

## REPORT 2013/11

### BALTIC BEEF

- a handbook for beef production

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**PRODUCTION AND LAYOUT**

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## CHAPTER 1

### BEEF PRODUCTION AND THE ENVIRONMENT

Beef production and the environment is a complicated issue. On the one hand, grazing cattle are very important to keep the natural grasslands open and full of biodiversity. The more grazing animals we keep the more semi natural grasslands will continue to provide biodiversity and a beautiful landscape with strong recreational values. Permanent grasslands also provide an important buffer zone between arable land and streams, rivers, lakes and the sea. The pastures catch and lessen the nutrient run off from agricultural land and help to save the Baltic Sea from eutrophication.

But – on the other hand, the cattle industry is co-responsible for causing climate change because large quantities of green house gasses are emitted from the digestive tracts of the cattle and their manure. Valuable rainforest and other natural lands are degraded to provide grazing and arable land for feed production. Overgrazing is a big environmental threat in some areas of the world. So, there are many different aspects to keep in mind when considering cattle and the environment.

For those of us who are concerned about the environment and the climate, it is very important to know where and how the beef we consume is produced. Instead of denouncing all beef, choose meat from producers where you know how and on what type of land the cattle are raised, and what feed they are given.

#### CATTLE AND LAND

In dry areas of the world overgrazing can be a big problem. When cattle graze the grass and other plants down to the roots bare soil appears which can be eroded by wind and heavy rainfall. The fertile topsoil is gradually lost and the land becomes worthless for grazing and food or feed production.

Large areas of arable land are used to produce grain, soya bean and other feed crops instead of producing human food crops. In Sweden for instance 80% of the grain producing land is used for animal feed. In areas where there is a shortage of good agriculture land meat production is an inefficient way of using arable land to produce human food. In South America large areas of rainforest are still destroyed every year to



Pic 1. A lot off different plants thrive in a grazed semi-natural grassland that has not been fertilized or ploughed. (Photo: Maria Hoflin)



Pic 2. In arid areas most feed producing land is irrigated which is a threat to natural water bodies in the area.

create pasture for cattle and arable land for growing soya bean and other feed crops. The rainforest is a hugely important source of biodiversity and a very powerful carbon sink too. The practice of destroying rainforest to feed cattle and other animals is one of the major negative impacts of the animal husbandry sector on both the environment and the climate.

### **CATTLE AND WATER**

In drier areas of the world, agriculture land is often irrigated to produce good enough harvests. Even grazing land is quite often irrigated, for instance in the US. This causes problems with depleted ground water levels and/or drying up of streams where fish and other animals lose their habitat. Badly managed cattle manure can cause eutrophication, as is the case in the Baltic Sea. On the other hand, permanent pastures act as filters which absorb nutrient run off before it reaches the water ways and the sea. Grass lays, used for hay and silage production, leaches only 10 % of the nutrients compared to arable land where grain crops are produced. This means that grazing based cattle production where the animals are fed mainly hay and silage in the winter, counteracts eutrophication.

### **CATTLE AND CLIMATE CHANGE**

It is an undisputable fact that cattle emit methane, CH<sup>4</sup> from their digestive tracts and nitrous oxide, NO<sup>2</sup>, from the manure. Methane is a very potent green house gas, 20 times stronger than CO<sup>2</sup>, and Nitrous oxide is 300 times stronger. All green house gasses break down the ozone layer around the earth and cause a gradual and very detrimental warming of the climate. The growing cattle industry is seen as a major contributor to climate change. One worry is that the growing economies, and with it the growing meat consumption, in Asia and Africa means that the cattle production will continue to grow exponentially and speed up the global warming even more.

Many things can be done to lessen the negative climate impact from the cattle industry:

- *Proper manure handling systems* can minimize the NO<sup>2</sup> emissions from the storage facilities. Cattle manure can also be used for biogas production. The manure waste from the biogas plants is an excellent natural fertilizer with higher fertilizer value than fresh manure. If more manure is used on arable land, less artificial fertilizers are needed. The production of artificial fertilizers is responsible for a large portion of the agriculture's climate impact.
- *The production model and efficiency* also influences the degree of climate impact from the beef industry. Degrading of rainforest to create grazing land and land for feed production releases a lot of green house gasses. One way of minimizing the climate effects from beef is to intensify the production and make sure the cattle are healthy and fertile. An efficient production system results in less methane emitted per kg beef produced. If the cattle are two years old at slaughter instead of four, they have emitted only half of the methane during their lifetime.
- *Produce the beef on semi natural grasslands.* Grasslands are powerful carbon sinks. This means that they bind CO<sup>2</sup> from the atmosphere in the growing bushes, plants and grasses, just like the forest. A big portion of this CO<sup>2</sup> is stored in the soil. If the land is never ploughed or cultivated the CO<sup>2</sup> stays in the ground. Grazing cattle keep the natural and semi natural grasslands open and biologically active.

## **CATTLE AND FEEDING THE WORLD**

To produce one kilo of beef much more land is needed than to produce one kilo of beans or other vegetable protein crops. Because of the growing population in the world there is a great risk of food shortage in the future. Good arable land will be needed for human food production rather than feed production for animals. This is often used as an argument against beef production. To let grain or beans like soya beans pass through cattle on the way to becoming human food is inefficient. But there is a solution to this problem and that is to use natural grasslands for cattle production instead of grain, maize and soya bean. Cattle and other ruminants have the ability to eat and grow on fibres that humans cannot digest, such as grass and bushes. This means that ruminants can produce meat, and milk, on land that is not suitable for human food crops. From a feed-the-world point-of-view this is a win-win situation where high value protein (meat and milk) is produced on marginal lands whilst the good arable land is used for grain and other vegetable crops for human consumption.

## **CATTLE AND BIODIVERSITY**

The rapid loss of biodiversity is one of the bigger threats to life on earth. Well maintained semi natural grasslands are very rich in biodiversity with many rare species of birds, plants and insects. The intensification of the agricultural sector with fewer grazing animals has meant that semi natural grasslands are one of the most threatened biotopes in Europe today. In Sweden, 20 % of the high nature value grasslands have been lost since 2005.



Pic 3. This wooded grassland produces meat and biodiversity. Production of other human food is not possible on this kind of land. (Photo: Anett Wass)

Semi natural grasslands were created by man and his grazing animals in cooperation over centuries. In the old days the open arable land was never used for grazing, it was too important as a source of human food. Instead the animals were grazed in the transition zone between arable land and forest or water such as the sea, lakes or rivers. When these grasslands are not grazed regularly they become overgrown with tall grasses, bushes and trees. The tall grasses and bushes competes with the lower growing and more sun loving herbs, legumes and flowers that are so vital for the existence of many insects and hence also birds. To restore or maintain semi natural grasslands a suitable grazing pressure combined with clearing of invasive bushes and trees is important. Drier grasslands are easier to maintain than wetter areas but can be over grazed if too many animals are kept on the land.

## CHAPTER 2 WORKING WITH BEEF CATTLE

*Working with cattle is rewarding and exciting but there is always a risk of injuries when such large animals are handled. Knowledge of animal behaviour, functional handling equipment such as gates and crushes and good working routines are all important parts of safe cattle handling.*

### NATURAL BEHAVIOUR

In all work with animals it is very useful to know how they normally behave and what motivates them to move, run or stand still. The secret to safe and easy cattle handling is to work with their natural behaviour and instincts rather than against them.

*The flock instinct* is very strong and one should try to handle cattle in a group for as long as possible. Even if only one animal needs treatment or examination – bring everyone in to the box or handling pen. To be separated from the flock can make bovines attack or throw themselves against/through walls and fences to return to the others. The flock instinct makes cattle follow the herd and stop when the herd stops. The first animal that moves will be followed whatever direction she takes. This is important to know when herding animals. Ranking within the flock is also important to the cattle. If a superior cow threatens a subordinate cow she may choose to walk straight over a person in order to escape the threat even if she normally is not aggressive. Bulls often have a strong instinct to guard their flock even if the flock are all male animals. When there are cows on heat the whole flock becomes more stressed and agitated.

*Cattle are curious and like familiar routines.* Cattle are very curious and will often come back for a second look even when they have been scared or startled. If, on the other hand, they are severely scared and stressed it will take them at least 20-30 minutes to calm down enough to be worked with safely. To keep to the same working routines makes cattle feel safe and relaxed. If you give them a little grain inside the catching pen during your daily visit it will not



Pic 4. Where coastal meadows are well grazed a lot of bird species thrive.



be difficult to bring them in there the day you want to catch them. Cattle have good eyesight and are very aware of little details. If the keeper wears unusual clothes or there are two people coming instead of the normal single person this can be enough to make them nervous and difficult to handle. On the other hand, they can easily learn to follow a person or an ATV vehicle since that usually means being let out on fresh new grass.

*Cattle have strong flight behaviour.* At what distance the animal will run from a person depends on how tame they are but also the situation they are in. Stressed or agitated animals will flee at a greater distance than calm ones. Your speed when approaching the animals is also important. The higher the speed you have the sooner and the faster the animals will run from you. If you move slowly through the animals daily they will soon develop a shorter flight distance and will calm down faster if there is a stressful situation. Time spent with the animals is always valuable and will make the work easier.

*Cattle have excellent hearing* and can hear both lower and higher frequencies compared to humans. They have different eyesight to us because their eyes are placed on each side of the head. They can see more than 300 degrees around them but only have a very small area of three dimensional vision straight ahead of them. Everything else is two dimensional with a blind spot directly behind their tail. If you are in their blind spot they get nervous and need to turn around to see where you are. Their best focus area is from about waist height and down. When driving animals forward, or trying to stop them, you should therefore move a stick or a flag in front of your legs and not wave you arms up in the air. Cattle also have a much better developed sense of smell than humans. Old blood smell or scent from dogs or other predators can create obstacles and reactions that we are not aware of.

## **COWS WITH YOUNG CALVES**

A cow will defend her calf if she feels that it is threatened. This can make even an otherwise calm and friendly cow dangerous. Always be extra aware of new cows when they have calved. The first few days after calving many cows keep their calves hidden in a bush or in long grass. All calves must be ear tagged within 20 days of birth and it is easier to catch a very young calf than a two week old one.

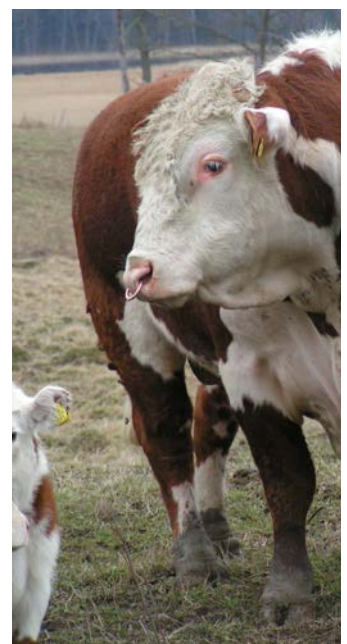
If a calf gives out a distress call by screaming, the whole flock will come running to help protect it. This makes ear tagging young calves one of the most dangerous tasks on the beef cow farm. Never work alone when tagging calves. Try to arrange for a safe place where you can bring the calf during the actual tagging. An empty hay trailer or a portable cage attached to the tractor works well. If the cow can see the calf during the process she keeps calmer.

## **HANDLING BREEDING BULLS**

Take time to socialize with a new breeding bull before he is let out to the cow herd. This is your chance to make the bull both trust and respect you as the leader of the herd. Make sure he respects you by insisting on him moving away from you when you enter his pen or box. Never enter the bull pen without a stick or other suitable tool. Do not hit the bull unprovoked but if he refuses to move away from you a stick is useful to prod with or wave in front of the bull. If the bull is friendly, scratch or pat him on the back and sides, never on the head since touching on the head can make the bull want to butt you. Even a playful push from a large bull can knock a person over and once you are on the ground the playing can turn in to an attack. An adult bull should always have a ring in the nose to make leading and controlling him safer and easier.



Pic 5. Always be extra careful around cows with newborn calves.



Pic 6. Always keep the breeding bull ringed in the nose.

### *Tips for manageable cattle*

- Socialise early with young calves.
- Practice handling the animals when nothing needs to be done to them. This creates a calm and relaxed relationship.
- Work with fixed routines doing the same things in the same way and order.
- Move amongst the animals daily.
- Make sure the animals move away from you – not the other way around. This will establish you as a leader.
- Send difficult and nervous cows and heifers to slaughter instead of breeding from them. Bad behaviour is contagious and passed down from cow to calf.

### **SAFE CATTLE HANDLING INDOORS**

It is important to think through how you are going to move and handle the cattle when designing and building new cattle sheds. Make sure passages are the right width and can be connected to create a driving race for receiving cattle from or loading them on to a truck. A passage for driving animals through should be narrow enough to prevent the cattle from turning around. The floor should be even and non slippery.

Avoid creating sharp corners where the animals cannot see where they are going. A blind corner will be perceived as a wall and will make the animals stop. Cattle move towards the light so it is important to keep the passages light but without direct sunlight shining in through a window or opening. Such a glare of sun can cause the animals to stop and refuse to move forward.

You must be able to separate out single animals for medical treatment or other management such as weighing, insemination, pregnancy testing etc. This is best done by having a combined scale/crush or treatment box attached to one of the passages. Make sure there is plenty of room around the crush for people to be able to work with the animal.

People working inside the passages or boxes must be able to exit quickly and easily in case of an animal attack. To run to and open an ordinary gate might take too long in



Pic 7. This man is using rattling paddles to herd the cow and calf in to a box.

an emergency and if you are hurt climbing over a gate may not be possible. Manholes, passages that are big enough to let a person through but not an animal, are a good idea. A double wall that a person can escape behind in for instance a corner is another useful safety detail.

## MANAGING CATTLE OUTDOORS

During the grazing period you must be able to catch groups of, or individual animals, for sending to slaughter, different treatments, inspections etc. Depending on the layout of the grazing you will probably also move the whole flock to and from different paddocks.

*Herding cattle on foot.* When herding cattle remember that all kind of haste induces fear in animals. The ideal pace for herding cattle is at a slow walking pace. The animals will keep calm and have a shorter flight distance and you have a chance to see and react to any adverse movements they make. You can use the cattle's flight zone to calmly move them by gently putting pressure on the zone from an angle and a direction that will produce a calm and predictable response. The pressure you apply should come from the side making the front animals move in the desired direction. Keep walking up and down alongside the herd to keep the front animals moving and to keep the rest of the herd together. To push cattle from the rear only create stress and confusion when the animals turn around to try and look at you. A cattle herd wants to follow a leader, not being pushed from behind.

*A sturdy permanent handling pen is the ideal handling facility.* When most of the grazing paddocks are in the same area a permanent handling pen works very well. Build the pen where it can be reached from all the paddocks. The lay-out of the handling pen is very important and also the way you treat the animals when they are inside it. Let the animals walk through the pens without actually doing anything to them, and give them some hay ore pellets whilst they are there. This will teach the cattle that the pen is a safe place to go to when they are being pushed and herded in the grazing paddock.



Pic 8. Frightened cattle run without thinking and will follow the animals in the front of the herd.



Pic 9. A selection of gates that can be put together as a race and a treatment pen is a good investment.

A good handling pen consists of:

- Several catching pens, a race, a crush or cage with a head locking front and a loading ramp.
- A catching pen big enough to hold the entire herd.
- A catching pen with a sliding or otherwise moving gate to help push the cattle from the catching pen into the race.
- A pen that can be combined with scales and a footbath when needed.
- A well placed cage or crush so that the people working with the animals are not disturbed by the cattle in the pen.
- A reinforced surface in the pen with gravel or concrete preventing it from getting muddy and making it easier to clean. If the ground in the pen is always muddy and wet it can spread foot rot and other bacterial foot disease.

A permanent handling pen is best built from wood with sturdy posts and rails. The sides and gates must be at least 1.80 meter high and the rails should be spaced at 25–30 cm from each other to prevent the animals from getting stuck. Make use of the cattle's natural circling behaviour by making the passages and driving alleys curved. The curved shape keeps the animals moving forward without too much need for pushing the cattle.

*Portable handling pen.* For smaller groups of animals, or when the grazing paddock is far away from the main farm, a smaller portable pen can be used. 8–10 combinable gates will make a good catching facility. Remember to use the layout of the land and the existing fences to maximize your chances of getting the animals in to the pen.

- Make sturdy gates with the same measurements as above – or buy ready made metal gates
- Place the pen on level ground or a gentle uphill slope
- Use existing permanent fence lines as "catching arms" to extend the range of the pen
- Use the portable pen for catching groups of animals only – do not attempt to catch individual animals in such a pen. It will not hold if the cattle throw themselves at the gates or try to jump out.
- The portable pen can be shared by several farms or neighbours making it more affordable

#### *Practical tips and examples for cattle handling pens*

The web page of Doctor Temple Grandin, associate professor of animal science at the University of Colorado, has many different handling pen designs. Dr. Grandin is a world renowned expert on cattle handling and is an inspiration to anyone involved in cattle management.

[www.grandin.com](http://www.grandin.com)

## CHAPTER 3

### PLANNING AND MONITORING THE BEEF PRODUCTION

*Beef production can be done in many different ways. Compared to dairy or egg production the beef sector is a very diverse one. The reason for this is simple. For most beef farmers the type of land on their farm will decide what kind of beef production they develop. A farm who has land with fertile grain production suites a different kind of production model than a farm with mainly grass lays and plenty semi natural grasslands.*

Many factors influences what type of production you should have on your farm. Type of land, existing buildings, other income possibilities and of courses your own interests and financing capacity. When it comes to beef production the most defining factor is whether there are grazing land eligible for EU support, either on the farm or available for rent. There is a big difference between how to plan for intensive indoor reared beef or for a more extensive grazing based beef production. In each case, it is important to have a goal and a plan for the production, and to keep to that plan.

#### COW-CALF OPERATIONS

A cow-calf operation/suckler cow business produces weaned suckler calves from beef breed or cross bred cows. The calves are usually born in the spring and graze together with their mothers during the grazing season. The calves are weaned when the grazing fades in the autumn at 6–7 months of age.

There are also suckler cow herds that calve in the autumn and wean and sell the calves in the spring. This model is only profitable if the farm has plenty of cheap, but good quality, winter feed for the lactating cows. The farms also need plenty of space for the cows and the growing calves during the winter. If there is a demand, with good prices, for weaned calves in the spring the business model can be economically sound.

Pure breed dairy cows are not well suited for suckler calf production since they normally produce too much milk. They can develop mastitis if they produce more milk than the calf can drink. A possibility to use dairy breed cows for calf rearing is to buy in one or two extra calves for each dairy cow and foster them on to the cow shortly after calving. This is a labour intensive production model but it can be profitable if one has the knowledge and time to spend on the fostering process. There also has to be calves of the right age to be bought locally. The cow will need more and better feeding/grazing than the beef breed suckler cows and should not be run in the same herd as them.

#### FINISHING BOUGHT IN SUCKLER CALVES

Beef breed or cross bred suckler calves are weaned at about 6–7 month of age. They are then raised for beef either at the farm where they were born or sold to a specialized beef finishing farm. A finishing farm does not need grazing land since the beef breed bull calves are well suited to intensive rearing on a diet of silage/hay and grain. One year old beef breed bulls can be difficult to rear out side on grass since they use up a lot of energy fighting and also can crash through fences trying to get to nearby cow and heifer herds. If the finishing farm has access to grazing he can buy in heifer calves and send them out to graze their second summer. Castrated bull calves, steers, can be grazed together with heifers without causing any problems.



Pic 12. Beef cattle breeds are best suited to cow-calf operations.



Pic 13. This group of Angus cross bred heifers have grown very well on semi natural grasslands.

### **FINISHING BOUGHT IN DAIRY CALVES**

The bull calves from dairy herds are sold off from the dairy business when they are around 2–3 months old. These dairy bull calves are best suited to intensive rearing on a high protein and high energy feed ration. If dairy bull calves are to be raised on grasslands they should be castrated as calves and finished in a more extensive system.

### **GRAZING BASED PRODUCTION MODELS**

*Beef production based on grazing* describes production models where the cattle are kept out doors on grasslands for almost half the year. Grazing can be a very good feed and give high growth rates, at least in the spring and early summer. On average grazing animals will grow slower than the intensively reared indoor cattle. The slower growth rates results in a different kind of beef with more marbling and a more developed flavour. Grazing animals also help to maintain and develop the biodiversity in the agricultural landscape. On the negative side slower growing animals binds the beef producer's capital for a longer time which is important to be aware of in the production planning. Beef breed heifers and steers and dairy breed steers are all well suited to beef production based on grazing. Beef breed heifers are typically ready to slaughter after 20–24 months, beef breed steers after 18-20 months and the dairy steers after 20–26 months.

### **INTEGRATED OR SPECIALIZED BEEF PRODUCTION**

*Integrated beef production* describes a farm with the whole chain from suckler cow to finishing the calves to beef. Whether your farm should be integrated or specialize in one production model is an important question. One advantage of being integrated is that there is no

need to buy in calves which is a good thing from the point of view of disease. It might also feel like a saving not to have to pay for calves. On the other hand you bind the animal capital for a long time, 3 years from covering a cow until slaughtering the finished young stock. This means you need to be careful with the cash flow especially when starting up the business.

*Specializing in either cow/calf production or finishing for beef* means that you can concentrate your efforts on one kind of production model which usually mean that you get better at it. Also, the feed production needs can be very different for the various production models. Suckler cows need plenty of low protein hay/silage and no grain, whilst intensively reared bulls need the best possible hay/silage with high levels of protein and energy to grow well and be profitable. The bull rearing farm also need to have access to cereals and some protein feed such as peas.

For a smaller farm with grazing land it is a good idea to specialize on either cow/calf production or buying in grazing animals each spring. For the bigger farm with plenty of grazing, an integrated business where you rear your calves as heifers and steers can work really well. If you wish to keep the bulls entire you need buildings to keep them inside or separate grazing paddocks with very good electric fencing.

## **PRODUCING BREEDING ANIMALS**

To produce breeding animals for sale to other suckler cow operations is a specialized business with specific demands that can be profitable if it is done right. You can either produce registered pedigree bulls and heifers or cross bred females for sale.

*A pedigree beef cattle producer* needs to register the herd with the appropriate breeding society and follow their rules for registering, recording and selling animals. You need to buy in good quality animals when you start your herd and keep on buying in good quality bulls to keep the herd at a high genetic level. Your aim is to produce high quality bull and heifer calves to sell to other farmers. There will be extra costs involved in the production, such as the registration fees and the extra labour needed for weighing cattle at certain ages etc. You will also need to actively market your calves and keep the place looking tidy and be prepared to receive prospective buyers at the farm. There will always be animals that do not make the pedigree grade so there will be a certain amount of beef produced on the farm as well.

*Producing cross bred females for sale* is a different production model. The very best suckler cows are cross breeds. This is so because they make use of a genetic mechanism called the cross breeding effect, or heterosis effect. Heterosis has a very positive effect on fertility, calf vitality and health in the herd, all very important traits in a suckler cow. So, unless you are a pedigree breeder there really is no need to keep a pure breed herd of cows – almost the opposite! When you have got your own herd up to the desired size you can start selling crossbred heifers to other beef producing cow/calf operations that are still increasing their herd.

## **PLANNING THE PRODUCTION**

As in all business ventures, you need to know where you are going in order to steer your beef production in the right direction. For instance, when raising young stock for slaughter, there is usually a time of the year when the prices for meat is higher. How can you maximize the number of cattle being ready for slaughter at that specific time? Also, there is usually a specified weight interval, fat class and conformation class that fetch the

highest slaughter price. How do you make sure most of your animals reaches this weight and these classifications?

Make a plan for how your young cattle will be ready for slaughter at the desired time and at the required weights and classes. How many kilos do they need to grow until then? What daily growth rates do they need to have to reach the target weight? What feed rations do you need to give them to make them grow that fast? By deciding on specific growth rates and calculating the right diet to make them grow that fast, you put yourself in control of your production.

For the suckler cow farmer the goal will be to have one well grown calf weaned per cow presented to the bull for covering. To achieve that goal he needs to have healthy cows in good condition when they are put to the bull. He also needs to have good grazing for the cow and calf heard to be able to wean heavy calves in the autumn.

Once you have started planning and monitoring your production you can start asking questions like: is it worth the money to invest in better silage making equipment so that I can be sure of really high quality silage for the young stock? Do I get a higher price for my weaned calves in the autumn if I spend money on buying really expensive bulls from abroad? Will I have more live calves born if I invest in a cow shed where it is easier to oversee the calving and assist cows with problems? All this takes careful planning and being able to prioritize what work is needed to make the plan come true. Being in charge means being a business man or woman who is able to make a plan and able to stick to it.

Pic 14. A handsome looking group of cross bred beef cattle heifers.





## ECONOMIC PRODUCTION CALCULATIONS

Before starting any form of beef producing venture it is a worthwhile exercise to create some production calculations to predict the costs and incomes in the business. Calculations can be made at different levels, taking in varying amounts of costs such as cost of capital, purchasing or renting the land and the cost of your own labour. In the simplest form of a production calculation you list the predicted incomes from one production unit; can be one suckler cow or a bought in suckler calf. You then subtract the expected direct costs from the income. Remember to add any animal dependent subsidy to the income, such as grazing support or organic subsidies that are payed out per animal. This creates the first level of the calculus, showing if the animal can support its own direct costs.

**Table 1. Economic calculus for suckler cow based on Swedish economic circumstances.**

Suckler cow financial calculus	euro/animal	yearly balance
Market value weaned calf (50-50 bull/heifer)	500	
20 % slaughter value for a culled cow (expected productive life span 5 years)	167	
Environmental payment for 1,5 hectare of HNV semi natural pasture	300	
Total revenue from cattle enterprise		+ 967
Replacement cost; 20% market value of pregnant heifer	- 155	
Home produced silage and straw, includes labour for harvest etc	- 200	
Bought in feed (salt, minerals etc)	- 50	
Other variable costs (grazing, veterinary, bull etc.)	- 135	
Revenue – variable costs		+427
Maintenance cost Building (annual repairs etc)	- 11	
Interest on Working Capital tied up in animals, feed etc	- 12	
Revenue – maintenance, variable and financial costs		+404
Depreciation value building (Building cost divided on number of years before a new one is needed, 15 years in this example)	- 130	
Interest on building capital, 5%	- 50	
Labour cost for animal care, 10 hours/cow at 18 euro/h	- 180	
Result to cover fixed costs and profit		+44

In the next level you add the cost of maintaining any buildings and the interest due for the capital that is bound in the animals. For the final level you also add the depreciation value of the building, often calculated over 15 years and the cost of your own labour. When all this is added up you can see if your production can contribute to the fixed costs (rental or buying cost of the land/the farm) and if there is a true profit margin.

### **MONITORING AND BENCHMARKING THE BEEF PRODUCTION ENTERPRISE**

Making a detailed calculation of the predicted result of your beef enterprise is a valuable exercise. It is often needed to persuade a bank to give you a loan for instance. But it is just as important to monitor your real life production results, costs and incomes to find out what the result of the business venture is. It is also interesting to compare one's own production result to other farmers with similar production models. This is a very stimulating form of group advisory that can help develop the profitable beef enterprise. Together with other farmers with similar production models you can make study visits, invite guest speakers or just discuss common problems and challenges.

*The production measures* are created by putting figures on real things that happens on the farm. Daily weight gains and mortality rates are production factors for a beef finishing farm. Number of calves weaned per cow or calves born per cow presented to the bull are useful production factors for a suckler cow herd.

*Economic production factors* can be taken from the book keeping and can for instance be the production costs per kilo hay/silage, the cost of bought in feed and the market price per kg live weight beef sold.

By choosing your production factors, you create a focus on different aspects of the beef enterprise. The production factor “**calves born per cow presented to the bull**” puts the focus on the cow fertility. The production factor “**total number of calves weaned**” also takes in to consideration the calf health and vitality. By identifying where the biggest challenges are on your farm you can work to change them to the better.

The production factors can be expressed per one animal, per 100 animals or even per hectare on the farm, all depending on who and what you want to compare them to. The most important thing is to make sure that the figures you base the production factors on are real and not estimated. Estimated figures are useful for planning and predicting results. Only real figures can be used for monitoring the beef enterprise or you are deceiving yourself. By monitoring your result you can correct mistakes early and steer your business back on track.

## CHAPTER 4

### HAY AND SILAGE – PRODUCTION, HARVEST AND STORAGE

*During the non grazing parts of the year cattle will consume a large amount of forage in the form of hay or silage. Different categories of cattle have various nutritional requirements but their main diet should always be forage. To have good silage and hay it is important to harvest the grass at the right time and to store it well.*

#### HAY OR SILAGE

The most common forage fed to cattle today is silage. Harvesting, drying and storing hay is a more expensive and time-consuming process than making silage. On average silage has a much higher nutritional value than hay. To make nutritionally good hay you need to have an indoor hay-drier with a well dimensioned fan. Drying the hay outside in the field is a very risky business and each rain shower leaches out sugar and nutrients from the grass. On the other hand silage machinery is expensive and if you conserve the silage in bales a lot of plastic is used. Still, the advantages of making silage are so great that silage must be seen as the best way of conserving the grass as winter fodder. Especially on a small farm with few buildings, making silage in plastic wrapped bales is very suitable. The bales can be handled by fairly small tractors and no building is needed to protect the feed from rain and snow in the winter.

#### HERBACEOUS PLANTS FOR SILAGE MAKING

There is a whole range of herbaceous plants used in modern cultivated grass leys. Some of the more common ones are Timothy, English Rye grass, Meadow Fescue and Cocksfoot together with the legumes Red clover, White clover and Lucerne. Largely speaking one can say that the grasses provide sugar and energy and the legumes provide protein to the forage. When creating a suitable mix of plants for a grass ley one should consider both the purpose of the ley; will it be used as feed for young beef cattle, dairy cows, or suckler cows? But also consider the type of soil and climate at hand since not all types of grasses and legumes thrive everywhere.

Usually a grass ley is created by sowing in grass and legume seeds in an arable crop such as oats or barley. The grass and legume seeds germinate slower and are protected by the fast growing arable crop. After the arable crop has been harvested, the grass ley stays in production for two – maybe three years before it is ploughed up and the land is again used for arable production. Grass leys can also be sown without an arable crop. Usually the sowing is done later in the season after repeated harrowing and treatment with herbicides to keep down the weeds.

The short life span of the grass ley is mainly due to a drop in production and nutritional value. Red clover is very strong in the first two years after establishing the ley but will then expire gradually over a couple of years. Fertilizing the ley makes the clover disappear even faster since the fertilizer makes the grass species grow stronger than the clover.

Pic 15. A mixture of grasses and legumes makes a good silage ley.



## LONG TERM GRASS LEYS AND THEIR MANAGEMENT

Instead of the short term, intensive grass leys one can establish and manage long term grass leys. They have a life expectancy of at least 15 years, often much longer. A long term grass leys leaches virtually no nutrients to the surrounding waterways. This is very important in nitrogen sensitive areas but the effect on phosphor retention is also great. A ploughed arable field leaches 90% more nitrogen and phosphorous than a permanent or long term grassland.

Long term grass leys can also save money and resources. Establishing a grass ley takes time and is expensive. A lot of tractor driving and herbicides is needed to help establish the grass sward, especially if the grass ley is sown in without a protective arable crop. It is the nature of young grass to take time to establish and during this time weeds infest the open soil. But once a dense grass sward has been established weeds have difficulty invading the grass ley.

Until now, it has been considered a problem that the older leys loose the legume content and hence the protein levels of the herbage drop. Periods of drought and cold spells in the winters can harm the sward and let in weeds, also with loss of production as a result. Encouraging new trials with reseeding long term grass leys without cultivating them has shown that with the right management long term grass leys can be successful. Experiments using different seed mixes for increased sustainability have also shown new ways to grow grass. For a more long-term pasture other legumes than Red clover, such as White Clover, Yellow and White Lucerne and Birds foot trefoil are more suitable. They will not expire in the same way as the Red clover and gives a good biomass harvest.

This new knowledge together with a growing awareness of the environmental benefits of long term grass leys has started to change the view of grass ley management in favour of the long term grass leys.

Pic 16. A specialized drill support seeding an existing grass ley without having to plough and harrow the land.



## HARVESTING THE FORAGE

A correct *harvesting technique* is important for a good end result when making silage. Because soil bacteria ruins the silage process the stubble should be kept high, 8–10 cm, to prevent soil being mixed in to the grass.

If the silage is to be made in bales it should be wilted down to 40–50% dry matter before bailing. Drier bales will be easier to handle, there is less problems with run off fluids and the drier roughage is better for the cattle digestion system. The wilting (pre drying) will be faster if a combined crimper/mower is used. A drier bio mass is less likely to have problems with protein degradation before the silaging process is in place. Crimping also increases the surface that the desired lactic acid bacteria have to engage with. On the other hand the crimping must not be so rough that too many of the legume leaves are lost. It is a delicate balance getting it right.

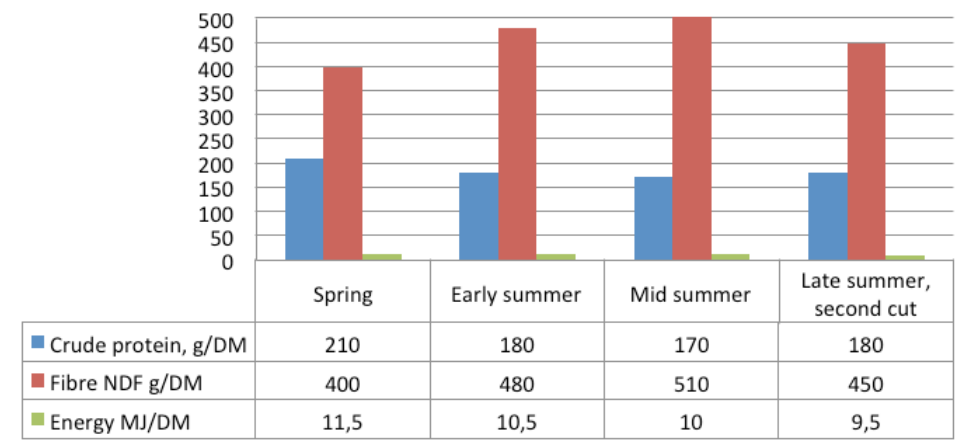
Making silage in tower silos or silage clamps is much less weather dependant. The bio mass can be brought straight to the silo or clamp after mowing. On the other hand, more technique is needed, to extract the silage from the silo or clamp and feed it too the cattle.

The correct *harvesting* time is maybe the most defining factor for the silage nutritional value. All herbage plants develop in roughly the same way. In the early summer the protein and the energy levels are high. As time goes on, the fibre content of the grasses and legumes increase and with it, the energy content drops quite fast. The protein level stays more level but will also drop gradually over the summer.



Pic 17. When making silage you only need to turn the rows of mown grass once before bailing.

**Figure 1. Nutritional changes in grass biomass over the season**



To achieve high energy levels in the silage, you must start the harvest early. The total bio mass per hectare will not be so high due to the low fibre content in the grasses. On the other hand, starting the silage harvest early means you can get two, sometimes three, grass cuts over the whole season. This creates a higher total harvest than cutting the grass only once but later.

One way of monitoring the right time to harvest a ley is to notice when the predominant grass species is heading. The weather forecast must also be considered since it will jeopardize the hygienic quality of the silage if it is harvested in too wet conditions. It is often worth it to accept a drop in energy levels to achieve a good hygienic quality.

For beef production the extreme energy and protein levels in the early cut grass are rarely necessary. It is better to wait for a bigger bio mass crop and accept lower energy levels. Even for growing young bulls, a slightly later cut with energy levels around 10, 5 – 11 MJ is sufficient. For the suckler cows, steers and heifers the more fibrous, later cut silage is preferable. For a beef producer it might also be preferable to harvest the silage only once and then graze the young stock on the regrowth.

The grazing and grass management plan needs to be flexible since there are many considerations. Annual variations in weather and rainfall will influence both the amount and the quality of the harvested grass and the grazing situation.

*Analyzing the nutritional values in the bio mass* is very useful. This information is necessary for being able to feed the cattle correctly in the winter. Three values are needed, the energy content measured in MJ/kg dry matter, the crude protein content measured in gram/kg dry matter and the Neutral detergent fibre content measured in grams NDF/kg dry matter. With these three parameters you can balance the cattle diets. The nutritional value of silage and hay vary so much that it is impossible to calculate diets without analysing these parameters. One can just look at how the animals are doing and weigh them to see if they are growing as expected. But by the time you get the answer by having low growth rates or noticing that the animals are looking poor, you have lost a lot of time in your beef production business. If possible, mineral analyses and hygienic analyses are also useful. (Read more about calculating cattle diets in chapter 5)

*To collect representative samples* for the analyses, gather the bio mass as it is being mowed. Walk diagonally across the rows of mowed grass and pick up a little from each row that you pass. Mix the bag thoroughly and send in a sample from each field. Samples can be taken from silage bales too, by drilling in to a bale and then sealing the hole with strong tape. It is far too expensive and unnecessary to sample each bale. Make sure bales from different fields are stored together and mark them with number codes for fields and harvests, for instance F1:2C meaning Field 1 Second Cut. This way samples can be taken later in the season when the ensiling process inside the bales have finished.

## SILAGE MAKING

Silage can be made in tower silos, clamps, big bales and plastic tubes. Which method that is chosen usually depends on how far from the farm the grass leys are situated and what equipment for feeding the animals there is on the farm.

The principle for silage making is the same for all the methods. The art of making good silage is getting the bio mass in a silo or under plastic as soon as possible and pressing as much oxygen as possible out of the bales, the silo or the clamped silage. The oxygen free/anaerobic silaging process begins and halts the natural decomposing processes that start as soon as the grass is cut in the field.

*The silaging process* is a fermentation process driven by lacto acid bacteria that are present in all herbage. These bacteria thrive in an oxygen free environment where they produce lactic acid. The acid in its turn makes the silage a hostile environment for the protein degrading

Pic 18. Wrapping the bales of grass immediately after baling ensures the best silage quality.



#### *Measures of good hygienic quality in silage pH (acidity)*

- Silage at 20 % dry matter < 4,2 is good
- Silage at 30 % dry matter < 4,5 is good

The pH is a quick and easy guide to silage quality. Low pH is always good. High pH always means there might be harmful micro biotic processes going on.

#### *Suitable dry matter content for different methods*

- Silage clamp : around 30 % dry matter
- Tower silo : 50 % dry matter in the bottom half, 30–35 % dry matter in the upper half of the tower
- Big bale silage : 40–50 % dry matter

#### *Storage time for silage*

An unopened tower silo keeps the silage in good quality for several years.

Unopened silage clamps and big bale silage keeps till the following early summer. Once a silage bale or clamp is opened the silage will be ruined in 1 day in the summer and after 2-3 days in the winter depending on temperature.

microbes that would otherwise turn the grass in to a slimy mess. By packing the silos or pressing the bales hard we minimize the presence of oxygen and help the lactic acid bacteria thrive. The bacteria need easily digestible sugar in order to produce plenty of acid. Hence young grass in a vegetative stage is good for the silaging process. To cut the grass in the middle of the day when the sugar content is at its peak is also positive for the process. When silaging older and tougher grass with less sugar content, the bacteria often need help to get going. Silage additives can be useful in such situations. Silage additives can be in the form of acids to lower the pH, sugars to kick start the bacterial activity and ready-made lactic acid bacteria culture to ensure the right fermentation process. Some silage additives are a mix of all three.

### **OTHER ROUGHAGE FEEDS**

Straw and different types of whole grain silage crops are also useful roughages in beef production.

*Straw* can be very useful as a complement to high energy silage for suckler cows. When suckler cows are fed free access of high energy silage they will over consume, get too fat and in a way waste this good feed. In such a case every other bale fed to the cows can be straw, or if the farm has a mixer wagon, the silage can be mixed with the straw.

*Whole grain silage* is made by harvesting and silaging the whole cereal plant, including the straw and the immature ear. This is very tasty feed for the animals that they can consume a lot of. Whole grain silage is high in fibre and energy but quite low in protein. This makes it especially suitable for growing heifers and steers that can be fed 100% whole grain silage.

*Maize silage* is made by chopping and silaging the whole maize plant. Maize silage is also high in energy but quite low in fibre so is best mixed with high protein silage with a high fibre content.



Pic 19. Fungi and weeds are growing in these hay bales that were stored without protection.

## STORING SILAGE AND HAY

*It is important to store the hay or silage well* to stop it being ruined by dampness during the autumn, winter and spring. Hay bales that are stored outside on the bare ground will suck up moisture both from the air and from the ground. It is therefore not enough just to put a sheet of plastic or a tarpaulin over the bales. They also need to be placed on pallets or something else that lifts them off the ground. When exposed to dampness the hay loses the protection against micro biotic degradation that it has when dry. To be stored safely the hay must not have higher moisture content than 15%. Fungi, moulds and bacteria will start growing on the surface and work its way in as long as there is moisture present. The microbes will use up the energy and protein stored in the hay, making it much less valuable as feed. At least 20-30% of a hay bale is ruined when it is stored without protection.

*The microbes in badly stored hay and silage are a health hazard to the animals.* If there is no other food they will be forced to eat mouldy hay and bad silage. The mold spores are airborne and will affect the animals even when the mouldy hay is used as bedding. Especially pregnant cows and heifers are at risk since mould toxins can cause abortions and deformed calves.

*Silage bales wrapped in plastic are easier to store safely.* They can be kept in most places without being damaged by mold or dampness. It is advisable to make a flat and vegetation free storage area for the silage bales. Sharp stones can pierce the plastic letting in air and damaging the silage. Lots of vegetation around the bales attracts rodents and other animals that may also damage bales in winter.

To store the silage bales out in the field is unsuitable for many reasons. If the bales are left scattered around the field they will kill off the grass regrowth under each bale. A surprisingly large area of grass is killed in a productive grass ley where many bales have been made. To fetch the bales from the field in the winter causes damage to the often wet and soft ground which means even more production of grass is lost during the next harvest season. Fetching the bales from the field one by one uses up an unnecessary amount of diesel, especially during the cold season when tractors use more energy to start than in the summer. It is best to bring the bales as close to the animals winter quarters as possible, but at least move them off the field as soon as they are made.



Pic 20. Silage bales wrapped in plastic are easy to store and to transport.





Pic 21 The hay bales are stored on pallets under tarpaulins to protect them from moisture both from above and below.

## CHAPTER 5

### FEEDING CATTLE FOR GESTATION, LACTATION AND GROWTH

*To be able to produce a calf, milk and body growth, cattle need to be fed properly. The need for energy, protein, minerals and vitamins change depending on the production level, age, environment and health of the animal. In this chapter we look at basic nutritional principals and how different types of feed can be used to fulfil these needs.*

#### NUTRITIONAL NEEDS

When making sure cattle have enough feed to produce well, we look mainly at the energy and protein content in the feed. This is not surprising since energy concentration is very critical for both lactation and growth. Protein levels, expressed as crude protein, are very important, especially for young cattle that are still developing their bodies. For the pregnant and lactating cows and heifers the mineral supply is also a critical point. Too little of one or two minerals and the fertility goes down. Let's look at the nutritional building blocks one by one:

*Energy* is not a nutritional component in the same way as the other elements. Most feed components contain energy in some form. The energy is packaged in the shape of carbohydrates (fibres, sugars and starch), fat and protein. All these components can be broken down to energy in the body; it just takes more or less time and work in the digestive tract. Fat is the most energy rich feed component but for ruminants, such as cows and sheep, fat is not a suitable feed. It makes the work of the microbes in the rumen difficult and can seriously upset the whole digestive system. Protein can also be transformed in to energy in the body, but the process of doing so is very energy draining and taxing for the metabolic system. For cattle carbohydrates should be the main energy source. Cattle can extract energy from very complex carbohydrates, such as cellulose and coarse fibres that humans and other single stomached creatures cannot digest.

#### *Maintenance and body weight*

All living creatures need energy for maintenance. This is the energy needed just to keep alive, warm and to keep the bodily functions ticking over. Any energy input above the maintenance will be either stored as fat or used up for work, growth, lactation or gestation. The live weight of the animal determines the size of the maintenance need. That is why it takes more food to produce 1 kilo of live weight gain in a 500 kilo animal than in a 200 kilo animal.

Before the body can use energy for growth, the maintenance need must be filled. In the larger animal it takes almost twice as much energy to grow a kilo. Expressed in feed the heavier animal needs to eat near to 10 kilo of hay whilst the smaller one needs to eat 5 kilos to grow the same amount. An intensive system with high growth rates uses up less feed in total over the animal life span than a slower, more extensive system. In the extensive system more feed is used to cover the maintenance need without creating any growth.

*Proteins are complex chemical compounds* made up of carbon, oxygen, hydrogen and nitrogen. Proteins are used in many ways in the body. Muscles are made up of proteins as is hair, skin, digestive enzymes and inner organs. Proteins are built by 20 different amino acids that can be combined to proteins in countless numbers of ways. When making sure an animal has enough protein, both the quantity and the quality of the protein is important. The protein quality of the feed is determined by the needs of the animal. In humans and pigs, the ideal protein composition is that of meat. The single stomach animals cannot change, or rebuild, the amino acids that they eat. This makes the amino acid content of the feed very important for them.

A ruminant, on the other hand, can create all amino acids they need in the rumen. All they need is enough crude protein, a measure that describes the amount of amino acids rather than the type, in combination with enough energy.

Adult ruminants can create most of the protein they need by fermenting grass and other feed stuff in the rumen. The microbes that live in the rumen have a short life span, approximately two weeks. When they die they enter the rest of the digestive tract where they are broken down in to separate amino acids. Those amino acids are absorbed in the ruminant's body and used to build new protein. Young animals grow quickly and develop their bodies fast. They will need higher amounts of protein but also protein of a higher quality than more mature animals. Young calves up to 6 month of age are still developing their rumens and are dependent on having high quality protein through suckling milk from their mothers. If the calves are raised without milk, as dairy calves are, a good protein supplement is needed until at least 6 month of age.

*Salt* is the only feed component that animals can feel a need for. If there is not enough salt in the diet cattle might start licking fence posts or eating soil in an attempt to find salt. Lack of salt can depress growth in young stock and lower the milk production in cows. There should always be salt licks available to the cattle, both indoors and outdoors while grazing. Salt is a desirable flavour for cattle and is mixed in to mineral feeds and mineral licks to lure the cattle to eat the minerals.

### ***Microorganisms in the rumen provide energy and protein to the cattle***

The rumen is a huge fermentation chamber where billions of microbes live. Most of them are bacteria, protozoa and fungi. They live of breaking down the fibres the cattle eat in the form of grass, bushes, straw, hay and silage. We can actually say that the microbes live off the grass and the cattle live off the microbes.

During the breakdown of the fibres, fermentation, methane gas and volatile fatty acids are produced by the microbes. The methane leaves the animal during the regurgitation of the roughage. The volatile fatty acids are absorbed in to the ruminant's blood and used as energy in the metabolism. At the end of the microbe's life they are passed on into the rest of the digestive tract of the cattle and broken down in to protein and vitamins. The ruminant absorbs the microbes as amino acids and uses them to build whatever protein they need in the body.



Pic 22. Plenty of clean water is necessary for all cattle.

*Minerals* and trace elements such as calcium, phosphor, iron and copper are very important to all living creatures. The need for minerals increase with increased body weight, growth rate or lactation. Cow fertility is very sensitive to mineral deficiency and problems such as weak heats and low pregnancy rates are often related to lack of minerals. Fast growing young stock can develop skeleton problems and muscle degeneration due to mineral deficiency. It is important to have enough minerals in the diet but it is equally important to have the right balance between them. Too much of one mineral can inhibit the uptake of other minerals. The two most important minerals are calcium and phosphor. There must be no deficit of either and they should be present in the diet at a ratio of 1–2,5 times more calcium compared to the phosphor. Potassium and magnesium are also important minerals to keep an eye on. If there are high levels of potassium in the silage or hay it will inhibit the uptake of magnesium. A deficit in magnesium leads to convulsions and difficult calving. Minerals should be fed to the cattle both indoors and outdoors while grazing.

*Most vitamins needed by cattle* are provided for them in the hay or silage and by the microbes in the rumen. Calves that are suckling get all their vitamins from the milk. In badly harvested and or stored silage or hay the levels of the fat soluble vitamins A, D and E are low. Symptoms of vitamin deficiency are rare in adult cattle but can appear in calves and young stock.

Some areas are naturally low in selenium and any crops grown there will have low selenium levels. Selenium and vitamin E replace each other in the body so a lack of selenium can be corrected by adding vitamin E. A lack of vitamin E can cause a very serious condition called muscle degeneration in young calves. If you are in a low selenium area it might be wise to give extra selenium and vitamin E to all pregnant cows or directly to the new born calves. Selenium in too high a dose is toxic so always confer with a veterinarian before adding selenium to the feed.

Pic 23. A suckler cow should be in good condition, but not too fat, when calving.



*Water is not a nutritional element* but absolutely necessary for survival. Cattle need a lot of water, especially lactating cows. The water needs to be as clean and free of harmful substances as the water we drink ourselves. The reason for this is the microbes in the rumen; they are very sensitive to bad water. Cattle outdoors grazing have a very varying need of water. As long as the grass is moist and juicy they may not drink much. As soon as the weather turns hot and dry their water intake raises sharply. There must always be good clean water available, all year round. (Read more about water supplies in Chapter 6 and 7)

### FEEDING THE SUCKLER COW

Suckler cows are excellent converters of roughage (hay, silage or straw) and grass in to milk and meat. They have very well developed rumens where even the coarsest fibres will be turned in to energy and protein for the cow. When planning for feeding the suckler cows we should make the most of this talent and not be tempted to use expensive pellets or grain.

*Hay or silage* of medium nutritional value is the best winter feed for suckler cows. Hygienically it must be of excellent quality since the foetus in the pregnant cow is sensitive to mold and fungal toxins. The second cut of hay or silage with plenty of fibres, but relatively low in energy and crude protein is fine for the cows. See the table below for some examples:

**Table 2: Nutritional requirements suckler cows (pregnancy and lactation)**

Cow live weight	Maintenance need		Pregnancy supplement 8 weeks before calving		Lactation supplement for 10 litre of milk/day	
	Energy MJ	Crude protein, g	Energy MJ	Crude protein, g	Energy MJ	Crude protein, g
500	54	260	18	255	50	600
600	62	300	22	306	50	600
800	76	370	29	232	50	600

Source: Swedish Agriculture University, feed table for ruminants, 2003

As shown in the table, the need for pregnancy supplement is not big. If the cows are fed a medium hay or silage they will be able to manage this increase themselves by eating a little more. The lactation on the other hand puts a lot of pressure on the cow with an almost doubled need for energy and nearly 200 % higher crude protein requirement.

**Table 3: Nutritional content in different roughages, expressed per kg dry matter (hay and silage)**

	Energy MJ	Crude protein g	NDF (fibre) g
Hay	8,9	47	605
Very late cut silage	8,4	98	667
Medium quality silage	8,9	119	474
Good quality first cut silage	10,0–11,0	130–150	530–550

**Table 4: Amount of feed needed to satisfy the cow's nutritional requirements during low pregnancy, late pregnancy and lactation**

	For a cow of 600 kg live weight	Amount of hay needed (kg dry matter)	Amount late cut silage needed (kg dry matter)	Amount medium quality silage (kg dry matter)	Maximum intake of dry matter for a 600 kg cow
Energy and protein requirement low pregn.	62 MJ 300 g c.prot	7 6,4	7,4 3	7 2,5	12–15 kg
Energy requirement late pregn.	8,4 MJ 606 g c.prot	9,4 12,9	10,0 6,2	9,4 5	
Energy requirement lactation	112 MJ 900 g c.prot	12,6 19	13,3 9,2	12,6 7,5	

The example above shows that during pregnancy the cow will have no problems meeting her requirement from any of the hay and silage qualities. Many cows are fed ad lib (free access to) silage or hay during the winter. By making this calculation using the nutritional values of your silage you check if your cows can meet their requirements or not. Both silage qualities in this example will over feed the cow with protein. This is unavoidable since most cows must be fed enough to meet their energy requirement. Only cows in very high condition (overly fat) can be fed under their energy requirement. Pregnant heifers

Pic 24. Make sure the growing young cattle have the best silage the farm can produce.



should be given 5 % extra energy to make sure they grow properly.

What we can see in this example is that the roughest silage or hay with the lowest energy content should be fed to the cows during low and mid pregnancy. Save the better feed to late pregnancy and, most importantly, the lactation. As is seen above, the cow will not be able to meet her protein requirement on the hay and must eat to her maximum ability to have enough energy from the late cut silage. It is also obvious from the example in table 3 that it is good to get the cows out on to grass as soon as possible after calving. It will take the cow 3–4 weeks to get up to maximum lactation. Try to plan the calving season so that the time on winterfeed after calving is less than a month. The cows will milk very well on the nutritious and easily digestible early summer grazing.

### **FEEDING CALVES AND YOUNG STOCK**

The young stock should always have the best feed. This is because they are growing and, in proportion to their live weight, has the highest nutritional need. This does not mean that we necessarily have to feed them a lot of grain and pellets, but a young ruminant does not have the same ability to manage on hay or silage that is low in nutrients. Their stomachs are smaller so their feed needs to be higher in energy and protein per kg dry matter. The most sensitive young cattle are dairy calves. They are weaned early and need to replace the high quality milk with other feeds. A good calf concentrate plus hay or silage of really good nutritional quality should be on their menu. The suckler calves are less sensitive since they have access to milk until 6-7 months age. In their case the limiting factor is their restricted consumption capacity.

**Table 5. Consumption capacity in kg dry matter expressed as percentage of live weight**

Live weight, kg	Intensive feeding	Extensive feeding	Beef breeds
100–200	3,5	2,8	
200–300	3,1	2,4	2,4
300–400	2,7	2,1	2,3
400–500	2,3	1,9	2,2
500–600	2,0	1,7	2,1
600–700		1,6	2,0

Source: Swedish Agriculture University, feed table for ruminants, 2003

**Table 6. Nutritional demands on feed when rearing beef breed heifers to slaughter**

Live weight	Expected daily weight gain in grams	Energy requirement MJ	Protein requirement Crude protein, g	Maximum consumption, kg dry matter	Minimum level of energy in Silage, MJ/kg dry matter	Minimum level of protein in silage, g crude prot/kg dry matter
200	800	49,6	615	4,8	10,3	128
300	800	63,1	706	6,9	9,1	102
500	800	88,2	917	10,5	8,4	88

The table above shows how the silage quality must be higher the younger the animals are. As an example, only the oldest heifers in this example could manage to grow on the roughages we used in the suckler cow examples. The hay and the late cut silage are both too weak in energy and protein to be used for the young animals. Only the good quality silage in table 2 is good enough for young growing animals.

**Table 7. Nutritional demands on the diet when rearing beef breed bulls (Angus) to slaughter**

Live weight	Daily weight gain in grams	Energy requirement MJ	Protein requirement Crude protein, g	Maximum consumption, kg dry matter	Required level of energy in diet MJ/kg dry matter	Grain + concentrate fed, kg
275	1500	109	1264	6,6	16,5	3,8 +0,4
400	1500	129	1393	8,8	14,7	4,7 + 0
550	1400	158	1595	11,6	13,6	5,3 + 0

The example above shows that in order to rear bulls fast with high growth rates more than just silage is needed. There is no silage that can match an energy level of 13–16 MJ/kg dry matter. Grain is needed all through the rearing and for the very youngest bulls also a small amount of extra protein feed. This can be home grown peas or beans or a concentrate pellets. Even though there is grain fed in this example, the silage must still be of good quality with a minimum of 10, 5 MJ/kg dry matter and a crude protein content of at least 140 gram/dry matter.

### **GRAZING AS FEED TO GROWING AND PREGNANT ANIMALS**

Well managed grazing (*Read more about management of grasslands in Chapter 6*) is a very suitable feed for growing, pregnant and lactating cattle. The grazing animals are continuously cutting the grass and making it stay in the vegetative state. This means that well grazed grazing pastures, whether they are cultivated or natural, have low fibre content and a high energy and protein content, comparable with good silage. Heifers and steers can be expected to grow 700–800 grams/day on grazing alone. A suckler cow milk very well indeed on well managed grazing and there is no problem for her to get pregnant whilst out on grassland. If there are any fertility problems while grazing the first thing to check is the mineral supply. Lack of certain minerals has been shown to cause fertility problems in dairy breed heifers whilst grazing. Suckler cows rarely have any such problems. The time for them to get pregnant usually is early summer when the grazing is at its best. They should have no problem maintaining a good nutritional balance at this time.

Pic 25. Heifers can grow 700 grams/day on semi natural pastures.





## CHAPTER 6

### MANAGING THE PASTURE AND THE GRAZING ANIMALS

*Grazing is both a production input and a production output. It is both a resource and a responsibility. In beef production correct grazing management often is the difference between a profitable and a non-profitable enterprise.*

#### THE VALUE OF GRAZING LAND

Good grazing is comparative to grain in nutritional value and tastiness for the cattle. This means that the cattle can have really good growth rates, and produce plenty of milk, when out at grass. There is possibility to have EU and national support for managed grasslands, especially if they are of high nature value. There are many different kinds of grasslands, with the main division running between cultivated grazing and natural/semi natural grasslands.

*Cultivated grazing* is created on arable land and is often part of a crop rotation. Usually the cultivated grasslands are also used for harvesting winter feed such as hay and or silage. Cultivated grasslands are often fertilized and in some areas irrigated. They are often broken after 3 years and drilled in again, but there are also cultivated grasslands that are more permanent, so called long term pastures.

*Natural or semi natural grasslands* are created over a long time, either by nature itself or by nature and man together with grazing animals. The natural and semi natural grasslands have their own flora and were never seeded by man. They are very valuable for their outstanding biodiversity but also as providers of animal feed on land that is not suitable for cultivation and growing crops.

Pic 26. Semi natural pasture to the right and a cultivated pasture to the left.



### *Grazing the eco system*

Animals eat grass before it becomes old, dry and unpalatable. Periodic grazing maintains the grass in its growth, or vegetative, state. During this stage the root system increases and spreads out. As the grass spreads across the soil it becomes an insulating layer that shields the earth from direct heat and helps retain moisture. When the rains finally come, the carpet of live grass and dead grass litter slows the water runoff. This gives the water more time to be absorbed in to the soil. The more water that is absorbed the more water is stored and the longer it will take for the ground to dry out after the rains. Grazing animals and grass are a perfect match – they coevolved on earth 24 million years ago to take advantage of each other.

All grasslands act as natural sponges and will retain and absorb water and nutrients. This is especially important for grasslands surrounding cultivated and fertilized fields. Nutrients from the cultivated land would otherwise flow into the waterways and later in to the sea where they cause eutrophication.

### **GRAZING AS FEED**

#### **Nutritional value of grazing**

There is a common misunderstanding about natural and semi natural pastures, that they have very low nutritional value. In the table below results from a Swedish research project shows that this is not so. The nutritional value of the grazing can be compared to good silage and the project heifers grew 600 g/day over the whole grazing period. The 18 hectares of grazing in this research project were grazed by 24 one year old heifers.

**Table 8: Nutritional values in semi natural grasslands, varying type and seasons.**

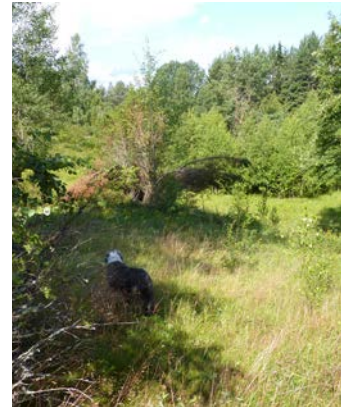
	Dry	Mesic	Wet	Spring	Summer	Autumn
	Average values over the whole season			Average values for all three types of grazing		
Dry matter g/kg herbal mass	270	272	265	312	229	265
Energy, MJ	9,9	9,4	9,0	11,5	8,5	8,4
Crude protein, gram	140	124	122	152	114	121
NDF fibres, g	553	600	608	480	654	627

Source: Anna Hessle, Doctoral Thesis 2007:32, SLU Sweden

*When to let the animals out to graze* is important to get right. As is shown in table 1 the nutritional value of grazing is highest in the spring. It is important to have the animals out grazing early so that they can ripe the benefits from the spring growth. The grasses lose nutritional value very fast if they are ungrazed and allowed to go to seed. A rule of thumb is that cattle should be let out on cultivated grazing paddocks when the average grazing height is 9–14 cm. On the semi natural pastures this would be too long; the grasses would already be turning to seed. For the natural and semi natural pastures the rule of thumb is simple – as early as possible!

### Fibres in grassland

The modern way of describing fibre content in cattle feed is by using the expression Neutral Detergent Fibre in grams/kg dry matter. In young plants the fibres are easily broken down in the digestive system of the cattle. This gives the feed a high energy level. The more the plant develops the more of the fibre is attached to less digestible structures such as cellulose and lignin. The energy levels drop as the fibres become less digestible. Good quality grazing has 40–50% easily digestible NDF. Overgrown grazing has more than 60% less digestible NDF. This is one reason to let the animals out early to make sure that the grazing does not become overgrown but stays in the easily digestible vegetative state longer.



Pic 27. Overgrown pastures like this hold a lot of feed but with very low nutritional value. They should have been grazed earlier in the season.

### Grazing pressure

Grazing pressure describes the number of animals kept per hectare of grazing. High grazing pressure (= more animals per hectare) is used early in the season and on very productive grazing, such as fertilized arable grazing. Low grazing pressure is used during draughts and on grasslands with lower production. If the grazing pressure is right it helps to keep the grass and other grazing plants in a vegetative state which prevents them from going to seed, or heading. This will keep the productivity and nutritional value high longer in the season.

**Table 9. Grazing pressure guidelines**

Type of animal	Age of animal	Number of animals per hectare			
		Cultivated grazing on arable land		Semi natural grazing	
		Early summer	Late summer	Early summer	Late summer
Heifer	<1 yr	8	4	4	2
Heifer	>1 yr	4	2	2	1
Bull	1 year	6	3	3	1,5
Steer	<1 yr	8	4	4	2
Steer	>1 yr	4	2	2	1
Suckler cow with calf		3	1,5	1,5	0,75

It is difficult to give advice about the right amount of animals per hectare of grazing. So much depends on the year (weather), type of grazing, age and type of grazing animals and the grazing system used. In table 2 some guide lines are given, but remember that droughts, rains and cold weather can change the conditions. One must always be prepared to move grazing animals in or out of the paddocks to keep the grazing pressure right.

### GRAZING STRATEGIES

A grazing strategy describes the system used to graze a paddock or area. There are two main grazing strategies, continuous grazing and rotational grazing. There is not always a clear distinction between them since there are many different variants.

*Continuous grazing* describes a situation where the animals have access to the entire

grazing area during the whole grazing period. Research shows that animals in continuous grazing utilize 50% of the paddocks feed potential. Some parts of the grazing will become overgrown and lose palatability and nutritional value whilst the animals are busy grazing the more attractive parts of the paddock. Continuous grazing can be useful for large, dry semi natural grazing areas with fairly low biomass production.

*Managed large grazing area* describes a situation where the large grazing area is subdivided with temporary fences that can easily be moved. During fast growing parts of the season some of the paddock is fenced off and harvested for silage and hay leaving the animals to graze the rest with a higher grazing pressure.

*The Allan Savory Holistic Grazing management* is a whole systems approach to managing grasslands. It considers water and mineral cycles in the soil, wildlife habitats and the whole surrounding eco system. It has proven very useful especially when restoring over- or under grazed grasslands in dry regions of the world.

*Rotational grazing* describes a system where the grazing is divided into several smaller areas which are grazed one by one by the whole herd of animals. The rate of grazing is quite high, often just one or two days in each grazing area. The animals should not come back to an area before 14 days has gone past to give the grass enough time to recover and grow. If the grass grows fast and the animals can't keep up, some areas can be harvested instead of grazed.

*Strip grazing* describes a system similar to rotational grazing. The animals are grazed in a paddock where a temporary fence in front of them is moved once or twice per day. This system is often used for dairy cows since it is practical to move the fence when they come in for milking. Strip grazing creates a high grazing pressure and is very suitable for highly productive fertilized arable grazing. Strip grazing and rotational makes the most of the feed potential of grazing land but are also the most labour intensive.

Pic 28. A pasture harrow can be used to spread out clumps of manure on the grazing.



## MAINTENANCE OF GRASSLANDS

*A flail mower* is a useful tool for maintaining and improving grasslands. This is a tractor carried grass mower that can be used in rough conditions with stones, bushes and uneven ground. It has more of a slashing action than ordinary grass mowers and is carried by, rather than pulled, behind the tractor. The flail mower is used to tidy up after the animals by cutting grass that they have refused, for instance around their manure piles. The flail mower is also very useful for cutting down old rough grass when restoring a paddock that has been unused for a long time. A thick cover of old vegetation will stunt the growth of new grass. By cutting and chopping the old material, light and air reaches down into the sward. This stimulates new growth both above and underground creating a strong and vital sward.

*A pasture harrow* is also a good tool that can be used for harrowing out the manure piles and speeding up the decomposing of the manure. The pasture harrow can also be used to “brush up” and aerate old rough grass when restoring overgrown areas.

*A brush cutter* is needed for keeping grass and bushes from growing on to the electric fences but also to prevent the semi natural pastures from being bushed over. A well balanced grazing pressure minimizes the need

for both the flail mower and the brush cutter but there will always be certain years and certain areas where they are needed.

## CATTLE FENCES

Fencing is one of the biggest expenses in grazing based beef production. The fencing material costs money and putting up good fences takes time. The fences must keep the animals in without hurting them or any wild animals in the area. They must be reliable, durable and not too expensive. All types of fences need maintenance to function properly and be secure. There are different types of fences that function in different ways.

*Physical fences*, such as barbed wire or post and rail fences, physically prevent the animals from leaving the paddock. A well put up barbed wire fence is very safe and should not hurt the animals. But, they are costly and labour intensive to erect and also to maintain. When they start rusting and falling down they start posing big risks to both the cattle, humans and wildlife. To take down and roll up old rusty barbed wire is a heavy and difficult job. Post and rail fences are very good, extremely reliable and safe but enormously expensive for larger areas. It can be a very well spent investment to have a smaller post and rail paddock close to the barn when letting out newly bought animals. The animals will stay there until they have calmed down and learned that the new place is home.

*Electric fences* can be both permanent and temporary. Most farms will have a mixture of the two. An electrical fence works as a psychological border. An electric fence consists of an energizer (electric fence unit), conductive wire, insulators and posts. The animals get a shock from the wire and learn that passing through the posts is dangerous. This mental fear of the fence makes it possible to use a minimum of material which keeps the costs down considerably. The wires themselves cannot hold the cattle in by force so it is imperative to always have good power on the fence. The permanent electric fences should cover the outer perimeter of the farm and the grazing area. Temporary electric fences should be used to subdivide and direct the grazing animals within the outer border. This way the cattle become a versatile tool for eco system services as well as producing milk and meat.

*Permanent electrical fences* should be planned carefully before they are erected. By considering where the fence line should go and where there should be gates you can avoid many problems in the future. Always look to the whole grazing system when putting up fences:

- Where can you have a workable catching pen? It should be in a place where you can approach with a lorry and in a place where it is easy to move the cattle.
- Where should the gates be to facilitate cattle passing through them? Cattle like to go into corners of a pasture and along the bottom of gullies. There should be free sight through the gate. If the cattle see another fence line through the gate they will be confused of if the gate is open or not.
- Can you reach all the paddocks with water? Dig in as much water pipe as you can and try to create drinking places that can service more than one paddock by putting baths and water troughs under the fence line.
- Can you create a system whereby the cattle can walk from one paddock to another so the need for transportation is minimized? Catching and loading cattle on trucks is always stressful and should be avoided if possible.
- Where do you need wide enough gates to pass through with tractors and



Pic 29. A brush cutter is a necessary tool to combat bushes and to mow down the grass under electric fences.



Pic 30. A line of temporary electric fencing is useful for subdividing pastures.



Pic 31. A permanent electric fence with three galvanized threads and one plastic thread at the top works for both cattle, horses and sheep.



Pic 32. A good quality insulator has a steel core and durable plastic coating.



Pic 33 & 34. A self closing gate or a stile are ways of making a pasture accessible for people (SOB).

implements? There are driveable electric gates that can be passed over with a tractor. This can be very useful if you work alone and regularly need to get in and out of the paddock.

- Will you use some or all the paddocks for other animals beside cattle? An electric fence with 4 wires works fine for both cattle, sheep and horses if you space them well. For cattle and horses 2 wires might be enough but 3 is a safer option especially for a suckler herd where there are young calves out on grasslands.
- What areas should be fenced off and saved for harvesting winter feed before grazing? Create the paddocks so that they are easy to subdivide with temporary electric fences. Grazing every other year only might be required in some high nature value areas.

### NEVER COMBINE ELECTRIC WIRES WITH BARBED WIRES!

*The secret to a well put up fence* is to work with straight lines as much as possible. It makes the fence strong and minimizes the amount of posts and wire needed which saves money.

Take time planning where the corner post should go. You also need good strong posts in places where the fence changes direction, the inflection points. The corner posts and the inflection points are the backbone of the fence. They might need to be dug in and often secured with braces or parallelograms. In between these posts you can use fibre glass stakes or thin wooden posts. Their job is just to keep the wires at the right distance from each other and from the ground. The thinner posts can be spaced at 7–10 meters.

*The energizer* can be both battery driven and/or plugged in to the net. There are also solar and wind powered energizers to be had. It is important to choose a strong enough energizer for the amount of wire that is going to be attached to it. Equally crucial is to ground the energizer well or it will not give the shock they are designed for. Many farmers have given up on electric fencing when it has not managed to keep their animals in. Usually the reason is quite simply that they have not grounded the energizer properly. Two to

#### Practical fencing tips

- Posts that are barked last a longer time in the ground.
- Posts should be pointed at the end that is put into the ground.
- Posts can be banged into the ground with a mallet or a man killer.
- If the posts are to be split, do it with an axe or similar, so that the cut follows the fibres of the wood. The pole will be much more resistant to rot.
- The part of the post below the ground can be burned or treated with tar to protect it against rot. The harder wood the better. Oak, larch, juniper and slow growing pine are good for making poles.
- Gate posts should be made as a single parallelogram on each side of the opening. (Photo 3). If not, the wires will eventually bend the posts and the fence will break.
- Posts should be banged in to a depth of 60–80 cm. Even deeper for corners and other inflection points where the posts need strength to handle larger pressure.
- Try to include woodland edges, bits of forest and other biotopes which are often left ungrazed nowadays. They are very valuable for the biodiversity.

six meter long metal rods should be driven in to the earth and attached to the energizers grounding contact. If the soil is particularly dry, sandy or stony where the grounding rods are put in add a couple of extra rods. Try to place the ground rods where water will naturally reach them as along the drip line from a roof, or where you can water them from time to time.

*The wire* must be highly conductive. The thicker the wire that is used the less resistance and the better the fence. Using galvanized wire is a good investment since it has much longer lifespan and better conductivity than ungalvanized wire. For temporary fences there are plastic strings with metal wires/conductors inside them. Make sure you choose a plastic string with enough metal conductors and weather and UV light resistant plastic. The temporary strings will brake and knot over time because of the frequent putting up and taking down. The sun and weather will also fray and wear the plastic over time so the temporary string will need to be replaced with regular intervals or it will stop conducting the electric pulses. For cattle three wires placed at 40, 80 and 110 cm above ground is recommended, but two spaced at 40 and 80 cm will suffice.

*The insulators protect the wire* from shorting out on to the wooden posts. They need to be of good quality to have a long life span. The best insulators for high tensile wire are made with a metal core covered with good quality plastic. They can withstand the pressure from a tight wire and do not crack easily. There is a fencing system that works without using insulators, Insultimber trademark. The Insultimber fence posts are made from hardwood that does not conduct electricity. The insultimber posts are interesting also because they are so hard that they do not need to be treated with tar or other strong agents. This can be a big advantage in environmentally sensitive areas.

*Crossing places for people and/or vehicles* must be fitted in to the fence line if the public are going to be able to enter the grasland. This might be the case in nature reserves and other populated areas. For people, some kind of stile that lets people but not animals, through or over the fence can be built.

For vehicles a cattle grid is the safest option. Where a road crosses the fence a wide ditch is dug across the road. The ditch is then covered by a strong metal grid that cars but not cattle can pass over.

## **WATER AND MINERAL SUPPLY IN THE GRAZING Paddock**

*The cattle will need large amounts of water* also when they are out grazing. When the grass is lush and the weather damp the water requirement is only half of when the animals are fed inside. Dry weather and high temperatures can change that quickly. It might be tempting to let the cattle drink from a nearby lake, the sea or a stream. Cattle can manage to drink brackish water (slightly salted) from the sea if the salt content is not too high. Lactating dairy cows cannot manage higher salt content than 0,1 % whilst young stock should manage up to 0,5 %. Lactating suckler cows are probably somewhere in between.

Letting the animals drink from natural water sources can sometimes cause problems. If the shoreline is soft and muddy and the cattle defecate in to the water. If the water is not running fast this means that the cattle will infect their water source quite quickly. The risk of developing and spreading foot rot and other lameness is also higher when the animals



Pic 35. Posts should be sharpened at one end and banged in to the ground.



Pic 36 A man killer is used to bang down fencing posts.



Pic 37. The cattle use a grazing pump to pump water up from streams or lakes without ruining the shoreline. (Photo: Alain Cosnet)

regularly trample around in damp conditions. They might trample and ruin sensitive shorelines and escape by walking out when the water table is low.

Another problem is the spreading of EHEC/VTEC. These are a kind of E-coli bacteria found in cattle that can cause serious diarrhoea and kidney failure in humans. One way the bacteria spread to humans is by cattle defecating in water near to where people swim and play in the water.

For all the above mentioned reasons the use of a water pump for grazing is advisable. The pump operates by making the animals push a lever back and forth when they are trying to get to the water. The pump has a drinking bowl and is equipped with a long tube that reaches down in to the natural water source. The pump itself must be securely fastened to the ground in the grazing paddock or the animals will push it over.

*Salt licks and mineral feeders* are important when the animals are kept at grass. For the suckler cows and heifers the mineral balance is important since grazing is the time when they get pregnant again. Make sure that the mineral feed is protected from rain since it can become unpalatable if wet. Saltlicks and mineral feeders become popular gathering places for cattle when out at grass. This can be used when moving the cattle. Train the animals by dragging the mineral feeder in to a new field with plenty of fresh grass. They will soon learn to associate the noise and the sight of the mineral feeder being moved with a positive move.

## **INTENAL PARASITES IN GRAZING CATTLE**

Intenal parasites can cause problems in grazing based beef production. The best defence is prevention but when there is an established parasite problem medication is necessary. Knowledge of how the parasites live and multiply is a good tool for prevention.

*Intestinal parasites* – sometimes called worms – live in the stomach and the intestines of the host animal. Inside the animal they become mature and excrete eggs that are passed out of the host by the dung. The parasite eggs hatch in moist and warm conditions and develop through a range of larvae stages in to an infectious stage when they are ready to re-enter the host animal. The infectious parasite – now looking like a thin worm – climbs up to the top of a piece of grass and waits for an animal to digest it. Once inside the host the cycle starts again with maturity and egg excretion. The larvae and the infectious parasite need warmth and moisture to develop. They do not like direct sunshine or dry conditions. A long dry period will lessen the parasite pressure in a grazing paddock whilst warm and humid weather will make it worse.

Some parasites need an *additional intermediate host*. The large liver fluke (*Fasciola hepatica*), for instance, needs to pass through a snail that lives only in damp conditions. The small liver fluke (*Dicrocoelium dendriticum*) needs two intermediate hosts, a snail that likes dry conditions and an ant, to reach maturity. The intermediate hosts limit the liver flukes to areas where the host species flourish.

*Young dairy breed calves* and other animals that are turned out on to grass for the first time in their lives are the most vulnerable to parasite infection. Adult animals develop resistance to parasites after their first summer on grass. They can have a mild parasite infection without showing any symptoms or losing in production. Immune animals do not excrete as many parasite eggs as newly infected ones. Calves can be very badly affected by a parasite infection. The parasites burrow in to the mucous of the calves intestines and ruins the calf's ability to digest and absorb nutrients. In severe cases the damages becomes permanent and the calf will always be stunted.



*Suckler calves* often manage their first summer without getting badly infected by parasites. This is partly because the suckler cows ingest and incapacitate most of the overwintering parasites in the spring grass before they have a chance to reach the calves. The calves live mainly on milk during this period and do not graze so much. When they graze more later on in the season they have had just the right amount of exposure to develop immunity.

*Parasite medication, anthelmintics*, should be used to treat infected animals. On badly infected pastures the medications can be administered with regular intervals during the whole grazing period. There is also parasite medication administered as a bolus, a slow release capsule, placed in the rumen, when letting the animals out to grass. When using anthelmintics routinely there is always a risk of the parasites developing immunity to the medication. Prevention is therefore a much better solution than perfunctory use of anthelmintics.

**Preventive measures are:**

- *Make sure the animals are in good condition*, healthy and in a good mineral balance. This gives them natural resistance to parasite infection.
- *Move the animals* before the grazing runs out completely. The animals will not be forced to graze too close to their dung piles, where the highest concentration of parasites are found.
- *Fence off, or drain, waterlogged areas* in the grazing paddocks. This will effectively prevent infection from the large liver fluke.

Pic 38. Animals who have been affected badly by parasites loose condition and can have permanent damages to their intestines.



- *Let first time grazers out on parasite free grazing.* Parasite free grazing are areas where there has never been animals, such as a grass lay only used for mowing. It can also be grazing areas where there were no cattle during *the whole previous year*. Any parasites excreted by the cattle during the previous year will die in the absence of suitable host animals. Sheep, cattle and horses can be used as alternating grazing animals since they do not share any intestinal parasites.
- *Lessen the parasite pressure* by letting adult, immune animals graze the paddocks first in the spring. They will ingest and incapacitate the overwintering parasites without excreting to many fresh eggs. This does not create a parasite free pasture but makes the infection pressure much lower for the younger animals.
- *Start the grazing season later* on the cultivated grasslands. Harvest silage in the early summer and graze later when the regrowth has come. Many parasites will die when there are no host animals to infest in the spring.
- *Use Birdsfoot trefoil (Lotus corniculatus and Lotus pedunculatus , Sulla (Hedysarum coronarium) and Cikoria (Cichorium intybus)* when reseeding grazing pastures. These plants seem to prevent or at least lessen the parasite infections in both sheep and cattle. They also increase the nutrient uptake of the animals making them grow better.

## CHAPTER 7

### HOUSING AND FEEDING SYSTEMS FOR CATTLE

*There are many different ways of housing and feeding cattle during the non grazing period. The farm location, the chosen production model and the economic conditions of the cattle business all influence the choice of buildings. All buildings, or other housing arrangements, need to do the same things; keep the cattle safe, well fed, manageable and clean.*

#### THE MANY PURPOSES OF A CATTLE BUILDING

A cattle building fulfils many more purposes than just to provide a roof over the animals' heads. It is important to remember this if planning to keep the animals outside in the winter. Most of the purposes of a cattle shed needs to be accommodated also by the out wintering systems:

- *Provide the animals with a dry and clean place* to lie down. No animal like to rest on a wet surface. When they are forced to do so it makes their coat dirty and full of clots which ruin the insulation ability of the coat. A wet animal will feel cold and need much more maintenance food than a dry and clean animal. A building should be designed so that it can be bedded easily with straw or wood shavings.
- *Provide the possibility to group animals* with different needs. In any cattle production system you need to be able to separate different groups of animals. Animals of different ages and sexes need different types of feeding to grow according to plan. Young heifers should be kept apart from adult suckler cows or they will not manage to eat enough to grow. If the breeding bull runs with the herd all the year round you have calving all year round which is not ideal. The young bull calves must definitely be separated from all female cattle once they are 8 months old and sexually mature.
- *Provide a separate and sheltered place for unwell or weak animals and cows/ heifers after calving.* An animal that is injured or ill should not be left in the herd. The other animals do not take care of a sick herd member but might trample and stress it unnecessarily. The herdsman needs to be able to safely catch the sick animal for treatment and medication. A newly calved cow wants to be separate from the flock for a day or two to create a bond with her calf.
- *Provide feeding and drinking places* for the cattle. Depending on type of feeding regime you should either provide one feeding place per animal (for restricted amounts of forage and/or when feeding concentrates) or one feeding place/three animals (for free access to straw, hay and silage). The feed needs protection from rain and snow and the feeding gates should also prevent the cattle from wasting feed by dragging it on to the ground and lying or defecating on it. The water supply needs to be protected from frost and provide enough and clean water to all animals.
- *Provide safe handling facilities* for the herdsmen. There will always be occasions when the animals need to be handled, one by one or as a group. A good building is planned for this with driving passages and plenty of gates and catching places where animals can be singled out, caught and/or treated.
- *Provide a time efficient way of looking after the cattle.* All animals need to be fed, cleaned, watered and looked at daily. If they are in a confined, well lit space with automatic water cups and efficient feeding and mucking out systems the time spent on routine every day jobs can be shortened.



Pic 39. These cows are kept in a loose house system with a deep straw bed.

- *Provide a manure handling system.* Cattle manure is valuable as a fertilizer on the farm and should not be allowed to leach in to the groundwater or the sea. A good building act as a storage place for deep litter manure and helps manage slurry and solid manure so that it can be stored until spreading on the land.
- *Provide a sheltered lunch/changing room* for the staff. If you have hired staff they need somewhere to eat, change their clothes, wash their hands and have access to a WC.

There are many different ways that a building, or an out wintering system, can provide all these things. No one system is right for everyone. The important thing is to think everything through before building a new, or adapting an existing, building. It is always more expensive and time consuming to change something once it is built.

### DIFFERENT TYPES OF CATTLE BUILDINGS

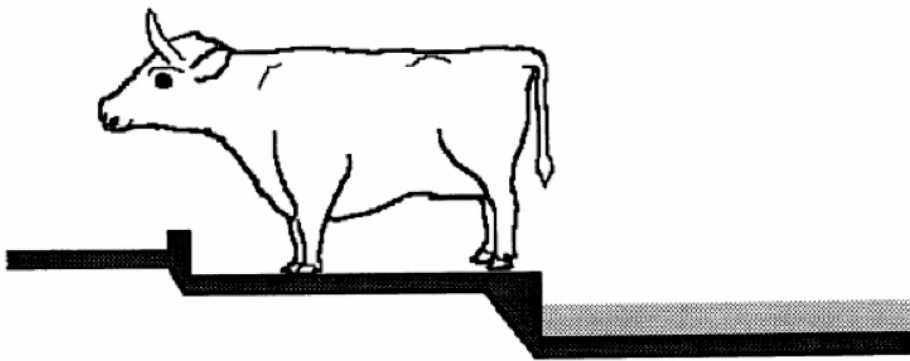
*Loose housing system or tied up animals.* Tied up animals gives the herdsman good control over the animals and what he feeds them. Having cattle tied up is a very time consuming way of keeping them. Each animal place must be cleaned out and bedded several times per day. It is not the best system from an animal welfare point of view either. The cattle do not get any exercise during the winter, they cannot perform many of their natural behaviours and it is difficult to keep them clean.

*Loose housing system with deep straw bedding.* This is a building where the animals are kept on a bed of straw that will be cleaned out once or twice per year. The cattle are fed from a feed table/trough that is either set directly adjacent to the deep bedded area or with a separate concrete area in front of the feeding table that is scraped and kept clean. To have a separate feeding area lessens the need for straw since the animals only use the straw bed for resting. A suitable division is 60% bedded area and 40% concrete eating area. The concrete feeding area is scraped, with a tractor or automatic scrapers, daily or at least several times per week. To have access to a concreted area is better for the cattle's feet and there is less need to have them trimmed during the winter.

**Table 10. Straw requirements in different types of cattle housing**

Type of cattle	Daily straw requirement in house with all area deep straw bedded	Daily straw requirement in house with 60% bedded area and 40% concrete area
Young bulls and heifers	7 kg	4 kg
Suckler cows	10–15 kg	8 kg

The drawing to the right shows cattle housing where the separate feeding area is elevated above the deep straw bedding area. The depth of the straw bed area can be 0,4–0,6 meters without the cattle needing any steps to climb up on. The straw bed will in this case have to be emptied after 2–3 months or it will grow and start entering the eating area. If steps or a ramp is used, the depth of the bedded area can be increased and the straw bed be left in longer. Steps should be 0,5 m deep and 0,2 m in height. The first step can be 0, 4-0, 6 m in height.



Bedding the cattle shed is a time consuming job. To minimize the amount of straw needed the rule is to give the cattle new straw little and often. A straw shredder hung from the ceiling or a straw shredder that is attached to the front end loader of the tractor makes the job easier.

*Loose housing with cubicles.* In this building there is a separate resting cubicle for every animal plus a concrete area for the feeding. The cubicles are either equipped with a rubber mat for softness or bedded with sand or shavings. This is a popular choice for dairy cows but can also be suitable for suckler cows.

*Wind shelter with feeding area outdoors.* A wind shelter building with deep straw bedding or cubicles can be combined with a permanent outdoor feeding area. The feeding area can be with or without a roof over the feed and can also be movable feed gates. If the feeding area is permanent it should be concreted or at least reinforced since there will be a lot of pressure on that small area of land. A permanent feeding area needs to be scraped regularly and should preferably have a run off system to catch manure water and urine. With moveable feed gates the feeding area can be rotated to help prevent trampling and ruining the land in the winter.

Pic 40. Using a tractor driven straw distributor makes the job of bedding for cattle easier.



Pic 41. These cows have an open sided wind shelter and a hard surface where the feeding of hay bales takes place.



*Movable wind shelters* are useful when the cattle winter paddock is part of the crop rotation and the winter paddock is alternated between different parts of the farm. There are metal sheet hangar buildings, tents and plastic sheeted greenhouses that are all moveable and suitable for cattle if they are internally reinforced by gates.

### **WATER AND FEEDING SYSTEMS**

*The ideal height of a feed trough* or feed table is 10 cm higher than the cattle floor. This makes the cattle reach the feed easier and they are less likely to lean on the feed gates and ruin them. A feed trough, instead of just a flat feeding table, lessens the need to sweep the feed in so that they can reach but makes it more difficult to distribute the feed with machines/tractors.

*A feed table with lockable feed gates* is a handy tool for catching animals and for feeding certain individuals special portions or medicated feed. This type of gate is very useful for suckler cows and calves since it also very effectively stops the calves gaining access to the feed table. When using lockable feed gates you must make sure you have one eating place per

#### ***Tips for creating a good composting straw bed***

A straw bed with active composting going on will keep firmer, cleaner and use less straw during the winter.

- Use a lot of straw when you first bed for the cattle – at least twice as much as you normally do!
- Start the straw bed before the weather is too cold – this helps with starting the composting processes.
- Do not have too many cattle in the box or cowshed in the beginning. To start the composting process oxygen is needed and too many cattle packs the straw bed too densely.
- Do not drive with a tractor on the straw bed in the beginning – it also packs it down to hard, see above.

### *Useful planning tools for a cattle shed*

Feeding area when the animals have free access to fodder

- 0,7 m<sup>2</sup> per 3 cattle with a weight of less than 650 kg.

Drinking places

- a minimum of 1 cup/25 cows.

Lying area on deep straw bedding with a separate feeding area

- 2 m<sup>2</sup>/ animal up to 200 kg live weight
- 2,6 m<sup>2</sup>/animal up to 400 kg live weight
- 3,5 m<sup>2</sup>/cow over 600 kg live weight
- Lying area when the straw bed also includes the feeding area
- 2,9 m<sup>2</sup>/animal up to 200 kg live weight
- 3,7 m<sup>2</sup>/animal up to 400 kg live weight
- 4,8 m<sup>2</sup>/cow over 600 kg live weight

Boxes for calving

- 1box /10 cows or heifers. Boxes can be temporarily put up by using gates of metal or wood that is stored against a permanent wall.

Malady box

- 1 box/50 cattle.

*These are minimum recommendations based on Swedish animal welfare regulations.*

animal in the group.

*Make sure there are enough eating places.* In most young stock rearing systems you will want to feed concentrates during some period. As soon as you feed concentrates there must be one feeding place per cattle in the group.

*Moveable feeding gates for big bale hay or silage* is a fairly inexpensive way of minimizing the waste of roughage. The feed gates can be taken apart and are light enough to be moved by one person. When cattle eat freely from silage or hay bales they waste between 20–50% of the roughage by lying, stepping and defecating on it.

*Using temporary electric fencing* to regulate the feeding of big bale silage or silage from a clamp is possible. The cattle must be used to and respect temporary electric fencing. Use glass fibre posts to allow the cattle to eat over or under the electric wire without being able to trample the feed.

*There must be at least one water cup per 25 animals* in the group. Cattle often guard the water cups and behave aggressively around them. Therefore, it is better to install one or two cups "too many" if you can. Control the flow in the water cups regularly – an adult cattle can drink up to 20 litres/minute when drinking from an open source. Most cattle like to drink after they have eaten their silage or hay so there will be high pressure on the water cups after feeding time.

*Frost free water cups or troughs* are needed in cold cattle sheds and in outdoor systems. There are several ways to protect the water from freezing:

- Electrically heated water cups or troughs. Only the water cups are heated so the pipes providing the water must be insulated or equipped with a heating cable inside the pipes.
- Heated water is pumped round in the system by a circulation water pump. The water is



Pic 42. A tent with metal gates inside can work well as a wind shelter and a hard surface where the feeding of hay bales takes place.



Pic 43. A wind shelter made from metal sheets on a steel frame can be moved shorter distances by lifting it with a tractor inside.



Pic 44. These feed gates are light enough to be able to move by hand when taken apart to three sections. It will stop the cattle trampling the feed and defecating in it.

heated by an immersion heater in a water cistern. The system is good but very sensitive to power cuts.

- Insulated water containers where the water is fed in to the container from insulated pipes underneath. There is a sunken float valve regulating the water flow in to the container.



Pic 45. This water trough is mantled with electric wires that keep the water frostfree. The water is supplied automatically by a pipe in the ground.



## CHAPTER 8

### EUTROPHICATION AND CATTLE MANURE MANAGEMENT

*Manure management and eutrophication are two very connected topics. If we do not handle the manure from the cattle properly, we will be part responsible for ruining the Baltic Sea. Also, the cattle manure is a valuable asset on the farm, full of nitrogen and phosphor that is needed in the soil in order to produce good crops.*

#### AGRICULTURAL POLLUTION IS DAMAGING THE MARINE ENVIRONMENT

Our own sea – the Baltic Sea – is highly polluted because of insufficient water circulation, a dense population of people surrounding the sea and a very large catchment basin. Every litre of effluents or kilogram of runoff fertilizer from arable fields will eventually reach some body of water and take its effect on the living organisms there.

Eutrophication is a process which happens when too many nutrients enter a body of water causing large growth of algae with degradation of sea life and overgrowth of water bodies as a result. Eutrophic bodies of water have massive blooming of blue-green algae, which decreases the transparency and the natural beauty of water. The blue-green algae use up all the oxygen and causes numerous problems. Such as replacement of long-lived plants with fast growing short-lived plants, death of fish species due to overgrowth of spawning areas, degradation of sea bottom flora and fauna, and the breaking of the food chain. Another effect of eutrophication is that because of the lack of oxygen so called "dead zones" appear where all life disappears. The overgrowth of coastal areas with reed is also often caused by water pollution. The only way to limit eutrophication of water bodies is to decrease the pollution levels.

#### HOW NITROGEN AND PHOSPHOR END UP IN THE WATER BODIES

Nutrients from the agricultural sector often leach into bodies of water because of improper use of manure and fertilizers. This can be caused by:

- Leaking silage and manure storage
- Spreading manure on frozen ground
- Using mineral fertilizers without considering the balance of nutrients
- Spreading fertilizers at the wrong time

If water bodies are polluted for a longer period of time, nutrients, especially phosphorus, are accumulated in large quantities in sediments. Phosphorus can be reintroduced into the water from these sediments if there is a mechanical stir-up or a storm. The same can happen due to lack of oxygen, which triggers a chemical reaction and phosphorus is made available for algae once again.

#### THE AMOUNT OF NUTRIENTS REACHING THE WATER BODIES CAN BE DECREASED

In agriculture special attention should be paid to fertilizing, the handling of manure and the keeping of animals in the winter. It is necessary to create leakage-

Pic 46. Coastal areas grow over with reed and algae grows in shallow bays when too much nutrients leach into water ways.(Photo: Katrit Karus)





Pic 47. Eutrophication causes blooming of algae in water bodies. (Photo Reet Laugaste)

proof manure and silage storages, feeding places and cattle sheds. When deep straw bedding is used the solid manure must be managed correctly. Exact and well timed spreading of manure is important to ensure that the nutrients are quickly absorbed into the soil. Manure piles should be covered to avoid leaching of nutrients into the ground and surface water via rain.

In the summer natural pastures can be used for grazing. Compared to cattle that are kept indoors and fed with grains, the grazing animals contribute less to nutrient run-off by eating unfertilized grass. The manure from grazing cattle will also be taken up by plants naturally and not contribute to pollution.

### **POLLUTION OF WATERWAYS CAN BE REDUCED**

Pollution of water bodies can be reduced, for example by having buffer zones near ditches and other waterways. The plants and trees growing in the buffer zones use nutrients for growth, preventing the nutrients from reaching the water. Buffer zones are also habitats for many species. Willows growing on banks by ditches are an important source of food for bees and other pollinating insects in early spring.

Very good measures for reducing water pollution are natural or purpose-built wetlands, buffering flood plains and sedimentation ponds. When talking about ditches, it is important to remember that straight and deep ditches have a strong water flow. Nutrients in this water do not settle down but reach bigger water bodies (lake, sea) very fast. Therefore, wide and straight ditches should be avoided and water flows minimized. This can be achieved by creating meandering stretches or sedimentation ponds. Sedimentation of nutrients can also be increased by placing big stones on the bottom of ditches.

Leaching of fertilizers can also be avoided by planting winter vegetation on fields, which prevents the leaching of nutrients during spring time and the snow melt. Landscapes that are continuously covered with grass have practically no erosion and minimal run off of nutrients. Thus pollution of the Baltic Sea can also be reduced through use of semi-natural grasslands for grazing or production of hay.

### **MANURE IS A VALUABLE COMMODITY ON THE FARM**

Maybe the most important thing we can do to lessen the eutrophication is to start valuing the cattle manure as a fertilizer on the farm. Once we realize how much good the manure can do if it is used in the right place, the problems with nutrients leaching from manure in to the waterways will lessen or disappear all together.

A suckler cow produces about 4m<sup>3</sup> of solid manure and about 2 m<sup>3</sup> of urine and manure water when kept indoors for 6 months. The manure contains between 3–5 kg of P and 15–20 kg of total-N per cow and winter season. This is a valuable resource of nutrients that can increase the crop production on the farm without extra costs.

Natural, organic, manure is better than mineral fertilizers from many environmental aspects. Firstly, it is a natural by-product from beef and dairy production that has not needed any additional energy to be produced. Secondly the natural manure is part of the

natural cycle of life which means it does not add or subtract from the nutrients already in orbit. Phosphorus, for instance, is a finite resource that we must economize with. It is absolutely vital for most of the food production around the world and it can not be manufactured in the same way as nitrogen. Hence, every ton of phosphorus that ends up in the Baltic Sea is a double negative. It causes eutrophication and it is lost from the natural cycle of growing.

Lastly, by adding natural manure instead of mineral fertilizers, the humus content of the soil is improved. The loss of humus in the soil is a growing problem and a threat to our ability to feed ourselves in coming generations. The humus content in the soil can be increased also by ploughing down catch crops and straw residues and by using more long term grass leys.



Pic 48. Deep straw bedding with manure is taken away from the cow house and stored on the field in spring (Photo: Sven-Olov Borgegård)

## MANURE STORAGE

The nitrogen effect of cattle manure is reduced by 30% if the manure is stored without cover. This is because the nitrogen compounds in the manure are volatile and will escape in to the atmosphere during storage. The ideal manure storage facility is therefore a covered concrete base with a drainage system that catches the run off water and urine so that it can be spread on the land too.

Modern loose housed cattle sheds can be designed without deep straw beds and with a concrete area where the cattle eat and move around. The concrete area is scraped daily and creates liquid manure that is mixed with water and urine. This kind of manure is called slurry and is the easiest form of manure for a growing crop to absorb. It needs a basin for storage and preferably also a cover since the high water content in the slurry increases the loss of volatile nitrogen complexes in to the air.

With deep litter manure it is an advantage to let the manure decompose over the summer before spreading it on the arable fields in the autumn. Deep litter manure is not suitable to spread directly on to growing grass leys because it cannot be tilled in a growing crop. Deep litter manure can be stored outside in the field where it is going to be used if;

- It is dry enough, 25–30% dry matter at least.
- The place of storage is chosen so that rain or high water tables do not leach the nutrients in to the water ways.
- The land where it is stored is not sandy and permeable soil where the nutrients will leach easily.
- The storage pile is spread and used within a year.

## MANURE SPREADING

Solid manure should be spread with a vertical muck spreader with a flailing action that finely shreds the manure. It must be tilled in as soon as possible after spreading or the nitrogen content will drop dramatically due to the shredding. Deep litter manure can also be spread like this once it has been decomposed.



Pic 49. Vertical muck spreader spreading solid manure (Photo: Närke AB)

Slurry can be used on growing crops all through the growing season and should be spread with a slurry tank that places the slurry directly on the ground. This can be done with pipes or injectors that slice the ground whilst letting out the slurry. The old style slurry tanks with splash-plates should be avoided since this causes big losses of nitrogen in to the air.

**Table 1: Fertilizer effect of cattle manure when spread on arable land.**

	Nitrogen effect	Total Nitrogen	Phosphor	Potassium
Kg per 10 ton manure (wet weight)				
Solid manure 18 % dry matter	10	52	14	45
Deep litter manure(with straw) 27% dry matter	5	54	15	103
Liquid manure, slurry, 9 % dry matter	15	40	6	40

Source: Swedish Board of Agriculture, manure database, 2012

### MINIMIZING NUTRIENT LEACHING FROM OUTWINTERED CATTLE

Light sandy soils are the best for outwintered cattle systems since the soil stays realtively dry and the cattle trampling does not ruin the ground so easily. But, light sandy soils are very permeable and leaches nutrients form the cattle feed and the manure in to the ground water and surface waters. There are techniques for minimizing this problem:

- Avoid keeping cattle outdoors in the winter in paddocks that are close to the sea and to open ditches.
- If you are building a permanent windshelter place it so that there is growing vegetation or forestland underneath it that will absorb the run off from the cattle.
- Gather and compost as much as possible of the feed residues, straw and manure. In the spring the land where the cattle has been should be cultivated and drilled with a fastgrowing crop that will use the nutrients that is in the soil. Annual Ryegrass grows fast enough to be able to be harvested the same year and then grazed in the autumn.
- Move the silage/hay feeders around the field. This way the manure and urine is spread evenly around the entire area. Spread grass seed to repair the areas where the cattle has ruined the grass cover in the spring. Harvest the grass in the summer.
- Use portable windshelters and rotate the winter field around the whole farm from year to year. The winter paddock becomes part of the crop rotation and adverse build up of potassium in the soil is avoided. The nitrogen and phosphorous will be used by growing crops.
- Use ground fortification to lessen the trampling damage the cattle cause in the winter. Trampled ground leaches much more than land with an intact surface. The same goes for tractor tracks in winter – store the feed in such a way that you can avoid driving through the cattle paddock in winter. The damage from the tractor makes the leaching from the cattle manure and feed worse.



Pic 50. If a silage feeder is kept in the same place all winter the land becomes very trampled and will leach much more nutrients from manure and feed.



Pic 51. This large wind shelter is built for 90 cows and calves. The farmer has to reseed the grass sward around the barn and the feeding places every other year.

## **CHAPTER 9**

### **BREEDING FOR PRODUCTION**

*Breeding is important in the agricultural world. Over the centuries we have changed and developed the traditional farm animals to suite modern production systems. Knowledge of how to choose the best breeding females in the herd, or pick out a suitable bull at an auction, is needed to maintain good production results.*

The term breeding describes the practice to consciously choose which males and females are going to be the parents of the next generation of animals. The objective of breeding is to systematically improve each generation in a desired direction. The domesticated animals all have in common that they will mate with any individual of the opposite sex when the time is right. This made it easy to control their breeding and change their characteristics in a direction that best served our production purposes. All beef producers need to understand the basic theories behind breeding and crossbreeding to be able to manage the herd or buy the best animals for his or her farm.

#### **SINGLE TRAIT OR COMPLEX INHERITANCE**

Colour of the coat, markings on the skin, body size and horns or no horns are all characteristics that are quite easy to change by consequential choice of breeding animals. This is because these traits are ruled by a limited number of genes that are either dominant or recessive. Dominant genes will take command and express themselves even if there are other genes present wanting to express their version of the trait. Recessive genes need to be present in two sets to express their version of a trait. Hence they can be present in an animal without showing. This type of genetic relationship is called single trait inheritance. Most of the traits which are important for production animals, such as fertility, growth rates, health and mentality have a much more complicated genetic structure than that. Structured breeding programs are needed to impact most production characteristics. To formulate a breeding program you need to start with a breeding objective.

#### **BREEDING OBJECTIVE**

The breeding objective describes the goal of the breeding. It can be expressed for a specific herd on farm level, for a specific breed of cattle or even a whole industry in a country. For instance, in Sweden the breeding objective for beef production on a national level is:

*To create animals that makes it possible to produce high quality beef at the lowest possible cost.*

A breeding objective must be formulated so that it will last for a long time since it takes time to change animal traits by breeding.

The breeding objective for a breed is often more detailed with for instance specific fertility levels, calf vitality measures and minimum weaning and 365 day weights.

On the farm level the breeding objective can be even more specific, for instance stating that the lactating ability of the suckler cow is the most important trait since calves are raised on grazing only. In order to influence this trait the weaning weight of the calves becomes the target.

Breeding objectives are most often talked about when discussing pure breed animals. But it is just as important to have a breeding objective for a cross bred herd of suckler cows. Let's carry on examining the example from above, a suckler herd that sells calves in the autumn after weaning.

*The breeding objective is: To have long lived suckler cows with high fertility, good milk production from grazing and a gentle temperament that produces one heavy weaned calf per year.*

The animal characteristics described in the breeding objective are *ease of getting pregnant and calving ability, healthy calves, good milk production without additional feeding and calm and easily managed cows.* The longevity is an important trait since it saves on expensive replacement heifers. These are all key characteristics for a good, profitable herd of suckler cows, whether they are cross bred or pure bred.

For the national Swedish beef breeding objective the characteristics are *growth rates, feed conversion rates, fertility, calving ability, milk production and longevity.* The way the breeding objective is formulated reflects the production goal. For the suckler farm that produces weaned calves for sale the growth rates and feed conversion rates of the young cattle are not of interest to work with since they are not part of the production goal.



Pic 52. The Swedish breeding objective is to produce beef cattle that can produce good quality beef, like this Hereford heifer.

## MEASURABLE TRAITS

In order to work towards the breeding objective, whether it is on farm or breed level, you need measurable traits that can be easily, cheaply and correctly measured and documented. For breeding scheme to be successful, a high number of measurements recorded are very important. This is because the breeding progress is dependent on the choice of breeding animals. The bigger the difference between the chosen animals and the rest of the herd, the bigger the breeding progress will be. If only a few animals are recorded the breeding progress will be slow since there are not so many animals to choose from. For the farm example above the measurable traits would be:

### *Longevity*

- Age of cow at culling

### *High fertility*

- percent pregnant cows after running with the bull for two months
- Number of live calves born /cow presented to the bull for covering

### *Healthy calves*

- Low mortality rates for the calves

### *Good milk production*

- Calf weight at 200 days ( if the calves are not fed additional feed, the milk production of the mother has the biggest impact on the growth in this period)

### *Gentle temperament*

- Low percent of cows culled due to aggressive behaviour

To work towards the breeding objective this farmer must record these traits for all his animals and document them. He will use this information when deciding which cows to send to slaughter and which cows to keep heifers from as replacements. The farmer needs to decide if all three traits are as important or if he wants to prioritize for instance the temperament trait. The fewer traits that are included in a breeding objective the faster the herd changes towards the goal. If one animal is very good in one trait it might be bad in another. In the end it might well be a mediocre cow that is the overall best cow for all the chosen traits and hence the breeding progress slows down compared to if you only need to



Pic 53. In the suckler cow herd high fertility is very important and should be measured in both in the bulls and the female cattle.



Pic 3. This pedigree Simmental bull calf will probably be sold as a breeding bull.

look at one trait when choosing the next generation of breeding animals.

On the pure breed level the measurement traits are recorded as a part of the pure breeding programme and are controlled by each breed society. The principle is the same as at the farm level, the more traits that are included the slower the whole pure breed flock changes. Usually a pure breed breeding programme will consider more traits than on the farm level. There are many more animals to record and measure and this will make the breeding programme work faster towards the objective. In a large number of animals even small differences between animals can be found and used for choosing the right animals.

### **PEDIGREE OR CROSS BREEDS FOR BEEF PRODUCTION**

A suckler cow might be a cross bred cow or from a pure breed herd. When it comes to producing calves for finishing for slaughter the cross bred cow is as good as, or even better, than a pure breed cow. This is due to the heterosis effect present in crossbred animals. The heterosis effect gives a “turbo” effect to vitality and health in the calves and fertility in the cow – some of the most important factors for a successful suckler cow business. Cross bred calves have lower mortality rates and higher growth rates until weaning. Cross bred heifers are sexually mature earlier than pure bred heifers and cross bred cows have more pregnancies per 100 covered cows compared to pure bred cows. In a healthy and established cross bred herd the replacement rate should be around 10–15% which leaves enough heifers to be able to sell some to other farmers too.

If the main purpose of the business is to sell breeding bulls and heifers, the pure breed herd, or pedigree herd, is preferable. Even in a cross bred suckler cow herd the bull should be a pure breed animal. The reasons for this are several. Firstly, to maximize the heterosis effect in the calves the bull should be pure bred. The heterosis effect is at its maximum when two pure bred animals are crossed. Secondly, with the pure bred animals you know what you get. A Hereford is a calm and easily managed animal with somewhat limited milk production but a very good ability to feed itself on grass. A Charolais has exceptionally good slaughter conformation and high growth rates but the cows are heavier and hence more expensive in maintenance feed during the winter. And so on. When using a pedigree bull you can add exactly the characteristics that you want to have present in your calf crop. If you use a cross bred bull you can't be sure of what characteristics he will give the calves. There is a need and a place for both cross bred and pedigree animals in a well functioning beef production industry.

#### ***Heterosis or cross breeding effect***

All pure breeding systems create animals that will be more and more alike in their genetic makeup. Pure breed animals has a larger amount of gene pairs that are alike (homozygote) than other animals. In this way all pure breeding creates a certain degree of inbreeding.

When two pure bred animals from different breeds are crossed the offspring have a maximized number of different gene pairs (heterozygote). In one strike this minimizes the degree of inbreeding and minimizes the number of recessive genes that are expressed. The recessive genes often carry unwanted traits such as susceptibility to disease and genetic faults in the organs. The heterosis effect is 100 % when two pure bred animals from different breeds are crossed, the so called first cross. If the progeny is then crossed back to one of the two parent breeds the heterosis effect is halved in the next generation.



## BREEDING PROGRAMMES

*Official breeding programmes* for pure breed animals are organized and run in cooperation with the breeding societies for each breed. The breeding societies are in charge of setting the breeding objective and threshold values for the measurable traits. To run an approved breeding programme one also needs an official cattle control organisation that can collect and process the measurable traits and document the kinship between individuals. The breeders send in data from their herds to the cattle control database and receive pedigree documents, breeding evaluation scores and general breeding statistics for their animals. The breeding programmes are funded by participant fees.

Cross breeding programmes are more informal and are run completely by each individual farmer. The cross bred herd will benefit from all the selection and breeding work done in the pedigree herds by using pure bred bulls. It is important to also actively manage the selection of the cross bred suckler cows from within the herd.

Distinctive characteristics for a good suckler cow:

- Low maintenance requirements saves on feed
- Gets pregnant easily
- Calves easily
- Good mothering instincts
- Good milk production
- Gentle temperament – easily managed
- Long lived
- Good body conformation

When selecting the replacement heifers these are the traits to keep in mind. Select heifers after cows that have performed well in these categories and make sure to also check the heifers for physical defects such as too many or too few teats, bad feet or legs.

Pic 54. Because of the Heterosis effect cross bred beef cows make excellent suckler cows.





Pic 4. This Charolais bull is being sold at the annual 'breeding Bull auction in Sweden.



Pic 55. A prize winning Angus bull at the Swedish Mila Agricultural show.

## THE BREEDING BULL

“The breeding bull is half the herd”. This is an old saying that holds a lot of truth. Your calves are going to take 50% of their genetic makeup from the bull. If you raise your own replacement heifers they are bringing half of the bull with them in to the herd too. It is wise to spend as much money as you can afford on a good bull and to spend your time choosing him.

Make sure you have enough bulls. A young bull should not cover more than 10–15 females in the first season. A mature bull can manage 35–40 females. Bring the bull home in good time before the mating season so that he has time to get to know you and the farm.

### *A good breeding bull should:*

- *Have good legs and hoofs.* When jumping up on the cows and heifers the bull must be able to rely on his legs and his feet. This gets more and more important the older and heavier the bull becomes.
- *Have evenly sized and well developed testicles.* The circumference of the scrotum should be 29–34 cm depending on breed. Smaller testicles might be ok, but never buy a bull with obviously uneven testicles. One of them is most likely not functioning.
- *Have a previous breeding record.* If you are buying an older bull ask to see his calving results. Pay attention to how both cows and heifers have been calving after him. Certain bulls do not suit heifers because their calves tend to be too big for the young females.
- *Be 14 months old or more.* Do not attempt to cover with a younger bull than 14 months. He may well cover the females but is probably not producing functional semen yet.
- *Have a good temperament.* Do not accept any doubts when it comes to the temperament of a breeding bull. He can be a threat to you in himself but he will also inherit bad nerves in to the flock.

## EUROPEAN BEEF CATTLE BREEDS

**Angus** originates from Scotland and was previously known as Aberdeen Angus. The traditional Angus is black without horns but there is also a red variety. The Angus is well suited for grazing based production models and has a good ability to marble. Nowadays there is a strong north american influx to the Angus.

**Blonde d'Aquitaine** originates from France where they were used as both draught- and beef animals. The breed is very large but has easy calvings. The breed is characterised by high growth rates and very good body conformation.

**Charolais** originates from France. The breed has very good body conformation and excellent growth rates and is often used as a terminal sire in cross bred suckler herds where the calves are destined for slaughter. Most Charolais are polled but there is also a horned variety. Charolais are late maturing which means they are suitable to raise to high slaughter weights.

**Chianina** originates from the tuscan district in Italy. The breed has a history as both a draught and a beef animal. The Chianina has longer legs than any other beef cattle and appear to be very large. They grow very fast and have a very high killing out percentage due to having an unusually light skeleton.

**Galloway** originates from the western part of Scotland and are commonly black but there



Pic 56. Chianina is an Italian breed that has fast growth rates and easy calving.

are also white, beige red animals. They are a fairly light beef breed with adult weights between 500–800 kg. The Belted Galloways are similar and have a white belt around the middle of the body. All Galloways are polled and are known to produce a well marbled beef.

**Hereford** originates from the British Isles but is since a long time the most widespread beef cattle breed in the world. Herefords can be both polled or with horns. Herefords are very efficient roughage converters and are well suited to grazing based beef production. Herefords are popular in cross bred herds since they are well known for being hardy, easy to feed and good mothers.

**Highland Cattle** originate from Scotland. They are one of the lightest beef cattle breeds and are considered to be very hardy. They are well suited to extensive beef production and are a very healthy breed with a high ability to produce marbled beef.

**Limousin** originate from France and has become a very popular beef breed thanks to its high killing out percentage and good conformation. Limousin is very popular in cross bred herds since it tends to increase the conformation classification in the calves. Due to their very slimlined body the Limousine are known to have very easy calvings.

**Simmental** originates from Switzerland where they have been a combination breed used for both beef and dairy production. There is still specialized dairy blood lines of Simmental cattle. As a beef breed Simmental has gained a lot of popularity thanks to very high growth rates both in the young stock but also as calves thanks to the high milkproduction in the suckler cows.



Pic 57. Galloway is a hardy Scottish beef cattle breed.



Pic 58. The Scottish Highland Cattle has lower growth rates but produces well marbled beef.

## CHAPTER 10 MEAT AND MEAT QUALITY

*The ultimate goal of cattle rearing is to produce high quality meat. How the cattle are handled, their breed, sex and feeding regime all influence the end product. The killing out percentage and a good classification of the carcass is important for the economy of beef production. The slaughtering process and how the meat is treated after slaughter are also important parts in the quality meat production chain.*

### THE RIGHT TIME TO SLAUGHTER

The optimal time to slaughter an animal is when the cost to put more weight on the carcass is higher than the increase in slaughter value. The cost of feeding and keeping the animal, as well as the expected price per kilo live weight or carcass weight, will influence the right time for slaughter. In general a beef carcass should weigh at least 250 kg slaughtered to have developed a good conformation and fat class. There is no maximum weight as such, but many meat processors feel that carcasses weighing over 375 kg slaughtered weight creates cuts (steaks etc.) that are too big for most consumers and retailers taste.

### THE SLAUGHTER PROCESS

When an animal is slaughtered it is normally stunned first and then bled out. The stunning renders the animal unconscious which is very important to minimize the suffering and stress during the slaughter process. Stunning of cattle is done by using a retractable stun gun that penetrates the brain. The bleeding of the body is done within 60 seconds of the stunning and starts the process of turning muscle in to meat. The live muscle needs energy to move and function and the oxygen in the bloodstream keeps the energy production active in the cells. When the blood disappears from the muscles, lactic acid is produced due to the lack of oxygen. The drop in pH, acidification, starts a chemical process that turns muscle in to meat. A live muscle has a pH of 7 but in meat the pH should be 5,5 to ensure good eating quality. The muscle will try to contract until all the energy stored in the cells is used up and Rigor Mortis appears. The fact that the muscles are attached to bones in the body prevents them from contracting completely. A stretched out muscle will result in a tenderer piece of meat. To achieve maximum stretching of the muscles all carcasses are hung in a cool room for at least 24 hours until *Rigor* occurs. Only then can the carcass be butchered in to smaller pieces.



Pic 1. To find the right time for slaughter is very important for the economic result of the beef producer.



Pic 2. Directly after stunning the animal is bled to ensure the best possible meat quality.

### STRESS BEFORE SLAUGHTER CAN CAUSE QUALITY PROBLEMS

If the animals are stressed before sending them to slaughter the energy reserves in the muscles are used up and not enough lactic acid will be produced in the muscles after the bleeding. The pH will not drop enough in the meat which interferes negatively with the process turning muscles in to meat. A problem called DFD, Dark Firm Dry, appears. The meat will be dark, firm and dry and will have a very short shelf life. To avoid these problems, animals should be treated calmly during loading and transporting and should either be slaughtered immediately or given a rest of at least 12 hours at the slaughter plant to build up the energy reserves again.

### CLEANLINESS OF SLAUGHTER ANIMALS

Cattle should be clean when they are sent to slaughter. A thick cover of dried manure and dirt in the coat causes itching and irritation to the skin which is painful for the animal and also lessens the value of the leather. A wet or dirty coat also makes it difficult for the

animal to keep warm in the winter. An important reason for keeping the cattle clean is food safety. Manure on the skin can spread bacteria and other microbes to the meat and cause serious health problems for humans.

### EUROP CLASSIFICATION FOR CONFORMATION AND FAT

Conformation classification describes the development and shape of the slaughtered carcass. EU uses the common EUROP classification system where class E describes a carcass with very large and swelling muscles and class P is an underdeveloped animal with very thin muscles. The letters EUROP are used together with + and – to create a finer tuned classification scale. A higher conformation class will result in more meat on the bones and is therefore usually paid a higher price by the slaughterhouses.

The fat classification in the EUROP system describes how much fat there is in the carcass. Class 1 describes a carcass with very little fat and class 5 a carcass with large fat deposits. When there is too much fat on the body the butchers have to cut it off before packaging and processing the meat which takes time and lowers the value of the carcass. The best paid fat classes are usually 2+ – 3+.

### LIVE WEIGHT, SLAUGHTERED WEIGHT AND KILLING OUT PERCENTAGE

The slaughtered weight, or carcass weight, is the live weight of the animal minus the head, skin, stomach, feet, tail and blood. The killing out percentage is the slaughtered weight divided by the live weight. A high killing out percentage means that the animal has a lot of meat on the carcass which is positive for the meat processor and also the farmer if he is paid by slaughtered weight. The killing out percentage is higher for bulls than heifers and higher for beef breeds compared to dairy breed animals. Heavier animals have a higher killing out percentage than lighter animals.

**Table 1: Examples of killing out % in different types and sizes of animals**

Type of animal	Live weight, kg	Killing out %
Dairy breed bull	600	52,0
Dairy breed steer	600	51,5
Lighter beef breed heifer	500	51,0
Lighter beef breed steer	625	52,0
Lighter beef breed bull	625	54,5
Heavier beef breed heifer	575	52,5
Heavier beef breed steer	650	53,5
Heavier beef breed bull	650	56,0

### TENDERIZING OF BEEF

Tenderness is an important factor for beef quality. Many things influence how tender the beef will be, such as stressful handling of the animal before slaughter, the sex of the animal, its age and its breed. Different types of muscle have varying ability to tenderize after slaughter. The traditionally fine cuts, such as filet and tenderloin are more tender than other parts of the body because of lower content of connective tissue. Meat from heifers and castrated bulls is more tender than meat from bulls. But most of all the tenderness varies greatly between individuals and there is a genetic factor that influences tenderness. By selective breeding for tenderness these variations can be made smaller in the future.



Pic 3. A very dirty animal like this one cannot be slaughtered in the normal way. It has not been kept in the right way on the farm.



Pic 59. How to best tenderize beef is a big discussion topic in Sweden. By hanging for at least two weeks, says this butcher to the journalist.

At present it is most important to treat the carcasses in an optimal way to ensure maximized tenderness. It is enzymes in the meat itself that causes tenderizing and this process will continue until the meat is cooked and consumed. Time and temperature decides how far the process will go, and usually the longer the meat is stored after slaughter, the more tender it will be. Beef meat should be tenderized for at least a week, but the tenderness will continue to increase with time. All meat will, with time, start to decompose in a negative way and it is important to find a balance between good tenderness and a reasonable shelf life. During tenderizing the meat can be hung in open air or be packaged in vacuum bags with no oxygen access. The vacuum method creates a longer shelf life while open air hanging gives the meat an extra strong flavour. Aich bone hanging means that the carcass is hooked in the pelvic bone and the back leg is hanging out at an angle of 90 degrees from the body. This speeds up the tenderizing of the back leg muscles and has especially good effect on bull carcasses.

### MARBLED BEEF

Marbled beef has intra muscular fat, meaning fat deposits inside the muscles. This is another important factor defining beef quality. Marbled beef has more taste than lean beef since a lot of the flavour in meat comes from the fat. Marbled beef is also perceived as being more tender than lean beef since the fat seems to lubricate around the knife

and in the mouth when eating. Marbling in cattle is determined by genetic factors and some blood lines and some breeds marble more readily than others. The biggest difference is between the sexes. Heifers have the highest degree of marbling, followed by steers. Bulls do not marble very easily. The marbling process takes time which means that the production model also greatly influences the degree of marbling one can expect in the cattle. Fast growing bulls have little marbling whilst slow growing heifers has the highest degree of marbling. Cattle that are raised slowly on semi natural and natural grazing tend to be more marbled and have a more developed flavour than intensively raised cattle.



Pic 60. Well marbled, high quality beef from HNV grazing land is sold with a premium as Pasture Beef in Sweden.



This handbook gives you answers to why you should produce beef on semi-natural grasslands and how to do this in an economic and environmentally sound way. A lot of practical information and good examples are given.



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