UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria Agroalimentària
i de Biosistemes de Barcelona

Viability study of 1000 cattle places feedlot placed in Riverton, Wyoming.

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

By request of a private investor, wanting to put money in the beef sector, is ordered a viability study of a feedlot cattle operation. The objective of the blueprint is to break down and understand the feedlot industry. This study it's applied in a real case, with a real operation on sale. This way, it's easier to have more precision at the time of summing up the total amount of money that is need to be raised. The interested contacts a person knowledgeable in the agri-food sector so that he can carry out research and develop an analysis of the actual situation of the cattle industries. With this, take conclusions of the viability of this kind of business based on cattle feed, and reify the project if the prospectionis profitable. It's important to remark that this project aims to analyze to what extent it is profitable and if it is possible to start an operation of this magnitude. To make conclusions independently of the results.

The investor is interested in a property with a total of 666 hectares, of which 255 hectares are irrigated with five pivot sprinklers. The object of the investigation is to analyze the physical environment and estimate the livestock capacity based on the availability of food production that the farm permits to produce. Also, evaluate the investment needs in machinery and analyze the finances of the farm in order to study the economical viability.

The results of the study conclude that it is possible to feed a total of 1,130 head of cattle for a total of 210 days per year, achieving an annual turnover of $1,220,852.

Economically, the business is not quite viable, in part due to the high cost of the machinery and the high expenses, but taking into account the opportunity cost of a family operated farm, with the specified salaries, the proposal is more reasonable.

Resumen

Bajo demanda de un inversionista privado, buscando invertir en el sector de la carne de res, se ordena un anteproyecto de una operación de ganado de engorde. El objetivo del plan es desglosar y comprender la industria de corrales de engorde o feedlots. Este estudiose aplica a un caso real, con una finca real en venta. De esta manera, se tiene una mayor precisión al de sumar la cantidad total de dinero que se necesita invertir. El interesado contacta con una persona conocedora del sector agroalimentario para que realice una investigación y desarrolle un análisis de la situación actual de la industrias ganadera en el estado de Wyoming, en EEUU. El objeto, sacar conclusiones de la viabilidad de este tipo de negocio basado en la alimentación del ganado, y verl si la prospección del proyecto es rentable. Es importante remarcar que este proyecto tiene como objetivo analizar en qué medida es rentable y si es posible iniciar una operación de esta magnitud. Sacar conclusiones independientemente de los resultados.

El inversor se interesa por una propiedad con un total de 666 hectáreas, de las cuales 255 hectáreas son de regadío. El objeto de la investigación es analizar el medio físico y estimarla capacidad ganadera a partir de la disponibilidad de producción de alimento que nos permite la finca. También evaluar las necesidades de inversión en maquinaria y analizar financieramente los número de la explotación, para evaluar su viabilidad económica.

Los resultados del estudio concluyen que es posible alimentar un total de 1130 cabezas de ganado por un total de 210 días al año, consiguiendo una facturación anual de 1,220,852 $.

Económicamente el negocio no acaba de ser viable, en parte debido al alto coste de la maquinaria y los elevados gastos, pero teniendo en cuenta el coste de oportunidad de una explotación familiar, con los sueldos especificados hace que la propuesta sea más razonable.

Resum

Sota demanda d'un inversor privat, buscant invertir al sector de la carn de vedella, s'ordenaun avantprojecte d'una operació de bestiar d'engreix. L'objectiu del pla és desglossar i comprendre la indústria de corrals d'engreix o feedlots. Aquest estudi s'aplica a un cas real, amb una finca real en venda. D'aquesta manera, es té més precisió en sumar la quantitat total de diners que cal invertir. L'interessat contacta amb una persona coneixedora del sector agroalimentari perquè faci una investigació i desenvolupi una analítica de la situació actual de les indústries ramaderes a l'estat de Wyoming, als EUA. L'objecte és treure conclusions de la viabilitat d'aquest tipus de negoci basat en l'alimentació del bestiar, i veure'l si la prospecció del projecte és rendible. És important remarcar que aquest projecteté com a objectiu analitzar fins a quin punt es rendible i si és possible iniciar una activitat agrària d'aquesta magnitud, traient conclusions independentment dels resultats.

L'inversor s'interessa en una propietat amb un total de 666 hectàrees, de les quals 255 hectàrees són de regadiu. L'objecte de la investigació és analitzar el medi físic i estimar-nela capacitat ramadera a partir de la disponibilitat de producció d'aliment que ens permet produïr la finca. També avaluar les necessitats d'inversió en maquinària i analitzar financerament els nombres de l'explotació per avaluar-ne la viabilitat econòmica.

Els resultats de l'estudi conclouen que és possible alimentar un total de 1130 caps de bestiar per un total de 210 dies a l'any, aconseguint una facturació anual d'1,220,852$.

Econòmicament el negoci no acaba de ser viable, en part degut a l'alt cost de la maquinària i les despeses elevades, però tenint en compte el cost d'oportunitat d'una explotació familiar, amb els sous especificats fa una proposta sigui més raonable

Contents

Memory

1. Abstract

By request of a private investor, wanting to put money in the beef sector, is ordered a viability study of a feedlot cattle operation. The investor is interested in a property with a total of 666 hectares, of which 255 hectares are irrigated with a value of $5.500.000. The object of the investigation is to analyze the physical environment and estimate the livestock capacity based on the availability of food production that the farm permits to produce. Also, evaluate the investment needs in machinery and analyze the finances of the farm in order to study the economical viability.

2. About feedlot industries

The feedlot sector represents an intensive production system to grow and fatten cattle until they reach slaughter weight. The feedlot sector can be further divided into backgrounding (winning weight but not fat) and finishing (fattening) phases.

In North America, the backgrounding phase (typically the first 90 days after the arrival of feedlot calves) focuses on feeding high forage/low-grain rations to maximize growth and minimize fat deposition. Welfare issues in the backgrounding phase can include injuries during handling associated with revaccination and implant protocols, as well as increased morbidity due to the stressors related to the transition from the ranch to the feedlot indicated earlier.

The finishing phase (typically the last 100 days after backgrounding) focuses on feeding high-grain/low-forage rations to backgrounded calves or yearlings until they reach a prescribed finish (fat cover and weight) before marketing for slaughter. Some feedlots focus solely on either backgrounding or finishing; however, it is not uncommon to have one feedlot feed calves from growth to finish. Some ranches have their feedlot facilities where cattle are bred and finished for slaughter by the same producer, but this is less common. Both the background and finishing (fattening) phases of the feedlot sector use the same housing and facilities. The phases are defined more by the type of cattle and how they are fed rather than the way they are housed.

The business described will be both background and finishing feedlot. The calves will arrive

at an approximated age of 6 months and will leave the slaughterhouse at around 15 months.

The ranches in the open range will start the calving season between March and May. 6 months later, over October and November, the calves will be weaned off their dams, and moved onto the feedlot.

The approximated weight when the cow is born in the prairie is 30 kg (70 lb). After 6 months in the open range with their mother, the weight will increase to 175 kg (385 lb). For the next 6 months, the beef will be fed with forage and hay to win weight until the 430 k50 lb) in our facilities.

For having a final live weight of 550 kg (1200 lb), the last three months of life will pass through the stage of “finishing”, where the concentration ratio is increased progressively for winning fat between the tissues. When the truck leaves our feedlot on to the cattle sales place, calve will be around 15 months old and 550 kg.

3. Actual situation

3.1. Property description

The property, located in Riverton, Wyoming, consists of two different plots, containing irrigated fields focused on forageproduction.

The coordinates of the location are:
43,0925330,--108,494471

The feature includes structures as well as corrals, as shown in **Image 1**. There arealso some open-range surfaces useful for using as paddocks. The total amount of deeded surface is 1.646 acres (666.1 hectares). The property is offered in Land Watch Real Estate at the price of 5.500.000USD. It's well equipped but this doesn't suppose all the investment. To run the operation is also required investing in the herd and machinery, as well as some facilities that need to be updated. In the last two years, the prices have increased for the open range ranches because high economical standing people from the cities are wanting to move west. The market has plenty of farms and ranches for sale at exorbitant prices, but this kind of bubble does not directly affect the value of feedlot operations. Discarding open range options and researching irrigated farms, this property looks like one of the best options, and this project aims to clear if it's worth it to invest in the operation.

Image 1: aerial picture of the operation.

The property is divided into two different land units. The big one, located down south on **Image 2**, containing the headquarters of the operation offers 420 irrigated acres (170 hectares). In **Image 3,** we find the two Valley pivots little farm with only forage fields with a total of 210 acres (85 hectares).

Image 2: amplified satellite image of the headquarters

Image 3: the amplified image of the two pivot farms.

- Irrigation

The plots focused on the forage production gather of 630 acres (255 hectares). The irrigated lands are primarily pivot irrigated with 4.5 pivot systems. The deeded lands are located in two units, the Headquarters (Herman Place) consists of 1,413 acres (572 hectares) with three newer Zimmatic pivots. The two Valley Farm consists of 233.7 acres (95 hectares) with two Valley pivots one being a wiper.

- Corrals

In total, the property has a total of 14 pens, which are mainly intended to contain the herd, classified according to the owner, age, and sex. This segregation aims to make groups with similar needs in food. The pens are shown in **Image 4.**

Image 4: Satellite image of the corrals.

All of the pens are built from old pipes, which come from the oil industry along with rails changed from highways. The fences have a height of 1.7 m.

- Improvementsts:

The property includes some facilities, such as shops for machinery, barns for animals, and houses for labor. Also, there is a silage pit, with a storage capacity of 10,000 tons of corn silage and grain storage.

3.2. Actual business

The business is currently based on the fattening of around 3,000 heads during the winter months, with an approximate turnover of $1,000,000. These incomes come directly from the sales of part of their herd and the daily quota applied to the animals of other owners. This last source of income is the main one.

In most feedlots, the herd is not owned by the specific farm, but by ranchers in the area who want to give a "corn finishing" to their calves and calves that will go to slaughter. In this "finishing" the aim is to gain a target weight and improve the quality of the meat, making it softer and with greater fat infiltration.

The standard rate per cow per day is $4/day, while a very demanding finisher can reach $5/day. With the 3,000 seats filled for half a year, we achieved a total income of $1,092,000.

Knowing the real income offered by the operation, which will hardly be altered, the key lies in estimating the production costs and sizing the entire production process to maximize the margin.

4. Natural environments

4.1. Climate

In Riverton, the summers are warm, dry, and mostly clear. Winters are icy, snowy, windy, and partly cloudy. During the year, the temperature generally ranges from -10°C to 32°C, rarely going below -19°C or rising above 36°C. In Riverton, the summers are warm, dry, and mostly clear and the winters are freezing, snowy, windy, and partly cloudy. During the year, the temperature generally ranges from -10°C to 32°C, rarely going below -19°C or rising above 36°C. The average annual temperature is 7.6 °C and the approximate rainfall is 377 mm.

The climate of the Köppen system is BSK (cold and temperate semi-arid climate).

4.2. Soil

The soil of the property is characterized by being light and deep. The two farms are adjacent to the river, which has been accumulating sediment. The class is Sandy Loam, and it is an easy soil to work.

These lands have only been cultivated for the last 100 years. The main crop has been sugar beet, which is still very important throughout the region. Barley has also been grown for brewing, which is shipped by train to Golden Co. where the Coors brewery is located.

The fields purchased with the property have been used for forage production since the mid-1990s when feedlot-type systems were imported from Nebraska. These are only viable in areas near the river, since, without irrigation, with rainfall of 377 mm per year, it is difficult to achieve serious production. The series of crops used so far has been mainly a rotation of alfalfa with maize, although on occasion a mixture of grasses has been used.

4.3. Water resources

The property includes water rights, supplied by the Midvale Irrigation District (M.I.D.). Formed in 1921, Midvale manages a 400-mile-long system of canals and laterals known as the Riverton Unit of the Bureau of Reclamation, delivering irrigation water to over 73,000 acres of irrigable classed lands in Central Fremont County, Wyoming. The District's water supply is derived from the Wind River and its tributaries, a portion of which is stored annually in Bull Lake and Pilot Butte Reservoirs; facilities also managed by M.I.D. Local farmer/irrigators comprise a five-member Board of Commissioners who provide direction and establish the policies under which the District operates to fulfill Midvales stated M.I.D. delivers water to the farm at a headgate from its canal system. Midvale has ditch riders that ensure the proper delivery of water. The annual cost of the water for 2021 was $11,716.20 or about $20/acre. Annual real estate taxes are low as well. It is important to note that M.I.D. It has more and more water available to serve farmers thanks to the fact that water waste is being reduced by installing innovative systems that optimize the use of water.

5. Analysis of alternatives

5.1. An overview about Wyoming ranches

The traditional ranching system in Wyoming is based on extensive grazing of the Great Plains during the summer months, where the native flora of the Parrot provides rich food for raising livestock. Over time, more and more homesteads were established, where the authorities gave free space, and the settlers promised to establish and take advantage of the lands acquired.

Currently, homesteads have passed through different generations, and have generally tended to join together in large properties dedicated exclusively to extensive grazing. These ranches are dedicated to cattle breeding, but due to the low rainfall, it is only possible to take advantage of the summer to graze. The business is based on reproduction, not fattening because that would make it necessary to buy and bring the forage to very remote places. Due to the cost of feed, most ranches dedicate a part to hay production, but it is usually insufficient to maintain the herd of mother and replacement cows, which greatly reduces the margin. As a solution to this increase in feed prices, it is common to find farmers who supply some fiber (low-quality forage) during the winter and provide nutrients with "cake". The cake is mainly cottonseed pressed in the form of pellets and provides energy and protein along with highly digestible fiber.

With this background, most of the cattle that go to market need to go through the feedlots, where all the necessary feed is supplied to acquire the desired body condition and the quality parameters expected by the market. This is where forage production and the provision of an adequate diet come into play. This is the reason why the feedlots are located in areas with good forage production. An example of this is the states of Nebraska and Texas.

Although Wyoming does not have a large forage production, there is the possibility of producing good food in the areas near the river. This has meant that in the last 20 years this system imported from Nebraska has been flourishing.

5.2. Crops

The crops that would be appropriate to implant are those that give the possibility of producing quality forage and grain. Classically, a rotation of alfalfa combined with corn has been carried out, but it is interesting to study the possibility of implanting some grass such as fescue or ryegrass, and some barley.

	% use in ration	kg/ha	kg DM/ha	kg DM need	Surface ha
Barley Straw	5,2	3500	3115	128,9	0,0414
Alfalfa Hay	13,3	40000	36400	329,1	0,0090
Corn Silage	17,4	42000	14700	430,7	0,0293
Corn Grains	18,8	13000	11570	464,1	0,0401
Barley Grains	5,9	10000	8800	145,9	0,0166
Soyabean Meal	20,4			504,4	0,0000
DCP	6,2			153,5	0,0000
Calcium Carbonate	1,3			32,5	0,0000
Vitamin Premix	1,0			24,7	0,0000
Urea	1,1			26,5	0,0000
Fescue Hay	9,3	18000	16380	228,7	0,0140
TOTAL					0.1504

Table 1: Crops yields and needs per cattle unit.

In the Table 1, the percentage of use in the Dry Matter ration, estimated yields per hectare and total amount of surface need for feeding one cow during 9 months in our facilities. The percentage of each feed is calculated with WinFeed program.

5.3. Cattle feed requirements

To calculate the dietary needs of livestock, we will first determine the amount of dry matter per day an animal can eat based on its size. This value will vary each month, as the animals grow. Once we are clear about how much dry matter each animal needs daily, based on the nutritional needs, we will formulate a TMR (Total Mixed Ration) for each month based on the different foods that can be grown on the farm.

- **Dry Matter Intake**

All the percentage data needed to calculate the Dry Matter Intake (DMI) and the nutrient needs according to the weight of the cattle are extracted from the document “Beef Cattle Nutrient Requirements” of the Mississippi State University.

To determine the Dry Matter Intake (DMI) corresponding to each month, it is necessary to know the Average Body Weight (ABW), since the dry matter consumed by an animal is expressed as a percentage of ABW. This percentage fluctuates between 2.3 and 2.7%.

Table 2 shows the approximate weight that the animals will have for each month, and this value multiplied by the percentage corresponding to the live weight of the same month gives us the DMI. All weights are expressed in both kg and lbs. The orange column corresponds to the weaning stage while the green one corresponds to the green one.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Aprox weigth (lb)	385	498	611	724	837	950		
Aprox weigth (Kg)	175	226	278	329				
% of BW	0,027	0,025	0					
DMI (lb/day)	1							
DMI (Kg/								

Table 2: DMI calculation

- Total Mixed Ration

  To formulate the TMR, the WinFeed program is used, with which we determine nutritional requirements, and based on the richness of each ingredient added to the feed store, the program suggests the corresponding proportion of each food. While the percentages of each nutrient will not vary over time, the DMI (Dry Matter Intake) will. This makes it necessary to formulate a TMR for each month since the cattle will eat more and more feed.

Annex 3 specifies the TMR calculated for each month. Table 3 details the proportion of DMI corresponding to each food in the %Use column. As mentioned in Table 1, the DMI corresponds to 4.7 kg DM/day throughout October. For this month, since the calves arrive from the pastures and their rumen is used to consuming 100% forage, we will give them a maximum value of 40% concentrate. That value will increase over the months until it

reaches 60%.

October

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.07
Alfalfa Hay			16.79
Corn Silage	17		24.74
Corn Grains			7.48
Barley Grains	5		5
Soyabean Meal			17.62
DCP			3.19
Calcium Carbonate			0.84
Vitamin Min Premix	1	1	1
Urea			1.78
Fescue Hay			16.49

Nutrients	Min	Max	Analysis
Dry Matter %age	4.7		65.056
Forage			53.196
Concentrate		40	40
Protein %age	16		16.082
Energy KCal/Kg	2500		2509.825
NDF %age			40.156
Lysine %age			1.236
Methionine %age			0.404
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 3: October TMR calculation.

5.4. Forage and feed production

According to Table 1, the average percentage of each feed that is used, and the amount of DMneed during 9 months for maintaining a model animal. Knowing the requirements of eachingredient, we estimate an average production and calculate the necessary surface of eachcrop to maintain a cow. Those with a 0 in the area column will not be produced on the farmbut will be purchased on the market.

Once we have the area that a model animal requires, knowing the surface, we will be able to know how many cows we can keep.

5.5. Feedlot capacity

Knowing the total forage available for each moment of the year and the needs demanded by our set of pens that make up the herd, we can approximate that we can fit a total of 1130 head of cattle for 9 months. Annually 1130 heads would be housed since in the three summer months it makes no sense to fatten cattle in feedlots. Table 5 shows the total surface needed of each crop in order to be able to feed the herd.

	Surface (ha/cow)	Tot Surface (ha)
Barley Straw	0,0414	46,8
Alfalfa Hay	0,0090	10,2
Corn Silage	0,0293	33,1
Corn Grains	0,0401	45,3
Barley Grains	0,0166	18,7
Soyabean Meal	0,0000	0,0
DCP	0,0000	0,0
Calcium Carbonate	0,0000	0,0
Vitamin Premix	0,0000	0,0
Urea	0,0000	0,0
Fescue Hay	0,0140	15,8
TOTAL		169.9

Table 5:Surface distribution of the crops.

Knowing how much surface of each crop a model cow needs (Table 1), we multiply the surfaces by the number of cows (1130 cows), and we will have the total of each crop.

By multiplying the total head (1130 cows) by the number of days housed (210 days) for a daily housing price of $4/day, we can calculate the farm income. This annual income would be $ 1,220,852. It is important to note that this will be the only source of income for the feedlot. In Annex 4, is justified the expenses, with an amount of$1.068.245 .

6. Agriculture machinery

6.1. Machines

- **Tractors**

To cultivate the land, two tractors will be required, because not all tasks have the same power needs and sometimes several machines will work simultaneously.

The main function of the tractors will be to push the implements described in point 9.

John Deere 7210R Tractor (210hp) $205,938

John Deere 6140D Tractor (140 hp) $93,722

- **Shovel**

The bulldozer has a fundamental role in the cleaning of the pens. With it, the manure is piled up and loaded into trucks to apply on toe cultivated fields. It is also essential for moving grain piles and moving silage around the farm.

Liebher $115,888

- **Combine**

The cereal harvester for grain will have the function of collecting the part of the feed corresponding to the concentrate. The comb needed to harvest barley or corn is different. Therefore we will need a comb for row crops, such as sorghum, corn, or sunflower, and another for winter cereals (barley, oats, wheat...)

In this case, because users are not going to be very

John Deere S760 $224,900

- **Forklift**

The function of the forklift will be to move all kinds of objects that are not loadable by hand. The main utility will be to move the baled forage, but also, like the excavator, it will have a use for cleaning or moving pallets. You will need as accessories a shovel, bale spike, and a pallet tool.

Manitou MLT 633 $32.348

- **Mower**

Due to the large area that will be used for forage production, a large self-propelled mower is required. This aims to cut hay (whether alfalfa or ryegrass) for later processing. This machine does not require implements, and due to the low rainfall in the region, it will not be necessary to use a conditioner type.

John Deere W235M $184,000

- **Corn chopper**

The corn grinder will crush all the crop that does not go to grain. In addition, this requires a tractor with a trailer to carry the chopped corn to the silage pit.

John Deere 9500 Forage harvester $480.000

- **TMR truck**

This truck will mix all the TMR (Total Mixed Ration) and will supply it along the corridors arranged in the pens.

JAY-LOR H1650 $93.000

- **Semi truck**

The truck will have the function of carrying all kinds of loads by road. The main task will be to bring the harvest to the headquarters, but also to move the cattle of the clients or go to buy supplements.

The necessary trailers will be one for grain and one for cattle.

Kenworth T680 $110.000

6.2. Implements

- **Sowing machines**

The vast majority of times a precision single-grain seeder will be used because tillage makes production more expensive and does not always improve the soil.

Kuhn 9400NT $78.000

Since direct seeding is not always possible, it is necessary to have a second option.

John Deere 1520 Integral Drill $67.000

- **Cultivator**

The cultivator is used for less severe cases of compaction where you want to leave a finer finish on the ground.

KUHN Krause 5635 $45.000

- **Windrower**

This machine, through the rotary movement of the PTO, rotates some rakes, arranging the hay in rows. It also dehydrates it when turning it over. This makes it easy to bale the hay.

Lely hibiscus 1515 $62.000

- **Big Baler**

This rectangular baler forms blocks of hay to store it and then supply it to the TMR Truck.

John Deere Big Baler $95.000

- **Bale trailer**

The trailer has only the function of transporting the bales from the field to the warehouse. This will be powered by a tractor.

The selected model is an arcussin since it has a self-loading system thanks to a mechanized ramp.

Arcussin Bale Stacker $110.000

6.3. Trailers

6.3.1. Livestock trailer

The livestock trailer is needed for hauling cattle between the ranches and the feedlot. Also will be used to haul the livestock once is ready for the slaughterhouse.

Willson Silverstar $55.000

6.3.2. Grain trailer

The grain trailer is necessary for hauling harvest between places buying soybeans or moving crops.

Willson Hopper $48.000

7. Economic viability

In this section we proceed to analyze the economic data at the level of prospecting. The approximation is made for the first 10 years, thanks to calculations made with an Excel template found on the internet.

7.1. Investment

Land	$	3.000.000,00
Machinery	$	1.800.435,00
Buildings	$	2.500.000,00
TOTAL	$	7.300.435,00

Table 6: $invest_{ments}$

The total sum of the investments is broken down in Table 6, with a total a value of $7,300,435.

7.2. Amortizations

Assets	Amortization Years	Year adquisition	Amount
Machinery	15	2022	1.800.435
Buildings	30	2022	2.500.000

Table 7: amortizations

Table 7 shows the machinery is amortized over 15 years while the buildings are fixed at 30 years. The land doesn't apply to be amortized because the value remains through time.

For calculating the amortizations its used the German system.

7.3. Financing

Shows the total investment, and the external financing needs to start the economic activity. The capital contributed by the partners adds up to the value of the land and the buildings ($ 5.500.000). External financing needs correspond to investment in machinery, Therefore, the company needs a loan of $1.8 million for buying the machines, will ask for $2 million for having $200.000 in tesorery account. The loan has a fixed interest rate of 1,5%, to be repaid over 10 years.

7.4. Variable costs (plus labor)

The costs consists mainly of the costs of producing the animal feed, the expenses of buying the feed and nutritional supplements not produced on the farm, and the management of the pens. In each of these values, the expenses corresponding to labor are included.Table 8 shows with details the amount of costs for the first ten years of the business in operation.

Total	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031

Feed production	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015
Corrals managment	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000
Feed suplement	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563

Table 8: Structural costs first 10 years.

7.5. Income and Gross Margin

With a price of $4/day, each cow spending 9 months in the feedlot will give an income of $1,080 per cow. With the price and the cost ofeach cow, we can calculate the Gross Margin. Every cow offers a Gross margin of $230. Table 8 details these values.

	Price	Cost	Gross Margin	% Gross Margin	Quantities 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Animal/9 months	1080	850	229,9	21%	1.130	1.130	1.130	1.130	1.130	1.130	1.130	1.130	1.130	1.130

Table 8: Prices, costs, and sales first 10 years.

Table 9 details the margins, costs, and revenues for each of the first 10 years. Note that the total income is increasing over the years. This is because, in some way, the market is becoming known and more income is obtained due to the marketing activity. Although costs should rise, as has been the trend in recent years, they are fixed because the company knows the market better and where to get better prices when buying food. The % of Gross Margin corresponds to the percentage of profit respect to the total income or revenue.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Total Income	1.220.400	1.232.604	1.257.256	1.294.974	1.346.773	1.414.111	1.470.676	1.514.796	1.545.092	1.560.543
Total Costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965
% Gross Margin	21%	22%	24%	26%	29%	32%	35%	37%	38%	38%

Table 9: Gross margin calculation 10 first years.

7.6. Results account

The income statement is shown in Table 10 for the first ten years. In the first two years, the profits are very small, but later, as the company matures, higher returns are acquired. Despite this, the results after taxes end up being very low compared to the initial investment. Taxes correspond to water and 0.57 of the value of the property.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	**Total**
Income	1.220.400	1.232.604	1.257.256	1.294.974	1.346.773	1.414.111	1.470.676	1.514.796	1.545.092	1.560.543	**13.857.225**
Costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	**9.605.780**
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965	**4.251.445**
Gross Margin %	21%	22%	24%	26%	29%	32%	35%	37%	38%	38%	**31%**
Labor costs											
Structural costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	**9.605.780**
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965	4.251.445
Amortizations	166.010	172.773	179.812	187.138	194.763	202.698	210.956	219.550	228.495	237.804	**1.999.999**
Gross Margin	93.812	99.253	116.866	147.258	191.432	250.835	299.142	334.668	356.019	362.161	**2.251.446**
Financial costs	28.719	25.898	23.035	20.128	17.177	14.182	11.141	8.054	4.921	1.741	**154.996**
Result Before Taxes	65.093	73.355	93.831	127.130	174.255	236.654	288.001	326.614	351.098	360.420	**2.096.450**
Taxes	42.516	42.517	42.518	42.519	42.520	42.521	42.522	42.523	42.524	42.525	**425.205**
Operating Results After Taxes	22.577	30.838	51.313	84.611	131.735	194.133	245.479	284.091	308.574	317.895	**1.671.245**
% Operating Results	2%	3%	4%	7%	10%	14%	17%	19%	20%	20%	12%

Table 10: Result Account.

7.7. Profit

The profit is shown in Table 11. It is calculated by dividing the operational results after taxes with the initial investment. The first years is very low, but the tendence is to go higher. The average is a 3% during the ten first years.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	**Total**
% Profit	0%	1%	1%	2%	2%	4%	4%	5%	6%	6%	3%

Table 11: Profit % respect the initial investment.

7.8. Cash Flow

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Income										
Capital	5.500.000									
Loan Amount	2.000.000									
Income sales	1.120.093	1.231.601	1.255.230	1.291.874	1.342.515	1.408.577	1.466.027	1.511.170	1.542.602	1.559.273
Total Income	8.620.093	1.231.601	1.255.230	1.291.874	1.342.515	1.408.577	1.466.027	1.511.170	1.542.602	1.559.273
Expenses										
Investments	7.300.435									
Devolution External Financing	186.780	189.601	192.465	195.372	198.323	201.318	204.359	207.445	210.578	213.759
Structural Costs + Labor	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Dividends										
Total Expenses	8.447.793	1.150.179	1.153.043	1.155.950	1.158.901	1.161.896	1.164.937	1.168.023	1.171.156	1.174.337
Annual Balance	172.300	81.422	102.187	135.924	183.615	246.681	301.090	343.147	371.446	384.936
Accumulated Annual Balance	172.300	253.722	355.909	491.832	675.447	922.128	1.223.218	1.566.364	1.937.810	2.322.746

Table 10: Cash flow

The cash flow studies the inflows and outflows every year. The first year, a lot of money comes in since that is when the company is formed. The structural costs, including labor will be $ 960.578every year but the income will rise during the first ten years.

CONCLUSIONS

Economically we can conclude that the business is profitable but does not have an exorbitant economic ratio. The initial investment is very high. The total revenunue it's pretty high, arroun 1/7 of the investment, though the margin is low. The profit is around a 3% as an average douring the first ten years. Analyzing the points where more margin is sacrificed, profitability could be increased without practically altering incomes changing a couple things.

First, a mechanisms to make the business more profitable, can be buying used equipment. The investment on machinery is exaggerated. Both John Floccini of Durham Ranches[1] and Luke Lungren of Nine Iron Feedlot[2] agree that it is possible to use non-new machinery without cutting back on production, as long as you have mechanical and welding skills. This measure would minimize the initial investment.

Regarding the purchase of supplements, there is nothing to do, but soybean production could be considered to avoid having to buy the 640 tons for a value of $360.00 per year. For this improvement, the establishment of the sixth pivot described in Annex 1 would come into play. Although the initial investment would be considerably more expensive, the Gross Margin would be much higher.

It's important to keep in mind that the value of the land is very stable, and the agriculture sector is not a very risky place where to put the money. You don´t have huge benefits, but having a 3% is more profitable than having the money stuck in the bank, and the price of the land is raising fast. Finally, name the amount of aid and loans with interest lower than those described in this plan offered by the USDA.

[1] Rancher of the biggest Buffalo ranch in the world

[2] Owner of a feedlot in Worland, WY.

Annex 1: Actual situation

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

Annex 1 has as the principal objective of introducing the project and understanding the justification of this research, describing the actual situation of the operation in the economical and physical environment to prove the value of the property. This is only possible while analyzing the facilities and highlighting the potential of the property. This potential is easily provable by understanding the actual owner's financial situation and the infrastructures included in the plot.

The description of the property is crucial to understanding the business because it's based on natural and physical support. This annex also shows the nature of the project and the approach, based on a private investor providing the economical resources for the correct development of the business in the approach section.

1. Background

1.1. Approach

By request of a private investor, wanting to put money in the beef sector, is ordered a blueprint of a feedlot cattle operation. The objective of the blueprint is to break down and understand the feedlot industry. This study it's applied in a real case, with a real operation on sale. This way, it's easier to have more precision at the time of summing up the total amount of money that is need to be raised.

The interested contacts a person knowledgeable in the agri-food sector so that he can carry out research and develop an analysis of the actual situation of the cattle industries. With this, take conclusions of the viability of this kind of business based on cattle feed, and reify the project if the prospection is profitable.

It's important to remark that this project aims to analyze to what extent it is profitable and if it is possible to start an operation of this magnitude. To make conclusions independently of the results.

With all this background, I could travel to Wyoming and research more about the cattle industry at the beginning of this year. Having several meetings with people from the beef sector gave me a lot of information that is valorous for this project. This combined with my Agriculture Engineering formation it's a great help for the whole project.

1.2. Actual operation

The operation is a property developed for livestock wintering production which provides the feed base and facilities to winter and care for 3,500 cows and/or calves from December through April.

The farm located in Central Wyoming is located 8 miles West of Riverton, Wyoming just off Highway 20/26. The area is well known as a feed production area in Wyoming due to plentiful water supplies, productive lands, and mild, open winters. Situated on just over 1,000 acres, the operation involves growing 10,000 Tons of corn silage and 2.000 tons of alfalfa hay complete with feeding and calving facilities consisting of living quarters, shops, barns, corrals, lots, and feeding paddocks.

The operation is a value-added business providing feed and service to livestock producers. The improvements are mostly newer and well designed for the business. The land is well fenced and capable of handling livestock with facilities in place for handling, feeding, watering, and calving large groups of cattle.

The property offers a solid wintering and calving facility integrated with feed production from irrigated lands making an all-in-one livestock operation for handling 3000 cows or an equivalent number of stockers. The improvements are substantial and together with the feed resources, allow the operation to gross over $1.0 Million in annual revenue. Quality large-scale farming and feeding equipment allows for an efficient cost structure. The offering produces the opportunity for an excellent return on investment.

The actual size of the herd able to fit in the feedlot needs to be resized and approximated with more precision, but talking about a 3.000 cow operation is a good approximation.

2. About feedlot industries

2.1. An overview

The feedlot sector represents an intensive production system to grow and fatten cattle until they reach slaughter weight. The feedlot sector can be further divided into growing (winning weight but not fat) and finishing (fattening) phases. In North America, the backgrounding phase (typically the first 90 days after the arrival of feedlot calves) focuses on feeding high-forage/low-grain rations to maximize growth and minimize fat deposition. Welfare issues in the backgrounding phase can include injuries during handling associated with revaccination and implant protocols, as well as increased morbidity due to the stressors related to the transition from the ranch to the feedlot indicated earlier. The finishing phase (typically the last 100 days after backgrounding) focuses on feeding high-grain/low-forage rations to backgrounded calves or yearlings until they reach a prescribed finish (fat cover and weight) before marketing for slaughter.

Some feedlots focus solely on either backgrounding or finishing; however, it is not uncommon to have one feedlot feed calves from growth to finish. Some ranches have their feedlot facilities where cattle are bred and finished for slaughter by the same producer, but this is less common.

Both the background and finishing (fattening) phases of the feedlot sector use the same housing and facilities. The phases are defined more by the type of cattle and how they are fed rather than the way they are housed.

The business described will be both background and finishing feedlot. The calves will arrive at an approximated age of 6 months and will leave the slaughterhouse at around 15 months.

2.2. Live weights

The ranches in the open range will start the calving season between March and May. 6 months later, over October and November, the calves will be weaned off their dams, and moved onto the feedlot.

For having an approximation of the weights during all the process, it's been used the online program "BeefSpecs" available on the website of the Department of Agriculture of New South Wales, Australia. The selected breed is 100% English since we will work mainly with Aberdeen Angus. And we apply a forage feed for the first 6 months (weaning). In the last 3 months, while finishing the cattle for the slaughterhouse, the formulation will include 70% grain concentrate. With this, the program estimates the weight that each animal will gain according to:

- Initial Weight (175 Kg or 385 lb)
- Feed type (forage vs. concentrate)
- Breed (Aberdeen Angus)
- Average Daily Weigth (3 lb/day or 1.4 kg/day)
- Days on feed (180 and 90)
- Frame score (4)

Once the cattle are placed in our corrals, will pass through two different stages, the weaning (6 months) and the finishing (3 months).

The approximated weight when the cow is born in the prairie is 30 kg (70 lb). After 6 months in the open range with their mother, the weight will increase to 175 kg (385 lb). For the next 6 months, the beef will be fed with forage and hay in order to win weight until the 430 kg (950 lb). For having a final live weight of 550 kg (1200 lb), the last three months of life will pass through the stage of "finishing", where the concentration ratio is increased progressively for winning fat between the tissues.

When the truck leaves on to the cattle sales place, calve will be around 15 months old and 550 kg.

2.3. Beef sales

Currently, in the US and specifically in the state of Wyoming, the majority of beef sold ready to go to slaughter is put on the market through auctions. The capital of cattle sales in Wyoming is Torrington, although the entire state is full of local sales barns.

The auction-based system somehow favors the producer by protecting him from cattle brokers squeezing prices. The meat companies have to face each other in the auction and fight among themselves, generating a very healthy competition for those who put cattle up for sale.

The cattle auction halls have corrals in the back of the barn, where the different lots that will be auctioned are divided. The delegated meat brokers walk through the pens to take note of each batch number and its corresponding body condition. Many use a "bid cap" where they calculate the maximum price they are willing to pay for the batch.

3. Property description

3.1. Value

The property consists of two different plots, containing irrigated fields focused on forage production. Also, it included structures as well as corrals, as shown in **Image 1**. There are also some open-range surfaces useful for using as paddocks. The total amount of deeded surface is 1.646 acres (666.1 hectares).

The property is offered in Land Watch Real Estate at the price of 5.500.000USD. It's well equipped but this doesn't suppose all the investment. To run the operation is also required investing in the herd and machinery, as well as some facilities that need to be updated.

In the last two years, the prices have increased for the open range ranches because high economical standing people from the cities are wanting to move west. The market has plenty of farms and ranches for sale at exorbitant prices, but this kind of bubble does not directly affect the value of feedlot operations. Discarding open range options and researching irrigated farms, this property looks like one of the best options, and this project aims to clear if it's worth it to invest in the operation.

Image 1: drone picture of the property.

3.2. Surface distribution

The property is divided into two different land units. The big one, located down south on **Image 2**, containing the headquarters of the operation offers 420 irrigated acres (170 hectares). Is placed at the Southwest and includes three new Zimmatic pivots. Also, we find here the corrals and all the facilities. In the upper right corner of **Image 2,** we find the two Valley pivots little farm with only forage fields with a total of 210 acres (85 hectares).

Image 2: Satellite picture of the two plots

The separation between the places is 10 miles in a straight line but 15.6 miles (25 km) by road drive. Approximately, that supposes around 20 minutes by car and one hour by a tractor.

In **Image 3** and **Image 4**, the amplified picture with more detail of both places.

Image 3: amplified satellite picture of the headquarters.

Image 4: amplified satellite image of the two valley pivots farm.

3.2.1. Irrigation

The plots focused on the forage production gather of 630 acres (255 hectares). The irrigated lands are primarily pivot irrigated with 4.5 pivot systems. The deeded lands are located in two units, the Headquarters (Herman Place) consists of 1,413 acres (572 hectares) with three newer Zimmatic pivots shown in **Image 5**. The two Valley Farm consists of 233.7 acres (95 hectares) with two Valley pivots one being a wiper. One additional pivot of 140 acres (57 hectares) is leased to round out annual feed production needs for feeding 3,500 cattle. The alfalfa stands are mostly newer top-quality plantings.

Image 5: aerial picture of the pivots in the headquarters.

The irrigated lands are serviced by Midvale Irrigation District. Formed in 1921, Midvale manages a 400-mile-long system of canals and laterals known as the Riverton Unit of the Bureau of Reclamation, delivering irrigation water to over 73,000 acres (30.000 hectares) of irrigable classed lands in Central Fremont County, Wyoming. The district's water supply is derived from the Wind River and its tributaries, a portion of which is stored annually in Bull Lake and Pilot Butte Reservoirs; facilities also managed by Midvale.

Local farmer/irrigators comprise a five-member Board of Commissioners who provide direction and establish the policies under which the district operates to fulfill Midvales stated objective to provide the maximum amount of available water to the district's constituents at the lowest reasonable cost each year.

Midvale delivers water to the farm at a headgate from its canal system. Midvale has ditch riders that ensure the proper delivery of water. The annual cost of the water for 2021 was $11,716.20 or about $20/acre. Annual real estate taxes are low as well.

3.2.2. Dry range

Having in the headquarters plot 1.413 acres (572 hectares), now we find three pivots, each with a surface of 140 acres. But the approximated dry range consisting of 900 acres (365 hectares) is now without use.

The operation needs to lease one more pivot (280) in order to feed the 3.500 cow herd. This need for additional hay fields can be resolved by installing one more pivot on the open range surface. The pivot would take place on the red circle marked in **Image 6.** But this investment would be interesting to be developed once the bussines is well stablished.

Image 6: amplified satellite image with the location of the new pivot.

3.2.3. Corrals

In total, the property has a total of 14 pens, which are mainly intended to contain the herd, classified according to the owner, age, and sex. This segregation aims to make groups with similar needs in food.

All of the pens are built from old pipes, which come from the oil industry along with rails changed from highways. The fences have a height of 1.7 m.

Four of the pens, shown in **Image 7** are 60 x 70 m, joined together by a 5-meter wide corridor with their respective doors to work and move the different herds.

Image 7: amplified satellite photo of the four corrals.

Another six pens, shown in **Image 8** are 60 X 60 m, and another is 60 X 120 m. The latter is the largest on the estate. Finally, there is one of 60 X 20 m subdivided into six smaller ones that, depending on the season, are used to prepare batches of calves to go to the slaughterhouse or as an infirmary during the calving season.

Finally, two small additional pens, one used to work with the horses and the other as a nursing facility.

Image 8: amplified satellite photo of the six corrals.

The total area used in pens is approximately 125 acres (50 hectares).

3.3. Improvements

The property consists of several infrastructures and facilities dedicated to the care and feeding of livestock. As shown in **Image 4**, the farm includes homes for labor, sheds, barns, silage pit, grain storage, and pens.

image 9: amplified satellite image of the headquarters improvements.

3.3.1. Facilities

The facilities consist of a set of structures dedicated to storing the machinery (**Image 10**) and providing accommodation for the workers as well as the animals in the infirmary (**Image 11**).

Image 10: machinery shop.

Currently, the farm includes three spacious sheds with mixed use of storage between forage and machines. In addition, there are two stables that cover part of the corrals dedicated to nursing (**Image 11**).

Image 11: infirmary and nursery shop.

Finally, there are three houses for workers. Two of them have a wooden structure and the last one is a simple mobile home.

3.3.2. Corrals

The pens described above in section 2.2.3 and shown in **Image 7** and **Image 8,** meet the objective of containing the different herds separated by the owner, age, and sex. This is crucial in a feedlot operation since a price per day is usually agreed upon according to the input weight of the animals and the objective to be achieved. From that agreed monetary figure per cow and day of a batch, it is fattened homogeneously. With this, we will take the lot to auction with specific conditions.

The management of the manure is pretty simple. A big power shovel is put up into big mountains in the middle of each corral. Once at a time will be moved on to the big manure mountain for being composted and spread around the fields.

In **Image 12**, there is a more precise aerial shot from a drone.

Image 12: drone photo of the corrals.

3.3.3. Silage pit

The silage pit has a capacity to store 10,000 tons of corn silage. The concrete platform is 100 X 25 m, and the wall is 5 meters high as shown in **Image 13**. All silage comes from crushed corn from the pivots at the headquarters. Fits the place to highlight that the silage is not covered with a canvas. That's because of the low rainfall of the area and the huge volume of corn silage managed.

Image 13: satellite picture of the bunker silage pit and grain storage.

3.3.4. Grain storage

The two silos used for grain storage, placed in the **Image 13** are simple and well-built with sheets of metal. The measure is not very large because in the area is not uncommon to store grain in mounts. As it is not placed in a place with a lot of moisture, a larger warehouse does not make sense.

4. Economic situation

The business is currently based on the fattening of around 3,000 heads during the winter months, with an approximate turnover of $1,000,000. These incomes come directly from the sales of part of their herd and the daily quota applied to the animals of other owners. This last source of income is the main one.

In most feedlots, the herd is not owned by the specific farm, but by ranchers in the area who want to give a "corn finishing" to their calves and calves that will go to slaughter. In this "finishing" the aim is to gain a target weight and improve the quality of the meat, making it softer and with greater fat infiltration.

The standard rate per cow per day is $4/day, while a very demanding finisher can reach $5/day. With the 3,000 seats filled for half a year, we achieved a total income of $1,092,000.

Knowing the real income offered by the operation, which will hardly be altered, the key lies in estimating the production costs and sizing the entire production process to maximize the margin.

Annex 2: Natural environment

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

Annex 2 aims to describe the physical and natural environment of the place where the livestock business will be developed. Mainly the climate of the region will be analyzed as well as the characteristics of the soil and water supplies of the farm.

1. Climate

In Riverton, the summers are warm, dry, and mostly clear. Winters are icy, snowy, windy, and partly cloudy. During the year, the temperature generally ranges from -10°C to 32°C, rarely going below -19°C or rising above 36°C. In Riverton, the summers are warm, dry, and mostly clear and the winters are freezing, snowy, windy, and partly cloudy. During the year, the temperature generally ranges from -10°C to 32°C, rarely going below -19°C or rising above 36°C. The average annual temperature is 7.6 °C and the approximate rainfall is 377 mm.

Riverton is located at an elevation above sea level of 1,353 m.

1.1. Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	15	19	31	53	74	41	23	18	27	37	22	17

Table 1: Average accumulated rainfall. Source: https://es.climate-data.org/america-del-norte/estados-unidos-de-america/wyoming/riverton-17127/

As Table 1 shows, rainfall accumulates in the spring months, specifically in March, April, May, and June. Winter and autumn, except for October, are very dry. In total, it rains an average of 377 mm annually.

Crossing data from Table 1 and Table 2, we can say that all the precipitation contained between November and March will fall as snow. This is transcendental for the life of the prairie since the snow cover takes time to melt and soaks the ground, allowing the water to be absorbed by the plants. Without this event, only with the spring rains, the necessary humidity is not reached in the soil.

This fact has a great impact on open-range grasslands. Because if grasslands are overgrazed, you leave the meadow without a sufficient height of grass and the snow does not settle on the entire surface. The wind accumulates it in the most sheltered places and

there it produces small floods. The parts where the wind does not blow so strongly are the favorite places for the cows to rest, and this causes more of the ground to be stepped on. Therefore, with a bad grazing practice, we can over-water the parts where the grass does not do so well and dry out the rest of the field. This event would not be of major importance in the feedlot industry, since fodder is supplied directly to cattle. But on this property, some surfaces can be used directly by the cows and it becomes something to take into account.

On the other hand, it is important to highlight the importance of water reserves in the mountains. The plain of the studied region is comprised between two mountain bodies, the Rockie Mountains and the Big Horn Mountains. This valley is about 120 km wide by 300 km long. The Big Horn River flows from South to North, heading from the state of Wyoming to Montana to end up joining the Yellowstone River.

1.2. Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average(°C)	-6.3	-4.1	1.7	6.1	11.6	18.8	24.1	22.2	16.1	7.4	0.2	-6.3
Av. high(°C)	1	3.5	10	14.2	19.4	26.9	32	30.1	24.5	15.4	7.4	0.3
Av. low(°C)	-11.3	-9.4	-4.5	-0.6	4.5	10.6	15.7	14.2	8.8	1.5	-4.8	-10.8

Table 2: Average accumulated rainfall. Source:

Table 2 shows the average temperatures for each month. Winter is very cold due to pockets of cold air moving down Canada from the North. The fact of not being influenced by any large body of water means that the temperatures are extreme both in winter and summer.

The very low temperatures during the extreme and long winter make it necessary to install water heating equipment in the troughs to prevent it from freezing, and it is essential to choose fast-cycle crops.

1.3. Climatic classification

To determine the climatic classification, the Köppen system is used, which is based on the fact that natural vegetation has a clear relationship with the climate, so the limits between one climate and another were established taking into account the distribution of the vegetation. The parameters to determine the climate of an area are the average annual and monthly temperatures and precipitation, and the seasonality of the precipitation.

It divides the world's climates into five main groups: tropical, dry, temperate, continental, and polar, identified by the first capital letter. Each group is divided into subgroups and each subgroup into climate types. Weather types are identified by a 2 or 3-letter symbol.

The procedure to determine each group, subgroup, and type of climate is described in detail below. For each main group, the types of climates into which it is subdivided are shown in a table, with its associated vegetation and the regions in which they are found, naming some specific examples of representative zones.

Following all these criteria, the climate by the Köppen system is BSK (cold and temperate semi-arid climate).

The steppe climate, steppe or temperate and cold semi-arid climate is a semi-arid climate characteristic of steppe ecosystems. Semi-arid climates have an average annual temperature below 18°C. Precipitation can be between 200 and 500 mm approximately. The term "steppe" refers to steppes, which are treeless grassland ecosystems of cold or temperate climates.

The steppe clime includes regions such as the prairies and plains of North America, the dry Pampas and part of the Andes in South America, the South African Veld, and the Australian Outback.

2. Soil

The soil of the property is characterized by being light and deep. The two farms are adjacent to the river, which has been accumulating sediment. The class is Sandy Loam, and it is an easy soil to work.

These lands have only been cultivated for the last 100 years. The main crop has been sugar beet, which is still very important throughout the region. Barley has also been grown for brewing, which is shipped by train to Golden Co. where the Coors brewery is located.

The fields purchased with the property have been used for forage production since the mid-1990s when feedlot-type systems were imported from Nebraska. These are only viable in areas near the river, since, without irrigation, with rainfall of 377 mm per year, it is difficult to achieve serious production. The series of crops used so far has been mainly a rotation of alfalfa with maize, although on occasion a mixture of grasses has been used.

3. Water resources

As mentioned in section 2.2.1 of Annex 1, the property includes water rights, supplied by the Midvale Irrigation District (M.I.D.). Formed in 1921, Midvale manages a 400-mile-long system of canals and laterals known as the Riverton Unit of the Bureau of Reclamation, delivering irrigation water to over 73,000 acres of irrigable classed lands in Central Fremont County, Wyoming. The District's water supply is derived from the Wind River and its tributaries, a portion of which is stored annually in Bull Lake and Pilot Butte Reservoirs; facilities also managed by M.I.D. Local farmer/irrigators comprise a five-member Board of Commissioners who provide direction and establish the policies under which the District operates to fulfill Midvales stated objective to provide the maximum amount of available water to the District's constituents at the lowest reasonable cost each year.

M.I.D. delivers water to the farm at a headgate from its canal system. Midvale has ditch riders that ensure the proper delivery of water. The annual cost of the water for 2021 was $11,716.20 or about $20/acre. Annual real estate taxes are low as well. It is important to note that M.I.D. It has more and more water available to serve farmers thanks to the fact that water waste is being reduced by installing innovative systems that optimize the use of water.

4. Central Wyoming Landscape

The intermountain basins are the relatively low-elevation areas that lie between Wyoming's mountain ranges. Typically flat, arid, and populated by hardy sagebrush (**Image 1**), juniper, and prickly pear cactus, these basins offer sweeping, panoramic views broken only by the occasional rocky outcropping or dusty Western town.

Image 1: detail of sagebrush with plains and the Rockies in the background.

Driving across the state on I-80 between Laramie and Evanston offers a seemingly endless example of this type of landscape. In other areas, the intermountain basins can be surprisingly vibrant, diverse areas. In the Bighorn Canyon National Recreation area, which straddles the border between Wyoming and Montana, the landscape ranges from the craggy walls of the park's namesake canyon and the peaks of the Bighorn Mountains to the parched Great Basin Desert and the riparian woodlands along the Bighorn River.

Annex 3: Analysis of alternatives

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

Annex 3 aims to specify the cultivated forage species and, based on an estimate of production, determine the forage capacity we have to size the capacity of the feedlot. Also to justify the cattle feed monthly requirements.

1. Forage and feed production

The traditional ranching system in Wyoming is based on extensive grazing of the Great Plains during the summer months, where the native flora of the Parrot provides rich food for raising livestock. Over time, more and more homesteads were established, where the authorities gave free space, and the settlers promised to establish and take advantage of the lands acquired.

Currently, homesteads have passed through different generations, and have generally tended to join together in large properties dedicated exclusively to extensive grazing. These ranches are dedicated to cattle breeding, but due to the low rainfall, it is only possible to take advantage of the summer to graze. The business is based on reproduction, not fattening because that would make it necessary to buy and bring the forage to very remote places. Due to the cost of feed, most ranches dedicate a part to hay production, but it is usually insufficient to maintain the herd of mother and replacement cows, which greatly reduces the margin. As a solution to this increase in feed prices, it is common to find farmers who supply some fiber (low-quality forage) during the winter and provide nutrients with "cake". The cake is mainly cottonseed pressed in the form of pellets and provides energy and protein along with highly digestible fiber.

With this background, most of the cattle that go to market need to go through the feedlots, where all the necessary feed is supplied to acquire the desired body condition and the quality parameters expected by the market. This is where forage production and the provision of an adequate diet come into play. This is the reason why the feedlots are located in areas with good forage production. An example of this is the states of Nebraska and Texas.

Although Wyoming does not have a large forage production, there is the possibility of producing good food in the areas near the river. This has meant that in the last 20 years this system imported from Nebraska has been flourishing.

1.1. Crops

The crops that would be appropriate to implant are those that give the possibility of producing quality forage and grain. Classically, a rotation of alfalfa combined with corn has been carried out, but it is interesting to study the possibility of implanting some grass such as fescue or ryegrass, and some barley or oats.

Next, the section describes the different crops to be taken into account, in order to justify their implementation.

1.1.1. Alfalfa (Medicago sativa)

Identification: perennial plant of 10-80 cm, herbaceous, with variable hairiness. Trifoliate leaves are appreciable in **Image 2**, obovate leaflets, more or less narrow, with the margin serrated at its end, the central one petiolate. Flowers, as shown in **Image 1**, are violet with a yellow corolla. Inflorescence with numerous flowers in dense terminal racemes, with a peduncle longer than the adjacent leaf. Spiral legume (2-3 open whorls) to falcate.

Image 1: Alfalfa flower

Image 2: Alfalfa field.

Environmental requirements: wide climatic range. It tolerates heat and is quite resistant to drought. It can withstand low temperatures (subs. falcata). It needs deep and permeable soils, with a neutral or basic reaction (optimal pH of 7.5). It tolerates salinity but not waterlogging.

Type of crop: it is established in irrigated land as a single crop, and in dry land alone or mixed with grass (oats, barley, dactylus,...).

Environmental requirements: optimum growth between 20-30 ºC. Does not tolerate cold or drought. It is demanding in water. It adapts to different edaphic conditions but resists waterlogging poorly.

Implantation and persistence: rapid germination and implantation. Sowing dose: 20-25 kg/ha. The establishment can be problematic due to the invasion of spontaneous vegetation in the most fertile lands (it is useful to apply herbicides in this first phase or to carry out an early mowing at the end of winter if the invasion is important). In regions with very cold winters, spring sowings can be made. The average productive life of alfalfa is 4-5 years. The causes of the productive decline after these years of cultivation are not precisely known, although different hypotheses are considered (infestations of soil nematodes, autotoxic phenomena, etc.).

Forage interest: in irrigated land, it is a very productive plant with sustained growth throughout the summer. The annual production ranges between 15-28 t ms/ha. In dry land, its productions are lower and depend largely on the rainfall pattern and the textural characteristics of the soil. Its nutritional value is excellent due to its high protein content (up to 22% CP) and its high digestibility. It has the drawback of causing meteorism if it is not grazed with caution. Most of the use will be for dehydrated forage, windrowed (**Image 3**), and packed in square bales (**Image 4**).

Image 3: belt windrower for drying and packaging hay.

Forms of use: the main form of use of alfalfa erecta is harvesting. In irrigation, it allows the realization of 5-6 cuts every 25-35 days. The first and last cuts are of the highest quality because there are fewer individuals in the flower. The forage can be consumed green or preserved by making hay or dehydrated, as shown in **Image 4** (dehydrated alfalfa represents 10% of the total alfalfa produced). Fallen or prostrate alfalfas are usually used in a mixed way or through grazing.

Image 4: alfalfa hay bale.

1.1.2. Corn *(Zea mays)*

Identification: annual plant of 20-120 cm. Leaves with 15-20 nerves, ligulate, and large auricles. Inflorescence in spike, with three spikelets at each rachis node. Spikelets with one flower each; only the central flower (two-row barley) or all three flowers (four- and six-row barley) may be fertile. The glumes are small, acuminate, lemma with a very long edge, scabrid, it will remain attached to the pericarp next to the palea. Detail of the plant in **Image 5.**

Implantation and persistence: annual cultivation. To obtain forage, a sowing density of 90,000-100,000 plants/ha is recommended, for which high sowing doses are used, 50-100 kg/ha (15-20% higher than those recommended for grain corn). . Nascences occur rapidly from 15ºC.

Image 5: corn field.

Forage and grain interest: it is a very productive crop (it can exceed 20 mt ms/ha). It has a high content of soluble sugars that guarantee a high energy supply and adequate ensilability. The protein content is low (6-9% CP). The digestibility of the whole plant is high and relatively independent of the moment of cutting (grain production compensates for the loss of digestibility of the rest of the plant). Both the grain (feed formulation, monogastric feed) and the whole plant (ruminant feed) are used for animal feed.

Forms of use: the most common practice is to make a single cut destined for the silo at the pasty grain stage (30% dry matter content in the entire plant). At this stage, the spathes begin to dry out and the grains are floury and challenging, but they can be scratched with a fingernail. Chopping the plant is recommended and, on some occasions, the addition of urea or anhydrous ammonia to the silo to correct low protein content. It is not grazed because its regrowth capacity is scarce. But when finishing cattle in the feedlots, using it as grain concentrate is the key to having fat inside the tissues. That gives to the meat that marble looking, longed by the American market. The typical corn used as concentrate on TMR (Total Mixed Rations) is dent coIn the **Image 6**, detail of classification onion of the corn.

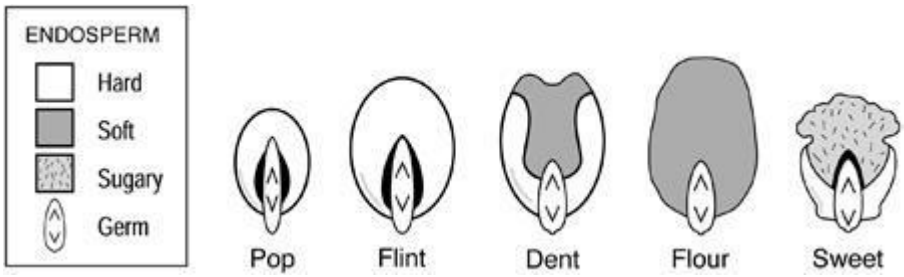


Image 6: different t kinds of corn.

Varieties: there is a wide range of varieties on the market that are grouped according to the length of their vegetative cycle. The ultra-early varieties (C100) have a cycfewerf less than 80 days. Very late varieties (C900-C1000) are more productive but take more than 140 days to reach physiological maturity. In the Iberian Peninsula, long-cycle varieties (C600-C900) are used, except in the northwestern regions where medium-cycle (C400-500) and short-cycle varieties (C200-C300) are mainly grown. Some cultivars planted for fodder are: 'Aligore', 'Cumbre', 'Goia', 'Dracma', 'Cerbere, 'Benicia', 'Attribute', 'Magullan'.

1.1.3. Forage corn (Zea mays)

Identification: annual plant of 1.5-3 m. Stems thick (>15 mm), solid. Wide leaves (2-10 cm), with marked central nerve. Monoecious plant, with male flowers in a terminal panicle (plume), male flowers formed by lemma, palea, 2 lodicules, and 3 stamens, two in each spikelet, also paired, one almost sessile and the other shortly pedicelled. Female flowers in axillary inflorescences (panicle or cob), two per spikelet (one of them sterile), very reduced lemma and palea; spikelets sitting on the thick axis of the ear, glumes reduced. Styles of great length, exserted by the apical part of the cob, form the hair. Caryopsis fruit is hard, usually yellow.

Crop type: summer monophyte crop. It is sown in an irrigated and fresh dry land. Currently, it is a crop widely used in intensive forage rotations.

Implantation and persistence: annual cultivation. To obtain forage, a sowing density of 90,000-100,000 plants/ha is recommended, for which high sowing doses are used, 50-100 kg/ha (15-20% higher than those recommended for grain maize). Nascences occur rapidly from 15ºC.

Forms of use: the most common practice is to make a single cut destined for the silo (**Image 8**) at the pasty grain stage (30% dry matter content in the entire plant). At this stage, the spathes begin to dry out and the grains are floury and challenging, but they can be scratched with a fingernail. Chopping the plant, with results like in **Image 9** is recommended and, on some occasions, the addition of urea or anhydrous ammonia to the silo to correct low protein content. It is not grazed because its regrowth capacity is scarce.

Image 8: bunker silage being compressed with machinery.

Image 9: chopped corn ready for storage.

Forage interest: it is a very productive crop (it can exceed 20 mt ms/ha). It has a high content of soluble sugars that guarantee a high energy supply and adequate ensilability. The protein content is low (6-9% CP). The digestibility of the whole plant is high and relatively independent of the moment of cutting (grain production compensates for the loss of digestibility of the rest of the plant). Both the grain (feed formulation, monogastric feed) and the whole plant (ruminant feed) are used for animal feed. In **Image 10**, the harvester chops ping corn for making silage.

Image 10: corn chopper harvesting a corn field for silage.

Varieties: there is a wide range of varieties on the market that are grouped according to the length of their vegetative cycle. The ultra-early varieties (C100) have a cycle of fewer than 80 days. Very late varieties (C900-C1000) are more productive but take more than 140 days to reach physiological maturity. In the Iberian Peninsula, long-cycle varieties (C600-C900) are used, except in the northwestern regions where medium-cycle (C400-500) and short-cycle (C200-C300) varieties are mainly grown. Some cultivars planted for fodder are: 'Aligore', 'Cumbre', 'Goia', 'Dracma', 'Cerbere, 'Benicia', 'Atribute', 'Magullan'.

1.1.4. Fescue (Festuca arundinacea)

Identification: perennial plant of 45-180 cm, caespitose. Leaves with a flat blade and protruding nerves, up to 1 cm wide, ligulate and with ciliate, embracing auricles. Panicle inflorescence, erect or curved, lanceolate to ovate, with long branches and more or less contracted. Spikelets, as shown in **Image 11,** are elongated, with 3-10 flowers, with nearly equal glumes. Lemmas without edges or with edges less than 4 mm.

Image 11: fescue spike.

Environmental requirements: adaptation to very diverse climatic and soil conditions. Good tolerance to cold, heat, and drought (although it tolerates water deficit worse than dactyl). It prefers limestone and clayey substrates but can grow in acidic, saline, and waterlogged soils. Little demanding in fertility. It is recommended on dactylus when there is a presence of salts in the soil.

Type of crop: preferably as a monophyte crop, although it can also be part of polyphyly meadows. It is cultivated in a dry land with more than 500 mm of annual rainfall and irrigated land.

Implantation and persistence: slow initial growth and vulnerable to competition from more aggressive species, such as ryegrasses, therefore it is recommended to mix it only with dactyl, alfalfa, or white clover. Its management in this phase must be careful, especially in irrigated meadows, where various weeds may appear. Sowing dose: 20-24 kg/ha in pure sowings, lower doses are used in mixtures. High persistence, exceeding 5 years.

Forage interest: high production, close to 10 t ms/ha, and sustained throughout the year. Among the long-lasting grasses, it is the earliest to start spring growth, it produces in summer, regrows in autumn, and extends its cycle until well into winter. Its palatability by livestock and its digestibility are low. It tends to bolt early in spring and the grass quickly becomes hard, losing digestibility. Nutritional quality is somewhat inferior to dactyl. **Image 12** shows the typical conditioner mower, which cuts and squeezes the plant in toke the moisture. A typical way of stocking it is in square bales like the one in **Image 13.**

Image 12: tractor mowing with conditioning machine in a fescue field.

Image 13: fescue hay bales.

Forms of use: both in a mowing regimen, to give green or for making hay, as well as in a grazing regimen. It tolerates grazing and cattle trampling well, however, its pastoral management is complicated given its tendency to form tillers. It is not advisable to mix it with more palatable grasses if you want to carry out exploitation in an exclusive grazing regime. Due to its rapid regrowth and loss of digestibility during heading, intensive and frequent harvesting is recommended to keep the plant young (eg rotational grazing with larger cattle at harvesting intervals of no more than 4-5 weeks).

Image 14:windrowed fescue hay.

Image 15: big baler putting up hay.

1.1.5. Ryegrass (Lolium multiflorum)

Identification: annual or biennial plant, 40-120 mm. The plant shown in **Image 17** Stems smooth or rough on towaitsheir upper end. Leaves with 1-2 mm membranous ligule and auricles. spike inflorescence. Spikelets with a single glume covering half the spikelet (**Image 16**), the latter usually with 11-22 flowers. Edged slogans or not.

Image 16: ryegrass spike detail.

Image 17: ryegrass field.

Environmental requirements: temperate climates. Somewhat cold resistant, but very sensitive to heat and drought. It completely stops its growth in hot and dry summers. Does not tolerate waterlogging. In fertile soils, it develops a high productive potential.

Type of crop: it is used both in fresh drylands (>700 mm of annual rainfall) and in irrigated land, as a short-lived monophyletic crop (alternative varieties 'Westerwald' type) or forming biphytic or polyphyletic meadows of longer duration (non-alternative varieties). Its association with violet clover is frequent.

Implementation and persistence: establishment and initial growth very fast. It is an aggressive species towards other grass species, including adventitious (natural herbicide). It is annual (Westerwald-type alternative varieties) or biennial (non-alternative varieties) and can be reseeded to lengthen its duration in the meadow. The sprouts can also form spikes, unlike what happens with other grasses. Sowing dose in monophyte cultivation: diploid varieties 20 kg/ha, tetraploid varieties 30 kg/ha. Sowing dose in phytic meadows: Italian ryegrass 15 kg/ha and purple clover 10 kg/ha.

Forage interest: the main reasons for the great development of this crop are its high productivity, its earliness, and its nutritional quality. Unlike the other meadow grasses, if it is sown early in autumn, it allows the first use before the end of the year (1.5-2 t ms/ha). In mild winter areas, the next mowing can be done in mid-March. Its summer production is practically nil. From sowing in autumn until the end of the following year, productions of over 15 t ms/ha can be achieved. In the second year, production declines but can be above 12 t ms/ha. The forage has a high richness in soluble sugars and good palatability.

Image 18: ryegrass under windrowing process.

Forms of use: it is preferably used by mowing, contributing green, or keeping hay **Image 19** or silage **Image 20**. It can also be grazed. It presents a high ensilability related toits high sugar content.

Image 19: ryegrass square bale.

Image 20: detail of ryegrass hay.

1.1.6. Barley *(Hordeum vulgare)*

Identification: annual plant of 20-120 cm. Leaves with 15-20 nerves, ligulate, and large auricles. Inflorescence in spike (**Image 26**), with three spikelets at each rachis node. Spikelets with one flower each; only the central flower (two-row barley) or all three flowers (four- and six-row barley) may be fertile. The glumes are small, acuminate, lemma with a very long edge, scabrid, it will remain attached to the pericarp next to the palea **Image 27**.

Image 26: Detail of the barley spikelet.

Image 27: barley grain.

Type of crop: it is established as a monophyte crop and is also used mixed with other grasses such as oats (to prolong the period of use) or with legumes such as vetch.

Implementation and persistence: easy installation. There are long-cycle varieties, more productive and suitable for autumn sowing, and short-cycle varieties, suitable for winter-spring sowing. Sowing dose of 120-150 kg/ha. Annual persistence.

Image 28: black Angus grazing barley.

Forage interest: The barley grain and the whole plant (forage) are used in animal feed. Its forage production ranges between 5-8 t ms/ha. Its grain production varies between 1-3 t/ha. The forage production of barley is lower than that of oats but, as the barley cycle is shorter, it fits better than oats in rotations with summer crops. From a nutritional point of view, it is a food with a high energy content although it is poor in protein. It has a great strategic value, like other cereals, in the programming of livestock feeding in times of scarcity, such as summer. The grain harvest also offers good roughage as a complement to the harvest.

Image29: round bales of barley straw.

Forms of use: traditionally, the barley grain has been harvested and fed to the animals in the manger, taking advantage of the stubble from the harvest for summer grazing. At present, different practices are carried out: winter grazing of the foliage (winter sprouting), mowing and making hay or silage in the milky-pasty grain state, and summer grazing of the standing dry plant (grain and forage). Direct harvesting through grazing is feasible because the spike does not shatter easily (although it is not advisable to wait too long to avoid the dry spike falling to the ground), although the long edges can make animal consumption difficult.

Varieties: there is a wide commercial offer. Some short cycle varieties are: 'Linden', 'Graphic', 'Gomera', 'Cecilia', 'Prestige', 'Riviera'. Long cycle: 'Hispanic', 'Ordalie', 'Volley', 'Sonrora'.

2. Cattle feed requirements

To calculate the dietary needs of livestock, we will first determine the amount of dry matter per day an animal can eat based on its size. This value will vary each month, as the animals grow. Once we are clear about how much dry matter each animal needs daily, based on the nutritional needs, we will formulate a TMR (Total Mixed Ration) for each month based on the different foods that can be grown on the farm.

All the percentage data needed to calculate the Dry Matter Intake (DMI) and the nutrient needs according to the weight of the cattle are extracted from the document “Beef Cattle Nutrient Requirements” of the Mississippi State University.

2.1. Dry Matter Intake

To determine the Dry Matter Intake (DMI) corresponding to each month, it is necessary to know the Average Body Weight (ABW), since the dry matter consumed by an animal is expressed as a percentage of ABW. This percentage fluctuates between 2.3 and 2.7%.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Aprox weigth (lb)	385	498	611	724	837	950	1033	1116	1200
Aprox weigth (Kg)	175	226	278	329	380	432	470	507	545
% of BW	0,027	0,025	0,024	0,023	0,026	0,026	0,024	0,024	0,024
DMI (lb/day)	10,4	12,5	14,7	16,7	21,8	24,7	24,8	26,8	28,8
DMI (Kg/day)	4,7	5,7	6,7	7,6	9,9	11,2	11,3	12,2	13,1

Table 1: DMI calculation

Table 1 shows the approximate weight that the animals will have for each month, and this value multiplied b the percentage corresponding to the live weight of the same month gives us the DMI. All weights are expressed in both kg and lbs. The orange column corresponds to the weaning stage while the green one corresponds to the green one.

Daily weight gain for the Black Angus breed: 1.7 kg/day (3.74 lb/day).

2.2. TMR Formulation

To formulate the TMR, the WinFeed program is used, with which we determine nutritional requirements, and based on the richness of each ingredient added to the feed store, the program suggests the corresponding proportion of each food. While the percentages of each nutrient will not vary over time, the DMI (Dry Matter Intake) will. This makes it necessary to formulate a TMR for each month since the cattle will eat more and more feed.

Below you can see the formula calculated for each month in **Table 2-10**. The %Use column expresses the percentage used of each ingredient concerning the total daily ratioratiocan be seen how, over time, the box corresponding to Max Concentrate increases from 40% to 60%. This increase is done gradually in order to get the rumen to adapt to digest more of the concentrate. The last three months, corresponding to the corn finishing, have 20% of the DMI of corn grain, a food that promotes the tenderness of the meat and favors the appearance of fats between the tissues of the meat.

- **October**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.07
Alfalfa Hay			16.79
Corn Silage	17		24.74
Corn Grains			7.48
Barley Grains	5		5
Soyabean Meal			17.62
DCP			3.19
Calcium Carbonate			0.84
Vitamin Min Premix	1	1	1
Urea			1.78
Fescue Hay			16.49

Nutrients	Min	Max	Analysis
Dry Matter %age	4.7		65.056
Forage			53.196
Concentrate		40	40
Protein %age	16		16.082
Energy KCal/Kg	2500		2509.825
NDF %age			40.156
Lysine %age			1.236
Methionine %age			0.404
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 2: feed formulation

- **November**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.63
Alfalfa Hay			13.8
Corn Silage	17		25.35
Corn Grains			10.59
Barley Grains	5		6.08
Soyabean Meal			18.19
DCP			3.17
Calcium Carbonate			0.87
Vitamin Min Premix	1	1	1
Urea			1.73
Fescue Hay			13.58

Nutrients	Min	Max	Analysis
Dry Matter %age	5.7		64.545
Forage			48.225
Concentrate		45	45
Protein %age	16		16.087
Energy KCal/Kg	2500		2510.215
NDF %age			38.133
Lysine %age			1.303
Methionine %age			0.424
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 3: feed formulation

- **December**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.4
Alfalfa Hay			11.63
Corn Silage	17		25.29
Corn Grains			12.18
Barley Grains	5		9.06
Soyabean Meal			18.64
DCP			3.14
Calcium Carbonate			0.91
Vitamin Min Premix	1	1	1
Urea			1.3
Fescue Hay			11.45

Nutrients	Min	Max	Analysis
Dry Matter %age	6.7		64.505
Forage			43.654
Concentrate		50	50
Protein %age	16		16.084
Energy KCal/Kg	2500		2509.55
NDF %age			36.192
Lysine %age			1.408
Methionine %age			0.451
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 4: feed formulation.

- **January**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.4
Alfalfa Hay			11.63
Corn Silage	17		25.29
Corn Grains			12.18
Barley Grains	5		9.06
Soyabean Meal			18.64
DCP			3.14
Calcium Carbonate			0.91
Vitamin Min Premix	1	1	1
Urea			1.3
Fescue Hay			11.45

Nutrients	Min	Max	Analysis
Dry Matter %age	7.6		64.505
Forage			43.654
Concentrate		50	50
Protein %age	16		16.084
Energy KCal/Kg	2500		2509.55
NDF %age			36.192
Lysine %age			1.408
Methionine %age			0.451
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 5: feed formulation.

- **February**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.21
Alfalfa Hay			10.6
Corn Silage	17		25.26
Corn Grains			13
Barley Grains	5		10.48
Soyabean Meal			18.96
DCP			3.12
Calcium Carbonate			0.92
Vitamin Min Premix	1	1	1
Urea			1.02
Fescue Hay			10.43

Nutrients	Min	Max	Analysis
Dry Matter %age	9.9		64.484
Forage			41.392
Concentrate		55	52.541
Protein %age	16		16.097
Energy KCal/Kg	2500		2513.111
NDF %age			35.221
Lysine %age			1.461
Methionine %age			0.464
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 6: feed formulation.

- **March**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.21
Alfalfa Hay			10.6
Corn Silage	17		25.26
Corn Grains			13
Barley Grains	5		10.48
Soyabean Meal			18.96
DCP			3.12
Calcium Carbonate			0.92
Vitamin Min Premix	1	1	1
Urea			1.02
Fescue Hay			10.43

Nutrients	Min	Max	Analysis
Dry Matter %age	11.2		64.484
Forage			41.392
Concentrate		60	52.541
Protein %age	16		16.097
Energy KCal/Kg	2500		2513.111
NDF %age			35.221
Lysine %age			1.461
Methionine %age			0.464
Calcium %age	1.1		1.35
Phosphorus %age	0.9		0.9

Table 7: feed formulation.

- **April**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.07
Alfalfa Hay			15.4
Corn Silage			0
Corn Grains	20		35.37
Barley Grains			0
Soyabean Meal			24.62
DCP			13.16
Calcium Carbonate			2.27
Vitamin Min Premix	1	1	1
Urea			0.5
Fescue Hay			2.61

Nutrients	Min	Max	Analysis
Dry Matter %age	11.3		90.91
Forage			23.078
Concentrate		60	59.996
Protein %age	16		16.641
Energy KCal/Kg	2500		2503.059
NDF %age			22.84
Lysine %age			0.818
Methionine %age			0.259
Calcium %age	1.1		4.175
Phosphorus %age	0.9		2.783

Table 8: feed formulation.

- **May**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.07
Alfalfa Hay			15.4
Corn Silage			0
Corn Grains	20		35.37
Barley Grains			0
Soyabean Meal			24.62
DCP			13.16
Calcium Carbonate			2.27
Vitamin Min Premix	1	1	1
Urea			0.5
Fescue Hay			2.61

Nutrients	Min	Max	Analysis
Dry Matter %age	12.2		90.91
Forage			23.078
Concentrate		60	59.996
Protein %age	16		16.641
Energy KCal/Kg	2500		2503.059
NDF %age			22.84
Lysine %age			0.818
Methionine %age			0.259
Calcium %age	1.1		4.175
Phosphorus %age	0.9		2.783

Table 9: feed formulation.

- **June**

Ingredients	Min%	Max%	%Use
Barley Straw	5		5.07
Alfalfa Hay			15.4
Corn Silage			0
Corn Grains	20		35.37
Barley Grains			0
Soyabean Meal			24.62
DCP			13.16
Calcium Carbonate			2.27
Vitamin Min Premix	1	1	1
Urea			0.5
Fescue Hay			2.61

Nutrients	Min	Max	Analysis
Dry Matter %age	13.1		90.91
Forage			23.078
Concentrate		60	59.996
Protein %age	16		16.641
Energy KCal/Kg	2500		2503.059
NDF %age			22.84
Lysine %age			0.818
Methionine %age			0.259
Calcium %age	1.1		4.175
Phosphorus %age	0.9		2.783

Table 10: feed formulation.

3. Feed production

	% use	kg/ha	kg DM/ha	Kg DMneed	Surface ha
Barley Straw	5,2	3500	3115	128,9	0,0414
Alfalfa Hay	13,3	40000	36400	329,1	0,0090
Corn Silage	17,4	42000	14700	430,7	0,0293
Corn Grains	18,8	13000	11570	464,1	0,0401
Barley Grains	5,9	10000	8800	145,9	0,0166
Soybean Meal	20,4			504,4	0,0000
DCP	6,2			153,5	0,0000
Calcium Carbonate	1,3			32,5	0,0000
Vitamin Premix	1,0			24,7	0,0000
Urea	1,1			26,5	0,0000
Fescue Hay	9,3	18000	16380	228,7	0,0140

Table 11: surface requirements for each crop.

Table 11 shows the average percentage of each feed that is used, and from the DM that a typical animal requires of each ingredient throughout its passage through the feedlot, we estimate an average production and calculate the necessary surface of each crop to maintain a type cow. Those with a 0 in the area column will not be produced on the farm but will be purchased on the market.

Once we have the area that a typical animal requires, knowing that the property has 170 hectares available, we will be able to know how many cows we can keep.

4. Cattle feedlot capacity

Knowing the total forage available for each moment of the year and the needs demanded by our set of pens that make up the herd, we can approximate that we can fit a total of 1130 head of cattle for 9 months. Annually 1130 heads would be housed since in the three summer months it makes no sense to fatten cattle in feedlots.

	Surface ha	Tot surface
Barley Straw	0,0414	46,8
Alfalfa Hay	0,0090	10,2
Corn Silage	0,0293	33,1
Corn Grains	0,0401	45,3
Barley Grains	0,0166	18,7
Soybean Meal	0,0000	0,0
DCP	0,0000	0,0
Calcium Carbonate	0,0000	0,0
Vitamin Premix	0,0000	0,0
Urea	0,0000	0,0
Fescue Hay	0,0140	15,8

Table 12:Surface distribution of the crops.

Knowing how much surface of each crop an example cow spends (Table 11), we multiply the surfaces by the number of cows, we will have the total of each crop, shown in Table 12.

By multiplying the total head (1130 cows) by the number of days housed (210 days) for a daily housing price of $4/day, we can calculate the farm income. This annual income would be $ 1,220,852. It is important to note that this will be the only source of income for the feedlot. In Annex 4$1.068.245, the expenses will be estimated to make an economic balance to analyze to what extent the business is viable.

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria Agroalimentària
i de Biosistemes de Barcelona

Annex 4: Agriculture machinery

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

Annex 2 aims to estimate investments in machinery and describe the function of each machine and implement. Justify its acquisition and estimate the hours of use that will be given annually to each one. Annex 2 aims to estimate investments in machinery and describe the function of each machine and implement. Justify its acquisition and estimate the hours of use that will be given annually to each one.

1. Tractors

To cultivate the land, two tractors will be required, because not all tasks have the same power needs and sometimes several machines will work simultaneously.

The main function of the tractors will be to push the implements described in point 9.

- John Deere 7210R Tractor $205,938 (210hp)

- John Deere 6140D Tractor $93,722 (140 hp)

2. Shovel

The bulldozer has a fundamental role in the cleaning of the pens. With it, the manure is piled up and loaded into trucks to apply it on the cultivated fields. It is also essential for moving grain piles and moving silage around the farm.

- Liebher $115,888

3. Combine

The cereal harvester for grain will have the function of collecting the part of the feed corresponding to the concentrate. The comb needed to harvest barley or corn is different. Therefore we will need a comb for row crops, such as sorghum, corn or sunflower and another for winter cereals (barley, oats, wheat...)

In this case, because the use is not going to be very

- John Deere S760 $224,900

4. Forklift

The function of the forklift will be to move all kinds of objects that are not loadable by hand. The main utility will be to move the baled forage, but also, like the excavator, it will have a use for cleaning or moving pallets. You will need as accessories a shovel, bale spike and a pallet tool.

- Manitou MLT 633 $32.348

5. Mower

Due to the large area that will be used for forage production, a large self-propelled mower is required. This aims to cut hay (whether alfalfa or rygrass) for later processing. This machine does not require implements, and due to the low rainfall in the region, it will not be necessary to use a conditioner type.

- John Deere W235M $184,000

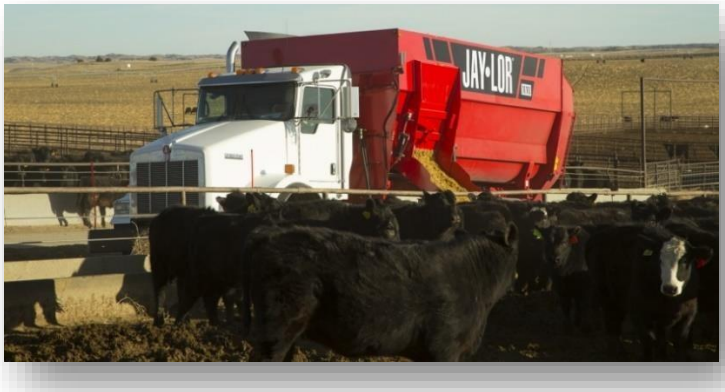
6. Corn chopper

The corn grinder will crush all the crop that does not go to grain. In addition, this requires a tractor with a trailer to carry the chopped corn to the silagge pit.

- John Deere 9500 Forage harvester $480.000

7. TMR Truck

- This truck will mix all the TMR (Total Mixed Ration) and will supply it along the corridors arranged in the pens.JAY-LOR H1650 $93.000



8. Truck

The truck will have the function of carrying all kinds of loads by road. The main task will be to bring the harvest to the headquarters, but also to move the cattle of the clients or go to buy supplements.

The necessary trailers will be one for grain and one for cattle.

- Kenworth T680 $110.000

9. Implements

9.1. Sowing equipment

9.1.1. No tilling sowing machine

The vast majority of times a precision single-grain seeder will be used, because tillage makes production more expensive and does not always improve the soil.

- Kuhn 9400NT $78.000

9.1.2. Traditional sowing machine

Since direct seeding is not always possible, it is necessary to have a second option.

- John Deere 1520 Integral Drill $67.000

9.2. Plowing equipment

9.2.1. Cultivator

The cultivator is used for less severe cases of compaction where you want to leave a finer finish on the ground.

- KUHN Krause 5635 $45.000

9.3. Hay equipment

9.3.1. Windrower

This machine, through the rotary movement of the PTO, rotates some rakes, arranging the hay in rows. It also dehydrates it when turning it over. This makes it easy to bale the hay.

- Lely hibiscus 1515 $62.000

9.3.2. Big Baler

This rectangular baler forms blocks of hay to store it and then supply it to the TMR Truck.

- John Deere Big Baler $95.000
- 

9.3.3. Bale trailer

The trailer has only the function of transporting the bales from the field to the warehouse. This will be powered by a tractor.

The selected model is an arcussin, since it has a self-loading system thanks to a mechanized ramp.

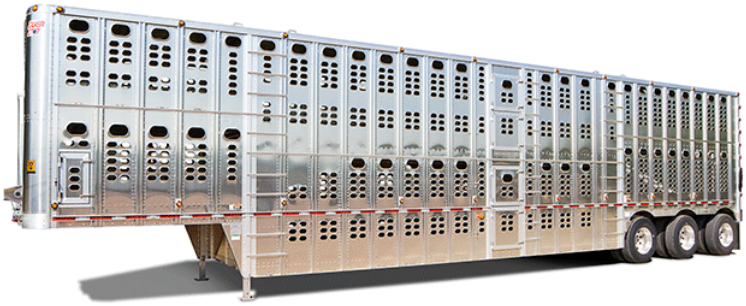
- Arcussin Bale Stacker $110.000

10. Trailers

10.1.1. Livestock trailer

The livestock trailer is needed for hauling cattle between the ranches and the feedlot. Also will be used to haul the livestock once is ready for slaughterhouse.

- Willson Silverstar $55.000



10.1.2. Grain trailer

The grain trailer is necessary for hauling harvest between places, buy soyabeans or move crops.

- Willson Hopper $48.000

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria Agroalimentària
i de Biosistemes de Barcelona

Annex 5: Economic viability

Final Career Project

Agriculture Engineering

Autor: Gerardo Maristany Marqués

Tutor: Francisco Iranzo

July 2022

Abstract

Annex 5 aims to discern the economic viability of the project by analyzing the income and production costs together with the expenses to calculate the benefit produced by the economic activity of the feedlot. These theoretical calculations are made from when the business is established.

1. Investment

Land	$	3.000.000,00
Machinery	$	1.800.435,00
Buildings	$	2.500.000,00
TOTAL	$	7.300.435,00

Table 1: investment.

The total sum of the investments is broken down in Table 1, with a total value of $7,300,435.

Land	$	5.500.000,00
Machinery	$	1.800.435,66
Tractors	$	299,66
Harvesters	$	888.900,00
Shovel	$	115.888,00
Forklift	$	32.348,00
TMR truck	$	93.000,00
Truck	$	110.000,00
Implements	$	560.000,00
TOTAL	$	7.300.435,66

Table 2: Investment breakdown.

2. Amortizations

Assets	Amortization Years	Year acquisition	Amount
Machinery	15	2022	1.800.435
Buildings	30	2022	2.500.000

Table 7: amortizations

Table 2 shows the machinery is amortized over 15 years while the buildings are fixed at 30 years. The land doesn't apply to be amortized because the value remains through time.

For calculating the amortizations its used the German system.

3. Financing

Shows the total investment, and the external financing needs to start the economic activity. The capital contributed by the partners adds up to the value of the land and the buildings ($ 5.500.000). External financing needs correspond to investment in machinery, Therefore, the company needs a loan of $1.8 million for buying the machines, and will ask for $2 million for having $200.000 in the tesorery account. The loan has a fixed interest rate of 1,5%, to be repaid over 10 years.

4. Structural costs

Total	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031

Feed production	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015	380.015
Corrals managment	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000
Feed suplement	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563	525.563

Table 3: Structural costs first 10 years.

The cost structure consists mainly of the costs of producing the animal feed, the expenses of buying the feed and nutritional supplements not produced on the farm, and the management of the pens. In each of these values, the expenses corresponding to labor are included. Table 3 shows in detail the number of costs for the first ten years of the business in operation.

	% use	Kg DMnee	Tot Tn DM	Tot Tn	$/Tn	Tot price$
Soyabean Meal	20,4	504,4	570	641	568,2	364027
DCP	6,2	153,5	174	174	350	60743
Calcium Carbonate	1,3	32,5	37	37	485	17839
Vitamin Premix	1	24,7	28	28	1900	53011
Urea	1,1	26,5	30	30	1000	29942
					Tot costs	$ 525.563,33

Table 4: Feed production costs.

Table 5: Feed supplement costs.

Table 4 details the prices of all the food that is need to be bought. Table 5 is an estimation of the production costs calculated by the University of Illinois.

5. Income and Gross Margin

Table 6: Prices, costs, and sales first 10 years.

With a price of $4/day, each cow spending 9 months in the feedlot will give an income of $1,080 per cow. With the price and the cost of each cow, we can calculate the Gross Margin. Every cow offers a Gross margin of $230. Table 6 details these values.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Total Income	1.220.400	1.232.604	1.257.256	1.294.974	1.346.773	1.414.111	1.470.676	1.514.796	1.545.092	1.560.543
Total Costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965
% Gross Margin	21%	22%	24%	26%	29%	32%	35%	37%	38%	38%

Table 7: Gross margin calculation 10 first years.

Table 7 details the margins, costs, and revenues for each of the first 10 years. Note that the total income is increasing over the years. This is because, in some way, the market is becoming known and more income is obtained due to the marketing activity. Although costs should rise, as has been the trend in recent years, they are fixed because the company knows the market better and where to get better prices when buying food. The % of Gross Margin corresponds to the percentage of profit concerning the total income or revenue.

6. Results account

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	**Total**
Income	1.220.400	1.232.604	1.257.256	1.294.974	1.346.773	1.414.111	1.470.676	1.514.796	1.545.092	1.560.543	**13.857.225**
Costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	**9.605.780**
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965	**4.251.445**
Gross Margin %	21%	22%	24%	26%	29%	32%	35%	37%	38%	38%	**31%**
Labor costs											
Structural costs	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	**9.605.780**
Gross Margin	259.822	272.026	296.678	334.396	386.195	453.533	510.098	554.218	584.514	599.965	4.251.445
Amortizations	166.010	172.773	179.812	187.138	194.763	202.698	210.956	219.550	228.495	237.804	**1.999.999**
Gross Margin	93.812	99.253	116.866	147.258	191.432	250.835	299.142	334.668	356.019	362.161	**2.251.446**
Financial costs	28.719	25.898	23.035	20.128	17.177	14.182	11.141	8.054	4.921	1.741	**154.996**
Result Before Taxes	65.093	73.355	93.831	127.130	174.255	236.654	288.001	326.614	351.098	360.420	**2.096.450**
Taxes	42.516	42.517	42.518	42.519	42.520	42.521	42.522	42.523	42.524	42.525	**425.205**
Operating Results After Taxes	22.577	30.838	51.313	84.611	131.735	194.133	245.479	284.091	308.574	317.895	**1.671.245**
% Operating Results	2%	3%	4%	7%	10%	14%	17%	19%	20%	20%	12%

Table 8: Result Account.

The income statement is shown in Table 8 for the first ten years. In the first two years, the profits are very small, but later, as the company matures, higher returns are acquired. Despite this, the results after taxes end up being very low compared to the initial investment. Taxes correspond to water and 0.57 of the value of the property.

7. Profit

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	**Total**
% Profit	0%	1%	1%	2%	2%	4%	4%	5%	6%	6%	3%

Table 9: Profit % respects the initial investment.

The profit is shown in Table 9. It is calculated by dividing the operational results after taxes by the initial investment. The first year is very low, but the tendency is to go higher. The average is 3% during the ten first years.

8. Cash flow

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Income										
Capital	5.500.000									
Loan Amount	2.000.000									
Income sales	1.120.093	1.231.601	1.255.230	1.291.874	1.342.515	1.408.577	1.466.027	1.511.170	1.542.602	1.559.273
Total Income	8.620.093	1.231.601	1.255.230	1.291.874	1.342.515	1.408.577	1.466.027	1.511.170	1.542.602	1.559.273
Expenses										
Investments	7.300.435									
Devolution External Financing	186.780	189.601	192.465	195.372	198.323	201.318	204.359	207.445	210.578	213.759
Structural Costs + Labor	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578	960.578
Dividends										
Total Expenses	8.447.793	1.150.179	1.153.043	1.155.950	1.158.901	1.161.896	1.164.937	1.168.023	1.171.156	1.174.337
Annual Balance	172.300	81.422	102.187	135.924	183.615	246.681	301.090	343.147	371.446	384.936
Accumulated Annual Balance	172.300	253.722	355.909	491.832	675.447	922.128	1.223.218	1.566.364	1.937.810	2.322.746

Table 10: Cash flow.

Table 10 shows how in the first year, a lot of money comes in since that is when the company is formed. The structural costs, including labor, will be $ 960.578 every year but the income will rise during the first ten years.

9. Conclusions

Economically we can conclude that the business is profitable but does not have an exorbitant economic ratio. The initial investment is very high. The total revenue it's pretty high, around 1/7 of the investment, though the margin is low. The profit is around 3% on average during the first ten years. Analyzing the points where more margin is sacrificed, profitability could be increased without practically altering incomes changing a couple of things.

First, a mechanism to make the business more profitable can be buying used equipment. The investment in machinery is exaggerated. Both John Floccini of Durham Ranches[1] and Luke Lungren of Nine Iron Feedlot[2] agree that it is possible to use non-new machinery without cutting back on production, as long as you have mechanical and welding skills. This measure would minimize the initial investment.

Regarding the purchase of supplements, there is nothing to do, but soybean production could be considered to avoid having to buy the 640 tons for a value of $360.00 per year. For this improvement, the establishment of the sixth pivot described in Annex 1 would come into play. Although the initial investment would be considerably more expensive, the Gross Margin would be much higher.

It's important to keep in mind that the value of the land is very stable, and the agriculture sector is not a very risky place where to put the money. You don´t have huge benefits, but having a 3% is more profitable than having the money stuck in the bank, and the price of the land is rising fast. Finally, name the amount of aid and loans with interest lower than those described in this plan offered by the USDA.

[1] Rancher of the biggest Buffalo ranch in the world

[2] Owner of a feedlot in Worland, WY.