http://calfcare.ca/calf-feeding/evaluating-milk-replacer

After 2 weeks feed the milk replacer at 4% of body weight with an early weaner diet for the next month and a half. Thereafter, use only the early weaner diet. The weaner diet should ideally be a mixture of molasses, vegetable oil, corn grains and soy products;

Salt should be included in the diet, ideally at about 15 grams per calf per day;

Scours (diarrhea) are arguably the most common problem faced when rearing calves. Scours can occur in different forms i.e., bloody, white, green, yellow or black. The disease starts as diarrhea and may pass bloody stools. It is listless and has a below normal temperature.

Preventative treatments: (the best option)

Buy animals direct from producers rather than auction

Scours are caused by pathogens (at least two that must work together) ⊠ Quality and quantity of colostrum

Adequate vaccinations and trace minerals

Good milk production

Treatment: (very difficult). The loss of salts results in a change of PH and as acidity increases acidosis takes over.

Calves are weak and uncoordinated

The calf cannot stand

Many die of cardiac arrest

Treatment involves correcting the fluid deficit and electrolyte imbalance with electrolytes

De-horn the calf as soon as possible.

3. FINANCIAL MODELS

3.1. Calf to weaner

Chapters 2.3, 2.6 and 2.7 provide an overview of the biological and production requirements of the calf for feedlot fattening. As mentioned previously, the calf requires at least 7-8 liters of milk per day to be able to grow sufficiently to meet both the maintenance and growth requirements to wean a healthy calf. We can probably assume that the average calf in Pakistan obtains 4-5 liters per day. This is barely adequate for its maintenance requirements and provides very little extra nutrition for growth. Providing a calf with two teats of milk should provide it with the adequate nutrition required.

The current retail cost of milk is Rs70.00 per kilogram. If calves were fed an additional two liters for four months, assuming that after one month a balanced ration that provides for both the protein and energy requirements will be phased in, the total cost would be approximately Rs12000 for just the milk component. The current price paid for a 150kg weaner is approximately Rs15000-20000.

Given the high price and shortage of milk in Pakistan, it is difficult to provide an economically feasible model for feeding the calf extra milk, unless it is in a natural cow-calf production system. Milk replacers will markedly reduce these costs. A liter of milk replacer costs approximately Rs20.00 per liter (this intervention would require extra management but is less than half the price of normal milk). In Chapter 2.7 we recommended that the calf be fed colostrum on day one.

The 50% mortality that exists amongst calves also means that the number of animals potentially entering the meat value chain is effectively halved.

Timeline if feeding a milk replacer:

From day two until week 1, the calf should be fed milk replacer at 8% of body weight. After week one, the calf should be given milk replacer at 8% body weight, roughage and the start of a calf weaner diet. After week 2 and for the next three months, feed milk replacer at 4% body weight, some roughage and an early weaner diet at libitum. Thereafter, only feed a calf weaner diet.

Costs of feeding milk replacer and a calf weaner diet:

The current cost of a milk replacer is approximately Rs20.00 and the weaner diet is similar in price. Very little research has been done on the cost/benefit of a cattle enterprise to feedlot feeding in Pakistan, especially using milk replacers. Recent research in buffalo by Azim and colleagues in 2012 has shown that buffalos can be adequately and economically fed a diet as described above (i.e. using a milk replacer and a calf weaner diet after week 2 until 90 days). A cattle feedlot system is usually more economically viable than a buffalo feeding system, Animal Production and Feedlot Cattle Fattening Manual for Pakistan 29 Section 3especially if it can target younger animals that are in good condition and have the genetic propensity to grow.

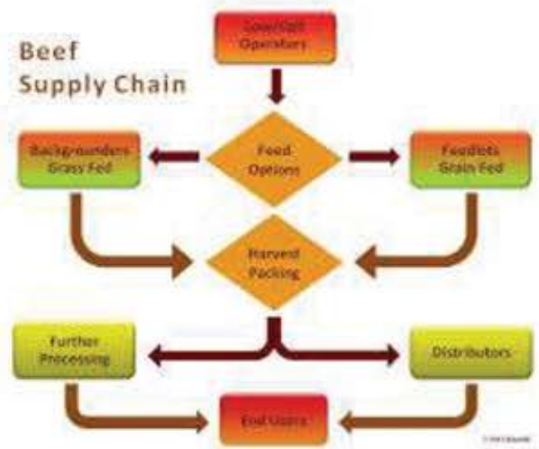
Feeding a dairy male animal is usually not economically viable in most Western Countries and bull calves are usually used in a vealer market. As is mentioned elsewhere in this document, the use of beef or dual purpose animals should be considered as an intervention to make the feedlot and meat sector more profitable.

Finally, it will be very important that the market differentiates the product as described in Chapter 1.4 because this will ultimately create a price differentiation to create the "pull" effect that adds value.

3.2. Matching Feed Resources with the Production Cycle

Feedlots were initially developed in the early 19th century due to an overproduction of corn silage in the USA. The industry soon realized that it could run a larger cow herd by placing weaner calves in fattening facilities and at the same time create a better and more consistent product for the market. The American appetite for marbled beef (meat with a high amount of intramuscular fat) also required animals with the genetics and the propensity to marble. These animals will only put on intramuscular fat if they spend at least three to four months in the feedlot.

Producers soon realized they could maximise the production breeding cycle by matching the periods of least forage (and lowest prices for their weaner animals) by sending animals to feedlots where animals are mostly fed on corn silage combined with high protein and energy diets.



Producers can keep more female animals on their property and sell the weaners during a time when there is a lack of forage. For the feedlotter the win is that the feedlot is essentially a "food bank" that purchases the animals at a lower than normal price, but also rewards the producer for having a better quality anima3l0 with a propensity to grow faster.

The steer oxen (or young bulls) are then sold at high prices to either the local retail market or for export. It is a win/win situation.

The feedlotter is able to sell animals for a premium price, often at the time of the year when the price of meat is high. A schematic concept of how the weaner system could match the production cycle is given in Chapter 2.2 and is given in Figure 13 on a monthly calendar.

Because production environments differ in a country such as Pakistan, the weaner cattle are available for large parts of the year. It will however take time for an industry to get used to a "breeding season" with specific dates when animals are mated to match the environment production system. Feedlots will also inspire good management practices such as the need for a breeding season in the long term.

In the Southern hemisphere, the breeding season starts in December/January with most of the calving occurring in August/September, just before the summer rains. It makes sense that in Pakistan (Northern hemisphere) this would be the opposite and is to some extent substantiated by Hussain (2007) and Ahassan (personal communication), as well as in the workshops. The example provided below of a production cycle is for Punjab province:

3.3. A Feedlot budget

A business plan for a feedlot was provided in an ASF report by the lead consultant titled "Breeding program for the large animal livestock sector and business plan model for the cattle fattening farms" referenced in the front of this Manual. This manual is available from the ASF office. Another comprehensive business plan has been provided by the Small and Medium Enterprise Development Authority (SMEDA) and can be found at the website www.smeda.org.pk.

Pennsylvania State University's animal livestock extension department has provided an online spreadsheet that lists the variable and fixed costs required for a feedlot operation and is adapted to kilograms and Pakistani conditions; this is provided below. The labor, building and equipment cost needs are specific to the enterprise.

Sample slaughter ox budget
Bought at 220kgs and sold at 590kgs

Items	Quantity	Your Quantity	Unit	Price	Total
Income					
Slaughter cattle	280		kg's	180	50400
Variable costs					31200
Feeder calf	160		kg's	195	
Feed Cost					
Silage Corn	1.36		To	10000	
Cotton Seed			Kg	1200	
Wheat straw			Kg		
Sal, Minerals	110		Kg	2400	
Rumensim			Kg	2400	
High Energy diet			Ton	2300	
Health program				1200	
Electricity				1000	
Repairs on Equipment and buildings				1200	
Marketing and transport				1000	
Miscellaneous				400	
Interest on Investment				3200	
Total variable Costs					
Fixed Costs					
Labour					
Building					
Equipment					
Total Fixed Costs					
TOTAL COSTS					
Returns					
Net returns over variable costs					
Net returns					

At various workshops, held with various stakeholders in numerous scenarios, inputs and outputs were considered. In one such scenario, the calf weight was at 6 months of age (150 kgs). Assuming a price per live weight of Rs150.00, the calf will cost Rs22500.00. If kept on the feedlot for 4 months, at 1.5kg per day, we can assume an increase in growth of 180kgs and a final weight of 330kgs. If sold at a nominal price of Rs 150.00 it would realize a price of Rs 49500.00.

The gross profit would thus be Rs 27000.00. Using a combination of silage in a TMR diet (provided from a local supplier), we calculated a profit per animal of Rs 9000.00 per animal.

3.4. Marginal vs. Total Costs

The economic trade-off between income and costs in a feedlot:

The challenge for any nutritionist balancing rations for the feedlot industry is to find a balance between the economics optimum versus the optimal growth:

The fact is that the lighter an animal is the less feed it needs to remain alive and survive. However, these calves are not the animals that necessarily perform in the feedlot. Feedlot cattle are those that have high gain relative to intake. The correlation between average daily gain (ADG) and Food Conversion ratio (FCR) is high at about 70%. This would imply that the larger maturing animals tend to be the high growth animals. It is for this reason that smaller framed breeds are rarely used in feedlot fattening farms (An exception would be Ethiopia, where Boran cattle are fed of pasture based systems).

The fact that the calves destined for the feedlot in Pakistan are in many instances emaciated right from birth, because calves need to share the resources in terms of milk production with the household, requires an economic assessment of the required mass that animals need for maintenance and growth without being permanently affected growth wise. The next point to consider is whether these animals would still recover sufficiently when placed on normal production rations.

The third question is to consider the economic optimum versus optimal growth. To answer this question requires research combining the economics, nutrition and breeding into an economical model that considers variables such as feed intake, food conversion, breed types and the price of feed to justify the weight gain.

The common model followed with livestock production is to balance the different energy sources in order to let an animal grow to its full potential and achieve a maximum slaughter weight. This model was essentially adopted in many western countries because of an oversupply of corn/corn for human consumption and the remnants fed to animals.

However, energy as a feed source has become expensive especially in developing countries such as Pakistan where it is primarily used for human consumption. In order to ensure profitable production the production methods of the enterprise should be to maximize profit and not maximize output.

Revenue, cost and product relationships:

The most important relationships are between Total and Marginal costs.

The total revenue, cost and product is the total of a particular item for the whole enterprise (feedlot). Examples include total feed cost, total sales, total fuel cost, total output or total rental income. These numbers are important for the calculation of the cash flow and income statement and give an indication of the size of the enterprise. However, total revenue and costs are not very useful in a detailed business analysis.

Marginal revenue, cost and product are important concepts for decision making and are used to choose the optimal level of production to maximize profits or minimize losses. Marginal in the true sense of the word means "extra" or "additional". Marginal revenue thus refers to the value of the additional product per additional unit of certain input and marginal cost refers to the additional cost for adding the additional unit of input. Marginal product is the additional product that was produced by implementing the extra unit of input.

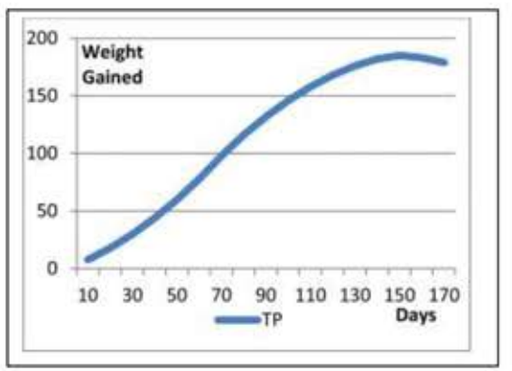
Correctly calculating production input and output:

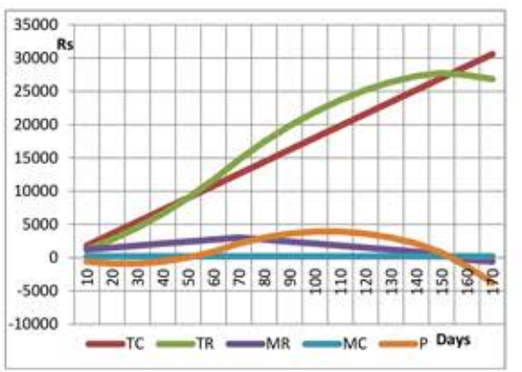
Does the increase of an input which resulted in an increase in output that justified the expense in a feedlot operation?

This principle involves the law of diminishing returns, which states: "as additional units of an economic variable are used, the additional impact of that variable will eventually increase at a decreasing rate." The law states that the impact of a certain production factor (input) will become smaller and smaller as more units of the same input is applied, keeping everything else in the production process constant. Each resource, or input, should thus be used at the quantity at which it will give greatest returns (profit). This concept is very important in a feedlot operation.

Maximizing profit does not equate to maximum input.

Current economic models use Total Product and Total Revenue as explained above. For example, cattle are fed in a feedlot and can stand there for increments of 10 days. The calves can be fed for up to 170 days, but as soon as the calves are fed for more than 150 days they become uneconomic. The obvious answer from the illustration in Figure 9 shows that the total product reaches a maximum at 185kg where calves are fed for 150 days.





However, this may not necessarily be the most profitable equation.

The answer is to calculate the Marginal costs, revenue and product as shown in Figure 10. By adding price information to both the input (Days) and product (Weight) of the same example it is possible to calculate the Total Cost (TC), Total Revenue (TR), Marginal Revenue (MR), Marginal Cost (MC) and Profit (P).

EXAMPLE:
Assume that the price per day in the feedlot (Input) is (Rs) 180 and that the price for the added weight (output) is Rs150/kg. Putting these inputs/outputs into a spreadsheet where we account for the input over a 10 day period and using the marginal revenue and cost structure, we calculate the Total revenue to be Rs 27750. The marginal profit is obtained at 100-110 days and is Rs 3900.

Every additional 10 days cost the feedlot owner Rs1800 per calf. The Marginal Revenue curve shows how much additional revenue will be created for every additional 10 days the animal is held in the feedlot.

This example can be applied to other variables, for example, the different types of feed fed to cattle. Each example is unique and needs to be calculated for each individual feedlot.

The spreadsheet for the above example can be obtained from the ASF office.

4. NUTRITION

Nutrition is usually three-quarters or more of the expense associated with livestock production. It is very important to plan a feeding program for optimal production on a least cost basis. Feed needs to be produced economically and "blended" in the most efficient manner. As explained in the previous chapter, we also need to match the feeding regimen to the growth curve of the animal and also ensure that an animal receives enough feed from the onset. A permanently handicapped calf can never make a true come back.

In all modern feeding regimens the handicapped calf is disposed of to reduce the loss. Handicapped animals also occupy space that could have been given to another animal that could have yielded the required returns.

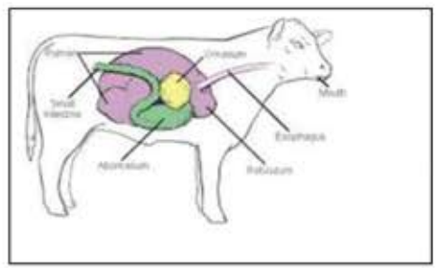
Approximate Chemical composition of an animal:
Water: 60% [Provides body fluid and helps regulate body temperature]
Fat (lipid) 15% [An Energy source for fuel and essential fatty acids]
Carbohydrates 2% [An Energy source that is a fuel for body heat and work]
Protein 17% [Also an Energy source but used mostly for growth and repair]
Minerals 6% [Used for developing body tissues and for metabolic processes and protection]
Vitamins <1% [For metabolic processes and protection]

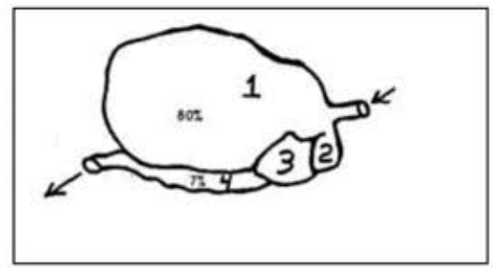
4.1. Understanding Nutrition Concepts

Dry Matter Basis:
The water content of feed can vary greatly and analytical data is therefore given on a dry matter (DM) basis. DM is obtained after the moisture has been removed in the feed sample. The DM is often expressed as a percentage of body weight, for example, a 200kg animal eating 7kg of dry matter has an intake of 3.5 % of body weight. Feed should always be compared on a dry matter basis.

4.1.1. Basic Anatomy and Function of the Stomach

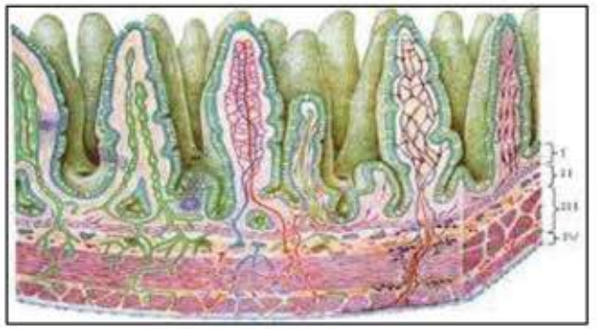
4.1.1.1. Ruminant vs non ruminant
Difference between ruminants and non-ruminants is that ruminants can efficiently digest plant material to convert to meat compared to simple stomach animals. The ruminant digestive system however is less efficient than monogastric animals at digesting high- energy diets, such as grain





4.1.1.2. The Rumen (1)
Acts as a fermentation vat
Is small at birth but changes as the animal grows
Bacteria and protozoa supply enzymes to break down the fiber in the feed
Over 60% of all digestion happens in the rumen.
Carbohydrates are fermented to fat, and then absorbed across rumen wall into blood stream. Converted by body to glucose and fat

 The rumen must be slightly acidic to function (PH 6.5 to 7). There must be a plentiful supply of ammonia and carbohydrates to feed microbial population. The environment must also be oxygen free (anaerobic)
 Balance required between grass (low in protein and carbohydrates thus limiting microbial growth) and high grain diets that can lead to high acidity (low PH) that then becomes toxic and also compromises microbial growth
 When roughage is eaten by the adult animal, it is chewed on, soaked with saliva, and then swallowed producing the cud. Is then broken down or digested by the micro-organisms
 Once the food particles of cud become small enough, they pass to the reticulum



4.1.1.3. Reticulum(2)
Foreign objects that may have been swallowed with the feed settle out in the honeycomb structure of the reticulum s walls, also called the "hardware stomach".

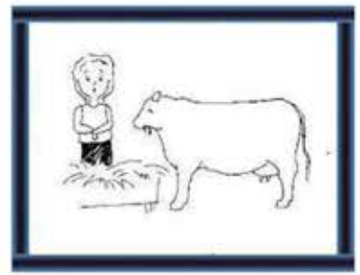
4.1.1.4. Omasum(3)
The omasum removes the water from the fermenting particles and also absorbs more nutrients, called volatile fatty acids, which help supply the animal with energy.

4.1.1.5. Abomasum(4)
Also called the "true" stomach. Here, particles are digested by the stomach acid (hydrochloric acid and enzymes).

4.1.1.6. SmallIntestine
Particles are then passed into the small intestine where absorption of amino acids, fats and some glucose takes place. Bile and pancreatic ducts open into the small intestine and delivers enzymes, solvents and other agents to aid the digestive process.

4.1.1.7. Largeintestine
Consists of the caecum, colon and rectum. Some breakdown of feed takes place here but products are generally not absorbed. The large intestine s role is to absorb water and collect waste material.

4.1.2. Feed Types/Groups
There are basically two groups of feed for animals, roughages and concentrates:



Roughages are high in fiber (18% crude fiber or more). Fiber adds bulk to the animal's diet and will also keep its digestive tract working properly because it has a laxative effect. Diets that are high in fiber tend to increase butterfat content. Most roughages are forages, i.e., they come from the green vegetative parts of the plant. Forages tend to be low in energy.

Concentrates are low in fiber and high in either energy or protein. They often come from the seeds of a plant. Examples include corn, oats, grains and soybeans

Feed Types:

Dry Forages: Feed that is cut and windrowed (cured in the sun) and stored for later use. Hay is an example of forage that is cut before or at maturity. It is either cut before it has formed seeds or while the seeds are still on it. Straw is forage that is cut after it is past maturity and the seeds have already dropped or been harvested from it.
Green Forages: Pastures or shrubs that the animal grazes fresh.
Silages: Forages that have been cut and then stored without air to allow bacteria to be able to ferment the forage. It is then preserved.
Energy Concentrates: Contain at least 20% crude protein and less than 18% crude fiber and are high in digestible nutrients.
Protein Concentrates: Contain at least 20% crude protein.

4.2. Nutrients
Nutrients are substances that provide nourishment essential for the maintenance of life and for growth of an animal and are divided into six broad categories: Water, Energy, Protein, Minerals and Vitamins. These are described below:

4.2.1. Energy
Energy is not a nutrient but it is common practice to include it under nutrients when discussing the total nutrient requirement of an animal. It is also the first substance that is considered in the diet formulation and, to some extent, can determine the ability of an animal to utilize other nutrients. The major components that contribute to energy content are carbohydrates, and then fat and protein. The components provide different amounts of energy to the animal and are used in different ways by an animal:

Energy requirements are affected by the size and maturity patterns of the animal and whether animals are confined or grazing on pasture, and the environmental temperatures. Free-grazing animals for example require 30-50% more energy than confined animals.

Major sources of energy include the oils (soy, corn and fish oil) and the by-products from livestock rendering.

There are two main components of energy:
- o Crudefiber
- o Nitrogen free extracts (some sugars and starches etc.)

Energy Units:
A calorie (Cal) is the amount of heat required to raise the temperature of one gram of water from 16.50C to 17.50C. Joule is another measure of energy. In Europe the Joule is mostly used and in the USA Calorie. Food energy is measured in kilojoules (kJ). The common term for this used to be „calorie⊠ but „kilojoule⊠ is the term now accepted internationally

Partitioning of Energy:
Energy in feed is lost as it passes through an animal. It starts as gross energy and finishes as net energy as per the flow chart in Figure 15 below. Net Energy is used for maintenance, growth, milk and pregnancy.

Gross Energy (GE)	**• Energy excreted**
Digestible Energy (DE)	**• Energy in urine and rumen gases**
Metabolisable Energy (ME)	**• Heat loss due to sweatinging and radiation**
Net Energy : Maintenance (NEM)	**Net Energy used by the animal for Maintanance (NEM)**
Net Energy : Gain (NEG)	**• Net Energy used by the animal for Gain (NEG)**

Gross Energy (GE): includes all the energy available in a feed. It refers to the heat generated when a feed is completely oxidized (burnt). To measure GE a known amount of sample is placed in a bomb calorimeter and oxygen is filled into the chamber so that the sample is completely oxidized.

It should be noted that there is little association with the GE of feed and the energy available to the animals. For example, wheat straw and grain have the same amount of Gross energy (18 MJ/Kg) but an animal can metabolize (utilize) much more of the energy in grain (13 MJ/Kg vs 5.8 MJ/Kg) as shown in Table 5 from the MLA Beef cattle Nutrition handbook.

Digestible Energy (DE): represents energy absorbed by the animal and thus explains how much energy does not end up in the feces.

Metabolisable Energy (ME): determined by subtracting the energy lost in urine and rumen gases from the DE consumed. To measure the ME we collect feces, urine and the gaseous losses (minus the heat production). An example of the ME for cattle is given in Table 4 below.

Table 4 Metabolisable Energy in some typical food (MJ/kg DM)

Table 4 Metabolisable Energy in some typical food (MJ/kg DM)

Food	Energy lost in				ME
	Gross Energy	Feces	Urine	Methane	
Corn	18.9	2.8	0.8	1.3	14
Barley	18.3	4.1	0.8	1.1	12.3
Wheat Bran	19	6	1	1.4	10.6
Lucerne hay	18.3	8.2	1	1.3	7.8

Net Energy (NE): what is left after accounting for losses to feces, urine & gasses and heat increment. Heat increment is energy lost in fermentation and in metabolic processes. Net Energy is available for the animal to use and most accurately describes energy requirements for maintenance and milk production. It is not the most efficient measure for gain, for example growth and fattening, but these components are variable and difficult to measure.

Net Energy for maintenance (NEM): an estimate of the energy value of a feed to maintain animal tissue without weight gain or loss of weight. NEM
is used in formulating beef and sheep rations for
maintenance plus energy for pregnancy and lactation. It is
important to remember that when balancing a ration, maintenance needs must always first be met.

Net energy for Gain (NEG) (and fattening): an estimate of the energy value of a feed used for body weight gain above that required for maintenance.

Total Digestible Nutrients (TDN): an old method used for many years for estimating the energy content of a feed, on a carbohydrate equivalent basis, and sums all the fractions that are digestible. Though not as accurate as NE it is much cheaper to determine.

TDN = digestible crude protein (CP) + digestible crude fibre (CF) + 2.25 digestible fat or ether extract (EE) + digestible nitrogen-free extract (NFE) i.e. starch and sugars

The ether extract is multiplied by 2.25 in an attempt to adjust its energy value to reflect its higher caloric density (fat = 9.1 cal/g and carbohydrates = 4.1 cal/g). The TDN is very similar to DE, but DE and NE are more commonly used.

Figure 16 Net energy for maintenance estimates the energy value required to maintain animal tissue without weight gain or loss

Energy for Maintenance and Production:
The animal always first needs to meet its energy requirements for maintenance before gaining weight or putting on fat. If the energy intake does not meet its maintenance requirements the animal will start losing weight.

Appendix 1 gives the Metabolisable energy requirements in Megajoules per day (MJ/day) for cattle, for both maintenance and growth.

Table 5 A example of two feeds with the same Gross Energy but very different Metabolisable Energy

	Type of feed	
	Grain	Straw
Gross Energy (MJ/Kg)	18	18
Digestibility	90%	40%
Digestible Energy	16.15	7.2
Metabolised (%)	80%	80%
Metabolisable energy	13	5.8

4.2.2. Protein

Protein is a critical nutrient in cattle diets. Signs of protein deficiency include lowered appetite, weight loss, poor growth, depressed reproductive performance, and reduced milk production. Young, growing cattle and lactating cows are classes of cattle most likely to require protein supplementation. Providing adequate protein in beef cattle diets is important for animal health and productivity as well as profitability. Protein percentage in diets can be calculated by multiplying the percentage of nitrogen in feed by a factor of 6.25 (protein contains 16% nitrogen on average). For example, Urea at 46% Nitrogen will have a protein percentage of 287% (46*6.25).

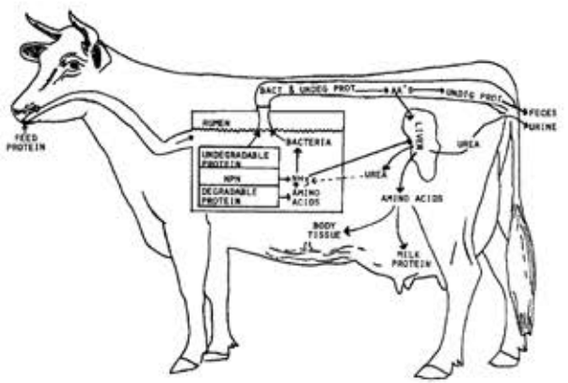
True Protein: refers to substances that are chemically pure, such as amino acids, but does not include compounds such as urea, ammonia and nitrates.

Crude Protein (also called total protein): is the most useful indication of the nutritional value in feed because it accounts for all the amino acids in feed.

Protein falls into two categories:
1-Protein required to meet the requirements of the rumen microorganisms called rumen degradable intake protein (DIP), and;

2-Protein that escapes from the rumen into the small intestine of cattle where it can be used directly by the animal

Figure 17), called rumen undegradable intake protein (UIP). Undegraded or bypass protein is protein that is not degraded in the rumen but passes directly into the small intestine.



4.2.3. Water

The most critical nutrient:
Non-lactating animals consume about 3 parts water for 1 part dry matter intake. Cattle with a livemass of 160kgs require at least 5-20 liters of water per day, and cattle that weigh 350 kgs (for example mature animals) require at least 45-70 liters of water per day. Animals that weigh over 450 kgs require over 90 liters of water per day. The water needs of animals differ markedly and depend on the stage of production (lactating cows for example require more water), and of course environmental factors such as dry, hot and humid periods. Lactating cows need additional water.

A brief guideline of the daily water requirements for cattle is given below in

Table 6 Daily water requirements of cattle

Liveweight (kgs)	Water Requirements (Litre)
Growing heifers, steers and bulbs	
100 kg's	10
200 kg's	36
350 kg's	57
Finishing	
250 kg's	45
300 kg's	54
450 kg's	78
Lactating cows	
400 kg's	60
Mature Bulls	
730 kg's	78

4.2.4. Lipids (fats and oils)

Fats can be added to ruminant diets as an extra source of energy. It also helps to make feed more palatable when dusty or which is very finely processed. Fats in feed can also reduce the incidences of bloat. Adding fat to diets would also depend on the feed costs of other grains. For example, when the price of grain is high it may be more economical to include fat for increasing energy and thus the performance of the animal.

Fats and oils contain more than double the amount of digestible energy as the carbohydrates in grain. They are thus a very concentrated source of energy. Fat supplements can be found in oilseeds that contain 20 to 45% oil. Pure fats are made up of vegetable fats. The difference between fats and oils is based on the physical form at room temperature: fats are solids and oils are liquids.

In feedlot diets they are usually added at the rate of 2 to 5 percent of the diet's total dry matter. Total fat levels exceeding 6 to 8 percent can cause digestive disturbances, diarrhea and reduce feed intake.

4.2.5. Vitamins

Vitamin A is the most important vitamin for feedlot cattle fed high concentrate diets. Cattle that are fed green grass rarely need vitamin supplementation.

Animal Production and Feedlot Cattle Fattening Manual for Pakistan 47In feedlot diets that are based on barley, wheat, or oats, Vitamin A should be supplemented because a large proportion of dietary Vitamin A is destroyed in the rumen and abomasum of cattle. Deficiencies of Vitamin A or E may depress immune function. Vitamin E is an important antioxidant in muscle that can prevent oxidation of muscle pigments and fats. However, the amount of dietary Vitamin E sufficient for growth and health under normal conditions does not provide enough tissue.

4.2.6. Minerals

Minerals are important because they are a key component for essential functions that allows an animal to live and grow, and are especially important for bone development. Cattle need over twenty different elements in correct proportions to thrive. The most important minerals are Phosphorus and Calcium. However, Copper, Sodium, Potassium are also important.

Too many or too few minerals will cause problems, and minerals need to be balanced in the diet. Except for Phosphorus, most minerals are usually found in adequate quantities in green feed. A lack of minerals can be found in a feedlot when animals are fed mostly high concentrate diets. Diagnosing mineral deficiencies requires professional assistance from well qualified nutritionists.

Minerals	Dietary requirements
Phosphorus (P)	1.8-3.2
Sulphur (S)	1.5
Calcium (Ca)	1.9-4.0
Sodium (Na)	0.8-1.2
Magnesium (Mg)	1.9
Potassium (K)	5.0
Chlorine (Cl)	2.0

4.3. Measuring Efficiency of Feeding Cattle

The traditional way of measuring performance of an animal is to measure its Average Daily Gain and Food Conversion Ratio.

Average daily gain (ADG) is simply the rate of weight gain per day over a specified period of time. For example, if an animal weighs 150kgs on May 1 and later weighs 260kgs on June 31 of that same year, then it gained 110kgs in 60 days. Divide 70kgs by 60 days, and the ADG comes out to be 1.8kgs per day.

- Genetics play a key role in the ADG with the Bos Taurus (Limousin, Simmental/Vleckvieh and Charolias) in general, having a better ADG than the Bos Indicus breeds (Brahman, Sahiwal). Breed types are described in Chapter 2.1.

- The ADG of animals in the feedlot should be calculated every second week.

Food Conversion Ratio (FCR) is a measure of the Feed to Gain ratio and measures the intake of the animal and then uses the ADG to provide a measure of efficiency. For example, if an animal eats 5kgs of feed per day and grows at 1kg, the FCR would be 1:5. FCR is considered to be a useful management tool when evaluating the economics of growing and finishing cattle, especially in the feedlot.

However, it is not considered to be the perfect measurement of feed efficiency because feed conversion ratio is strongly correlated with growth traits as described in Chapter 2.0. This means that selecting for FCR can result in increased mature cow weights. Larger cows consume more feed and are not more efficient than smaller cows. In fact, geneticists suspect the opposite to be true, that smaller cows are more efficient. Because FCR is so highly correlated with growth, the concern is that FCR is not a good indication of feed efficiency in pregnant or lactating mature cows, the group of cattle that consumes the most feed.

An alternative measure of FCR is Net Feed Intake (NFI), or its converse, residual feed intake (RFI). RFI takes into account the growth of the animal and is defined as the difference between an animal's actual feed intake and its expected feed intake based on its size and growth. It is independent of the level of production (i.e. the growth or ADG), and the lower the value the more efficient the animal is. RFI or NFI have become the routine measure of efficiency in most modern breeding programs.

The challenge with measuring FCR or RFI is the individual intake of an animal must be measured. This is an expensive exercise and to date only happens on the breeding farms where bulls are selected for improved RFI. Animals are usually measured for a period of 84 days with a 21 day adjustment period. Many western countries recorded data on thousands of bulls of various breeds. Breeders such as the Leechman cattle co in the USA annually tests 1,200 bulls on farm for RFI.

New developments that will affect the feedlot industry are currently being implemented through companies such as Growsafe (growsafe.com). The Growsafe system is designed for feedlots and will measure ADG, FCR and RFI every time the animal feeds using an electronic ear tag. It is an early warning system and can detect animals that are sick or not performing up to two weeks before the ADG is affected.

4.4. Ad Lib vs. Restricted Feeding

More than two decades ago there was debate to the merits of ad-lib versus restricted feeding of cattle in feedlots. It is now common practice to feed diets between 2-4 times per day and for the animals to eat as much food as they can comfortably consume, with the stipulation that the correct diet has been given. In many countries, nearly 50% of feedlots will feed cattle more than 4 times per day. Some feedlots will feed 60% of the TMR diet in the morning and 40% in the late afternoon. Cattle should, however, have food 24 hours per day.

The challenge is to manage the bunkers properly which is a matter of timing and management. The bunkers should be just about empty when it is time to refill. Feed should not be allowed to accumulate from feeding to feeding. Mix the remaining concentrate in the trough with the fresh concentrate to minimize waste. Dry matter intake will decline if this is allowed to occur for long periods of time with large accumulations of stale feed. Cattle often gorge themselves on the new, fresh feed and some cases of grain bloat may occur. The final waste residues should be cleaned out on a daily basis or at least every two days to avoid acidosis, bloat and liver disease.

Only in cases where animals are only fed dry feeds based on dry grain and hay may they be fed only once per day. Some research has found that feeding once a day in the evening was as good as feeding twice a day and was better than feeding once a day in the morning. However, dry feeds will be fresher for cattle if fed twice a day during rainy or snowy weather.

Many feedlots use a score bunker management system that can range from -1 to 3. For example, a score of 0 means that the bunker has been empty for more than an hour (-1 means the bunker has been empty for more than one hour). Zero scores would imply that you feed 5-10% more feed at the next feeding.

Tall, firm stools are a sign that the cattle are consuming significant levels of roughage, while flat brown stools indicate the cattle are consuming higher amounts of grain. Flat, gray stools are a sign of acidosis. Flat, gray stools may be observed before an actual drop in feed intake occurs. Pens that have a majority of flat brown stools and a few gray stools are a sign that cattle are optimizing intake.

Finely ground meals and heavy ingredients such as minerals should not be falling to the bottom of the bunk. This only happens when small particle feeds, such as ground protein or mineral are fed with large particle feeds. If finely ground meals do appear in the bottom of the bunk, consider adding moisture in the form of silage, molasses, water or other wet products to help hold the finely ground meals in suspension.

4.5. Ration Formulation and Feeding Systems

Lighter, smaller framed cattle will require a ration with less grain (protein and energy) and will be taken to a "finishing" phase at an earlier stage. Much of the current research is focused on the economics of feeding medium framed cattle because feedlots tend to discriminate against smaller frame cattle because of low weight gains. The market requirements, however, dictate optimal cattle types. Bos Taurus breeds tend to finish early (they start putting a lot of fat on at an early stage and easily become over fat) while the Bos Indicus, and especially the European breeds, tend to fatten a lot later and are late maturing, hence the move to crossbreds as a final product as described in Chapter 2.1.

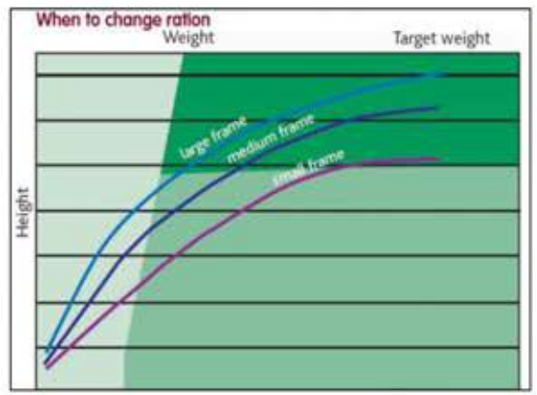
Ration formulation and feeding systems are dependent on the availability of feed and market requirements. For example, in Pakistan, similarly to Europe, there is no emphasis on marbling in meat. This means that animals can be fed rations that promote high average daily gains (ADG's) and the animal does not need be over fattened to enable them to marble. Diets should therefore have a high starch content to promote fast weight gains. In high starch diets adequate quantities of fiber is important (at least 0.5 -1.5 kgs).

The feeding and management of meat animals can be divided into three distinct phases and each phase requires a different ration formulation. These phases are:

Rearing: completed by the time the animal is weaned from its mother. In most countries that have feedlots this occurs at around 200 days of age. The calf is usually fed milk from the mother.

Growing: this phase would depend on the production system and the weaner price. Animals can be:
o Sent directly to the feedlot for fattening;
o Put on pasture or fed grass for "backgrounding". This backgrounding period can last up to 15 months for a "long weaner" production system. Growing the animal to the required size (height and length) would be the main aim;
o On a short weaner production system (i.e. the animals go to feedlot directly after being weaned) the animal will be backgrounded for about three months on natural pastures but must still attain a growth rate of at least 0.5-0.8 kgs/day;
o In the backgrounding phase, the primary focus is growth of bone and muscle tissue, the development of the immune system, and cheap gains based on a diet of primarily forages (usually high value grass).

Finishing: the finishing phase is a short sharp period of maximum weight gain that allows the animal to maximize meat yield and to optimize its fat cover.
Smaller framed cattle, usually found in Pakistan, require a longer growing but a shorter finishing period than larger framed cattle.
The recommended feeding regimen for Pakistan would depend on the market requirements. Below are some suggestions:
1. EID: Cattle fed for EID are usually between one and two years of age but are not in very good body condition. The recommendation would be to feed them a high concentrate, cereal based diet for a short period of time (maximum 60-80 days). The recommended diet (expressed relative to DM) is expressed in the table below:



Performance and economics of a long-back grounding period (long weaner) vs. a short (weaner) finishing system:

Calves in long back grounding systems have significantly greater ADG

Calves in short weaner systems are more efficient (up to 20%)

The economics would depend on the:

Condition of the calves entering feedlot (were they stunted at growth, for example)

Costs associated with standing in Feedlot

Final weights

In general: Long weaners tend to be more profitable but the calves must have grown at least at 0.8-1.0kg per day before entering the feedlot

DMI = 2% Bodyweight
Target gain: Aim for > 1.5 kg's live weight
30-60% Dry Matter (DM)
13-15% Crude Protein (CP)
> 12 MJ/kj DM Metabolisable energy (ME)
> 25% Neutral digestible detergent fibre (NDF)
5-8% Fibre
<5% Fat
>30 Starch and sugar
0.5% Calcium

The rumen of animals fed for EID would be properly developed but they would still need to go through an adaptation phase from a grass fed diet to a high energy diet. This needs to be done over a period of at least one week to 10 days with 0.5kg increments of energy per day.
In the finishing phase, as appetite falls in relation to bodyweight, intake should be encouraged through the quality of feed provided.
 Drier rations stay fresh longer
 Mix wet and dry rations to avoid very wet or very dry
 Energy drives fermentation in the rumen, however, at over 13MJ/kg, DM intake is compromised
 Small amounts of straw assists with rumination, prevent acidosis and improves FCR
 Too many fats and oils leads to acidosis and reduce intake
 The protein requirements should be met by microbial protein (i.e. diets that can be broken down by the rumen microbes).

2. Animals for local retail and export: Animals for retail and export can either be put directly into a feedlot after weaning or go through a back grounding phase on grass.
For the growing phase the ration should be high in fiber (e.g. straw) and digestive fiber (e.g. sugar cane), high in protein, minerals and vitamins with a moderate energy density. It is not recommended to have high levels of starch as this will simply lead to fat deposition, especially in the smaller framed breeds, without muscle development. The recommended ration for the growing phase would be:

DMI = 2.5% of bodyweight
Target Gain: 0.5-1.00 kg liveweight
30-60% Dry Matter (DM)
15-16% Crude protein (CP)
10-12 MJ/Kg Metabolisable energy
> 40% Neutral digestible detergent fibre (NDF) <3% fat
<20% starch and sugar
0.6% Calcium

After the growing phase, they can be given a similar ration to the finishing ration above. The primary change from growing to finishing is that finishing rations contain less forage and more supplements (grains). This leads to increased rumen acidity and means the rumen microbial population has to change from a population supporting fiber to supporting starch digesting bacteria.

This change costs time and money. Animals need to be assisted to adapt quickly in increments of about .5kgs per day as mentioned above.

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This change costs time and money. Animals need to be assisted to adapt quickly in increments of about .5kgs per day as mentioned above.

3. Creep feeding calves: Creep feeding should begin at least one month before weaning. The feed should be palatable, dust free and contain feed that high in digestible fiber. The feed should include trace elements and vitamins. A recommended ration would be:

Target Gain 0.8-1.2 Kg's
14-16% crude Protein
11-12 MJ/kg DM ME
35% Neutral digestible detergent fibre (NDF)

4. Balancing nutrient sources: The most important nutrient to consider is energy (mostly in the form of carbohydrates) and protein. They however have to be balanced so that the proper amount of soluble carbohydrate and rumen degradable protein is required for proper fermentation in the rumen and to optimize performance. Carbohydrate fermentation and protein degradation usually occurs at a different rate.

Foods high in fiber include: Straw, Low Digestable Silage, Soy hulls, Citrus pulp, High Digestable silage and sugar beet pulp.

Foods high in starch include: Cereals (especially cracked serials), biscuit blends, and potatoes, rolled and ground cereals.

Foods high in sugars include: Molasses and sugars found in products such as sugarbeet. Fibers can be divided into Structural and Digestible fiber:

 Structural fibers are found in plants that have long stems, for example, wheat straw and hay. Structural fibers should be cut into 5-10cm (about the width of the animals mouth).
 Digestible fibers are supplied by-products such as corn gluttons or sugar beet pulp. Cattle need between 30-40% digestible fiber in their diets. They also need both types, structural and digestible fiber (example, Table 5).

4.5.1. Growth Promotants

4.5.1.1. Ionophores

Ionophores are feed additives that alter the rumen fermentation patterns and are used in cattle diets to increase the feed efficiency and body weight gain. Ionophores are fed in small amounts and supplied via another feedstuff as a carrier. In cattle fed on grass, ionophores increase average daily gains by 5%–15% and improve feed efficiency by 8%–12%. In the feedlot, ionophores increase ADG by 1%–6% and improve feed efficiency by 3.5%–8%. The feedlot sector therefore contributes a smaller, but still a significant effect on breakeven price and production cost per head between 1-2%. Combining the use of ionophores with implants has a synergetic effect on performance because ionophores increase the amount of energy available from the diet, and implants stimulate lean tissue growth, which uses the increased available energy.

Feeding ionophores should be standard practice in a feedlot. Other advantages include:
- Decreased incidences of acidosis
- Prevention of coccidiosis
- More efficient utilization of protein

Rumensin is by far the most commonly used ionophore included in feedlot diets.

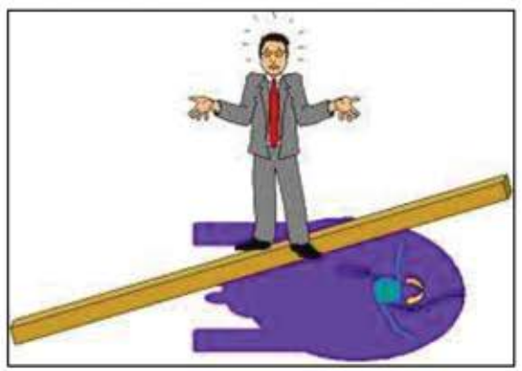
4.5.1.2. Implants

Dr. Ira Mandell from the University of Guelph in Canada, in detailed studies, reported a 21% increase in overall ADG and an improved efficiency of 23% for cattle given both implants and ionophores compared to animals not given the growth promoters.

Oestrogen based promotants stimulate the release of the animals own growth hormones, increasing the cell growth and protein retention. Androgen based hormones are usually used to reduce the breakdown of the muscle cells and to stimulate lean meat production.

However, animals must be on a high plane of nutrition to obtain the maximum benefit from growth promotants.

It is important that animals on growth promotants have some form of permanent identification. Many importing countries find the use of certain growth promotants unacceptable and it is thus important to be able to prove that your product is traceable and that these promotants are not used in the supply value chain.



5. ANIMAL HEALTH MANAGEMENT

It is clear from the stakeholder workshops held that the animal health cost makes up a very small percentage of the total cost for running a feedlot (less than 5%). In Chapters 2.3, 2.6, and 2.7 we discussed the highly mortality rates of calves. Acidosis remains one of the largest contributors to calf mortality and the best way to solve the problem is through preventative measures by providing the calf with minerals such as Vitamins A, D and E and the correct vaccinations.

The below animal health vaccine schedule is provided by Mr. Zeeshan Javed from the University of Faisalabad and can be found at the following website:

DISEASE	TYPE of VACCINE	DOSE & ROUTE	TENTATIVE SCHEDULE	MANUFACTURED BY
H.S	Alum precipitated (having strains of Pasteurella multocida Robert type-1)	5ml/300 kg B.W S/C	May-June Nov- Dec	VRI (LHR) VRI (Peshawar) CASVAB (Quetta) VETY CARE (ISBD) NIAB (FSD) Hira Labs (FSD) BIO LABS (ISBD)
	Killed oil adjuvant vaccine	3 ml for adult 1 ml for up to 1 year of age. I/M Booster in calves after 12 weeks	Once a year	VRI (LHR) VETY CARE (ISBD) NIAB (FSD) Hira Labs (FSD) BIO LABS (ISBD) Grand pharma (ISBD)
FMD	Aluminum hydroxide trivalent (O,A,ASIA- 1) vaccine	5 ml S/C 3 ml for young animals	FEB-MAR SEP-OCT	Avesina (LHR) FMD Research Centre (LHR) UVAS (LHR)
Black Quarter	Alum precipitated culture of Cl.chauvoei	5 ml/600 lbs. B.W	APR-MAY	VRI (LHR) VRI (PSHWR) CASVAB (QUE)

DISEASE	TYPE of VACCINE	DOSE & ROUTE	TENTATIVE SCHEDULE	MANUFACTURED BY
Anthrax	It is a suspension of live attenuated spores of non-capsulated Bacillus anthracis in glycerine saline	1 ml S/C	Once in a year	VRI (LHR) VRI (PSHWR) CASVAB (QUE)
Rabies				VRI (LHR)
Enterotoxaemia	Alum precipitated (prepared by incorporating equal quantity of perfringens type B & D.	3ml for adults 1 ml for lamb	JAN & JULY Ewe 7-10 days before parturition	VRI (LHR) VRI (PSHWR) CASVAB (QUE)
CCPP	It is a formalized culture of Mycoplasma mycoides	1 ml S/C	MAY & NOV	VRI (LHR) VRI (PSHWR) CASVAB (QUE) VRI (LHR) CASVAB (QUE
PPR	PPR vaccine			VRI (LHR) CASVAB (QUE)

6. GENERAL RECOMMENDATIONS

6.1. Building a Feedlot

Prerequisites for Developing a Feedlot:

Location: A feedlot must not be located in an urban area but rather at least 100km outside the periphery. It should also be close to the source of feed and have easy access to the source animals that are suitable for feedlot fattening.

- o Must have environmental clearance from the local authorities;
- o Easy access to land and a good source of water;
- o The feed source should be easily accessible, especially the source of roughage such as silage or hay;
- o Have good access to good sources of grain and other nutrients.

A feedlot owner must have a good knowledge of:

- o Sound business principles;
- o The production characteristics of animals to be fed;
- o The nutritional requirements of an animal.

Economy of scale: Modern feedlots survive only because of economies of scale. In good times (low cost of grains and high prices for animals) many small feedlots will enter the market. In tough times it is only the larger feedlots that survive.

o In Botswana, Zambia, Namibia and Zimbabwe, also developing countries, feedlots are rarely smaller than 500 head of cattle because of economies of scale. Transport logistics for the procurement of feed, cattle and access to markets that want a consistent supply has meant that small feedlots are unsustainable.

Effective Feedlot Design: A feedlot often includes a feedmill, storage facilities, facilities where animals and vehicles can be washed, stock lanes, handling yards, pens and a facility where rain water can collect and a separate facility for manure and excretion;

Make sure that future expansion is easy to do, so plan the feedlot that when it☒s time to expand it can happen easily;

Make sure it is planned properly from the outset. Buildings, yardage etc. are not easily changed. The slope must be correct because it is difficult to change once the feedlot is built. A decent slope allows proper run-off for both water drainage from rain and run-off from urine and effluent;

Manure is no longer infrequently removed from pens and dumped into stockpiles. Many feedlots have manure removal regimes that use windrow based systems to dry out. Manure composting systems are becoming commonplace;

Many feedlots in Pakistan are largely under roof, many are partially roofed. Most have invested capital in roofing infrastructure. Unless the weather is really extreme, such as the winter weather found in parts of Europe or the USA, it is often unnecessary to overcapitalize with expense sheds. Figure 19 gives the minimum and maximum temperatures for Lahore and shows that the time of the year when cattle will probably suffer some heat stress from April to October. It is probably more practical to have partial shading for cattle but this should be no more than 30% of the total area. Cattle should have adequate access to water and the strategic cleaning of high manure deposition areas is a priority.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
20 (68)	22 (72)	28 (82)	35 (95)	40 (104)	41 (106)	38 (100)	36 (97)	36 (97)	34 (93)	28 (82)	22 (72)	32 (89)
13 (55)	15 (60)	21 (69)	27 (80)	31 (88)	34 (93)	32 (89)	31 (87)	30 (85)	26 (78)	20 (67)	14 (58)	24 (76)
5 (41)	7 (45)	12 (54)	17 (63)	22 (72)	26 (79)	27 (81)	26 (79)	23 (73)	15 (59)	9 (48)	5 (41)	16 (61)

Biogas technology
Biogas technology (i.e. converting manure and effluents into electricity) has become more efficient and some feedlots, even in the developing world, are now able to use feedlots to develop their own electricity.

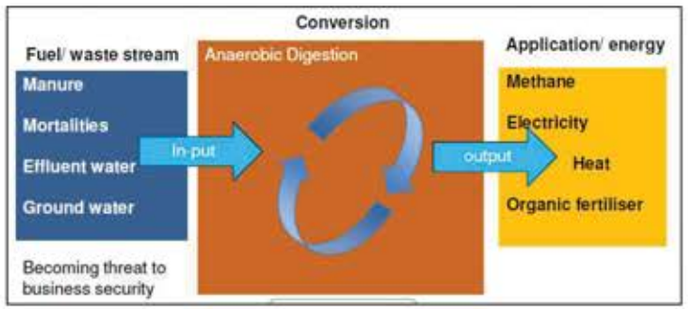


Figure 20 Biogas technology has become a lot more efficient in converting manure and effluent into energy, and is even used in developing countries.

A number of manuals which assist with the layout and design of a Feedlot and are provided in the references.

6.2. General Management Practices
Before animals are placed in the feedlot, they should be:
- Drenched with a broad-spectrum dosing agent for internal parasites;
- Sprayed for ticks if necessary;
- Injected with Vitamin A;
- Implant steers and heifers with a growth stimulant;
- Weigh and put an ear tag all animals. This will enable the growth rate of individual animals to be monitored;
- Group animals together according to their maturity patterns (i.e. large frame together) and age and condition;
- Implement a vaccination program against respiratory infections.

Adaptation:
- As mentioned previously, animals must have 10 to 14 days free (ad lib) access to good quality roughage (hay or even silage);
- Preferably only roughage must be given on the first day. If animals have already consumed concentrate supplements, only then can animals be given concentrates from the first day;
- Increase the concentrate intake gradually during the first 10 days up to ad lib feeding;
- Initially feed 2 kg per day; increase by 1 kg per day until no residues are left;
- Ensure that the mixture contains the optimal roughage for normal rumen functioning.

6.2.1. Making Corn Silage
Pure Grass Silage is very rarely used in feedlots. Small amounts help to meet digestible fiber requirements, but large amounts will reduce energy density and extend the days to finishing the animals.

The introduction of high quality corn revolutionized the cattle industry in many countries once the excess of corn that was first used for human consumption started being used as a source of high quality energy at a relatively low cost for cattle feed. The knowledge of silage making further enhanced corn as a high energy product in cattle feed. Making quality silage requires the correct seed (should be a hybrid that is highly digestible); the construction of a bunker and the corn should be harvested at the proper time. The compaction and sealing process is very important as well as the use of inoculants designed to speed up the fermentation process, reduce dry matter losses, improve nutritive value and improve protein quality by reducing ammonia production.

Good quality silage requires adequate heat, fertile soils and water. The Punjab Province has all three of these necessary components; there is no reason why two crops should not be grown per annum.

A comprehensive manual is provided on the USAID website (courtesy of the UN-FAO).This document details the various moisture contents and various ways to make silage and is especially targeted at small to medium scale producers: http://pdf.usaid.gov/pdf_docs/PNADQ897.pdf

On its website in Pakistan, Pioneer Seeds provides a detailed description of the whole process required to make high quality silage: http://www.pioneer.com/home/site/pakistan/silage/

It is important to engage with known seed companies that are able to provide a high level of support.

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7. Idrees Asif (2000) Value Chain Mapping of the Meat Sector in Pakistan

Internet Links including Manuals:

Animal Production
http://beef.unl.edu/cattleproduction/backgroundingfeedlot
http://www.eblex.org.uk/wp/wp-content/uploads/2013/06/Manual-7-feedinggrowingandfinishingcattle forbetterreturns.pdf
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http://www.motherearthnews.com/homesteading-and-livestock/raising-bottle-calves-zmaz78mazjma.aspx?PageId=3 http://www .pvj.com.pk/pdf-files/31_1/23-26.pdf

Nutrition
http://www.agritrading.ie/AdLib-Meal-Feeding
http://www.ag.auburn.edu/~chibale/an08energy.pdf

Silage Making
http://www.deheus.co.za/en/knowledgebase/detail/3/basic-principles-of-silage
http://www.pioneer.com/home/site/pakistan/silage/ http://pdf.usaid.gov/pdf_docs/PNADQ897.pdf

8. APPENDIXES

Appendix 1. Metabolisable energy requirements (MJ/day) of cattle for maintenance and growth

ME of diet (MJ/kg DM)	Liveweight	Liveweight Gain (kg/day)			
		0	0.5	1.00	1.50
5	100	19	35		
	200	31	53		
	300	40	69		
	400	48	83		
	500	58	108		
7	100	18	31		
	200	29	47		
	300	38	61		
	400	46	73		
	500	54	85		
9	100	17	27	47	
	200	27	42	66	
	300	36	54	85	
	400	44	65	103	
	500	51	76	119	
11	100	16	25	38	66
	200	26	38	56	89
	300	34	50	73	112
	400	42	60	88	135
	500	48	70	102	156
13	100	15	23	33	51
	200	25	35	50	72
	300	32	46	65	92
	400	40	56	78	111
	500	46	65	91	129

Appendix 2 Top 20 Energy Feeds

	MJ ME/kg DM	Starch%	Sugar%	Strengths	Weakness
Corn Grain	14.3	71	2	Slow Degrading	Low Protein
Wheat	13,8	69	3.5	High Starch	Low Fibre
Bread	14	69	4.7	High Starch	Low Fibre
Triticale	13.4	66.5	4	High Starch	Low Fibre
Potatoes	13.5	62	8	High Starch	Low Fibre
Barley	13.2	59	3	High Starch	Low Fibre
Biscuit Blends	15	49	9	High Starch	Low Fibre
Breakfast cereal Blends	14	52	6	High Starch	Low Fibre
Sugar beet	12.3	3	69	High sugar	
Fodder beet	12.1	2	65	High sugar	
Corn Silage	11.8	35	2	Low Cost	Variable
Molasses	12.6		65	High sugar	Low Fibre
Beet Pulp	12.5	1	20	High fibre	Low Starch
Corn Gluten	12.5	21	3	High fibre	
Oats	12.2	42	1	High fibre	
Good cereal	11	25	3.3	Low Cost	variable
Wheat feed	11.5	27.5	7	High fibre	Low energy
Citrus pulp	12.5	6.5	24	High fibre	Low energy
Soya Hulls	11.9	5	3	High fibre	Low starch
Palm Kernal	12.3	4	3	High fibre	Low starch

Appendix 3 Top 10 Protein Feeds

	MJ ME/kg DM	Starch%	Sugar%	Strengths	Weakness
Corn Distillers	14.8	5.5	28	High Energy	
Wheat distillers	13.5	8.6	32	High Energy	
Soya	13.8	14	52	High Energy	
Lupins	14.3	13	38	High Energy	
Pot Ale Syrup	14	3	37	High Energy	
Beans	13.8	47	29	High Energy	Low Fibre
Peas	12.8	53	24	High Starch	Low Fibre
Linseed	13	11	37	High Starch	Low Fibre
Rapeseed meal	12.1	14.5	38.5	High Fibre	Lower enery
Urea	0	0	287	Very Low Inclusion	Well mixed

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