Agrosource 3

The Farm as a Commercial Enterprise

to be used with AgroSource 4 (Farm Accounting)
Foreword

This guide is about the farm as a commercial enterprise operating in a market economy. Generally the word farm has a wider meaning namely land, livestock and crops, farm buildings and a house; and a place where people live and work and where financial-economic aspects are not the only ones which are important for the people who live on the farm.

In our guide the farmer owns or rents land and farm buildings, borrows money if and when necessary, owns and buys livestock, equipment and machinery, buys other input in the form of goods and services, etcetera, ……….. and he sells farm output; all this with the purpose of making (more) profit and a better and lasting living for the family.

The farmer is free to run the farm as s/he likes. However, there are certain restrictions, because farms do not exist or operate in a vacuum. Everywhere in the world, social, legal, political, economic, ecological, technical and infra-structural realities affect the freedom of the farmer to manage the farm business.

Our text is divided into two parts, The Farm as a Commercial Enterprise and Farm Accounting, both equally important. The underlying text is the "economics" part and it should be used together with the "farm accounting" text, also published by Agromisa. There is a third text, Economic Concepts in Market-oriented Farming, for use in undergraduate teaching.

The underlying text is far from being a "handbook"; it is an introductory text only, containing the basics of the subject, valid everywhere in commercial farming of some size. The concepts introduced in the text are followed by examples and exercises so that students gain working knowledge of the subject, which is very important.

The exercises can be used as they are; in this way the students learn to work with the different concepts introduced in the instruction part. But apart from the exercises provided in the text, teachers should try hard to construct exercises which are based on local conditions and which use the national currency. In such exercises students should recognize farming as it is done locally. Farm visits & surveys are also very important in this context.

The "M" in the text stands for M(oney), a fictitious monetary unit. The text generally refers to the farmer as "he", "him" or "his". We would like to assure the reader that it is only for the sake of textual convenience that we have chosen not to mention the woman farmer explicitly.

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The following persons have contributed to the original texts "farm economics" and "farm accounting", in their capacity as farm economics teachers in various countries: M.F.J.M. Cremers, A. Heykoop and Y.S. van der Valk.

C. Verduyn of Dairy Training Centre Friesland closely read the text of earlier versions and provided some new text for later versions. Agromisa is most grateful for all contributions.

May your farm as a business be like the proverbial hen with the golden eggs. May its prosperity be lasting. May your farm give professional satisfaction and be environmentally sound. Above all, may it be as source of happiness to you and your dependents...

Compilation and editing by B. Gietema
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January 2006
Notes

For further reading, we would recommend the handbook FARM MANAGEMENT by Ronald D. Kay of Texas A&M University and William M. Edwards of Iowa State University, USA; 3rd edition, 1994 or later. About 400 pages. Published by McGraw Hill Book Company.
The above really is a handbook, making one realize how complex the subject is. It is meant for academic training.

Our own texts offers some concepts only, in their most simplified form. Probably their strength lies in the exercises through which students really learn something.
They are for the training of present and future ‘commercial farmers’, with farms of some size. This training may take the form of self-tuition. Extension workers and bank personnel dealing with farm credit may also find the text useful in their work.
Consultation with local institutions - e.g. government departments, banks and farmers’ organisations - is highly advisable whenever the text is introduced in courses for (future) commercial farmers.

In the AgroSource series Agromisa has also published Economic concepts in market-oriented farming. This volume is for use in undergraduate teaching and has been written by Martin Hilmi.

Other training materials are available in the AgroSource series on farming without its financial economic aspects. We mention:

(a) modern dairy farming in warm climate zones (3 parts: ASC 21, 22 and 23)
(b) reproduction in dairy cattle (2 parts: ASC 25 and 26)
(c) fish farming in tropical fresh water ponds (2 parts: ASC 30 and 31)
(d) the basics of chicken farming (ASC 32)
(e) lecture notes on chicken farming in warm climate zones (ASC 33)
(f) potato growing in the (sub)tropics (ASC 18)

and

(g) basic calculations in agriculture and animal production (ASC 2)
(h) training elements in smallholder irrigation schemes (basin irrigation) (ASC 9 and 10)
(i) practicals basic land surveying and irrigation (ASC 11)
(j) lecture notes on tropical grasslands (ASC 19)
(k) one week course in participatory extension planning (2 parts: ASC 35 and 36)

For a full title list, we refer to the back cover list of all AgroSource editions.
## Contents

1 Introduction
   1.1 The Farming Cycle 7
   1.2 The farm as an economic unit: input and output 7
   1.3 Farm enterprises 8
   1.4 Costs 8
   1.5 The notion 'opportunity costs' 10
   1.6 Period covered 11
   1.7 Total costs 11

2 Calculation of fixed costs 12
   2.1 Introduction 12
   2.2 Depreciation costs 12
   2.3 Interest costs 13
   2.4 Maintenance costs 14
   2.5 Running costs (variable) 14

3 Calculation of variable costs 16

4 Gross output 20

5 Gross margin 23

6 Gross margin and farm management 29

7 Farm income measurement 33

8 Farm labour 37

9 Cash flow calculations 39
   9.1 Introduction 39
   9.2 Cash flow calculations 39

10 Credit
   10.1 Short-term credit 41
   10.2 Long-term credit 42

11 Market prices set by supply and demand 43
   11.1 Demand 43
   11.2 Supply 45
   11.3 The market price 47

12 Small-scale dairy farming: a cost calculation 50

13 An article in the farming press 53
   13.1 Economics of cotton growing in small-scale farming 53
   13.2 Some questions and remarks on the above article 54

14 What it means being ‘entrepreneur’ 56
   14.1 Introduction 56
   14.2 Skills 56
14.3 Being manager = taking decisions 56
14.4 Information and communication 58
14.5 Summary 58

15 Investment and costs 60

16 Economics in traditional livestock keeping 62
16.1 Quantify resources used and physical production obtained 62
16.2 Valuation 62
16.3 Estimation of other benefits 63

17 Exercises 64

18 Solutions to the exercises 80
1 Introduction

1.1 The Farming Cycle

Farming is a cyclic process, it is recurring in cycles. Crops are planted in early spring or rainy season, maintained, and harvested at the end of the season.

This is followed by the marketing of the produce, after which the farmer calculates the income derived from the crops which were grown (and/or the animals which are kept).

Then follows reflection: were my resources well spent, did I always take the right decisions, could I have had a better remuneration for my efforts? All this for the benefit of those who have to live from the farm.

This results in planning for the next season in which the farmer hopes to do better than in the previous season. Then follows the new cropping season, etc.

Of course, this is a very schematic presentation of what farming is like. A circle can illustrate the farming cycle, as shown below.

1.2 The farm as an economic unit: input and output

Farming is an activity in which we use resources such as seeds, fertilizers, water, feedstuffs and labour, in order to produce valuable products such as eggs, meat, milk, cereals, root crops and beans. The resources we put into the farm business are called **input** and the products which come out are called **output**.
If a farmer wants to run the farm as an economic production unit, his aim should be to produce output of which the total value exceeds the total value of the input. In that way there will be income for him (and his family). There will be no income if the total value of the input is higher than the total value of the output.

The total value of the output is called gross output and the total value of all input is equal to the total costs:

$$\text{Gross Output} - \text{Total Costs} = \text{Profit/Loss}$$

which is income for the farmer (this can be nil or negative).

Here we only deal with the input and output of the farm. If a farmer buys a sewing machine, a bicycle or perhaps a car, which are only going to be used privately, they will not be considered as farm input. But products produced on the farm which are consumed by the farmer's family will still be farm output, because they could have been sold.

### 1.3 Farm enterprises

Now we want to look at the farm business with more precision. On many farms we find more or less independent activities. On a farm we may find maize, sunflower, soya beans, a dairy herd, a poultry unit, etc..

These more or less independent activities within one farm business are called farm enterprises. So, often a farm business is made up of several farm enterprises. Each individual farm enterprise has its own input and output and sometimes we find that within one farm business the output of one farm enterprise is the input of another farm enterprise (for instance, maize is the output of a crop enterprise but when the same maize is used to feed dairy cattle it becomes the input of the dairy enterprise).

The profit or loss made on the farm business is the overall result of the profits/losses of the different farm enterprises.

A profit on the farm business does not necessarily mean that on that farm all farm enterprises are running at a profit. Some of them may run at a loss. So, to be able to explain the overall result of the farm, we have to know the result of each separate farm enterprise. This means that input and output have to be specified per farm enterprise as much as possible. We say ‘as much as possible’ because it will not always be possible to allocate all input to individual farm enterprises.

Some input may be used by more than one farm enterprise: for instance a tractor may be used for the dairy as well as for the crop enterprises. The value of such an input is then charged to the farm business as a whole and not to an individual farm enterprise.

### 1.4 Costs

In the context of this guide costs is input expressed in kind (‘money’) which is applied in order to obtain output. In economic language : something is ‘sacrificed’. By hindsight, some of it may not have been really necessary and this is called ‘waste’; a good farmer will have little or no waste.
Costs may be divided into land costs, costs of long-lasting input (e.g. buildings, machines; so-called dead inventory), long-lasting living inventory (livestock, tree crops), planting material and feedstuff, and human labour.

In other words, input used on the farm differs; some input lasts for over a year, other input can only be used once. Some are for general farm use and others will only be used in one of the farm's enterprises. For this reason we may also divide costs into two groups called variable and fixed costs. As follows.

**Variable costs** (also called direct costs) are short-term costs (usually for less than one year) and are defined as costs that:
- occur only if something is produced (and do not occur if nothing is produced)
- tend to vary according to the size of the enterprise (in other words, with the volume of output)
- can easily be allocated to individual enterprises.

For example, much labour is required in vegetable production. If a farmer has to hire labour, then as production increases the need for hired labour increases too. Likewise, the fuel costs for a hand tractor increase as the use of the tractor increases; or the greater the area a farmer plants to a certain crop, the higher the fertilizer costs. Thus, variable costs in farming are usually costs for seed, fertilizers, sprays, livestock feeds, veterinary costs etc.

**Fixed costs** (also called indirect costs) are long-term costs (they last for more than one year) and are defined as costs that:
- remain the same regardless of the volume of output
- do not tend to alter with small changes in the size of an enterprise

The costs of a tractor hardly vary regardless how much the tractor is used. The tractor may be used on any part of the farm. It may be used to transport feed to livestock, it may be used to plant and weed maize or any other crop. If a farmer grows an extra hectare of maize or keeps a few more cows, the farmer will hardly increase the tractor costs. If the farmer stops growing maize or keeping pigs it will not necessarily be possible to avoid all tractor costs.

Of course, the costs of using the tractor, fuel costs in particular, are variable but the costs of owning the tractor are fixed.

A rice huller (or a potato harvester) is used on one single enterprise, but the cost of owning it does not vary directly with the amount of time it is used. It is more convenient to treat costs of such specialized equipment as fixed.

The wages of full-time regular farm personnel are also fixed once this personnel has been hired. Even though a person may be hired to look after a single enterprise, such as poultry, his or her wages will not vary directly with the number of birds kept or the number of eggs laid.

If rent is paid for land, this is also a fixed cost because it has to be paid whatever small changes are made in the organization of the farm. Depreciation and repair of buildings and machinery are considered as fixed costs for similar reasons.

Thus, fixed costs in farming are the costs of land, farm buildings, fencing, machinery, permanent labour and farm tools. Also general overhead costs such as water and electricity charges are normally taken as part of the fixed costs.

On irrigated farms water charges may be a separate fixed cost item. If the charges are set according to volume used and the volume used per enterprise is measured, water charges may be variable costs.
1.5 The notion ‘opportunity costs’

Particularly in semi-subsistence farming, there is input which is not bought on the market, but which is generated by the farm (household) itself. Examples of such input are family labour and farm input produced on the farm (e.g. seed kept aside from the last harvest for use as sowing seed during the following growing season).

The input mentioned above is not bought ‘on the market’ and thus does not imply cash expenses by the farmer. How do we value such input? To value such input, the term opportunity cost has been introduced; it is a way to indirectly calculate certain (variable) costs:

The opportunity cost (also called the ‘shadow price’) of an input is equal to the income obtained by using the input in the best alternative way.

Instead of working on their own farm, the family members can also work as wage labourers on other farms. Their wage is the cost of family labour. This cost is equal to the cash payment the farmer has to make for hiring labourers.

Instead of keeping seed apart for use in the following season, a farmer can also sell this seed on the market. So, the income not obtained by selling this seed on the market, is the cost of home-produced seed used in the farm business. This cost is equal to the cash payment the farmer has to make for buying the seed on the market.

Instead of using home-produced grains, tubers or straw, for feeding his own livestock, a farmer can also sell these products on the market. So, the income not obtained by selling these products on the market is the cost of home-produced products used in the farm business. This cost is equal to the cash payment the farmer has to make for buying these products on the market. The same applies to manure.

Also family capital has its opportunity cost. Consider the situation of a farmer who has two alternative ways to spend M 300:

1. Buying fertilizer by which the farmer can obtain an additional income of M 600.
2. Buying improved sowing seed by which the farmer can obtain an additional income of M 540.

Suppose that the farmer decides to invest the money in fertilizer. Hence, the farmer will obtain an additional income of M 600. However, by doing so, the farmer loses the opportunity to obtain M 540 by using the money for buying improved seeds. In this case, the opportunity cost of spending M 300 on fertilizer is M 540.

You will understand that there are many alternative uses of capital. Therefore it will be very difficult to identify the best alternative use of capital.

To overcome the problem of identifying the best alternative use, it is common to consider the not-obtained interest, by putting the money on a commercial bank, as the opportunity cost of family capital. So, in our example the opportunity cost of M 300 is equal to the interest obtained by putting the money on a commercial bank.

Opportunity costs have something to do with choice and are not ‘real costs’ like variable costs and fixed costs of the previous section. Everytime we allocate a resource it generally means that we have made a decision, we have chosen between two or more options. In a way, opportunity costs apply to all costs.

However, quite often there may be no choice. For example, in areas where work outside the farm is (very) scarce, the opportunity cost notion makes little sense.

Anyway, retain the meaning of ‘opportunity cost’ and use it where necessary.
1.6 Period covered

Another point which we have to consider is the length of the period which we take into consideration when calculating the value of input and also output. To a large extent, the length of this period depends on the kind of farm enterprise. If, for instance, we look at a broiler unit it may take about 7 to 9 weeks from the time we buy the day-old chicks till the time we sell the mature broilers.

In this case the length of the period over which we can calculate the value of the input and output is the time between the purchase of the chicks and the sale of the broilers. This is a production cycle for one batch of fattening chicks.

In the case of a dairy or beef enterprise we can generally not identify a clear production cycle. In principle, for livestock enterprises this is possible only in so-called all in - all out systems.

In crop production we can identify the production cycles easily except in cases of perennial crops like tree crops.

Usually, we start the calculation of farm results, that is the difference between the value of input and output, by calculating the results per year. If possible, we may further calculate results per production cycle. Sometimes we even calculate results per quarter of a year.

To measure input and output properly we have to do stocktakings at the beginning and at the end of the period under consideration.

For example:

Stock of fertilizer on 1-10-2005 = 25 bags
Stock of fertilizer on 30-9-2006 = 10 bags
Purchases 05/06 season = 15 bags

Input of fertilizer period 1-10-2005 until 30-9-2006:

Stock 1-10-2005 = 25 bags
Stock 30-9-2006 = 10 bags

Change of stock = 15 bags
Purchases 05/06 season = 15 bags

Input of fertilizer 05/06 season = 30 bags

1.7 Total costs

Both groups of costs, variable and fixed, have to be calculated in their own way as we will see in the following chapters. For the time being it is enough to know the difference between variable and fixed costs and that variable + fixed costs are equal to the total costs:

Variable costs + Fixed costs = Total costs
2 Calculation of fixed costs

2.1 Introduction

A great deal of fixed costs are incurred on items which last longer than one year. Such items are also called durable capital items. If we buy an implement that will be used for several years, then the costs of having this implement should be spread equally over the number of years we expect that implement to use.

The costs of a capital item are built up of:
1 Depreciation costs } fixed costs
2 Interest costs } variable costs
3 Maintenance costs
4 Running costs

2.2 Depreciation costs

Suppose a farmer buys battery cages for poultry for M 5000. If the cages last for ten years it is wrong to say that the cost of production in the year the cages were bought should include all the M 5000. It is better to assume that the cages cost M 5000 divided by 10 each year. That is, the annual cost of having the cages is M 500.

These annual costs of long lasting items are called depreciation costs. After ten years, when the cages have come to the end of their useful ‘life’, the total of the annual depreciation costs of the cages has come to M 5000 which is equal to the amount of the original investment.

Normally depreciation costs are recovered in the output of the farm. It is better that a farmer does actually save the depreciation costs each year so that when the time of replacement has come he will have saved enough money to pay for the replacement.

Some farmers do not save the costs of depreciation, often because the output of their farms is not big enough. This means that at the time the item has to be replaced the money supposed to have been accumulated during the time of the items' use is not there. The result will be that the farmer has to look for a loan (resulting in payments for the farmer!), otherwise replacement will not be possible.

The annual cost of depreciation of a capital item can be calculated as follows:

\[
\text{annual depreciation costs} = \frac{\text{new value} - \text{scrap value}}{\text{useful life in years}}
\]

‘New value’ is the value of a new, similar capital item at the time when the calculation is made. It is not the value of the capital item at the time when it was bought.

The scrap value of an implement is the value of that implement at the time it has come to the end of its useful life.

In case of draft animals, the ‘scrap value’ is the selling price when the animals are slaughtered.

Example

The new value of a tractor is M 25000 and the scrap value is M 5000. If the expected useful life is 10 years, how much are then the depreciation costs this year?

See formula above.
Information on the expected lifetime and the scrap value can be obtained from the dealer from whom the tractor was bought. If information on this matter is lacking, or tends to be very unreliable, you can ask other farmers in the area who use the same kind of capital item and adapt the information to your particular circumstances.

In times of rapid inflation the new value as well as the scrap value of durable capital items will also increase rapidly. Hence, every year we will have to calculate the depreciation costs of such items again, using the values for that year.

As a rule of thumb we take the scrap value as a percentage of the new value, for machinery often 20%.

Depreciation costs will be calculated as long as the item is used. As we gain experience we may adjust the useful life of an item in the calculation. The calculated depreciations are usually kept in the farm business until needed for re-investment.

See also chapters 2.2 and 4.2.d of AgroSource 4: Farm Accounting.

### 2.3 Interest costs

At the time we buy a capital item we actually make an investment. Money is invested which would have yielded a return if it were invested outside the farm. For this reason we calculate a cost of interest on capital items no matter if the items have been bought on loan or with own funds.

If an item has been bought on loan, the calculated interest costs have to be paid to the lending institution.

By using his own funds a farmer loses the opportunity to invest his money in another ‘yielding’ way. Costs calculated in this way, where we look at the return we would have had if the money had been used in an alternative way, are called opportunity costs, as we have explained earlier.

If the item is bought with own funds the calculated costs of interest will not be the result of a payment. The amount of calculated interest costs of own funds will be part of the Farm Income as we will see later on.

Interest costs of capital items can be calculated as follows:

\[
\text{annual interest costs} = \frac{\text{new value} + \text{scrap value}}{2} \times \text{rate of interest}
\]

Where we do not deal with a single implement but with a whole range of implements and machinery, we usually calculate the costs of interest by multiplying the interest rate by 60% of the total new value of these capital items.

This is based on the assumption that the scrap value is 20% of the new value. Then the above formula reads

\[
\text{annual interest costs} = \frac{\text{new value} + 20\% \text{ of new value}}{2} \times \text{rate of interest}
\]

The first part of the formula can be written as

\[
\text{depreciation costs} = \frac{\text{M 25000} - \text{M 5000}}{10 \text{ years}} = \text{M 2000}
\]
The principle is that we calculate interest on the average invested capital over the useful life of the item. Calculated interest is also kept in the farm business.

2.4 Maintenance costs

Maintenance costs are costs which have to be made every year to keep the capital items in good working order. Our bookkeeping records will show the amount spent on maintenance, which includes normal repairs.

Repairs that increase the useful life considerably like the general overhaul of an engine should not be included here. These should be included in depreciation costs.

For planning purposes we often use standard figures expressed as percentages of the new value. These percentages differ according to the type of capital item. For example, we may estimate the annual maintenance costs of buildings at 2% of the new value per year while with farm machinery this percentage may be 10 to 15.

2.5 Running costs (variable)

Running costs are costs to operate a machine such as a tractor or a lorry. They include the costs of diesel, petrol, oil and lubricants. Also in this case the bookkeeping records should show the actual amount spent as running costs.

For planning purposes we use a standard figure expressed in an amount per working hour or kilometre.

Example A

Calculate the annual costs of a tractor bought for M 28000.

<table>
<thead>
<tr>
<th>Present new value</th>
<th>M 50000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrap value</td>
<td>M 5000</td>
</tr>
<tr>
<td>Useful life</td>
<td>3 years</td>
</tr>
<tr>
<td>Rate of interest</td>
<td>10%</td>
</tr>
<tr>
<td>Tractor use per year</td>
<td>720 hours</td>
</tr>
<tr>
<td>Fuel costs</td>
<td>4 litres/hr at M 1.50 per litre</td>
</tr>
<tr>
<td>Lubrication costs</td>
<td>7 litres of oil per 120 hr at M 2.50 per litre</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>20% of new value</td>
</tr>
</tbody>
</table>

Solution

Annual costs = (a) depreciation costs + (b) interest + (c) operating costs

a) depreciation = \( \frac{\text{new value} - \text{scrap value}}{\text{useful life}} \) = \( \frac{50000 - 5000}{3} \) = M 15000

b) interest = \( \frac{\text{new value} + \text{scrap value}}{2} \times \text{rate of interest} \) = \( \frac{50000 + 5000}{2} \times 10\% \) = M 2750

c) operating costs

\[
\text{fuel} = 720 \text{ hr} \times 4 \text{ L/hr} = 2880 \text{ litres} \times 1.5 \text{ M} = \text{M 4320} \\
\text{lubrication} = 720 \div 120 \times 7 \text{ L} \times 2.50 \text{ M} = \text{105} \\
\text{maintenance} = 20\% \text{ of 50000} = \text{10000} \\
\text{+} = \text{M 14425}
\]
Annual costs = a + b + c = M 32175

Example B
Calculate the interest costs of calf rearing during the first 9 months

<table>
<thead>
<tr>
<th>Initial value of the calf</th>
<th>M 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily costs of feeding, housing etc.</td>
<td>M 2 per day</td>
</tr>
<tr>
<td>Rate of interest</td>
<td>10%</td>
</tr>
</tbody>
</table>

Solution

\[
\text{Interest costs} = \frac{\text{Initial value} + \text{End value}}{2} \times \text{Rate of interest}
\]

\[
\begin{align*}
\text{Initial value} &= M 100 \\
\text{Added value 9 months} &= 9 \times 30 \times 2 \\
\end{align*}
\]

\[
\begin{align*}
\text{Interest over 9 months} &= 37 \times \frac{9}{12} = M 27.8
\end{align*}
\]
3 Calculation of variable costs

Variable costs are the costs of input which occur only if something is produced (see definition of variable costs on page 10).
In general we calculate these costs by multiplying the quantity by the unit price paid for the input.

In certain cases, when an input has not been bought but has been produced on the farm itself, we will use the opportunity costs i.e. the price we would have made if we had put the input to its best alternative use, as explained in Chapter 1 par. 3.
The variable costs too do include an amount of calculated interest over the capital used to cover these costs. As with fixed costs, we calculate the interest over the average invested capital. However, for enterprises with a daily marketable output we do not calculate interest on the variable costs.
If the total variable costs of a grain crop with a growing period of 5 months are M 300, and the interest rate is 12%, the interest will be (assuming that the costs gradually increase):

\[
\frac{M \ 300}{2} \times \frac{5}{12} \times 12\% = M \ 7.50
\]

Example A: Variable costs of 1 hectare maize
Calculate the total variable costs of a soya bean crop with a growing period of 7 months, and an interest rate of 12%.
The following input is used:

<table>
<thead>
<tr>
<th>Input</th>
<th>Quantity</th>
<th>Price per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>80 kg</td>
<td>M 0.86 per kg</td>
</tr>
<tr>
<td>Compound fertilizer</td>
<td>4 bags</td>
<td>M 11.75 per bag</td>
</tr>
<tr>
<td>Triple super</td>
<td>2 bags</td>
<td>M 13.65 per bag</td>
</tr>
<tr>
<td>Weedkiller</td>
<td>2 litres</td>
<td>M 7.75 per litre</td>
</tr>
<tr>
<td>Insecticide</td>
<td>2½ litres</td>
<td>M 20.70 per litre</td>
</tr>
<tr>
<td>Casual labour</td>
<td>5 days</td>
<td>M 2.- per day</td>
</tr>
<tr>
<td>Hire maize harvester</td>
<td></td>
<td>M 120.-</td>
</tr>
<tr>
<td>Empty bags</td>
<td>17 bags</td>
<td>M 1.05 per bag</td>
</tr>
</tbody>
</table>

hence the costs are:

\[
\begin{align*}
\text{Seed} & \quad 80 \times M 0.86 = M 68.80 \\
\text{Compound fertilizer} & \quad 4 \times M 11.75 = M 47 \\
\text{Triple super} & \quad 2 \times M 13.65 = M 27.30 \\
\text{Weedkiller} & \quad 2 \times M 7.75 = M 15.50 \\
\text{Insecticide} & \quad 2\frac{1}{2} \times M 20.70 = M 51.75 \\
\text{Casual labour} & \quad 5 \times M 2.- = M 10 \\
\text{Hire maize harvester} & \quad = M 120 \\
\text{Bags} & \quad 17 \times M 1.05 = M 17.85 \\
\end{align*}
\]

Subtotal \( = M 358.20 \)

\[
\begin{align*}
\text{Interest} & \quad \frac{358.20}{2} \times \frac{7}{12} \times 12\% = M 12.54 \\
\text{Total Variable Costs} & \quad = M 370.74 \\
\end{align*}
\]

In multiple cropping systems (i.e. intercropping, mixed cropping etc.) it is very difficult to allocate costs of input to the single components of the cropping system. For example, in Northern Nigeria,
millet is sown during June and a month later interplanted with sorghum. Millet is harvested at the end of September, while sorghum is harvested at the end of November:

We consider these two crops as if they were one crop (a millet/sorghum crop combination), in calculating the variable costs.

**Example B: Variable costs of a dairy enterprise**

The herd composition of a dairy enterprise is as follows:

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>Value per animal</th>
<th>1-1-20..</th>
<th>One year later</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Total value</td>
<td>Number</td>
</tr>
<tr>
<td>Cows</td>
<td>M 800</td>
<td>12</td>
<td>M 9600</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>M 600</td>
<td>4</td>
<td>M 2400</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>M 400</td>
<td>5</td>
<td>M 2000</td>
</tr>
<tr>
<td>Calves: female</td>
<td>M 100</td>
<td>7</td>
<td>M 700</td>
</tr>
<tr>
<td>male kept</td>
<td>M 60</td>
<td>1</td>
<td>M 60</td>
</tr>
<tr>
<td>Oxen</td>
<td>M 450</td>
<td>4</td>
<td>M 1800</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>M 16560</td>
<td>37</td>
</tr>
</tbody>
</table>

Or, in Livestock Units LU’s (a cow weighing 500 kg is the standard):

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>Livestock Unit per animal</th>
<th>1-1-20..</th>
<th>One year later</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>LU</td>
<td>Number</td>
</tr>
<tr>
<td>Cows</td>
<td>1.0</td>
<td>12</td>
<td>12.0</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>0.8</td>
<td>4</td>
<td>3.2</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>0.5</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Calves: female</td>
<td>0.2</td>
<td>7</td>
<td>1.4</td>
</tr>
<tr>
<td>male kept</td>
<td>0.2</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Oxen</td>
<td>1.2</td>
<td>4</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>24.1</td>
<td>37</td>
</tr>
</tbody>
</table>

**Calculate** the total variable costs of the dairy enterprise as the following input is used, with an interest rate of 7%.

1. **Feeds:**
   - concentrate for cows: 2 kg per cow per day at M 0.15 per kg
   - milk for calf feeding: 1500 litres at M 0.43 per litre

2. **For the pasture (fertilizer):**
   - ammonium nitrate: 120 bags at M 14.95 per bag
   - triple super: 60 bags at M 16.25 per bag

3. **Miscellaneous costs:**
   - minerals: 13 cows at M 25 per cow
   - A.I. costs: 13 cows at M 5 per cow
   - veterinary costs: 25.2 LU at M 25 per LU

We calculate the variable costs for the **average herd composition**.

The average herd composition in our case is:
The Farm as a Commercial Enterprise

<table>
<thead>
<tr>
<th></th>
<th>Original number</th>
<th>Number one year later</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>12</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>4</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>5</td>
<td>6</td>
<td>5.5</td>
</tr>
<tr>
<td>Calves: female</td>
<td>7</td>
<td>8</td>
<td>7.5</td>
</tr>
<tr>
<td>Calves: male kept</td>
<td>1</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Oxen</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>37</td>
<td>35</td>
</tr>
</tbody>
</table>

The average herd composition in Livestock Units is:

<table>
<thead>
<tr>
<th></th>
<th>LU originally</th>
<th>LU one year later</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>12.0</td>
<td>14.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>3.2</td>
<td>2.4</td>
<td>2.8</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>2.5</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Calves: female</td>
<td>1.4</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Calves: male kept</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Oxen</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>24.1</td>
<td>26.2</td>
<td>25.2</td>
</tr>
</tbody>
</table>

N.B.: Sometimes an average herd composition can be calculated from data registered per month. Then we add the numbers registered each month and divide the total by 12.

Calculate the interest over the average herd value:

\[
\text{Average herd value} = \frac{M \ 16560 + M \ 18120}{2} = M \ 17340 \\
\text{interest: } 7\% \times M \ 17340 = M \ 1214
\]

Variable costs calculation:

1. Feeding costs
   - concentrate for cows: \(13 \times 2 \times 365 \times M \ 0.15 = M \ 1423\)
   - milk for calf feeding: \(1500 \times M \ 0.43 = M \ 645\)

2. Fertilizer costs
   - ammonium nitrate: \(120 \times M \ 14.95 = M \ 1794\)
   - triple super: \(60 \times M \ 16.25 = M \ 975\)

3. Miscellaneous costs
   - minerals: \(13 \text{ cows} \times M \ 25 = M \ 325\)
   - A.I. costs: \(13 \text{ cows} \times M \ 5 = M \ 65\)
   - veterinary: \(25.2 \text{ LU} \times M \ 25 = M \ 630\)

Total miscellaneous costs: \(M \ 1020\)

Variable costs

- concentrate: \(M \ 1423\)
- milk for calf feeding: \(M \ 645\)
- total miscellaneous costs: \(M \ 1020\)
- ammonium nitrate fertilizer: \(M \ 1794\)
triple super fertilizer

M 975

sub var. costs

M 5857

4 Interest $7\% \times 0.5 \times 5857$

M 205

5 Interest dairy herd

M 1214

Total Variable Costs

M 7276

**N.B.:** In a commercial dairy farm we usually do not calculate interest over the sub var. costs, as these costs will be paid back immediately by the sale of milk.
4 Gross output

Gross output is the value of what is produced on a farm.
The Total Farm Gross Output is the sum of the output of the individual farm enterprises.

Output includes the following:
- value of farm produce sold;
- value of farm produce re-used on the farm;
- value of farm produce consumed by the farm family;
- the gain in value of tree crops and livestock;
- the gain in value of stored farm produce.

Output which is used again as input on the same farm should be valued as part of the gross output for the producing enterprise and as a cost for the enterprises that use it. Here again we have to do with opportunity costs. By using own farm produce as farm input, we have lost the opportunity to sell the produce.

The gain in value of farm produce stored on the farm is also included in the gross output, because it increases the farmer's wealth.

Example A: Gross output of a rice crop of 1 hectare

Produce:
yield milled rice: 1800 kg/ hectare at M 3.30 per kg = M 5940
rice straw: 400 bundles per hectare at M 1.25 per bundle, used for livestock feeding = M 500
rice bran: 900 kg per 1800 kg at M 0.15 per kg, used for poultry feeding = M 135

Gross Output

M 6575

As with variable costs, we consider all crops in a multiple cropping system as if they were one crop. Thus, the gross output of such a system is the sum of the output of all crops in the combination.

Gross output of perennial crops and livestock enterprises

Basically there is no difference between the calculation of the gross output of a perennial crop or livestock enterprise and annual enterprises.

As mentioned before, changes in value of tree crops or livestock and the value of produce stored on the farm are part of the gross output.

To incorporate these possible changes in value in our gross output calculations, stock takings have to be done at the beginning and at the end of the period over which we want to calculate the gross output.

The following is an outline of how the gross output of perennial crops and livestock enterprises can be calculated systematically:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing valuation</td>
<td>M ...........</td>
</tr>
<tr>
<td>Opening valuation</td>
<td>M ...........</td>
</tr>
<tr>
<td>Increase/Decrease in value</td>
<td>M ...........</td>
</tr>
<tr>
<td>Total sales</td>
<td>M ...........</td>
</tr>
<tr>
<td>Produce used for Home Consumption</td>
<td>M ...........</td>
</tr>
</tbody>
</table>
N.B. Purchases of animals on a regular basis may be entered as variable costs.

Remember that the gross output of an enterprise is influenced by:

- The unit yield (crop, livestock) and the scale of the enterprise.
- The price per unit received for products.

Example B: Gross output calculation of a small dairy herd

The size and composition of the herd is according to the table below.

During the year the farmer bought one heifer at M 600 to replace the one that died.

Prices of stock sales are according to the value given in the table.
Milk and meat used for home consumption is valued at the commercial price (opportunity costs!).
The milk production of the cows is 7 L per cow per day on average, for the average number of cows present. The average length of lactation is 300 days and the milk price M 0.43 per litre.
In total 750 litres of milk are used for home consumption and 850 litres have been fed to the calves.

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>1.1.20..</th>
<th>One year later</th>
<th>Value</th>
<th>Deaths</th>
<th>Sales</th>
<th>Home cons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>10</td>
<td>11</td>
<td>M 800</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pregnant &amp; bulling heifers</td>
<td>3</td>
<td>3</td>
<td>M 600</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>4</td>
<td>4</td>
<td>M 400</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Calves: female</td>
<td>5</td>
<td>6</td>
<td>M 100</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>male</td>
<td>1</td>
<td>2</td>
<td>M 60</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Total Head</td>
<td>23</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Closing valuation:

- Cows: $11 \times M 800 = M 8800$
- Pregnant & bulling heifers: $3 \times M 600 = M 1800$
- Yearling heifers: $4 \times M 400 = M 1600$
- Calves: female: $6 \times M 100 = M 600$
- male: $2 \times M 60 = M 120$

Closing value: M 12920

Opening valuation:

- Cows: $10 \times M 800 = M 8000$
- Pregnant & bulling heifers: $3 \times M 600 = M 1800$
- Yearling heifers: $4 \times M 400 = M 1600$
- Calves: female: $5 \times M 100 = M 500$
- male: $1 \times M 60 = M 60$

Opening value: M 11960

Increase in herd value (positive): M 960

Output
Cows \( 1 \times M \, 800 = M \, 800 \)
Yearling heifers \( 1 \times M \, 400 = M \, 400 \)
Bull calves \( 2 \times M \, 60 = M \, 120 \)
Milk \( 21300 \, L \times M \, 0.43 = M \, 9159 \)

\[ \text{sub output} \quad M \, 10479 \]

\textbf{home consumption (at commercial prices)}

Cow \( 1 \times M \, 800 = M \, 800 \)
Milk \( 750 \, L \times M \, 0.43 = M \, 322 \)

\[ \text{produce used for home consumption} \quad M \, 1122 \]

\[ \text{Total sub output} \quad M \, 11601 \]

\textbf{Purchases}

Heifer \( 1 \times M \, 600 = M \, 600 \)

\[ \text{total turnover during the year} \quad M \, 11001 \]

\[ \text{GROSS OUTPUT} \quad M \, 11961 \]

The following question is: \textbf{how much of the gross output consists of cash receipts by the farmer?}

The total quantity of milk produced:

average number of cows \( \frac{10 + 11}{2} = 10.5 \)

average milk production is 7 L per cow per day

average length of lactation is 300 days per cow

\( 10.5 \, cows \times 300 \, days \times 7 \, L \, per \, cow \, per \, day \)

\[ \text{home consumption} = 750 \, L \]

\[ \text{Amount of milk for sale and calf feeding} = 21300 \, L \]

\textbf{How much of the gross output consists of cash receipts by the farmer:}

\textbf{No} cash receipts: A/ Increase in herd value \( M \, 960 \)
B/ Home consumption meat \( M \, 800 \)
C/ Home consumption milk \( M \, 322 \)
C/ Milk used for calf feeding \( M \, 365 \)

\[ \text{total} \quad M \, 2447 \]

Out of the gross output the \textbf{cash receipts} are:

\[ M \, 11961 - M \, 2447 = M \, 9514 \]
5 Gross margin

In chapter 1 we have learnt:

\[
\text{Gross Output} - \text{Total Costs} = \text{Profit/Loss}
\]

and also:

\[
\text{Total Costs} = \text{Fixed Costs} + \text{Variable Costs}
\]

The gross output less total costs equals the profit or the loss.
This is perhaps the ideal way of comparing the performance of one enterprise with another. However, it is difficult, if not impossible, to allocate all fixed costs to individual enterprises.

Because of this a system has been devised for planning and comparing enterprise performance that does not require the allocation of fixed costs.

This is the **gross margin method**. Using this method, only the variable costs are deducted from the enterprise gross output:

\[
\text{Gross Margin} = \text{Gross Output} - \text{Variable Costs}
\]

The sum of the gross margins of the individual farm enterprises is called Total Farm Gross Margin.
See following table.

<table>
<thead>
<tr>
<th>Farm enterprise</th>
<th>Gross margin per hectare</th>
<th>Area in hectares</th>
<th>Total gross margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>cotton (irrigated)</td>
<td>M 5483</td>
<td>2.5</td>
<td>M 13708</td>
</tr>
<tr>
<td>rice (irrigated)</td>
<td>M 7787</td>
<td>0.8</td>
<td>M 6230</td>
</tr>
<tr>
<td>potatoes</td>
<td>M 10525</td>
<td>0.3</td>
<td>M 3158</td>
</tr>
<tr>
<td>maize</td>
<td>M 6554</td>
<td>0.8</td>
<td>M 5243</td>
</tr>
<tr>
<td><strong>Total Farm Gross Margin</strong></td>
<td></td>
<td></td>
<td><strong>M 28339</strong></td>
</tr>
</tbody>
</table>

Which gross margin in the above example is the best and why? What would you advise the farmer?

The profit/loss of the whole farm can be calculated by deducting the total fixed costs from the total of the gross margins of all the farm enterprises; for example:

\[
\begin{align*}
gross \text{ margin maize} & \quad M \ldots \\
gross \text{ margin soya} & \quad M \ldots \\
gross \text{ margin dairy section} & \quad M \ldots \\
& \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \\
total \text{ farm gross margin} & \quad M \ldots \\
fixed \text{ costs} & \quad M \ldots \\
\text{Profit/Loss} & \quad M \ldots \\
\end{align*}
\]

1 Gross Margin of 1 hectare potatoes; growing period 7 months

We start with the data, as follows.

Output:

- yield potatoes (50000 kg at M 0.20) = M 10000
- undersized potatoes sold to a livestock farmer = M 800
no income from straw, brans etcetera

Variable costs:
- seed potatoes
- fertilizer
- fungicide

The interest rate is 12%

**Gross Output**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ware potatoes</td>
<td>10000</td>
</tr>
<tr>
<td>other potatoes</td>
<td>800</td>
</tr>
<tr>
<td><strong>Total Gross Output</strong></td>
<td><strong>10800</strong></td>
</tr>
</tbody>
</table>

**Variable costs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>seed potatoes</td>
<td>2519</td>
</tr>
<tr>
<td>fertilizer</td>
<td>300</td>
</tr>
<tr>
<td>fungicide</td>
<td>850</td>
</tr>
<tr>
<td><strong>Sub var. costs</strong></td>
<td><strong>3669</strong></td>
</tr>
</tbody>
</table>

Interest: \(\frac{3669}{2} \times \frac{7}{12} \times 12\%\) = M 128

**Total variable costs** = M 3797

**GROSS MARGIN** = M 7003

2 Gross Margin of 1 hectare mixed cropping millet, sorghum, groundnuts, cowpea; total growing period 9 months

Output:
- yield millet 500 kg at M 1.90/kg = M 950
- yield sorghum 1050 kg at M 2.20/kg = M 2310
- yield groundnuts 700 kg at M 6.50/kg = M 4550
- yield cowpea 400 kg at M 7.80/kg = M 3120

No income from straw, brans etc..

The interest rate is 12%

Variable costs:
- Seeds:
  - millet 2 kg at M 1.90/kg = M 3.80
  - sorghum 2 kg at M 2.20/kg = M 4.40
  - groundnuts 19 kg at M 6.50/kg = M 123.50
  - cowpea 4 kg at M 7.80/kg = M 31.20

- Fertilizers:
  - compound fertilizer 2 bags at M 300/bag = M 600
Hired labour:
80 man-hours at M 2.5 per man-hour = M 200

Bags for transportation: 20 bags at M 0.25/bag = M 5

Gross output

Millet M 950
Sorghum M 2310
Groundnuts M 4550
Cowpea M 3120

Total gross output M 10930

Variable costs

seeds millet M 3.80
sorghum M 4.40
groundnuts M 123.50
cowpea M 31.20
fertilizers M 600
hired labour M 200
bags M 5

Subtotal M 967.90

Interest \( \frac{967.90}{2} \times \frac{9}{12} \times 12\% = M 43.56 \)

Total variable costs M 1011.46

GROSS MARGIN M 9918.54

3 Gross Margin of 1 ha cotton (irrigated); growing period 11 months

Yield cotton: first crop 700 kg
second crop 280 kg

Total yield 980 kg at M 13 per kg = M 12740

Interest rate is 15%.

Total yield M 12740

Variable costs:
Compound fertilizer M 1220
Insecticide M 530
Packing materials M 530
Fuel irrigation pump M 160
Casual labour
hoeing M 850
picking first crop M 2650
second crop M 850
Subtotal: M 6790

Interest: \( \frac{6790 \times 11}{2 \times 12 \times 15\%} \) = M 467

Total variable costs = M 7257

\[ \text{GROSS MARGIN} = \text{M 5483} \]

### 4 Gross Margin calculation of a poultry flock of 1000 laying birds

**Gross Output**

- eggs sold: 19300 dozen at M 2.50 = M 48250
- culls: 900 at M 3 = M 2700

Total sales = M 50950

- less pullets bought (1000 at M 8 each) = M 8000

\[ \text{Variable costs (including interest costs)} \]

- feed: 40 tons layers ration = M 28800
  (950 hens average present \( \times \) 115 g per day \( \times \) 365 days)
- litter, lighting, medicines, etc. = M 800

\[ \text{GROSS MARGIN} = \text{M 13350} \]

The gross margin is thus M 13350 for 1000 birds or M 13.3 per bird.

It can be compared with the gross margin of a previous flock and other flocks, to see whether our flock has done well or not, in relative terms.

### 5 Gross Margin of a dairy herd

Calculate the gross margin that is based on the following data:

- Opening value herd = M 15820
- Closing value herd = M 17250
- Output:
  - cows = M 1600
  - yearling heifers = M 800
  - bull calves = M 240
  - milk = M 12509
  - sub output = M 15149

- Home consumption:
  - cow = M 800
  - milk = M 250
Total home consumption M 1050
Purchases of animals M 1200

**Variable costs**

- corn-and-cob meal M 1850
- milk for calf feeding M 790
- total miscellaneous costs M 2200
- triple super fertilizer M 975
- ammonium nitrate fertilizer M 1800

sub var. costs M 7615
interest on average herd value 6% M 992

Total variable costs M 8607

**Now the Gross Margin calculation, as follows.**

Increase in herd value:
- closing value herd M 17250
- opening value herd M 15820

Increase M 1430

**Total turnover during the year:**

- Sub output M 15149
- Home consumption M 1050

Subtotal M 16199
- Purchases M 1200

Total turnover M 14999

Gross output M 16429
Variable costs M 8607

**GROSS MARGIN**

M 7822

6 Calculate the gross margin/ha and the gross margin/ha/man-day of the following farming activities:

<table>
<thead>
<tr>
<th></th>
<th>Dairy farming (stall feeding)</th>
<th>Food grain (maize)</th>
<th>Cash crop (cotton)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yields</strong></td>
<td>2500 kg/cow</td>
<td>1000 kg/ha/crop</td>
<td>800 kg/ha/crop</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>M 1/kg milk</td>
<td>M 2/kg</td>
<td>M 3/kg</td>
</tr>
<tr>
<td><strong>Harvest per year</strong></td>
<td>3 cuts</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Land preparation costs/ha</strong></td>
<td>M 200/year</td>
<td>M 600</td>
<td>M 600</td>
</tr>
<tr>
<td><strong>Seed &amp; fertilizer costs</strong></td>
<td>M 2000/ha/year</td>
<td>M 50/ha</td>
<td>M 200/ha</td>
</tr>
<tr>
<td><strong>Other variable costs</strong></td>
<td>M 1000/cow</td>
<td>M 100/ha</td>
<td>M 200/ha</td>
</tr>
<tr>
<td><strong>Carrying capacity</strong></td>
<td>4 cows/ha</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Labour costs</strong></td>
<td>M 30/cow</td>
<td>M 40/ha</td>
<td>M 50/ha</td>
</tr>
</tbody>
</table>

**Solution:**

<table>
<thead>
<tr>
<th></th>
<th>Dairy</th>
<th>Maize</th>
<th>Cotton</th>
</tr>
</thead>
</table>

Gross margin
<table>
<thead>
<tr>
<th></th>
<th>Dairy</th>
<th>Maize</th>
<th>Cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenu/ha</td>
<td>M 10000</td>
<td>M 2000</td>
<td>M 2400</td>
</tr>
<tr>
<td></td>
<td>(2500 × 4 × 1)</td>
<td>(1000 × 2)</td>
<td>(800 × 3)</td>
</tr>
<tr>
<td>Costs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>land preparation</td>
<td>M 200</td>
<td>M 600</td>
<td>M 600</td>
</tr>
<tr>
<td>seed &amp; fertilizer</td>
<td>M 2000</td>
<td>M 50</td>
<td>M 200</td>
</tr>
<tr>
<td>others</td>
<td>M 4000</td>
<td>M 100</td>
<td>M 200</td>
</tr>
<tr>
<td></td>
<td>M 6200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross margin/ha</td>
<td>M 3800</td>
<td>M 1250</td>
<td>M 1400</td>
</tr>
<tr>
<td>Gross margin/ha/manday</td>
<td>M 31.66</td>
<td>M 40</td>
<td>M 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M 31.25</td>
<td>M 28</td>
</tr>
<tr>
<td>Conclusion</td>
<td>++ *</td>
<td>+</td>
<td>+/-</td>
</tr>
</tbody>
</table>

++ * = very positive

Before we advise to enlarge (extend) an enterprise at the expense of another enterprise, we should consider the need for extra investments and the increase in regular labour.
6  Gross margin and farm management

‘Gross margins’ are useful for detecting weak points in the management of a farm.

To take a very simple example, assume that a farmer has 2.8 ha cropped as follows:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Gross Margin (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4 ha cabbage;</td>
<td>M 1000/ha</td>
</tr>
<tr>
<td>0.4 ha potatoes;</td>
<td>M 875/ha</td>
</tr>
<tr>
<td>2 ha cattle;</td>
<td>M 1250/ha</td>
</tr>
</tbody>
</table>

\[ \text{Total Gross Margin} = M 3250 \]

less:

<table>
<thead>
<tr>
<th>Fixed Costs (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.8 ha fixed costs</td>
</tr>
</tbody>
</table>

\[ \text{Profit} = M 2900 \]

The reason for presenting the results in this way is that it is then easy to see the effect on profit of altering or improving the system of farming.

Suppose that the farmer, by applying M 50 of fertilizer, can increase the gross margin of the potato crop by M 150. This would increase the total gross margin by M 150 and, as the fixed costs would remain the same, the profit would also rise by M 150.

Suppose that the farmer grew less potatoes (0.2 ha) and instead of that more cabbage (0.2 ha). The effect would be a loss of M 175 (potatoes) and a gain of M 200 (cabbage) gross margin. That is to say, a net gain of M 25.

Will this not change the man- and machinery-hours required? The answer is that if the change is not a large one, the regular labour force and machinery will remain virtually unaltered - it is being assumed here that all the work is done by regular labour.

If, on the other hand, the change in the farm programme is so large that an extra labourer is required, the fixed costs will rise by one lump sum.

The idea is now to use these gross margins for identifying weaknesses in farm organisation. If farm income is too low, the faults that are likely to be found can be classified under three headings:

1. The gross margins per hectare or per unit of output may be too low - due to low yields, expensive stock or excessive variable costs such as feedstuffs.
2. The farming is not intensive enough - not enough high value crops or livestock.
3. The fixed costs may be too high - labour, machinery and power, rent or other overheads.

Each of these faults has a different remedy and these remedies are summarized in the table on the following page. The table displays diagnosis of faults with the aid of gross margins.
Fault 1  Improve the present system:
Low gross margin
*  improve crop yields (fertility and drainage problems, diseases, etc.)
*  improve livestock yields (diseases, poor stock, poor feeding, etc.)
*  economise on livestock costs (especially feedstuffs, utilisation of grass and fodder)

Fault 2  Plan a more intensive system:
Low intensity
*  change to a more intensive livestock system (more cows per ha through pasture improvement and fertilisation; pigs or poultry)
*  grow more high value crops

Fault 3  Economise on labour, machinery and other overheads
High fixed costs
*  minimise buildings and fencing
*  streamline layout of fields to economise on labour and machinery
*  specialise to ensure full use of expensive equipment and/or buildings
*  keep a check on other overhead expenses

Of course these examples are over-simplified and they are merely intended to illustrate the principles involved. And in practice, more than one thing may be wrong on a farm, and in that case a combination of remedies may be needed. Moreover, the changes and improvements indicated above have their limitations, as outlined below.

**Improve the present system (1)**
The application of a second bag of fertilizer gives a lower increase in kg crop yield than the first, and the third bag less than the second, etc. The effect is similar with concentrate fed to dairy cows.

**Change to a more intensive system (2)**
It should be realized that these changes often require more labour and also capital investment (so increased fixed costs).

And, what is even more important, a much higher level of day-to-day management will be required. For instance, compare a cow-calf beef herd with a herd of dairy cows. The total output of the dairy herd is much higher than that of the beef herd. At the same time the costs of the dairy herd are also much higher.

If management is not of the required standard, the extra costs might use up (or even exceed) the extra revenue; all that the farmer gets is a lot more worries!

The same applies to milking twice per day with artificial calf rearing as compared with milking once a day and natural calf rearing.

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Fault 1 Low gross margin</th>
<th>Fault 2 Low intensity</th>
<th>Fault 3 High fixed costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beets</td>
<td>0.4 ha at 1075/ha</td>
<td>&gt; M 430</td>
<td>0.4 ha at 500</td>
<td>&gt; M 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.2 ha at 1075</td>
<td>&gt; M 1290</td>
</tr>
<tr>
<td>Potatoes &amp; peas</td>
<td>0.8 ha at 1750/ha</td>
<td>M 1400</td>
<td>0.8 ha at 1500</td>
<td>M 1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.4 ha at 1750</td>
<td>M 700</td>
</tr>
<tr>
<td>Cattle</td>
<td>2.8 ha at 1250/ha</td>
<td>M 3500</td>
<td>2.8 ha at 500</td>
<td>M 1400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.4 ha at 1000</td>
<td>M 2400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.8 ha at 1250</td>
<td>M 3500</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>4 ha at 700</td>
<td>M 2800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 ha at 1097</td>
<td>M 4390</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 ha at 1332</td>
<td>M 5330</td>
</tr>
<tr>
<td>Fixed Costs</td>
<td>4 ha at 75/ha</td>
<td>M 300</td>
<td>4 ha at 75</td>
<td>M 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 ha at 75</td>
<td>M 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 ha at 250</td>
<td>M 1000</td>
</tr>
<tr>
<td>Profit</td>
<td>M 5030</td>
<td>M 2500</td>
<td>M 4090</td>
<td>M 4330</td>
</tr>
</tbody>
</table>
Similarly it is more difficult to obtain a gross margin from a crop of potatoes, peanuts or peppers (to name a few crops) than from crops such as sugar cane. **If the right management is available,** it will be rewarded, but if the right management is not available the high costs are still there!

**High fixed costs (3)**

It is clear that there should be a proper relation between gross margin and fixed costs. High fixed costs (labour, machinery, rent of land, buildings) must be combined with intensive farming (a high gross margin). Farming with low intensity (a low gross margin) can only be profitable with low fixed costs.

For instance, beef cattle farming in areas of high land prices and with expensive buildings and machinery can never be profitable. The same can be said of extensive crops.

On the other hand, the farmer with little land and no alternative use for his labour, or who has had to set up new buildings and fences (high fixed costs over several years) can only survive if he engages in intensive farming such as dairying and vegetable growing.

Results of gross margin calculations of enterprises of different farms should always be compared very carefully since only a part of the total costs (i.e. the variable costs) are taken into consideration.

**Example**

On farm ‘A’ weed control and harvesting is done by casual labour while on farm ‘B’ this job is done by the regularly employed labour force. On farm ‘A’ the costs of weed control and harvesting are variable costs and therefore will be deducted from the gross output while on farm ‘B’ weeding and harvesting costs will be fixed and for this reason will not be deducted from the gross output to calculate the gross margin. This will cause a difference in the outcome of the gross margins but this difference does not necessarily indicate a difference in the final financial result of the two farms.
7 Farm income measurement

This chapter is about ways to measure farm income.

It is important to know that there are several ways to measure farm income. Often, similar measurements are used in a different way by different people and this is confusing. So, when you read an income calculation you must realize that the measurement applied may be different from the one that you learn here.

First of all, remember what was said earlier in this guide about variable and fixed costs, (total farm) gross output, (total farm) gross margin and profit/loss over, say, a one year period:

\[
\text{Gross Margin} = \text{Gross Output} - \text{Variable Costs} \\
\text{Profit or Loss} = \frac{\text{Total Value Output or Farm Gross Output}}{\text{Total Value Input or Total Costs (fixed and variable)}} \\
\text{and hence} \\
\text{Profit or Loss} = \frac{\text{Total Farm Gross Margin}}{\text{Fixed Costs}}
\]

‘Profit / Loss’ is generally called NET FARM INCOME.

Net Farm Income is used for (family) living expenses and for the payment of taxes (income tax; social security tax in many countries). The amount left after living expenses and taxes may be used for increasing the farm business' assets or decreasing its liabilities (see Balance Sheet in FARM ACCOUNTING). If there is not enough to cover living expenses, etc., the opposite happens but this cannot last for more than a few years.

The Net Farm Income is in general NOT equal to the cash income the farmer gets from the farm. As you know, we calculated opportunity costs for family labour, depreciations and also interest costs for the use of own funds. Although they are costs, they do not imply cash expenses by the farmer. On the other hand, paid interest is not included but has to be paid.

The Net Farm Income corrected (adjusted) for cash is often called MANAGEMENT AND INVESTMENT INCOME (M + I).

These corrections are shown in FARM ACCOUNTING, chapter 4.

Note that the M + I Income will still be positive as long as a possible loss on the Net Farm Income does not exceed the corrections.

Why is income (or profit) so important?
The answer seems to be obvious because almost everybody worries about income.
But there are more reasons why we are interested in a farm's income or profit. First of all, by measuring income or profit we actually measure the economic strength of the farm. If, for instance, we have invested a total amount of M 100000 in our farm and the yearly profit is M 4000, the interest rate of return is 4%.

Even if we can live from that amount of money, we are not very impressed by this 4% figure. Anyway, if we want to increase this farm's relative profitability (i.e. improve its economic strength), any new project would at least have to meet with this (low) 4% return figure.

This brings us to a second point. Sometimes we have to borrow money for our plans. It would not be wise to borrow money at a rate of, say, 10% and invest it in a project that promises 4% only.

To summarize:
1 Profit provides a mirror for seeing the economic strength of a farm. Consequently we get an impression of the continuity of the farm.
2 Farm income is necessary for living. However, be aware of the fact that we cannot extract from a farm more than its profit every year, or every other period that we take into account. Because in the long run this would ruin the continuity of the farm.

Whichever definition of income or profit is taken, the following is perhaps the most important one:

'profit is the amount of money you can use for domestic purposes without endangering the farms' continuity.'

Note:
The topic ‘farm income measurement’ is only very briefly discussed in this chapter, but it is important that it is well understood.

Everywhere in training courses students and (future) commercial farmers will be interested in this particular topic (see above). We suggest that you as teacher give this chapter a content which fits the local situation.

An outline for how to calculate the Net Farm Income, followed by the M + I Income calculations:

<table>
<thead>
<tr>
<th>Total Farm Gross Output</th>
<th>M .........</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Variable Costs</td>
<td>M .........</td>
</tr>
<tr>
<td>Total Farm Gross Margin</td>
<td>M .........</td>
</tr>
</tbody>
</table>

Fixed Costs:

- machinery and equipment depreciation M .........
- interest M .........
- maintenance M .........
  ─────── + M .........
- buildings, etc. depreciation M .........
- interest M .........
- maintenance M .........
  ─────── + M .........
- permanent labour including family labour M .........
- possibly tenants rent M .........
- miscellaneous paid costs (e.g. water and electricity charges) M .........
  ─────── +
NET FARM INCOME (Profit or Loss)

Total calculated interest costs minus paid interest costs
Calculated depreciation minus re-investments

Family Labour
Home Consumption

MANAGEMENT + INVESTMENT INCOME
8 Farm labour

Introduction
The resource called ‘labour’ is the work done by human beings. Economically speaking, when a farmer hires a labourer, he is buying only so and so many hours of work.

Good labour relations are very important.

Where no labour is hired, the amount of labour for farm work is limited by the size of the family. In many countries family labour becomes more and more scarce. In some countries there is a tendency that wives take up jobs outside the farm and almost everywhere children spend more and more time on education and training.

In certain countries in the tropics the area of cultivated land is determined by the amount of work the family can do. If the farmer could get more labour he would cultivate more land. In such a case the labour supply is limiting the size of the farm.

Man-days and number of man-days per man per year
The unit of labour is not ‘one man’ but the work of one person (man or woman) for a specified period of time: for example one man-hour or one man-day.
Two man-days may be the work of two men for one day or one man for two days.
The total number of man-days is obtained by multiplying the number of men by the days worked.
For planning purposes we may assume about 250 man-days per man per year.

Labour requirements, work peaks and slack periods
How much labour is required on the farm, in total and during specified periods (months or even weeks)?
In many countries data are available which give per activity an estimation of the number of man-days required during a specified period. Most farmers also know by experience how many days it takes to finish a certain job.

Once we know which farm enterprises are in operation, or are going to be set up, together with the number of man-days required to implement these activities, then we are able to draw up a labour profile showing the total labour requirements in man-days per month for the whole year.

Farm work, as is well known, is not regularly done month after month throughout the year. There are busy periods at the time of planting and at harvest; it is in these busy periods (work peaks) that the labour supply can be a serious limitation.
Work peaks occur because there is not much time to finish certain jobs.
If, for instance, planting is delayed there will almost certainly be a loss in yield. It is essential to finish such work in time.
But at other times in the year there may not be sufficient work to keep the whole family or the labourers busy.
It is likely that a farmer will have less labour than he wants at work peaks and/or more than he wants in slack periods.
One solution to this problem is to hire casual labourers. Alternatively, members of the family may be able to organise their household duties and other tasks in such a way that they are free to help on the farm at times when this help is most valuable.
Labour efficiency may be improved by spreading the labour requirements more evenly over the year; for instance, through a different combination of the farm's enterprises. Also by using better tools and by mechanisation.
Whatever method the farmer may apply to solve the problem, the amount of labour available in busy periods may limit total production.

**Permanent labour versus casual labour**
Labour may be hired on a permanent basis as full-time regular labour or on a temporary basis as part-time or casual labour.
Full-time workers may be more skilled and better at work than temporarily hired workers. They are also available throughout the year.
However, it is usually more convenient and cheaper in the long run to hire labourers when they are needed.
Temporary labourers may be paid a daily wage or they may be paid according to the amount of work done.
While the daily paid worker is required to work a definite number of hours each day, the piece worker can go home when his fixed amount of work is done.
The piece work system may be more difficult to organize since it means that the farmer has to establish new rates of pay for each task that has to be carried out, and probably more time is needed for control (time to check whether the task is done in the proper way).

**The cost of labour**
The cost of labour is equal to the net salary paid plus the levies for insurance, pension, etc. in-so-far as these have to be paid by the employer.
To calculate the farm profit or loss the family labour should be valued at the rate that would have been applied if this labour were employed outside the farm (opportunity costs of family labour!).

**NOTE:**
Labour is not a factor to be overlooked as is sometimes done in articles and books advocating ‘low external input agriculture’, ‘organic farming’ or ‘ecological agriculture’. However desirable they may be, they often require a very substantial labour input and this should receive due attention. The often heavy labour demand may make these types of farming less attractive to farmers.
9  Cash flow calculations

9.1  Introduction

So far in our calculations we have been dealing with costs (input) and revenues (output).
It should be clear that not all costs are in reality expenditures. Some expenditures are costs at the same time but we also have costs which are not really expenditures and finally expenditures which cannot be considered as costs.

A few examples may make these differences more clear:

- Costs and expenditures at the same time: purchase of fertilizers, stock feeds, etc.
- Costs but not expenditures this year: costs of calculated interest, costs of depreciation, calculated costs of family labour, decrease of stocks and herd value use of owner-occupier land
- Expenditures but not costs this year: purchase of livestock or land, purchase of farm machinery, family expenditures (for instance school fees), redemption of loans

The same can be said about receipts and farm output or revenues:

- Receipts and farm revenue at the same time: sale of farm products such as maize, milk, sunflower, eggs, etc.
- Farm revenue but not receipts: farm produce used for home consumption increase of herd value farm re-use
- Receipts but not farm revenue: money received on loans, money received for off-farm activities, sale of produce grown in the previous year

The calculations on costs and revenues which we have made so far were mainly made to get an idea about profitability. That is, to find out whether a certain enterprise or even the whole farm will give a profit.

These calculations are very important because no farm can be continued in the long run if there is no profit. If there is no profit, sooner or later the farm will have to be stopped due to lack of funds for the necessary input to keep the farm going.

Apart from profitability there is another important factor which is liquidity. A liquidity calculation is based on payments and receipts and not on costs and farm output or farm revenues.

In case the total amount of receipts exceeds the total amount of payments during a certain period the farm (or, in general, a business) is called liquid for that period.

In the opposite case (payments exceeding the receipts) the farm is called illiquid. In this case the farmer will need additional funds from outside the farm to enable him to make the payments required in order to keep the farm going.

In practice it happens quite often that a profitable business cannot be continued because of liquidity problems.

9.2  Cash flow calculations

The purpose of cash flow calculations is to know whether a certain farm enterprise or the farm as a whole is liquid or illiquid.

When making a cash flow calculation it is not the revenues and costs which are taken into account but the receipts and payments.

A cash flow calculation is a projection of the money coming in and going out.
The period over which we make the cash flow calculation may vary. If we want to know whether a farmer will be able to repay a loan, a cash flow calculation per year for several years may be required.

*See exercise number 15.*
10 Credit

A farmer may at times find that he has insufficient money to meet immediate business expenses and he may be compelled to borrow money to meet a temporary shortage. A loan may be needed to carry out permanent improvements such as the planting of tree crops or the building of a milking shed. The borrowing of money does not imply that the farm is showing a loss; even an efficient farmer may need a loan on occasion.

Credit may be obtained from institutional bodies or from private institutions (mainly commercial banks). Such credit is called formal credit. In this chapter our main concern is formal credit. However, many farmers, especially small-scale farmers, do not have access to formal credit. They depend therefore on family members, merchants and other money lenders in order to get credit. Such credit is called informal credit. Informal credit is generally the most important form of credit open to small-scale farmers. It is often a very delicate issue, and most farmers are not happy to give (reliable) information on such an issue.

10.1 Short-term credit

The dairy farmer whose receipts are spread over the year is perhaps in the most favourable position in respect of ready cash. However, on a crop farm expenses for seeds, manures and fertilizers have to be met when very little money is coming from sales, and it may be necessary to borrow money until the period of harvesting.

Two main sources of short-term credit are open to the farmer:

- a bank overdraft
- credit from merchants

A bank may require the borrower to provide securities to cover the loan, such as a deed of property. If the farmer has no possessions of his own to offer, a friend or relative may be willing to offer securities or to give a guarantee that the bank finds acceptable.

In some cases, when a farmer can show a Balance Sheet with a substantial Net Capital (see Agro-Source 4: Farm Accounting), a bank may be prepared to advance money without a formal security. But the farmer may be required to give the undertaking that when any part of his stock is sold the proceeds will be paid into the bank account.

A bank overdraft thus granted carries interest which may vary with time but is usually 1 to 1½% above the official bank rate set by the national Central Bank.

A bank overdraft is a very useful form of short-term credit to cover a seasonal shortage of cash that lasts for some months.

Merchants (for instance suppliers of feedstuffs, seeds and fertilizers) are sometimes prepared to allow their bills to remain unpaid for several months. In return the farmer must expect to pay a somewhat higher price than he would if the bills were paid promptly.

Another form of short-term credit is hire-purchase, which is often used for large implements such as tractors. It involves monthly payments (instalments) for a certain number of years, including interest on the whole amount borrowed. Thus the effective rate of interest is (much) higher than the stated interest rate. Theoretically the implement remains on hire to the farmer until the last instalment has been paid.
On the whole, a bank overdraft is usually the cheapest form of short-term credit. The price of merchant's credit varies but it is usually rather more expensive. This is not unreasonable because the farmer is using the merchant's capital and the merchant in turn may have to borrow from a bank. Hire-purchases are often used by farmers who cannot obtain a bank loan. Some of these farmers have difficulty in repaying their loans and this raises the costs of the hire-purchase company, hence the relatively high charges. Merchant's credit is often criticised, but it cannot be denied that (beginning) farmers without acceptable securities for a bank overdraft have often been helped over a difficult period by a merchant who had faith in their abilities (and who wished to earn their future goodwill).

10.2 Long-term credit

Various forms of long-term credit are available to the farmer to carry out permanent improvements on the farm. Such loans may be raised by private arrangement or through one of the officially approved schemes that exist in many countries. Usually the security is a mortgage on land or buildings; in that case, credit is only available to owners of real estate. Arrangements can be made to pay off loans over periods of up to, say, 30 years, each instalment consisting partly of interest and partly of the original loan.

The interest on a loan is a cost to the farmer (cost of capital investment).

Before expanding a farm business with the aid of a loan (e.g. new buildings, bigger crop acreage, more intensive farming, more livestock) the farmer has to make an estimate: will the yearly revenue from the expansion exceed the yearly costs? These costs are interest and depreciation. Even if a farmer can use his own funds to finance the investment, such a calculation must be made. Because the farmer should realise that, if his own funds are put in a bank, interest can be collected without any risk at all. And if depreciation is not considered as a cost, the farmer will find that after a time the investment has worn out and there is no money to replace it.

Conclusion

In many countries governments take elaborate measures to provide credit facilities for farmers, by encouraging the formation of special agricultural banks and co-operative credit societies of various kinds. In other countries banks and merchants remain the normal sources of credit. If it comes to borrowing from a bank, the owner-occupier of land or the man who is fortunate enough to possess stocks and shares seldom has difficulty in obtaining a loan. And the established farmer, who has carried on business with success over a number of years, can normally secure a loan on his personal reputation without formal security. But the tenant farmer who is not well known and whose need is primarily for short-term credit may have difficulty in borrowing at the beginning of his career when the need for such facilities is greatest. A bank cannot be expected to advance money unless there is a reasonable expectation of repayment. An ‘agricultural charge’ would allow a tenant farmer to pledge his crops and stock, but it is unpopular amongst bankers because it is difficult to enforce if a farmer is not co-operating.

Often the chief source of short-term credit is the bank. Here much depends on the manager of the bank, on his ability to distinguish between the farmer who needs credit to expand his farm on sound lines and the man who wishes to borrow to stave off bankruptcy. The farmer who keeps satisfactory accounts is more likely to receive sympathetic consideration on questions of credit and borrowing than one who has not kept accounts, because the former can present a plan for the future based on figures that express recent performance.


11 Market prices set by supply and demand

In this chapter we will briefly and in very general terms explain what causes prices to rise or fall or be stable. Under the assumption that there are many well-informed buyers as well as sellers, that there is uniformity in the supply and that buyers as well as sellers behave rationally

The market
At the food market of any town one finds people trying to sell food and other people who buy food. At the food market buyer and seller meet and come to an agreement on the price. But ‘market’ is not only a place, it is also a process, the marketing process. Therefore we can talk about the housing market, the labour market and other ‘markets’.

11.1 Demand

Let us observe the people who come to the food market to buy one particular product, let us say yam (edible tuber of tropical plant). Or any other produce, say, potatoes, apples or oranges.

A person may come there to buy two kg of yam. The person may go straight to a stall where yam is sold and ask for yam, pay the price that is asked and go away. But more often it will not happen so fast. Instead, he or she will walk through the market first and ask several stalls where yam is offered (so we suppose that there is a choice for the buyer!) about the price that is asked and compare the quality of the yam. He or she may also look at other products that are offered and which (to a certain extent) could replace the yam, such as cassava, sweet potatoes or Irish potatoes.

Now, after having walked through the market, what will our buyer (or ‘consumer’) most likely do?

1. If he or she still decides to buy yam, it will be bought at the stall that offers the best quality, unless the price is not the same at all the stalls. If lower quality is offered at a lower price, the lower quality may be bought. It depends on the buyer's budget and also on his or her preference.

2. He or she may decide not to buy yam but rather to buy something that can replace yam. This depends on:
   - the price of yam compared with the price of other products.
     If yam is at M 1 per kg and sweet potatoes at M 2 per kg, then yam is cheap, but if sweet potatoes are at M 0.40 per kg, yam is expensive and may not be bought.
   - the personal preference of the buyer. Some people want yam, no matter the price of other products, while others are prepared to switch to something else if the price is lower.

This process of the buyer choosing what to buy, when the prices are given, does not only take place at the town's food market, but also in the shops and indeed anywhere, when a person decides to buy or not to buy.

If we add up the decisions of all the potential buyers in a district or country, or even in the whole world, then we have the demand for a certain product, in this example - yam.

So at a certain price a set number of buyers decides to buy a set amount of produce.

If the prices were lower more people would decide to buy; if the prices were higher less people would buy.
This is being illustrated by the graph below.

Curve A shows the ‘normal’ demand curve for yam. The higher the price the smaller the quantity that can be sold at a given time.

Curve B shows increased demand. This is the case when:
- the population grows or when there are export possibilities (as short-term factor very important), which means added buyers from abroad;
- the prices of products that can replace yam have risen. When other products are less available, more people choose to buy yam at the same price;
- the preferences of the public are changing. For instance, more people learn to appreciate yam above other products, through advertising campaigns and cooking demonstrations;
- the income of the people has increased, so they can afford to buy more. This is for a product like yam (and food in general) not an important factor, because people have to eat and can only eat a certain amount no matter what their budget is. But for other products considered as ‘luxury’ (cars, expensive furniture, holidays abroad etc.) this can be a determining factor in deciding to buy or not to buy.

Curve C shows decreased demand. This situation is generally caused by the opposite of the four causes of increased demand:
- decrease in population and/or lost export markets (fewer buyers);
- products that can replace yam have become cheaper or are otherwise more readily available;
- people gradually loose their preference for yam, for instance through advertising campaigns or negative publicity about yam;
- the people's income decreases. Not so important in the case of yam (and food in general).

Curve D shows a (government) organisation buying any amount at a set price in order to prevent the price falling below a certain level. Of course this organisation will have to do something with the yam, because it is not a real consumer. For instance, donate it to people in the low income class who otherwise would never buy it. Or ‘dump’ it on the export market at any price it can get (to the detriment of the country's goodwill abroad!).

Note that for an individual farmer the demand for his produce is something over which he has no control. Only through joining together, for instance in co-operatives to sell their produce, can farmers possibly expect to influence buyers, for example through advertising. Or they may even in this way be able to explore markets abroad.

However, it is in the interest of the individual farmer:
1. To keep himself informed as well as possible about likely or actual changes in demand.
2 To make sure that he produces the best possible quality, and that the product reaches the final consumer in the best possible condition and presentation.

11.2 Supply

Now that we have analyzed the behaviour of the buyers in the market, let us turn to the sellers.

The main purpose of the sellers who are at the market is to make a profit, mostly in order to make a living.

If we continue with the example of yam, we can see that some of the sellers are farmers who have produced the yam on their farms.
Some sellers are not farmers but middlemen, who have bought the yam on farms where it was produced and who have then transported it to the market, hoping to sell it at a profit as their means of making a living.
But these middlemen would not have had yam to buy if it were not produced by farmers.
So the indirect seller at the market is always the farmer who produced the product, and he or she only produced it with the hope of selling it at a profit.

How does this profit come into being?
When a farmer grows, say, 1000 m² of yam, there are costs: use of the land, land preparation, planting material, possibly fertilizer and other materials, and labour costs.
When the crop is ready he can harvest a certain amount of yam. Then he can add up all his costs and divide this figure by the amount of yam harvested.

In this way he can define the cost price of the yam.
Suppose that the cost price is M 0.50 per kg. If yam can be sold for a higher price than this the farmer makes a profit, which is a reward for the care he has put into the crop and also a premium for the risk that he has taken.
The quantity harvested is not always the same: a crop may not give any yield at all for some reason (the weather being the most important), but the farmer still has his costs and these can only be paid out of the profit of earlier and more successful crops.

Of course, the farmer would like to make the profit as big as possible, but if he tries to sell at an exorbitant price he will find this impossible, because other farmers are also trying to sell the same product.
So if the farmer cannot get sales he is probably forced to lower his price until it reaches a level where he can find buyers.
This is the process of market competition.
Most of the products produced by farmers are perishable, so a farmer has to sell at whatever price he can get, even if this is below his cost price.

The only thing the individual farmer can do, is to decide to stop producing a certain product if the price falls (or is expected to fall) below his cost price.
However, the cost price is different for each farmer.
The farmer who uses the right technology can be expected to reap a (much) higher yield at slightly increased total costs. So his cost per unit (kg, litre, quintal) will be lower.

If we take the produce from all farmers together at a given time for a district, a country or for the whole world, then we have the supply of the product.

This is being illustrated by the graph below.
Figure 5: Curve A shows the ‘normal supply’ situation for yam. If the price is low, only a small quantity is supplied, because only a few of the better farmers are able to continue producing yam at such low prices (no farmer can continue selling below his cost price). When prices are higher, the weak producers (who produce at much higher costs) are also able to enter the market.

Curve B shows an increased supply of yam. This happens as follows.

- There is a general reduction in the prices paid by farmers for their input. For instance, seed and fertilizer prices are lower and every producer now has a lower cost price. However, there are still differences between individual producers.

  There may be several reasons for lower input prices, such as better technology in the industries producing this input or a government subsidy on a certain input.

  The situation of increased supply can also result from widespread application of better technology by the farmers. If, for instance, all producers have adopted better (higher yielding) plant varieties, use more fertilizer than before or apply a better way of planting, then everybody’s cost price has come down.

  However, again in this case, differences between individual farmers remain. Some farmers will always do a better job than others.

- For a country, the increased supply can also be the result of importation of the product from abroad.

  However, this can only continue if the farmers abroad are able to do a better job than the local farmers, because on top of their cost price they must also allow for the cost of transportation, insurance and handling of the product from one country to another.

  We leave out the case of ‘dumping’.

Curve C shows a decreased supply. This can be the result of the following.

- Higher input prices for all farmers.

- A general decline in interest in the product among producers, not because of a rise in costs, but because better alternative crops or even different activities become available to them. Even if this is only ‘imagination’ on the part of the farmers the outcome remains the same: less producers.

- For a country: cutting off or reducing imports through import levies or other ways of making imports difficult.

  The danger of this is that other countries will adopt the same policies and that it will work as a backlash on the country that started it.
11.3 The market price

Now that we have examined both demand and supply, we can figure out the possible result of all this for the actual market price.

In the situation illustrated above, in which both supply and demand are normal, there will be stable prices if the quantity supplied is the quantity marked X.

What will happen if there is an increase in demand? See following graph.

This graph shows that if demand increases it will make the price rise, eventually to level two, until the quantity on the market increases.

How can the quantity on the market increase? Only by increasing the local production or through imports.

If local farmers decide to increase production, it will take some time before this increased production reaches the market. Each product has its own time factor according to its production cycle.

Unfortunately, there are many ‘opportunistic’ farmers who will only produce if prices are high and, to make things worse, they often do not realise that prices are not the same all the time and their decisions are often made on the prices of the day.

So what will the increased quantity on the market eventually be? As follows:
The above graph shows that the quantity that will be produced based on today's price 2 will never be sold at that price, because a quantity $X_2$ can never be sold not even at price 0. The market is ‘flooded’.

Many producers will drop out again; gradually the quantity on the market decreases until at quantity $X_3$ prices stabilise again at a level slightly above price 1, but lower than price 2.

In reality both supply and demand are always changing. Both tend to increase in the long run. Demand increases because of increase in population in many countries and supply increases because of improved technology.

But it is mainly the opportunistic producer who causes the large changes in prices.

The above analysis for yam holds in general terms for any product and price anywhere.

What can be the conclusions and guidelines for the serious, individual farmer?

1 Above all: produce with the best possible technology (whether it is old or new) so that the cost price is as low as possible. In the long run only the farmers with a low cost price per unit of produce will survive.

2 Always produce the best possible quality. Especially in times with a flooded market only high quality products will be sold.

3 Always realise that prices are changing continually, so never base plans on today's prices. Try to analyze and estimate the prices that can be expected when the product is ready for the market. If this is not possible, remember that in the long run it is the steady producer of good quality products who will survive.

Farmers who start to produce only when prices are high will always come ‘behind the market’.

4 Be aware that a real profit is only an average of several crops or batches of farm animals. Because in farming we are working with live things and often the weather can have a big influence. We cannot expect to have top yields all the time. However, the best farmer will always have top yields compared with less efficient fellow-farmers!
Market prices set by supply and demand
12 Small-scale dairy farming: a cost calculation

A group of farmers in a village sells milk to a dairy plant in a nearby town. The farmers complain and say, they feel the price the dairy pays for their milk (= M 2 per litre delivered to the dairy) does not even cover production costs. However, the dairy maintains it pays a fair price to them. Who is right?

A cost calculation could be helpful in this situation. It would require farmers and representatives of the dairy to meet together, along with an impartial chairperson plus someone who is familiar with the type of calculation required.

The questions are:
(a) what are the actual production costs the farmers incur?
(b) what would be a fair price paid for the milk?

For the sake of the calculation we presume that there is one cow per farm. And we want to calculate the cost of producing one litre of milk.

STEP 1
The capital costs of the cow, the cowshed and the milking equipment are added together. The annual cost is calculated by dividing the number of years of useful life of each capital item (see chapter 2).

<table>
<thead>
<tr>
<th>Capital item</th>
<th>Value (M)</th>
<th>Useful life (years)</th>
<th>Annual costs (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy cow</td>
<td>2500</td>
<td>6</td>
<td>416</td>
</tr>
<tr>
<td>Milking shed</td>
<td>2500</td>
<td>10</td>
<td>150</td>
</tr>
<tr>
<td>Milking equipment</td>
<td>200</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>606</td>
</tr>
</tbody>
</table>

STEP 2
The annual cost of feed, veterinary treatment, labour, transport and artificial insemination A.I. is calculated (chapter 3) and added to the depreciated capital costs:

<table>
<thead>
<tr>
<th>Recurrent item</th>
<th>Unit cost (M)</th>
<th>Quantity</th>
<th>Annual costs (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
<td>2 per load</td>
<td>3 per day</td>
<td>2190</td>
</tr>
<tr>
<td>Concentrates</td>
<td>1.5 per kg</td>
<td>3 per month</td>
<td>54</td>
</tr>
<tr>
<td>Minerals</td>
<td>20 per kg</td>
<td>2 per month</td>
<td>480</td>
</tr>
<tr>
<td>Veterinary treatment</td>
<td>25 per month</td>
<td>12 per year</td>
<td>300</td>
</tr>
<tr>
<td>labour</td>
<td>5 per day</td>
<td>1 p.p.d.</td>
<td>1825</td>
</tr>
<tr>
<td>A.I.</td>
<td>50 per take</td>
<td>1 per year</td>
<td>50</td>
</tr>
<tr>
<td>Milk transport</td>
<td>0.25 per litre</td>
<td>4050 per year</td>
<td>1012</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td>5911</td>
</tr>
<tr>
<td>Capital depreciation</td>
<td></td>
<td></td>
<td>606</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td></td>
<td></td>
<td>6517</td>
</tr>
</tbody>
</table>

STEP 3
The value of milk and other items sold in a year is calculated. The net profit is worked out by subtracting the total costs (recurrent costs plus depreciated capital) from the total revenue:

<table>
<thead>
<tr>
<th>Item sold</th>
<th>Unit value (M)</th>
<th>Quantity per year</th>
<th>Annual value (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh milk</td>
<td>2 per litre</td>
<td>4050 litres</td>
<td>8100</td>
</tr>
<tr>
<td>Calf</td>
<td>300</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>Old cow</td>
<td>1200</td>
<td>1 per every 8th year</td>
<td>150</td>
</tr>
<tr>
<td>Total Annual Revenue</td>
<td></td>
<td></td>
<td>8550</td>
</tr>
<tr>
<td>Net Profit per Year</td>
<td></td>
<td></td>
<td>2033</td>
</tr>
</tbody>
</table>
STEP 4
The cost of production and the net profit per litre of milk is calculated and this shows whether the
return on investment is reasonable. Remember that at present the dairy plant pays M 2 per litre of
milk delivered to the plant.

| Total annual costs of milk production (M) | 6517 |
| Total milk produced (litres) | 4050 |
| Cost of production per litre of milk (M) | 1.60 |
| Net profit/loss per litre of milk (M) | + 0.40 |

Observations
(a) Which party will probably benefit from the final calculation?
(b) What do you think of the profit per litre? (it is 25% of the cost of production).
(c) For producers it is always interesting to have a good look at the "recurrent items" cost. Here
we see that "grass" (fodder) and "milk transport" costs are relatively high. Could fodder be
produced at a lesser cost (without affecting quality and quantity)? We all know that high qual-
ity fodder, in sufficient quantity, is of prime importance in dairy farming, but costs have to be
considered as well.
  Could transport costs be reduced?
  Reducing costs will increase profit.
(d) We have assumed that there is one cow per farm. What is likely to happen to profit per litre if a
farmer has two or three cows?

Acknowledgement
The text of this chapter has been adapted from a text in "Reference Guide on Economic Analysis", a
Page for a similar calculation, taken from a local situation:
13 An article in the farming press

Several years ago the following article appeared in the farming press in Central Africa. See section 13.1.

13.1 Economics of cotton growing in small-scale farming

“The cotton farmer, whether small-scale or commercial, is not only interested in the cotton yield per hectare, but quite naturally asks himself what economic results he will achieve with this crop. In this respect, apart from the cotton yield, the prices for input, the farm gate price for seed cotton and the labour involved are decisive.

To a very large extent cotton in this country is grown by small-scale farmers with only about 1 to 2 hectares of cotton crop each. So the economics of cotton growing with this type of farmer is looked into in the following paragraphs which examine variable costs, gross margin, break-even yield, man-days worked and the rate per man-day for family labour. The following table displays variable costs, gross margin and break-even yield per hectare of cotton in small-scale farming.

<table>
<thead>
<tr>
<th>Variable costs</th>
<th>seed</th>
<th>pesticides</th>
<th>packing material</th>
<th>costs for oxen and equipment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M 6</td>
<td>M 93</td>
<td>M 3</td>
<td>M 70</td>
<td>M 172</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Returns</th>
<th>800 kg seed cotton at M 5.12 per kg</th>
<th>M 410</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross margin</td>
<td>M 238</td>
<td></td>
</tr>
<tr>
<td>Break-even yield</td>
<td>335 kg</td>
<td></td>
</tr>
</tbody>
</table>

Under the assumptions in the table the gross margin of one hectare of cotton is in the region of M 240 whilst the break-even yield is around 355 kg.

It has to be stressed, however, that these calculations have been made on last year's farmgate price for cotton and that they do not include overheads and labour costs.

No fertilizer costs have been taken into account since cotton is usually planted after maize and feeds on the fertilizer put on the maize grown the year before.

The small-scale farmer quite often engages his family labour only, so he has no immediate explicit costs for labour. He does, however, consider these costs. But instead of putting them down as variable costs, he meets these, as well as the salary for his own labour and management, out of the profit (gross margin). Only when he engages labour from outside his family at fixed rates will these costs appear as variable.

The table below displays man-days worked per hectare of cotton in small-scale farming.

<table>
<thead>
<tr>
<th>man-days per hectare</th>
<th>Land preparation (oxen-cultivated; including uprooting and burning of cotton plant residues)</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planting</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Weeding and thinning</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Spraying</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Harvesting (picking)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total man-days</td>
<td>110</td>
</tr>
</tbody>
</table>

On the assumptions underlying the table, a small-scale farmer will work approximately 100 man-days per hectare for his cotton crop.

Dividing the gross margin for cotton worked out in the first table (M 238) by the number of man-days from the second table (110 man-days), one arrives at the rate per man-day for family labour - just over M 2 per man-day.
There are, however, other aspects to be considered which do not show in the return but do influence the farmer's decisions. Some of these aspects are:

1. Cotton is quite drought resistant especially as compared with maize.
2. With cotton not being a food crop, the farmer usually suffers little through thieving.
3. Unlike many food crops, cotton does not readily perish and is hardly attacked by pests after harvesting; it also withstands fairly rough handling during transport.
4. Since the organisation responsible for production, processing and marketing of seed cotton pays the farmer within a few weeks after delivery, cotton can be considered as a good crop as far as the farmer's cash flow is concerned.
5. The farmer has relatively easy access to credit as well as input facilities and enjoys a well developed marketing structure and an extension service meeting his needs.
6. Cotton growing to a certain extent makes use of labour at a time when it is not in competition with the labour needs of other crops. It thereby increases the efficient use of the farmer's family labour and can thus contribute to a higher total income for the farmer.

All in all it would appear that cotton has considerable potential for the small-scale farmer especially when he uses his own family labour force. The crop might become even more profitable if the farmgate price for seed cotton is raised for the coming cotton season.”

(End of article)

13.2 Some questions and remarks on the above article

1. Is it correct to include the costs for oxen and equipment under the heading: Variable Costs?
2. The variable costs do not include an amount for calculated interest.
3. Is it fair to omit fertilizer costs completely?

It may be true that farmers do not apply fertilizer to cotton, but the cotton will need N, P and K to grow. If the farmer does not apply fertilizer it means the cotton will reduce the amount of these nutrients in the soil. And these losses must be corrected sooner or later:

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maize</td>
<td>Maize</td>
</tr>
<tr>
<td>2</td>
<td>Cotton</td>
<td>Maize</td>
</tr>
<tr>
<td>3</td>
<td>Maize</td>
<td>Maize</td>
</tr>
</tbody>
</table>

If no fertilizer is applied to the cotton crop, most likely the maize crop following the cotton crop will need extra fertilizer in order to obtain a normal maize yield.

4. The author pays attention to some good points which will not be reflected in Gross Margin calculations:
   1. Drought resistance (less risks)
   2. No theft (less risks)
   3. Easy handling and storage (less risks)
   4. Payments are made soon after delivery by the farmer
   5. Credit facilities offered by the buying organisation
   6. Labour requirements of cotton do not coincide with the labour peaks of other crops.
14 What it means being ‘entrepreneur’

In the classical sense, an ‘entrepreneur’ is a person who owns (and is in effective control of) an enterprise. In the context of this guide the ‘enterprise’ is a commercial farm (crops, vegetables, livestock, a.o.). In the text we assume the entrepreneur to be one person, but, for instance, in reality decisions which are taken may be the outcome of discussions between several members of the farm family or even outsiders.

14.1 Introduction

It is not easy to define ‘entrepreneurship’. One could say that it is everything which the entrepreneur does in order to obtain good results from the enterprise. These ‘results’ need not only be best possible economic results; welfare and personal well-being often also play an important role for the farmer.

Specifically the ‘agricultural entrepreneur’ (= the farmer) needs to have a many-sided (versatile) mind. In the case of a farm with no hired labour, the farmer takes care of all the manual work that has to be done on the farm. Apart from doing manual work, the farmer is organizer, administrator and manager at the same time.

On top of this the farmer is usually the person who provides the necessary capital and who bears the financial risk of the enterprise. Hence, in the agricultural sector the entrepreneur is often the person on which the whole enterprise depends.

Quite often the agricultural entrepreneur is emotionally very close to his or her farm.

Training helps a farmer to be a better ‘entrepreneur’.

14.2 Skills

In his work the agricultural entrepreneur has to deal with several widely varying aspects of entrepreneurship. They may be divided into three different groups, namely:

1 Technical aspects of entrepreneurship

Because of these technical aspects the farmer should possess the necessary knowledge and skills relative to crops, machinery, livestock, etc.. This may be termed ‘craftmanship’.

2 Financial-economic aspects

These aspects are about purchases and sales, finance and financial returns, how they are related and how they influence each other. Administration (book-keeping) is part of them.

3 Social aspects

Matters such as welfare and well-being, the relation between the farm and the family and the representation of the farm to the outside world. Also the influence of the outside world (government policies and society at large) come into the picture under this heading.

To sum up: production, marketing and financing.

The agricultural entrepreneur should be able to deal satisfactorily with the above technical, financial-economic and social aspects. Here the term management applies.

14.3 Being manager = taking decisions

The most typical activity of the farmer as manager is decision taking, i.e. choosing between options. Often (partly) based on risk assessment. For example, a decision whether or not to apply extra labour,
change a cropping programme, sell vegetables or fruits held in stock or whether or not to treat a crop on a certain day (crop protection), to name just a few. And, decisions must be taken at the right time. Gaining more insight and greater skills in the taking of decisions may contribute considerably to good entrepreneurship.

How does proper decision-taking come about?
We can distinguish the following steps in the taking of rational (sensible) decisions:
- discovering or recognizing a problem
- observing (learning) the facts relative to the problem
- thinking of possible solutions to the problem (coming up with solutions)
- judging the various solutions (alternatives)
- taking a decision (making a choice)
- doing the work that is required to carry out the decision (implementation)
- checking; evaluation of the decision that has been taken.

An example to illustrate the above:

1 The problem is that the costs of a certain hand tractor are too high.

2 Learning about the facts which are relevant to this problem such as:
   - the age of the tractor and its purchase price
   - the present condition of the tractor
   - how often is the tractor serviced (maintenance)
   - how often is the tractor used and for which purpose (light or heavy duties)
   - who uses the tractor
   - tractor costs on other (similar) farms

3 Which alternatives can be thought of:
   - another repair shop (which one)
   - another way of driving the tractor (how)
   - other jobs for the tractor (which ones)
   - more or less maintenance
   - replacing the tractor (power; price)

4 Taking a decision (choice)

5 Implementation

6 Evaluation

Another problem may be that the fertility rate in a herd of dairy cows is very low.

It is evident that the first steps require a lot of attention. The real problem has to be discovered. In our example the assumption is that the tractor costs are too high, but further investigation may show that it is not the relatively high tractor costs but the low crop yield which is the real problem. Then the alternatives have to be carefully weighed against each other. This weighing process should be based on facts (= proper observation of everything that is relevant in this context).

Taking a decision and its implementation should not require so much time.

In actual practice ‘guessing’ will play a role, often to the detriment of proper ‘observation’ and the search for alternative solutions.
The time factor

A. ‘Long-term decisions’ are about the nature of the farm, its size, the purchase of land, construction of buildings and the delicate issue of succession (who will be the next farmer).

B. ‘Middle-term decisions’ are about the cropping plan, the purchase of machinery and equipment, whether to engage more or less labour, new crop varieties, new animal stock feeding and selection methods, to name a few. They should fit into long-term policy.

C. ‘Short-term decisions’: the daily organisation of the farm work such as sowing, weeding, manure/fertilizer application, harvesting and storage. Also culling of stock, veterinary interventions and A.I. routine. They should fit into middle-term policies.

14.4 Information and communication

‘Being informed’ is of great importance for the agricultural entrepreneur. In modern farming ‘information’ comes more and more from external sources: accountancy firms, agricultural extension service, bank personnel, supply companies and ‘the market’ (= agricultural produce buying firms or organisations, co-operatives a.o.). Fellow-farmers (colleagues) are also very important in this respect. In a general way newspapers, farm magazines, radio and TV play a role.

The entrepreneur should be able to make use of the information which is offered and to this end he or she should have certain social abilities:

- willingness to consult other persons and to listen to them
- capacity to co-operate with other persons
- capacity to make (sound) judgments
- willingness to be critical about oneself and to make comparisons with other persons
- being able to ask sensible questions

‘Information’ is never complete. Particularly the weather (rainfall) and the ‘market’ will always remain uncertain and they can hardly be influenced by the farmer. Also the replacement of manual labour by machines is something which cannot be entirely based on reason and facts: future technological developments and labour costs are not certain.

Each entrepreneur experiences uncertainties in his own way. For that reason one farmer is prepared to take more risks than another.

For a farmer, the decision to take action or to delay action on a certain matter is of great practical significance for his enterprise. For instance, think of selling and buying.

14.5 Summary

Viewing ‘entrepreneurship’ as a whole, it is possible to distinguish the following aspects:

1 Technical-material aspects, requiring knowledge and skills about crops, machinery and equipment, livestock and environmental issues.

2 Financial-economic aspects, requiring economical knowledge and skills about output and costs, profitability, financing, administration and book-keeping.

3 Social-organisational aspects, requiring social ability to deal satisfactorily with ‘the world outside’.
What it means being ‘entrepreneur’
15 Investment and costs

When starting a farming enterprise one must have proper insight in investments and costs. Simply because

\[
\text{Profit} = \text{Yield} - \text{Investments} - \text{Costs}
\]

There is a difference between the concepts \textit{Investments} and \textit{Costs}. Investments are expenses which one expects to earn back and which one can use for several years. A property of investments is also that the amount of money involved is relatively high compared with costs. Investments are depreciated (written off) and this depreciation is spread over several years. Good examples of investments are the construction of a fence or the building of a cattle shed. Also see Chapter 1.

Costs are expenses which one can (afford to) write off in one year and which have an economic value lasting less than one year.

Keeping in mind the difference between investments and costs is important for making an \textit{income-expenditure statement} which should give a reliable insight about the \textit{profit} that is expected and a \textit{balance sheet}.

\textbf{Investments}

When making investments one should have considered several aspects beforehand. As follows:

\textit{Turnover point}

The turnover point is defined as the moment when investments and other efforts are producing yields.

For example, if one buys a calf today it will not produce milk tomorrow but it will take some years before one makes some money. In the meantime one needs money to survive. The later the turnover point the more money one needs. Different livestock will have different turnover points (consider dairy cows and poultry). So, when deciding which kind of livestock to take one has to consider this aspect. If you have some money left (cash flow) or if you can borrow money from a bank (financing) you can choose for a later turnover point.

\textit{Return on investment}

The concept of return on investment is the ratio between investment and the earnings on that investment. This is an important figure because investments are generally based on cash flow and on loans. In general, the higher the investment the longer it takes to earn it back and the more vulnerable one is to risk factors like inflation and prices. This vulnerability will increase with a higher ratio between borrowed money and your own money. So, it is advisable to lower the investment if one wants to avoid (high) risks.

\textit{Replacement value}

When an investment is made for a lasting "economic good" you have to write-off this good (depreciation). There are different systems for writing-off. By writing-off on replacement value one must take into account the future price (mostly higher than the original price). Inflation makes future prices rise. Price rises because of inflation are often ignored and this is wrong!

\textbf{Model of an income-expenditure statement}

\textit{Investments}

* \textit{Land}
  - Price per ha?
  - How many hectares?
  - Own property, buying, tenancy?
* \textit{Buildings, sheds, fences, feeding troughs, etc.}
  - Which type(s) of livestock?
- Livestock in sheds or outside?
- Climate control in livestock sheds?
- Feeding of livestock?
- Inventory, water supply systems

* **Tools, equipment**
  - plough, harrow, etc.
  - replacement value

* **Livestock**
  - poultry, cattle, sheep, goats
  - replacement value
  - is it possible to buy new livestock of the kind you started with

**Costs**

* **Labour**
  - permanent labour for taking care of livestock (if you are not prepared to do that yourself)
  - labour for cultivating land
  - labour for selling products on the market
  - how much are you prepared to do yourself

* **Feed**
  - do you cultivate crops to feed your livestock
  - maize, grasses, a.o.
  - buying feed is more risky (price fluctuations); you depend on feed suppliers and their prices

* **Water**
  - is it freely available or do you have to pay for it

* **Seed**
  - produced by yourself or do you have to buy it

* **Fertiliser, pesticides**

* **Veterinary care** - medicines, vaccinations

* **Maintenance of buildings and equipment**

* **Interest on loans**

* **Taxes**

* **Insurance**

**Income**

* Analyse the (consumer) market where you can sell what you produce. Goods that you can sell are possibly eggs, milk and meat, or crops

* Examine the market for each product that you want to sell

**Risk factors**

Risk factors should be considered carefully. For instance:

* **Inflation** - if inflation is high, this is an important risk factor

* **Price fluctuations**
  Keep in mind that prices can change; this can be to your advantage or not.
  When making analyses it is wise to reckon with low prices for your sales and with high prices for purchases. Work out a "worst case scenario" in order to avoid nasty surprises.

* **Variation in the consumer market**
  There may be fluctuations in demand because of seasons and public festivities. Are there competitors wanting to sell the same products as yours?
16 Economics in traditional livestock keeping

Agromisa editor: As we know, the text of this guide refers to ‘commercial farming’ of a certain size, with proper bookkeeping, and operating in a free market economy. The content is hardly applicable to ‘nomadic’ livestock farming, with cattle, sheep and goats all producing milk for family consumption; or to zero-grazing with one or two dairy cows producing for the local town community.

The following is an analysis of the economics in the above ‘non-commercial’ livestock keeping systems which may be useful to policy makers and extensionists and believed to take into account the viewpoint of the livestock keepers in question. The text is from an article by H.A.J.Moll et al. (2001, Dept.of Social Sciences, Wageningen UR, the Netherlands).

16.1 Quantify resources used and physical production obtained

Resources which are used (input)
The resources are split into purchased recurrent inputs, such as medicines and drugs, feed supplements and fodders, hand tools and veterinary services, and the household production factors, such as family labour, land, and capital invested in animals and stables.

Livestock production (output)
The output is separated into recurrent production and embodied production. Recurrent production is physical production such as milk, wool, manure and draught power. It becomes available according to livestock types, sex, age and season. Embodied production is production that is not consumed but is directly invested in animals, such as changes in body weights and change in number of animals.

16.2 Valuation

Valuation of recurrent (physical) production
Valuation is not a straightforward process, as markets for resources and products are imperfect or even absent and thus do not necessarily provide prices. Therefore a distinction is made between marketed and non-marketed recurrent production. The marketed recurrent production is valued at market prices, and the non-marketed recurrent production is valued at estimated prices (both at farm gate level). This leads to two indicators for the recurrent production:

(a) The net recurrent cash income, defined as the value of the marketed recurrent production minus the purchased recurrent inputs. This income is a partial indicator, but a major one for livestock keepers, as they usually strive for cash income to pay for school fees, medical treatment, and the purchase of consumer goods.

(b) The recurrent income in kind. The non-marketed recurrent production is consumed, exchanged or invested and is as such directly observable by livestock keepers. The value of the embodied production is reflected in the third indicator:

(c) The sale price. This becomes available when animals are sold, and it reflects the value of the total embodied production over the lifetime of the animal. Markets for slaughter animals are usually present and thus result in prices, but markets for animals in their productive period may be thin, and in such cases prices must be estimated.

The first two indicators refer to the income derived from keeping an animal, and they usually refer to a period of one year. The third indicator gives the income obtained when selling an animal, thereby terminating the stream of income derived from keeping the animal.
16.3 Estimation of other benefits

Other benefits are in the functions in insurance, financing and status display, functions which are significant in communities where it is difficult or impossible to fulfil these through other means.

The *insurance function* results from the potential of being able to sell the animals in case of emergencies. In this way, having animals is a substitute for paying insurance premiums. The *function of livestock in financing* is noticeable in three things: the purchase of animals when income exceeds current consumption requirements; the implicit investment of embodied production in animals; and, the sale of animals for immediate consumption or investment requirements. The benefit of financing through animals results from the avoidance of cost involved either in storing money or goods, or in borrowing and is related to the sale price. The *function of livestock in providing status* to their owners is related to the presence or absence of other means to display wealth, such as durable consumer goods and building materials. The benefit from providing status is, as in insurance, a proportion of the average value of an animal (or animals) over a period of one year.

The acknowledgement and estimation of the benefits in insurance, financing and status display widens the perspective on the roles of animals for households in developing countries.

**Schematic appraisal of the livestock system:**

<table>
<thead>
<tr>
<th>Livestock system</th>
<th>On-farm and off-farm enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income keeping</strong></td>
<td><strong>Household</strong></td>
</tr>
<tr>
<td>• net recurrent cash income</td>
<td>• land</td>
</tr>
<tr>
<td>• recurrent income in kind</td>
<td>• labour</td>
</tr>
<tr>
<td>• benefits status</td>
<td>• capital</td>
</tr>
<tr>
<td><strong>Income selling</strong></td>
<td><strong>Return to household resources</strong></td>
</tr>
<tr>
<td>• sale price</td>
<td></td>
</tr>
<tr>
<td>• benefits financing</td>
<td></td>
</tr>
</tbody>
</table>

Keeping an animal provides net recurrent cash income, recurrent income in kind, and intangible benefits in insurance and status; selling an animal results in the sale price plus intangible benefits in financing. All income components are directly observable by livestock keepers, although they will not express them all in monetary values.

The incomes of keeping an animal, and eventually selling the animal result from the utilisation of the household's production factors, land, labour and capital. These production factors can generally also be used in other on-farm and off-farm enterprises and this means that in the appraisal of the livestock system by the livestock keeper the total benefits are compared with the returns to the household's production factors in other enterprises.

The outcome of the appraisal may differ per household according to their individual objectives, resource endowment, access to institutions, and options for using their resources in other on-farm and off-farm enterprises.

Agromisa editor: the article continues; the described method is applied to three dairy systems in widely different situations, namely

- cattle grazed on natural pasture in the Western Province of Zambia
- smallholder dairy production in the Coconut Triangle and the wet Lowlands zone, in Sri Lanka
- smallholder dairy production near Nakuru, Rift Valley, in Kenya.

**Source:** Abstracts 12th Symposium Dairy development in the Tropics, 2nd November 2001. Faculty of Veterinary Medicine, Utrecht University, The Netherlands.
17 Exercises

Exercise 1 (relates to chapter 1)
Describe in your own words:
1 farm input
2 farm output
3 farm business
4 farm enterprise
5 economic production unit
6 farm gross output
7 total costs
8 fixed costs
9 variable costs
10 profit/loss
11 general overhead costs
12 production cycle

Exercise 2 (chapter 1)
Answer the following questions:
1 Why do we divide a farm into different enterprises?
2 Is the following statement true: gross output – variable costs = profit/loss?
3 Comment on the following statement: ‘all farm output comes as cash-available to the farmer’.

Exercise 3 (chapter 1)
Describe in your own words:
1 capital items
2 depreciation
3 calculated costs of interest
4 maintenance costs
5 running costs
6 opportunity costs
7 how do we calculate the annual costs of depreciation?
8 how do we calculate the annual costs of interest?
9 the total fixed costs of capital items are made up by..............
10 describe ‘scrap value’

Exercise 4 (chapter 2)
A farmer wants to buy a new tractor. Two types of tractors are available, with the following particulars:

<table>
<thead>
<tr>
<th></th>
<th>Tractor ‘A’</th>
<th>Tractor ‘B’</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Value</td>
<td>M 25000</td>
<td>M 16000</td>
</tr>
<tr>
<td>Scrap value</td>
<td>M 5000</td>
<td>M 1000</td>
</tr>
<tr>
<td>Expected useful lifetime</td>
<td>10 years</td>
<td>5 years</td>
</tr>
<tr>
<td>Interest rate</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Estimated annual maintenance</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>costs as a% of the new value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated running costs as an</td>
<td>M 3</td>
<td>M 4</td>
</tr>
<tr>
<td>amount per working hour</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The farmer will use the tractor for 800 hours per year.
Calculate:  

<table>
<thead>
<tr>
<th>Tractor ‘A’</th>
<th>Tractor ‘B’</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Annual depreciation:</td>
<td>............</td>
</tr>
<tr>
<td>2 Annual costs of interest:</td>
<td>............</td>
</tr>
<tr>
<td>3 Annual costs of maintenance:</td>
<td>............</td>
</tr>
<tr>
<td>4 Annual running costs:</td>
<td>............</td>
</tr>
<tr>
<td>5 Total fixed costs:</td>
<td>............</td>
</tr>
</tbody>
</table>

6 Which of the two tractors do you advise the farmer to buy because it is the cheapest overall? (the answer should be based on the total annual fixed costs).

**Exercise 5 (chapter 2)**

A farmer has obtained the following farm equipment:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>New value/each</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>plough</td>
<td>M 65</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>harrow</td>
<td>M 45</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>pasture harrow</td>
<td>M 25</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>fertilizer bin</td>
<td>M 20</td>
<td>M .......</td>
</tr>
<tr>
<td>2</td>
<td>ox yoke</td>
<td>M 15</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>knapsack sprayer</td>
<td>M 125</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>ox cart</td>
<td>M 550</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>cultivator</td>
<td>M 45</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>ox planter</td>
<td>M 150</td>
<td>M .......</td>
</tr>
<tr>
<td>1</td>
<td>set of small farm equipment</td>
<td>M 250</td>
<td>M .......</td>
</tr>
</tbody>
</table>

**Total new value of the farm equipment**

M .......

The average lifetime of the equipment is estimated at 4 years. No scrap value is to be expected.

Annual interest costs have to be calculated at 7% of the average value.

The annual maintenance costs are estimated at 10% of the total new value.

**Calculate:**

1 The total new value of this farm equipment.
2 The annual costs of depreciation.
3 The annual costs of interest.
4 The estimated annual maintenance costs.
5 The total annual fixed costs of the equipment and the machinery on this farm.

**Exercise 6 (chapter 2)**

**Table 1: Fixed costs of buildings, fencing and infrastructure**

<table>
<thead>
<tr>
<th>Description</th>
<th>New value</th>
<th>Depreciation</th>
<th>Amount</th>
<th>Interest</th>
<th>Amount</th>
<th>Maintenance</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>dairy building</td>
<td>M 4000</td>
<td>5</td>
<td>M ......</td>
<td>7</td>
<td>M ......</td>
<td>2</td>
<td>M ......</td>
</tr>
<tr>
<td>feed store</td>
<td>M 3000</td>
<td>5</td>
<td>M ......</td>
<td>7</td>
<td>M ......</td>
<td>2</td>
<td>M ......</td>
</tr>
<tr>
<td>machinery store</td>
<td>M 1000</td>
<td>5</td>
<td>M ......</td>
<td>7</td>
<td>M ......</td>
<td>2</td>
<td>M ......</td>
</tr>
<tr>
<td>fencing</td>
<td>M 3800</td>
<td>5</td>
<td>M ......</td>
<td>7</td>
<td>M ......</td>
<td>2</td>
<td>M ......</td>
</tr>
<tr>
<td>water reticulation</td>
<td>M 3500</td>
<td>5</td>
<td>M ......</td>
<td>7</td>
<td>M ......</td>
<td>2</td>
<td>M ......</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td>M ......</td>
<td>M ......</td>
<td>M ......</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
N.B.:
- the scrap value is estimated at 20% of the new value; in case of (severe) inflation, the scrap value is often put at zero, to accumulate more depreciation money
- depreciation and maintenance costs to be calculated over the new value
- interest costs to be calculated over 60% of the average value

**Complete the table.**

**Exercise 7 (general)**
A farmer has the following piece of land (ignore the dotted lines):

![Figure 10](image)

The hypotenuse with the length of 80.6 m has been calculated as follows:

$$\sqrt{10^2 + 80^2} = \sqrt{6500} = 80.6 \text{ m}$$

1 Calculate the length of the hypotenuse ‘X’.
2 Calculate the distance round the whole field (perimeter).
3 The farmer wants to put a fence around this field, with 4 wires. How many metres of wire will he need?
4 One 25 kg roll of barbed wire has 175 metres of wire. How many rolls does he have to buy?
5 What will be the total cost of the barbed wire if one 25 kg roll costs M 25?
6 Calculate the total area of the (whole) field.

**Exercise 8 (general)**
A farmer has got a plot of medium fertility land on which he wants to grow maize. The following fertilizer applications are recommended by the extension service:

<table>
<thead>
<tr>
<th>Fertility status</th>
<th>Kilogram fertilizer per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Low</td>
<td>160-180</td>
</tr>
<tr>
<td>Medium</td>
<td>120-140</td>
</tr>
<tr>
<td>High</td>
<td>80-100</td>
</tr>
</tbody>
</table>

The farmer wants to fertilize his field with the maximum amounts of P<sub>2</sub>O<sub>5</sub> and N recommended for medium soil fertility according to the above table, by using compound fertilizer and ammonium nitrate.

<table>
<thead>
<tr>
<th>Kind of fertilizer:</th>
<th>% N</th>
<th>% P</th>
<th>% K</th>
<th>% S</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>compound fertilizer</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>M 14.95/50 kg bag</td>
</tr>
<tr>
<td>ammonium nitrate</td>
<td>34</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>M 14.08/50 kg bag</td>
</tr>
<tr>
<td>triple super</td>
<td>-</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>M 16.25/50 kg bag</td>
</tr>
</tbody>
</table>

**Questions:**
1 How many kg P<sub>2</sub>O<sub>5</sub> is in 100 kg compound fertilizer?
2 How many bags compound fertilizer does the farmer have to apply per hectare to meet the P\textsubscript{2}O\textsubscript{5} requirement?

3 What is the total cost of the basal dressing for the whole field?

4 100 kg ammonium nitrate contains how many kg N?

5 How many kg N has already been applied per hectare with the basal dressing.

6 After the basal dressing has been applied, how many kg N from the total requirement is left over for the top dressing?

7 How many bags ammonium nitrate does the farmer have to apply per hectare to meet this requirement?

**Exercise 9 (chapter 5)**

A farmer grows 10 ha of maize. He fertilizes his field with the maximum amounts of N and P\textsubscript{2}O\textsubscript{5} recommended for high soil fertility according to the table used in exercise number 8, by using compound fertilizer and ammonium nitrate.

For kinds and prices of fertilizer, see exercise number 8.

Part of the maize (80 bags) will be used as corn and cob meal for the dairy herd. No empty bags have to be bought for the maize used as corn and cob meal. The farmer expects a yield of 60 bags of 90 kg per hectare. The price of maize is M 18 per 90 kg bag. Seed is used at a rate of 25 kg per hectare. The price of the seed is M 52 per 50 kg.

Empty bags are only needed for the maize sold. The price of an empty bag is M 1. Casual labour is only used for weeding and for harvesting. Weeding needs 14 man-days per ha and harvesting 15 man-days per ha. One man-day costs M 2.

The interest rate is 7%. The growing period is six months.

**Calculate the gross margin.**

**Gross output** ..... ha × ..... bags/ha × M ...../bag M .........

**Variable costs**

Seed:

\[ \text{...... ha} \times \text{..... kg/ha} \times M \text{...../kg} = M \text{.......} \]

Ammonium nitrate:

\[ \text{...... ha} \times \text{..... bags/ha} \times M \text{...../bag} = M \text{.......} \]

Compound fertilizer:

\[ \text{...... ha} \times \text{..... bags/ha} \times M \text{...../bag} = M \text{.......} \]

Casual Labour

Weeding:

\[ \text{...... ha} \times \text{..... man-days/ha} \times M \text{...../man-day} = M \text{.......} \]

Harvesting:

\[ \text{...... ha} \times \text{..... man-days/ha} \times M \text{...../man-day} = M \text{.......} \]

Empty bags:

\[ \text{...... bags} \times M \text{...../bag} = M \text{.......} \]

Subtotal

\[ M \text{.......} \]

Interest:

\[ \% \times M \text{.....} \times \text{.......} = M \text{.......} \]

\[ M \text{.......} \]

**Total Gross Margin**

\[ M \text{.......} \]

**Exercise 10 (chapter 4)**

Calculation of the gross output of a dairy herd.
During the year the farmer bought one heifer at M 600. Prices of the sales are according to the above table. The farm produced in total 25000 L milk of which 1000 L have been used for home consumption and 1500 L for calf feeding.
The price of milk is M 0.43 per L.
The farmer slaughtered one cow with the normal value for home consumption.

Questions
1 Calculate the value of the herd at the beginning and at the end of the year.
2 How much is the increase of the value of the herd during the year?
3 What is the total value of the sale of animals during the year?
4 What is the total value of the animals slaughtered for home consumption during the year?
5 How much is the amount for sales and home consumption of animals taken together?
6 What is the total value of the animals purchased during the year?
7 How much is the total amount of sales + home consumption of animals less purchases?
8 What is the total value of the milk produced?
9 Calculate the gross output of this dairy herd.
10 How much of the gross output is ‘cash-available’ to the farmer?

N.B.:
➢ The milk used for calf feeding is included in the gross output.
➢ The milk and the meat used for home consumption is valued at the commercial price (opportunity costs!)

Exercise 11 (chapter 5)
Calculation of the variable costs and gross margin of the small-scale dairy herd of exercise number 10.

Milk used for calf feeding 1500 L (commercial price M 0.43/L).

Questions
1 Calculate:
   a value of the herd on 1-1-20..
   b value of the herd one year later
   c average herd value
2 Calculate:
   a number of LU per 1-1-20..
   b number of LU one year later
   c average number of LU present
3 The farmer estimates that he will need 2 kg corn-and-cob meal per cow per day for the average number of cows present. Corn-and-cob meal consists of 75% pure maize. The price of maize is M 0.20 per kg.
   a How many kg corn-and-cob meal is required in total?
   b Based on the price of maize, what will be the price of corn-and-cob meal per kg?
   c What is the total cost per year for the corn-and-cob meal?
4 The calculated cost of interest is estimated at 7% of the average herd value per year. What is the amount of the calculated interest cost?
5 Calculate the cost of the milk used for calf feeding.
6 The farmer has 15 ha improved pasture land. The annual fertilizer requirements per ha of improved pasture are 400 kg ammonium nitrate and 200 kg triple super. Ammonium nitrate costs M 14.95/bag and triple super M 16.25/bag.
   a Calculate the total number of bags A/N and T/S required.
   b Calculate the total costs of ammonium nitrate and triple super.
7 Miscellaneous costs:
   ➢ minerals M 30 per LU per year
   ➢ veterinary M 25 per cow per year
   ➢ A.I. M 5 per cow per year
   ➢ dip materials M 25 per LU per year

Calculate the total miscellaneous costs per year by using the average number of cows and LU's present.
8 Calculate the total variable costs of this dairy enterprise.
9 Calculate the gross margin of this enterprise by using the information provided by exercise 10.
   a calculate the total gross margin
   b calculate the gross margin per cow
   c calculate the gross margin per ha of improved pasture.

Exercise 12
1 According to animal husbandry specialists a dairy cow can produce 2 L of milk out of 1 kg of dairy meal (a certain concentrate) as long as the animal is fed properly. The price of dairy meal is M 250 per ton and the price of milk is 0.43 per L.
   How big is the expected profit per kg dairy meal, properly used for lactating cows?
2 Is mixing home-made dairy meal profitable?

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Price</th>
<th>Price per kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya beans</td>
<td>M 45/90 kg</td>
<td>...............</td>
</tr>
<tr>
<td>Shelled maize</td>
<td>M 18/90 kg</td>
<td>...............</td>
</tr>
<tr>
<td>Sunflower (whole head)</td>
<td>M 9/90 kg</td>
<td>...............</td>
</tr>
<tr>
<td>Salt</td>
<td>M 12.50/50 kg</td>
<td>...............</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>M 40/50 kg</td>
<td>...............</td>
</tr>
<tr>
<td>Nutrafos</td>
<td>M 50/25 kg</td>
<td>...............</td>
</tr>
</tbody>
</table>

3 Complete the above table.

Table 2: Mixture

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Kg required</th>
<th>Price/kg</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya beans</td>
<td>28</td>
<td>..........</td>
<td>..........</td>
</tr>
<tr>
<td>Shelled maize</td>
<td>42</td>
<td>..........</td>
<td>..........</td>
</tr>
<tr>
<td>Sunflower (whole head)</td>
<td>28</td>
<td>..........</td>
<td>..........</td>
</tr>
<tr>
<td>Salt</td>
<td>1</td>
<td>..........</td>
<td>..........</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1</td>
<td>..........</td>
<td>..........</td>
</tr>
<tr>
<td>Ingredients</td>
<td>Kg required</td>
<td>Price/kg</td>
<td>Total cost</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>Nutrafos</td>
<td>0.5</td>
<td>......</td>
<td>...........</td>
</tr>
<tr>
<td>Total</td>
<td>100.5</td>
<td>..........</td>
<td>...........</td>
</tr>
</tbody>
</table>

4. Complete the above table.
5. What is the price per kg home-made mixture?
6. Compare the price of 5 with the price of dairy meal from the local milling company.

**Exercise 13 (chapter 7)**

Gross output dairy section M 7825
Gross output crop section M 5125

**Total Farm Gross Output**

Variable costs dairy section M 3550
(including M 450 interest costs)
Variable costs crop section M 2550
(including M 70 interest costs)

**Total Farm Gross Margin**

**Fixed costs:**

- machinery and equipment:
  - depreciation M 263
  - interest M 55
  - maintenance M 131

- buildings, fencing and infrastructure
  - depreciation M 849
  - interest M 643
  - maintenance M 334

- permanent labour:
  - 1 man for 12 months at M 100/month M ........
- family labour M ........
- tenant's rent p.m.
- miscellaneous paid costs:
  - water & electricity charges at M 12/month M ........

**Net Farm Income**

M ........

**Additional information:**

Opportunity costs family labour: 2 men for 12 months at M 100 per man per month.
Paid interest: loan of M 17,000 at 7% per year.

**Question**

Complete the table and calculate the Net Farm Income and the Management & Investment Income.
Exercise 14 (chapter 8)
The size of a family farm is 40 ha. 15 ha is used to grow crops: 10 ha maize and 5 ha sunflower. The remaining 25 ha has been planted with star grass. This area is divided into 10 paddocks of 2.5 ha each. The size and composition of the dairy herd is expected to develop as follows:

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>LU/head</th>
<th>1-9-20..</th>
<th>One year later</th>
<th>Sales</th>
<th>Value/head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult cows</td>
<td>1</td>
<td>18</td>
<td>22</td>
<td>1</td>
<td>M 800</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>0.8</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>M 600</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>0.5</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>M 400</td>
</tr>
<tr>
<td>Calves: female</td>
<td>0.2</td>
<td>9</td>
<td>10</td>
<td>2</td>
<td>M 100</td>
</tr>
<tr>
<td>Calves: male</td>
<td>1.2</td>
<td>8</td>
<td>1</td>
<td>8</td>
<td>M 60</td>
</tr>
<tr>
<td>Oxen</td>
<td></td>
<td>8</td>
<td>8</td>
<td>-</td>
<td>M 450</td>
</tr>
</tbody>
</table>

The father with 3 adult sons and daughters together with 3 permanent labourers work on the farm. During busy periods casual labour may be engaged. We may assume 250 man-days per man-year. Cows calve down regularly throughout the year. No hay making is done on this farm.

Questions
You are asked to calculate the total labour requirement of this farm and to make a planning of work for the year starting on 1-9-20.. and ending one year later. Apply the labour requirements stated in the following table. Labour requirements in man-days/ha for crops and pasture are displayed below.

<table>
<thead>
<tr>
<th>Crop → Operation</th>
<th>Maize</th>
<th>Sunflower</th>
<th>Star grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughing</td>
<td>8</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Harrowing</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Planting &amp; basal dressing</td>
<td>7</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Weeding (2×)</td>
<td>14</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Topdressing</td>
<td>4</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Harvesting</td>
<td>15</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Shelling (*)</td>
<td>5</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Transport</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

(*) = amount of farm labour required to do the shelling for which a tractor and a sheller will be hired.

Labour requirement dairy section and oxen:

- 60 man-days per adult cow + followers per year.
- 13 man-days per ox per year.

For non period-fixed general farm work the above labour requirements (crop section and dairy section) have to be increased by 10%.

The distribution of man-days per month during the year of family- and permanent labour is as follows:

- Nov., Dec., Jan., Febr., May and June: 25 man-days / month
- April and July: 18 man-days / month
- Sept., Oct., March and August: 16 man-days / month

Exercise 15 (chapter 9)

Small-scale crop farm

1 See table below, showing as crops: 4 ha of maize + 1 ha of sunflower

<table>
<thead>
<tr>
<th>Input crops/ha</th>
<th>Maize</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>25 kg at M 0.72/kg</td>
<td>7 kg at M 0.42/kg</td>
</tr>
<tr>
<td>Compound fertilizer</td>
<td>4 bags at M 9/bag</td>
<td>4 bags at M 9/bag</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>6 bags at M 8/bag</td>
<td>2 bags at M 8/bag</td>
</tr>
<tr>
<td>Interest rate</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Empty bags</td>
<td>35 bags at M 1/bag</td>
<td>12 bags at M 1/bag</td>
</tr>
</tbody>
</table>
The farmer has one pair of oxen with an average value of M 450 each. During the year there is no change in the value of the oxen. For medicines, minerals, tick grease etc. an amount of M 25/ox is required. Interest rate 10%.

3 Fixed costs

<table>
<thead>
<tr>
<th>Item</th>
<th>New value</th>
<th>Depreciation</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ox equipment</td>
<td>M 600</td>
<td>25%</td>
<td>10% of n.v.</td>
</tr>
<tr>
<td>Farm buildings</td>
<td>M 300</td>
<td>10%</td>
<td>2% of n.v.</td>
</tr>
<tr>
<td>Fencing</td>
<td>M 800</td>
<td>10%</td>
<td>3% of n.v.</td>
</tr>
</tbody>
</table>

Interest has to be calculated at 10% over 60% of the new value (= n.v.). No scrap value is to be expected.

4 Casual labour is paid M 1.50/man-day. This is also the opportunity cost of own labour. See annexe I (at the end of ‘exercises’) for the labour requirements.

5 For the current year the farmer has obtained a seasonal loan of M 651 which has to be repaid in August with 10% interest. He has also a medium term loan of M 800 for five years. Instalments are due in August including 10% interest. This medium term loan has been used to buy fencing material in September.

6 The yield of maize is 35 bags/ha. All the maize will be sold at a price of M 11.70/bag. The yield of sunflower is 12 bags per ha and it will be sold at M 16.40 per bag. The farmer will receive the money of crop sales in August.

7 Casual labour will not be allocated to individual enterprises in the gross margin calculation. In this case casual labour will be treated as regularly employed labour.

8 When making a cash flow calculation it is not the revenues and costs which are taken into account but the receipts and the payments. An annual cash flow is a projection of money coming in and going out during the year.

9 The farmer needs M 50 every month to keep his family going.

10 Expenditures for maintenance of the fixed assets are equal to the calculated maintenance costs. The total amount has to be spread equally over all the months of the year.

Questions

1 Calculate the gross margin of maize and sunflower.
2 Calculate the total farm gross margin.
3 Calculate the fixed costs:
   a costs of oxen
   b casual labour
   c equipment
   d farm buildings
   e fencing
4 Calculate the total calculated interest and the total of the interest to be paid.
5 Calculate Profit/Loss (Net farm Income)
6 Calculate Management & Investment Income
7 Make an annual cash flow.

Exercise 16 (test)
Calculation of the Gross Output of a dairy section.

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>1-9-20..</th>
<th>one year later</th>
<th>sales during the year</th>
<th>value/head</th>
<th>LU/head</th>
</tr>
</thead>
</table>

The Farmer as a Commercial Enterprise
One yearling heifer and two female calves died during the year.
No purchase of animals during the year.
Animals are sold for the prices given in the above table.
Cows calve regularly during the year.
Average length of the lactation period per cow is 300 days.
Length of the wet season period is 150 days and the length of the dry period 215 days.
Milk yield: wet season 10 L per cow per day.
  dry season 6 L per cow per day.
The price of the milk is M 0.43 per L.

Calculations

1 Calculate:
  a herd value on 1-9-20..
  b herd value one year later
  c the average herd value
  d the increase in herd value during the year.

2 Calculate:
  a number of LU per 1-9-20..
  b number of LU one year later
  c average number of LU.

3 Calculate the average number of cows in milk.
4 Calculate the total number of lactation days.
5 Calculate the total number of lactation days during the wet period.
6 Calculate the total number of lactation days during the dry period.
7 Calculate the amount of litres of milk produced during the dry period.
8 Calculate the amount of litres of milk produced during the wet period.
9 Calculate the total value of the milk produced.
10 Calculate the Gross Output of this dairy herd.
11 Calculate the cash amount available to the farmer.

Exercise 17 (test)
You will be asked to calculate the Gross Margin of a dairy enterprise about which the following data are given:

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>1-9-20..</th>
<th>One year later</th>
<th>Sales during the year</th>
<th>Value/head</th>
<th>LU/head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult cows</td>
<td>18</td>
<td>22</td>
<td>1</td>
<td>M 800</td>
<td>1</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>M 600</td>
<td>0.8</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>M 400</td>
<td>0.5</td>
</tr>
<tr>
<td>Calves: female</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>M 100</td>
<td>0.2</td>
</tr>
<tr>
<td>Calves: male</td>
<td>2</td>
<td>1</td>
<td></td>
<td>M 60</td>
<td></td>
</tr>
<tr>
<td>Oxen</td>
<td>8</td>
<td>8</td>
<td></td>
<td>M 450</td>
<td>1.2</td>
</tr>
<tr>
<td>Totals</td>
<td>48</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the year the farmer bought two pregnant heifers at M 650 each.
Prices of sales are according to the above table. The farm produced in total 22500 L of milk of which 1500 L was used for home consumption and 1000 L for calf feeding. The price of the milk is M 0.43 per L.

The farmer slaughtered one cow with the normal value for home consumption.

**Variable costs**

The farmer estimates that he will need 3 kg corn-and-cob meal per cow per day for the average number of cows present. Corn and cob meal consists of 75% pure maize. The price of maize is M 0.20 per kg.

The cost of interest is estimated at 7% of the average herd value per year.

The farmer has 15 ha of improved pasture land. The annual fertilizer requirements per hectare of his improved pasture are 350 kg of ammonium nitrate and 150 kg of triple super.

Ammonium nitrate costs M 14.95 per bag and triple super M 16.25 per bag of 50 kg.

Miscellaneous costs are as follows:

- minerals M 35 per year per average number of LU
- veterinary expenses M 25 per year per average number of cows
- A.I. M 10 per year per average number of cows
- dip materials M 35 per year per average of number of LU

**Questions**

1 a Calculation of the value of the herd on 1-1-20.. and one year later, and the average herd value.

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>1-1-20.. No. × Value = Total Value</th>
<th>one year later No. × Value = Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult cows</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>Calves: female</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>male</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>Oxen</td>
<td>... × M ... = M ...</td>
<td>... × M ... = M ...</td>
</tr>
<tr>
<td>Total</td>
<td>M ......</td>
<td>M ......</td>
</tr>
</tbody>
</table>

1 b Average herd value: .................

2 a Calculation of the number of LU on 1-1-20.. and one year later, and the average number of LU.

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>1-1-20.. No. × LU = Total LU</th>
<th>one year later No. × LU = Total LU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult cows</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>Calves: female</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>male</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>Oxen</td>
<td>... × .... = .....</td>
<td>... × .... = .....</td>
</tr>
<tr>
<td>Total</td>
<td>......</td>
<td>......</td>
</tr>
</tbody>
</table>

2 b Average number of LU: .................

3 a Calculate the value of the total sale of animals:

- Adult cows .... × M ... = M ........
- Pregnant heifers .... × M ... = M ........
- Yearling heifers .... × M ... = M ........
- Bull calves .... × M ... = M ........
3 b Calculate the value of the animals purchased

\[ \text{......} \times M \text{......} = M \text{......} \]

3 c Calculate the value of the animals slaughtered for home consumption
3 d Calculate the total value of the milk produced.
4 Calculate now the Gross Output of this dairy herd:

**Gross Output** = M ............

5 a How many kg of corn-and-cob meal is required in total per year?
   b What is the price per kg of corn-and-cob meal?
   c Calculate the total cost of corn-and-cob meal.
6 What is the amount of the calculated cost of interest on herd value?
7 Calculate the cost of milk used for calf feeding.
8 a Cost of fertilizer for improved pasture. Calculate the number of bags of ammonium nitrate and triple super:

   ammonium nitrate ......... bags.
   triple super ............... bags.

8 b Calculate the total cost of fertilizer:

   ammonium nitrate: = M ............
   triple super: = M ............

9 Miscellaneous costs

   minerals: = M ............
   veterinary: = M ............
   A.I.: = M ............
   Dip: = M ............

10 a **Total Variable Costs:** M ............
    b **Gross Margin Dairy Section:** M ............

**Exercise 18 (test)**

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>Value per head</th>
<th>1-1-20..</th>
<th>One year later</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult cows</td>
<td>M 750</td>
<td>12</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>M 550</td>
<td>4</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>M 350</td>
<td>10</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Calves: female</td>
<td>M 85</td>
<td>7</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Calves: male</td>
<td>M 50</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Oxen</td>
<td>M 400</td>
<td>4</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
<td><strong>37</strong></td>
<td><strong>7</strong></td>
<td></td>
</tr>
</tbody>
</table>

During the year the farmer bought one heifer at M 550. Prices of the stock sales are according to the prices given in the table.
Milk production: 1500 L per cow per year for the average number of cows present. 1000 L of milk have been used for home consumption and 1500 L for calf feeding. The price of milk is M 0.43 per L.

The farmer slaughtered one cow, with the normal value for home consumption.

Questions
a Calculate the value of the herd on 1-1-20..
b Calculate the value of the herd one year later.
c Calculate the increase in herd value.
d Calculate the value of the stock sales.
e Calculate the value of the milk produced.
f Calculate the Gross Output of this dairy enterprise.
g Explain briefly the difference between Gross Output and Gross Margin.

2
A farmer has a dairy herd of 100 LU. During the winter season he wants to feed maize silage at a rate of 6.5 kg DM per LU per day. The length of the winter season is estimated at 215 days. The yield of maize silage has been estimated at 10 ton DM per ha. Harvesting, storage and feeding losses are estimated at 20%.

a How many tons DM of maize silage are required to feed this herd?
b How many ha have to be cropped to meet this requirement?
c The cost of maize silage may be calculated in two different ways:
   1 the costs to produce the maize (e.g. costs of ploughing, disk ing, planting and weed control).
   2 the value of the crop if it would have been harvested and sold as commercial maize.
d 1 How do we call costs as described under point c2? Give at least two other examples of these kinds of costs.
   2 Which way of costing is the most appropriate according to you?

3
A farmer has the following farm equipment:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>New value per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>plough</td>
<td>M 65</td>
</tr>
<tr>
<td>1</td>
<td>harrow</td>
<td>M 45</td>
</tr>
<tr>
<td>1</td>
<td>pasture harrow</td>
<td>M 25</td>
</tr>
<tr>
<td>2</td>
<td>ox yoke</td>
<td>M 15</td>
</tr>
<tr>
<td>1</td>
<td>knapsack sprayer</td>
<td>M 125</td>
</tr>
<tr>
<td>1</td>
<td>ox cart</td>
<td>M 550</td>
</tr>
<tr>
<td>1</td>
<td>cultivator</td>
<td>M 45</td>
</tr>
<tr>
<td>1</td>
<td>ox planter</td>
<td>M 150</td>
</tr>
<tr>
<td>1</td>
<td>set of small farm equip</td>
<td>M 250</td>
</tr>
</tbody>
</table>

The average lifetime of the equipment has been estimated at 4 years. No scrap value is to be expected. Annual interest costs have to be calculated at 7% over 60% of the total new value. The annual maintenance costs are estimated at 10% of the total new value.

a Calculate the total new value of the farm equipment.
b Calculate the annual cost of depreciation.
c Calculate the annual cost of interest.
d Calculate the estimated annual maintenance costs.
e Calculate the estimated total fixed costs of the farm equipment.
Exercise 19 (test)

1  a  For what reason do we subdivide the farm business into farm enterprises?
    b  For what reason do we subdivide the total costs into variable costs and fixed costs?
    c  How do we calculate gross margins and what is the use of this type of calculation?
    d  Why do we have to be careful when comparing gross margin calculations of different farms?

2  a  What is the meaning of ‘opportunity costs’? Give two examples in which we base calculations on opportunity costs.
    b  Explain briefly the concept of:
      i.  Net Farm Income
      ii  Management & Investment Income
      iii Profit/Loss.

You may use the following data in your explanations:

- Total calculated interest M 800
- Paid interest M 450
- Calculated cost family labour M 900
- Loss M 300

3  A farmer wants to buy a new tractor. Two different tractors are available:

<table>
<thead>
<tr>
<th></th>
<th>Tractor ‘A’</th>
<th>Tractor ‘B’</th>
</tr>
</thead>
<tbody>
<tr>
<td>New value</td>
<td>M 25000</td>
<td>M 16000</td>
</tr>
<tr>
<td>Scrap value</td>
<td>M 5000</td>
<td>M 1000</td>
</tr>
<tr>
<td>Expected useful life</td>
<td>10 years</td>
<td>5 years</td>
</tr>
<tr>
<td>Costs as a percentage of the new value</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>Interest rate</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Estimated running costs as an amount per working hour</td>
<td>M 3</td>
<td>M 4</td>
</tr>
</tbody>
</table>

The farmer will use the tractor 800 hours per year.

**Calculate:**

a  Annual costs of depreciation.
b  Annual costs of calculated interest.
c  Estimated annual costs of maintenance.
d  Estimated annual running costs.
e  Based on the total annual fixed costs, which of the two tractors do you recommend to the farmer as being the cheapest?

4  A farmer has a dairy herd of 80 LU in total. He plans to feed maize silage during the dry season, at a rate of 6 kg DM per LU per day. He estimates the length of the dry season at 200 days. Harvesting, conservation and feeding losses are estimated at 20% in total. The yield of the maize for silage is estimated at 10 ton DM per ha.

a  Excluding losses, how many kg DM of maize silage is required in total?
b  How many ha of maize for silage has this farmer to grow?
c  At the time of feeding the DM content of the maize silage is 25%. If an intake of 6 kg DM of maize silage per LU per day is required, how many kg maize silage does the farmer have to feed per LU per day?
Exercise 20 (test)

1. A farmer has a field on which he wants to grow maize, with the following measurements:
   a. Calculate the total area of this field.
   b. Calculate the length of the longest side of the field.
   c. How many bags of seed maize does he have to buy? (seed rate 25 kg per ha).
   d. One thousand (1000) seed grains weigh 400 grams. Calculate the number of grains needed per ha (seed rate 25 kg per ha).
   e. How many plants may be expected, with an overall germination rate of 80%?
   f. The farmer wants to plant the maize on lines (ridges) with 75 cm in between (line distance 0.75 m). Calculate the required distance of the seeds in the line.

2. The farmer wants to use 6 bags compound fertilizer per ha (the composition of this fertilizer is 10-20-10-10) as a basal dressing.
   a. How many bags of fertilizer does he have to buy?
   b. Calculate the number of kg's nitrogen, phosphate and potassium applied per ha.
   c. Calculate the cost per ha of the basal dressing.

3. The farmer considers chemical weed control. The available mounted sprayer has the following technical specifications:
   - capacity of the tank 400 L
   - number of nozzles 20
   - distance between the nozzles 50 cm
   - output per nozzle 250 ml per 15 seconds.
   a. What is the working width of the sprayer?
   b. Calculate the output per nozzle, in litres/minute.
   c. In how many minutes will the tank be empty?
   d. The farmer wants to use 500 L of water per ha. Calculate the required speed of the tractor.
   e. The recommended amount of weedkiller is 2.5 g per ha. How many kg of weedkiller must be put in the tank?
   f. Filling, mixing and transport to the field takes 35 minutes per tank. How many times does the farmer have to go to the field shown in question number 1?
   g. Tractor and sprayer are available for M 11 per hour and the cost of the weedkiller is M 10 per kg. Calculate the total costs of chemical weed control for the field shown in question number 1.
### Annexe I (exercise 15)
The table below displays labour supply and requirements expressed in man-days per month.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>4 ha maize + 1 ha sunflower</td>
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<tr>
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<td>14</td>
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<td>6</td>
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<td>1 x 6</td>
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<td>8</td>
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<td>2 x 1 x 10</td>
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<tr>
<td>Total man-days required</td>
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<td>40</td>
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<td>45</td>
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<td>25</td>
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<td>20</td>
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<td>Casual labour</td>
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<td>-</td>
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<td>5</td>
<td>15</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>3</td>
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</tbody>
</table>
18 Solutions to the exercises

Exercise 1
1 Farm input: These are the resources on the farm; they are not the same as expenditures. An input is the measure of how much of a resource (such as labour, fertilizer, tractor hours, etc.) is actually used on the farm in a given time period whether it was paid for in that period or not; also, in the case of family labour, whether it had an actual charge to it or not makes no difference. This means we have input which has to be paid for and other input for which we do not pay at all.
2 Farm output: Output is a measure of production in a given time period no matter whether what was produced was actually sold or not. Stocktakeings at the beginning and at the end of the period are necessary therefore, both for input as well as for output.
3 Farm business: Farming is an economic activity in which we use resources (input) in order to produce valuable products (output); with the intention that the total value of the output exceeds the total value of the input.
4 Farm enterprises: The more or less independent sections of which a farm business may be built up, each with its own input and output.
5 Economic production unit: A unit which involves human effort and decision making; with the intention to produce output with a total value exceeding the total value of the input.
6 Farm gross output: The total value of the farm output during a certain period (in most cases one year) and corrected for stock changes.
7 Total costs: The total value of all the farm input during a certain period, corrected for stock changes.
8 Fixed costs: These are long-term costs (including overheads) of resources which last for over a year. They apply to the farm as a whole and do not tend to vary according to the size of an enterprise. They cannot be avoided even if we want to discontinue a certain enterprise. Examples of fixed costs are the annual costs of farm buildings, farm machinery, regularly paid labour, etc.
9 Variable costs: These are short-term costs of resources which last for less than one year. They are easy to allocate to individual enterprises and they tend to vary according to the size of an enterprise. They can be stopped if an enterprise is discontinued. Examples of variable costs are the costs of fertilizers, stockfeeds, chemicals for weed control, casual labour, etc.
10 Profit/Loss: The balance left after the total costs have been deducted from the gross output.
11 General overhead costs: These are costs which are normally taken as part of the fixed costs. Overhead costs apply to the whole farm. Examples of overhead costs are the costs of electricity, water supply, telephone, stationery, etc.
12 Production cycle: The period in which all input into an enterprise is valued via the output and the production process can start afresh.

Exercise 2
1. We divide a farm into different enterprises in order to know the contribution of each of the individual enterprises to the overall result of the farm business.

The reason behind having several enterprises on a farm may be:
a to avoid risks: if one enterprise fails we will still have other enterprises which may give a good result;
b to be able to practise crop rotation;
c with more than one enterprise receipts and expenditures tend to have a more regular pattern;
d integration becomes possible, input needed for a livestock enterprise is produced on the same farm (maize as stockfeed for a dairy enterprise).
2. ‘Gross output – Variable costs = Profit/Loss’.

The above statement is not true.

Gross output – Total costs = Profit/Loss.

Total costs = Variable costs + Fixed costs.

3. ‘All farm output comes as cash-available to the farmer’.

The above statement is not true.

Farm output like produce used for home consumption and increase in herd value are examples of output which do not come as cash-available to the farmer.

**Exercise 3**

1. Capital items: These are items used on the farm which last for over a year.
2. Depreciation: This is the calculated annual decrease in value of capital items during the time of their useful life.
3. Calculated costs of interest: This is the calculated (opportunity) cost of having funds invested.
4. Maintenance costs: The costs which have to be made every year to keep the capital items in good working order.

Costs of maintenance can be found in bookkeeping records if we want to evaluate an existing situation.

For planning purposes we use a standard figure often expressed as a percentage of the new value of the capital item.

5. Running costs: These are the costs of fuel, oil and lubricants needed to run a tractor or a machine.

Here too bookkeeping records should be used to evaluate an existing situation.

Standard figures expressed as an amount per working hour or kilometre should be used for planning purposes.

6. Opportunity costs: The opportunity costs of a certain resource are equal to the return we would have obtained if the same resource had been put to its best alternative use.

For example, if the best alternative use of milk used for calf feeding is delivering this milk to the factory, the cost of milk for calf feeding should be the ruling factory price per litre.

7. The annual costs of depreciation are calculated as follows:

   a. Single capital item: \[
   \frac{\text{New value} - \text{Scrap value}}{\text{Useful life in years}}
   \]

   b. In case of a whole range of equipment: \[
   \frac{\text{Total new value} - \text{Total scrap value}}{\text{Average useful life in years}}
   \]

8. The annual costs of interest of capital items are calculated as follows:

   a. Single capital item: \[
   \frac{\text{New value} + \text{Scrap value}}{2} \times \text{interest rate}
   \]

   b. In case of a range of equipment: \[
   60\% \times \text{total new value} \times \text{interest rate}
   \]

9. The total fixed costs consist of:

   a. annual depreciation costs
   b. annual calculated interest costs
   c. annual costs of maintenance
   d. annual running costs

= Total annual fixed costs

10. Scrap value: is the sale value of a capital item at the time it has come to the end of its useful life (at the time it has been written off completely).
Exercise 4

1. Annual depreciation:
   - ‘A’ \( (25000 - 5000) \div 10 = M 2000 \)
   - ‘B’ \( (16000 - 1000) \div 5 = M 3000 \)

2. Annual costs of interest:
   - ‘A’ \( (25000 + 5000) \div 2 \times 8/100 = M 1200 \)
   - ‘B’ \( (16000 + 1000) \div 2 \times 8/100 = M 680 \)

3. Annual costs of maintenance:
   - ‘A’ \( 2/100 \times M 25000 = M 500 \)
   - ‘B’ \( 5/100 \times M 16000 = M 800 \)

4. Annual running costs:
   - ‘A’ \( 800 \text{ hr} \times M 3/\text{hr} = M 2400 \)
   - ‘B’ \( 800 \text{ hr} \times M 4/\text{hr} = M 3200 \)

5. Total fixed costs
   - ‘A’ M 6100
   - ‘B’ M 7680

6. Although the new value of tractor ‘B’ is M 9000 below the new value of tractor ‘A’, the annual fixed costs of ‘A’ are M 1580 lower than the annual fixed costs of ‘B’.
   For this reason tractor ‘A’ is the cheapest and we should advise the farmer accordingly.

Exercise 5

1. The total new value of this farm equipment is M 1370.

2. Annual cost of depreciation: \( \frac{M 1370 - M 0}{4 \text{ years}} = M 342.50 \)

3. The annual cost of interest: \( \frac{50}{100} \times \frac{7}{100} \times M 1370 = M 47.95 \) (no scrap value)

4. Annual cost of maintenance: \( \frac{10}{100} \times M 1370 = M 137 \)

5. The annual fixed costs of the equipment and machinery:
   - depreciation \( M 342.50 \)
   - interest \( M 47.95 \)
   - maintenance \( M 137.00 \)
   - Total fixed costs \( M 527.45 \)

Exercise 6

The table below shows fixed costs of buildings, fencing and infrastructure.
<table>
<thead>
<tr>
<th>Description</th>
<th>New value</th>
<th>Deprecation</th>
<th>Interest</th>
<th>Maintenance</th>
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</thead>
<tbody>
<tr>
<td>dairy building</td>
<td>M 4000</td>
<td>5%  M 200</td>
<td>7%  M 168</td>
<td>2%  M 80</td>
</tr>
<tr>
<td>feed store</td>
<td>M 3000</td>
<td>5%  M 150</td>
<td>7%  M 126</td>
<td>2%  M 60</td>
</tr>
<tr>
<td>machinery store</td>
<td>M 1000</td>
<td>5%  M 50</td>
<td>7%  M 42</td>
<td>2%  M 20</td>
</tr>
<tr>
<td>fencing</td>
<td>M 3800</td>
<td>5%  M 190</td>
<td>7%  M 159.60</td>
<td>2%  M 76</td>
</tr>
<tr>
<td>water reticulation</td>
<td>M 3500</td>
<td>5%  M 175</td>
<td>7%  M 147</td>
<td>2%  M 70</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>M 765</strong></td>
<td><strong>M 642.60</strong></td>
<td><strong>M 306</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Exercise 7**

1. \( X = \sqrt{30^2 + (30+10)^2} = \sqrt{30^2 + 40^2} = \sqrt{900 + 1600} = \sqrt{2500} = 50 \text{ m} \)

2. Perimeter = 80 m + 30 m + 50 m + 80.6 m + 30 m = 270.6 m

3. 4 × 270.6 m = 1082.4 metre of wire

4. 175 m / 1082.4 m / 6.19 → 7 rolls

5. 7 rolls × M 25/roll = M 175

6. Area section A = 80 m × 30 m = 2400 m\(^2\)
   Area section B = 30 m × 40 m × \( \frac{1}{2} \) = 600 m\(^2\)
   Area section C = 80 m × 10 m × \( \frac{1}{2} \) = 400 m\(^2\)

   **Total area of the field** = 3400 m\(^2\) = 0.34 ha

**Exercise 8**

1. 20 kg \( \text{P}_2\text{O}_5 \) in 100 kg compound fertilizer.

2. 100 kg compound fertilizer contains 20 kg \( \text{P}_2\text{O}_5 \); 50 kg compound fertilizer contains 10 kg \( \text{P}_2\text{O}_5 \).
   We need 60 kg \( \text{P}_2\text{O}_5 \) so 60/10 = 6 bags of compound fertilizer.

3. 5 ha × 6 bags compound fertilizer per ha = 30 bags × M 14.95/bag = M 448.50

4. Ammonium nitrate 34% N → 100 kg ammonium nitrate = 34 kg N

5. Basic dressing is 6 bags compound fertilizer = 300 kg × 10% = 30 kg N

6. Total requirement is 140 kg N/ha. 140 – 30 = 110 kg N left for topdressing.

7. \( \frac{110 \text{ kg N}}{17 \text{ kg N/bag}} = 6.5 \text{ bags ammonium nitrate per ha.} \)
Exercise 9

Gross output: \(10 \text{ ha} \times 60 \text{ bags/ha} \times M 18/\text{bag} = M 10800\)

Variable costs:
- Seed: \(10 \text{ ha} \times 25 \text{ kg/ha} \times M 1.04/\text{kg} = M 260\)
- Amm. nitrate: \(10 \text{ ha} \times 5 \text{ bags/ha} \times M 14.08/\text{bag} = M 704\)
- Compound fertilizer: \(10 \text{ ha} \times 3 \text{ bags/ha} \times M 14.95 = M 448.50\)

Casual Labour:
- Weeding: \(10 \text{ ha} \times 14 \text{ mandays/ha} \times M 2/\text{manday} = M 280\)
- Harvesting: \(10 \text{ ha} \times 15 \text{ mandays/ha} \times M 2/\text{manday} = M 300\)
- Empty bags: \(520 \text{ bags} \times M 1/\text{bag} = M 520\)

Subtotal: \(M 2512.50\)

Interest: \(7\% \times M 2512.50 \times 50/100 \times 182/365 \text{ (year)} = M 43.97\)

Total Gross Margin: \(M 8243.53\)

Explanations

- The compound fertilizer has 20\% \(P_2O_5\) so 1 bag of 50 kg contains 20\% of 50 kg = 10 kg \(P_2O_5\). We need 30 kg \(P_2O_5\), so we have to put \(30/10 = 3\) bags compound fertilizer per hectare.

- 100 kg N is needed in total. The compound fertilizer contains 10\% N. One bag of 50 kg contains 5 kg N; three bags contain in total 15 kg N. Left for topdressing 100 kg N – 15 kg N = 85 kg N.

Ammonium nitrate contains 34\% N so one bag of 50 kg ammonium nitrate contains 34\% \times 50 Kg = 17 kg N.

\[85 \div 17 = 5 \text{ bags amm. nitrate/ha} \times 10 \text{ ha} \times M 14.08\]

Empty bags: \(10 \text{ ha} \times 60 \text{ bags/ha} = 600 \text{ bags}\)

80 bags maize used for corn and cob meal

\(600 \times 80 \times M 1/\text{bag} = M 520\)

- In the interest calculation 50/100 for 'average value' and 182/365 for the growing period; here you can also write \(1/2\) (= year).

Exercise 10

1 Value of the herd at the beginning and end of the year.
2. Value at the end of the year = M 18120
   Value at the beginning of the year = M 16560
   Increase in value = M 1560

3. Value of the sale of animals during the year:
   Cows: 2 × M 800 = M 1600
   Yearling heifers: 1 × M 400 = M 400
   Bull calves: 4 × M 60 = M 240
   Total = M 2240

4. Value of animals slaughtered for home consumption = M 800

5. Amount for sales and consumption together = M 3040

6. Value of animals purchased: 1 heifer at M 600 = M 600

7. Sales + home consumption less purchases = M 2440

8. The total value of the milk produced 25000 L × M 0.43 per L = M 10750

9. Total gross output of the dairy herd = M 14750

10. The share of the gross output which comes as cash-available to the farmer
    Gross output minus:
        increase herd value = M 1560
        slaughtering for home consumption = M 800
        milk for home consumption = M 430
        milk for calf feeding = M 645
    Total deductions = M 3435
    The share of the gross output which comes as cash-available to the farmer = M 11315

OR
    Total value of animal sales = M 2240
    Minus animal purchases = M 600
    Cash-available to the farmer = M 11315

Remember:
Closing value less Opening value  M 1560
+ Sales less Purchases  M 1640
+ Slaughterings for home consumption  M 800
+ Total milk  M 10750

Total gross output  M 14750

---

**Exercise 11**

<table>
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<th>Herd composition</th>
<th>Value per animal</th>
<th>1-1-20..</th>
<th>one year later</th>
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<tbody>
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<td></td>
<td>Number</td>
<td>Total value</td>
<td>Number</td>
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<tr>
<td>Cows</td>
<td>M 800</td>
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<td>M 9600</td>
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<tr>
<td>Pregnant heifers</td>
<td>M 600</td>
<td>4</td>
<td>M 2400</td>
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<tr>
<td>Yearling heifers</td>
<td>M 400</td>
<td>5</td>
<td>M 2000</td>
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<tr>
<td>Calves: female</td>
<td>M 100</td>
<td>7</td>
<td>M 700</td>
</tr>
<tr>
<td>male</td>
<td>M 60</td>
<td>1</td>
<td>M 60</td>
</tr>
<tr>
<td>Oxen</td>
<td>M 450</td>
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<td>M 1800</td>
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</tbody>
</table>

Total 33 M 16560 37 M 18120

1 a Value of the herd on 1-1-20.. = M 16560
b Value of the herd one year later = M 18120

c Average value of the herd = M 34680 ÷ 2 = M 17340

<table>
<thead>
<tr>
<th>Herd composition</th>
<th>Livestock Unit per animal</th>
<th>1-1-20..</th>
<th>one year later</th>
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<tbody>
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<td>Number</td>
<td>LU</td>
<td>Number</td>
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<td>Cows</td>
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<td>12.0</td>
<td>14</td>
</tr>
<tr>
<td>Pregnant heifers</td>
<td>0.8</td>
<td>3.2</td>
<td>3</td>
</tr>
<tr>
<td>Yearling heifers</td>
<td>0.5</td>
<td>2.5</td>
<td>6</td>
</tr>
<tr>
<td>Calves: female</td>
<td>0.2</td>
<td>1.4</td>
<td>8</td>
</tr>
<tr>
<td>male</td>
<td>1.2</td>
<td>4.8</td>
<td>2</td>
</tr>
<tr>
<td>Oxen</td>
<td>1.2</td>
<td>4.8</td>
<td>4</td>
</tr>
</tbody>
</table>

Total 33 23.9 37 25.8

2 a Number of Livestock Units on 1-1-20.. = 23.9 LU
b Number of Livestock Units one year later = 25.8 LU

c Average number of LU during the year = 49.7 ÷ 2 = 24.85 → 24.9 LU

3 a Corn and cob meal required per year:
\[
\frac{12 \text{ cows} + 14 \text{ cows}}{2} = 13 \text{ cows on average} \times 2 \text{ kg/day} \times 365 = 9490 \text{ kg}
\]
b Price of maize is M 0.20 per kg. Corn and cob meal consists of 75% pure maize. In 1000 kg corn and cob meal are 750 kg maize.
\[
\frac{750}{1000} = 0.75 \times M 0.20 = M 0.15 \text{ per kg corn and cob meal.}
\]
c Cost of corn and cob per year is 9490 kg \times M 0.15/kg = M 1423.50

4 M 17340 \times 7\% = M 1213.80

5 1500 L \times M 0.43/L = M 645

6 a 400 kg ammonium nitrate/ha = 8 bags/ha; 8 \times 15 = 120 bags ammonium nitrate
\[
200 \text{ kg triple super/ha} = 4 \text{ bags}; 4 \times 15 = 60 \text{ bags triple super}
\]
b) Ammonium nitrate 120 bags \times M 14.95/bag = M 1794
Triple super 60 bags \times M 16.25/bag = M 975
Total costs of fertilizer M 2769

7 Minerals 24.9 LU × M 30/LU = M 747
Veterinary costs 13 cows × M 25/cow = M 325
A.I. costs 13 cows × M 5/cow = M 65
Medicines and chemicals 24.9 LU × M 25/LU = M 622.50

Total miscellaneous costs per year = M 1759.50

8 Total variable costs dairy enterprise:

Corn and cob meal M 1423.50
Milk for calf feeding M 645
Total miscellaneous costs M 1759.50
Interest costs of dairy herd M 1213.80
Ammonium nitrate fertilizer M 1794
Triple super fertilizer M 975

Total variable costs dairy enterprise M 7810.80

9 Gross Margin of the dairy enterprise:

Gross output (see exercise 10) M 14750
Total variable costs M 7810.80

Gross margin M 6930.20

Gross margin per cow is M 6939.20 ÷ 13 = M 533.78
Gross margin per ha improved pasture is M 6939.20 ÷ 15 = M 462.61

Exercise 12

1 2 L milk = 2 × M 0.43/L = M 0.86
1 kg dairy meal = M 0.25

Expected profit M 0.61 per kg dairy meal

2 and 3

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Kg required</th>
<th>Price per kg</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans</td>
<td>28</td>
<td>M 0.50</td>
<td>M 14</td>
</tr>
<tr>
<td>Shelled maize</td>
<td>42</td>
<td>M 0.20</td>
<td>M 8.40</td>
</tr>
<tr>
<td>Sunflower</td>
<td>28</td>
<td>M 0.10</td>
<td>M 2.80</td>
</tr>
<tr>
<td>Salt</td>
<td>1</td>
<td>M 0.25</td>
<td>M 0.25</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1</td>
<td>M 0.80</td>
<td>M 0.80</td>
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<tr>
<td>Nutrafos</td>
<td>0.5</td>
<td>M 2.00</td>
<td>M 1</td>
</tr>
<tr>
<td>Total</td>
<td>100.5</td>
<td></td>
<td>M 27.25</td>
</tr>
</tbody>
</table>

4 and 5

Price per kg of this home made mixture is M 27.25 ÷ 100.5 kg = M 0.27 per kg.

6 The dairy meal of the local milling company costs M 0.25/kg. The home made mixture is more expensive!
### Exercise 13 (chapter 7)

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<th>Section</th>
<th>Gross Output</th>
<th>Variations</th>
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<td>Dairy section</td>
<td>M 7825</td>
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<tr>
<td>Crop section</td>
<td>M 5125</td>
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<tr>
<td><strong>Total farm gross output</strong></td>
<td>M 12950</td>
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<tr>
<td>Variable costs dairy section</td>
<td>M 3550</td>
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<tr>
<td>Variable costs crop section</td>
<td>M 2550</td>
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<td><strong>Total farm gross margin</strong></td>
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<tr>
<td><strong>Total farm gross margin (carried forward)</strong></td>
<td>M 6850</td>
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</tbody>
</table>

#### Fixed costs:

- **Machinery and equipment:**
  - Depreciation: M 263
  - Interest: M 55
  - Maintenance: M 131
  - Total: M 449

- **Buildings, fencing and infrastructure:**
  - Depreciation: M 849
  - Interest: M 643
  - Maintenance: M 334
  - Total: M 1826

- **Permanent labour:**
  - 1 man for 12 months at M 100 per month: M 1200

- **Family labour:**
  - M 2400

- **Tenants rent:**
  - M 0

- **Miscellaneous paid costs:**
  - Water & electricity charges at M 12 per month: M 144
  - Total: M 6019

### Profit

Net Farm Income: M 831

- **Correction for interest:**
  - Total calculated interest costs: M 1218
  - Total paid interest costs (loan of M 17,000 at 7% per year): M 1190
  - Calculated interest own capital: M 28

- **Correction for family labour:**
  - Family labour income: M 2400
  - 2 men for 12 months at M 100 per man per month (opportunity cost): M 2400

---

88 The Farm as a Commercial Enterprise
correction for depreciation:
machinery and equipment  M 263
buildings  M 849

Management + Investment Income  M 4371

Remark: Even if the farm is running at a loss (Net Farm Income), the M + I Income will be positive until the loss equals the corrections.

### Exercise 14 (chapter 8)

The table below shows Labour Supply and Requirements in man-days.

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<td>110</td>
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<td>250</td>
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<td>108</td>
<td>178</td>
<td>198</td>
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<td>Ploughing (15 ha × 8)</td>
<td>120</td>
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<td>20</td>
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<tr>
<td>Harrowing (15 ha × 3)</td>
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<td>15</td>
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<tr>
<td>Basal dressing (10 ha × 7)</td>
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<td>40</td>
<td>30</td>
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<tr>
<td>+ planting (5 ha × 6)</td>
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<td>Weeding (10 ha × 14)</td>
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<td>Top dressing (10 ha × 4)</td>
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<td>25</td>
<td>15</td>
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<tr>
<td>Harvesting (10 ha × 15)</td>
<td>200</td>
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<td>50</td>
<td>90</td>
<td>60</td>
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<tr>
<td>+ planting (5 ha × 10)</td>
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<tr>
<td>Shelling (10 ha × 5)</td>
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<td>15</td>
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<tr>
<td>+ planting (5 ha × 3)</td>
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<tr>
<td>Transport (10 ha × 2)</td>
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<td>5</td>
<td>20</td>
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<tr>
<td>+ planting (5 ha × 1)</td>
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<td>Stargrass (25 ha × 2)</td>
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<td>Oxen (8 × 13)</td>
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<td>Dairy section (20 cows × 60)</td>
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<td>1200</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Subtotal</td>
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<td>139</td>
<td>260</td>
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<td>137</td>
<td>188</td>
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<td>248</td>
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</tr>
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<td>General farm work (10%)</td>
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<td>29</td>
<td>10</td>
<td>10</td>
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<td>10</td>
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<td>10</td>
<td>10</td>
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<td>Total</td>
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<td>163</td>
<td>270</td>
<td>362</td>
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<td>147</td>
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<td>238</td>
<td>286</td>
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</tr>
<tr>
<td>Family + Regularly Employed Labour</td>
<td>1750</td>
<td>112</td>
<td>112</td>
<td>175</td>
<td>175</td>
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<td>126</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>126</td>
<td>112</td>
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<tr>
<td>Balance (casual labour)</td>
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<td>27</td>
<td>27</td>
<td>85</td>
<td>168</td>
<td>83</td>
<td>-17</td>
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<td>11</td>
<td>8</td>
<td>38</td>
<td>122</td>
<td>26</td>
</tr>
</tbody>
</table>
Exercise 15 (chapter 9)

1 Gross Margin Maize

Gross output: 35 bags × M 11.70/bag

Variable costs:
Seed 25 kg × M 0.72/kg = M 18
Compound fertilizer 4 bags × M 9/bag = M 36
Ammonium nitrate 6 bags × M 8/bag = M 48
Empty bags 35 bags × M 1/bag = M 35

Sub var.costs
M 137

Interest \( \frac{M \times 137 \times 10 \times 6}{100 \times 12} = \) M 6.85

Total variable costs M 143.85

Gross Margin Maize M 265.65

Gross Margin Sunflower

Gross output: 12 bags × M 16.40/bag

Variable costs:
Seed 7 kg × M 0.40/kg = M 2.80
Compound fertilizer 4 bags × M 9/bag = M 36
Ammonium nitrate 2 bags × M 8/bag = M 16
Empty bags 12 × M 1/bag = M 12

Sub var.costs
M 66.80

Interest \( \frac{M \times 66.80 \times 10 \times 6}{12 \times 100} = \) M 3.34

Total variable costs M 70.14

Gross Margin Sunflower M 126.66

2 Total Farm Gross Margin

4 ha maize = 4 × M 265.65 M 1062.60
1 ha sunflower M 126.66

Total Farm Gross Margin M 1189.26
Total Farm Gross Margin (carried forward)  

M 1189.26

3 Fixed Costs

4

5 Oxen 2 × M 25/ox  
M 50

6 Interest M 900 × 10%  
M 90

7 a Total costs oxen  
M 140

b Casual labour 73 days × M 1.50/day  
M 109.50

c Equipment D(epr.) 25% × M 600  
M 150

M(tnc.) 10% × M 600  
M 60

I(ntr.) 10% × 60% × M 600  
M 36

Total costs equipment  
M 246

d Farm buildings

D 10% × M 300  
M 30

M 2% × M 300  
M 6

I 10% × 60% × M 300  
M 18

Total costs farm buildings  
M 54

e Fencing

D 10% × M 800  
M 80

M 3% × M 800  
M 24

I 10% × 60% × M 800  
M 48

Total costs fencing  
M 152

Total fixed costs  
M 701.50

Family labour 375 man-days × M 1.50/man-day

M 562.50

Loss

Calculation of Management + Investment Income:

Calculated interest:

maize 4 ha × M 6.85/ha =  
M 27.40

sunflower 1 ha × M 3.34/ha =  
M 3.34

Oxen  
M 90

Equipment  
M 36

Farm buildings  
M 18

Fencing  
M 48

Total calculated interest  
M 222.74

Interest to be paid:

Seasonal loan 10% × M 651 =  
M 65.10

Medium term loan 10% × M 800 =  
M 80

Total interest to be paid  
M 145.10

Family labour  
M 562.50

M 77.64

Solutions to the exercises
Total depreciation

<table>
<thead>
<tr>
<th></th>
<th>M 260</th>
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<tbody>
<tr>
<td>Management + Investment Income</td>
<td>M 825.40</td>
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## 8 Annual Cash Flow

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<tbody>
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<td>Installment med.term 20%</td>
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<td>Repayment seasonal loan</td>
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<td>Seed: maize</td>
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<td>Amm. nitr. (4 × 6 + 1 × 2) × M 8</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Compound fertilizer (4 × 4 + 1 × 4) × M 9</td>
<td>180</td>
<td>180</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Empty bags</td>
<td>152</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Casual labour 73 × M 1.50</td>
<td>109.50</td>
<td>40.50</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drugs 2 × M 25</td>
<td>50</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private 12 × M 50</td>
<td>600</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Maintenance fixed assets</td>
<td>90</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
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<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
<td>7.50</td>
</tr>
</tbody>
</table>

### Exercise 16

1. **Herd value 1-9-20. Herd value one year later.**

   
   \[
   \begin{align*}
   18 \times M 800 &= M 14400 \\
   5 \times M 600 &= M 3000 \\
   6 \times M 400 &= M 2400 \\
   9 \times M 100 &= M 900 \\
   2 \times M 60 &= M 120 \\
   8 \times M 450 &= M 3600 \\
   \end{align*}
   \]

   \[
   \begin{align*}
   22 \times M 800 &= M 17600 \\
   6 \times M 600 &= M 3600 \\
   7 \times M 400 &= M 2800 \\
   10 \times M 100 &= M 1000 \\
   1 \times M 60 &= M 60 \\
   8 \times M 450 &= M 3600 \\
   \end{align*}
   \]

   \[
   \begin{align*}
   \text{a Total herd value} & \quad M 24420 \\
   \text{b Total herd value} & \quad M 28660 \\
   \end{align*}
   \]

   \[
   \begin{align*}
   \text{c Average herd value} & = \frac{M 24420 + M 28660}{2} = M 53080 \\
   & = M 26540 \\
   \end{align*}
   \]

   \[
   \begin{align*}
   \text{d Increase in herd value} & = M 28660 – M 24420 = M 4240 \\
   \end{align*}
   \]
2 Number of LU 1-9-20.. Number of LU one year later

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18 × 1 =</td>
<td>18</td>
</tr>
<tr>
<td>5 × 0.8 =</td>
<td>4</td>
</tr>
<tr>
<td>6 × 0.5 =</td>
<td>3</td>
</tr>
<tr>
<td>9 × 0.2 =</td>
<td>1.8</td>
</tr>
<tr>
<td>2 × - =</td>
<td>-</td>
</tr>
<tr>
<td>8 × 1.2 =</td>
<td>9.6</td>
</tr>
</tbody>
</table>

\[ \text{a Total number LU} \quad \frac{36.4 + 41.9}{2} = 39.15 \rightarrow 39.2 \]

3 Average number of cows in milk \((18 + 22) \div 2 = 20\)

4 Total number of lactation days is \(20 \text{ cows} \times 300 \text{ days/cow} = 6000 \text{ days}\)

5 Lactation days during the wet period is \(150 \div 365 \times 6000 \text{ lactation days} = 2466 \text{ days}\)

6 Lactation days during the dry period is \(215 \div 365 \times 6000 \text{ lactation days} = 3534 \text{ days}\)

7 Milk production during the dry period is \(3534 \text{ lactation days} \times 6 \text{ L/cow/day} = 21204 \text{ L}\)

8 Milk production during the wet period is \(2466 \text{ days} \times 10 \text{ L/cow/day} = 24660 \text{ L}\)

9 Total value of the milk produced:
\[(21204 \text{ L} + 24660 \text{ L}) \times \text{M 0.43 per L} = \text{M 19721.52}\]

10 Gross output

A Total milk produced \(\text{M 19721.52}\)

B Increase in herd value \(\text{M 4240}\)

C Stock sales
\[
\begin{align*}
1 \times \text{M 800} &= \text{M 800} \\
1 \times \text{M 600} &= \text{M 600} \\
1 \times \text{M 400} &= \text{M 400} \\
2 \times \text{M 100} &= \text{M 200} \\
10 \times \text{M 60} &= \text{M 600} \\
\end{align*}
\]
\[
\text{M 2600} + \text{M 26561.52}
\]

Gross output dairy herd \(\text{M 26561.52}\)

11 Cash output:

A Gross output – non cash = \(\text{M 26561.52} – 4240 = \text{M 22321.52}\)

(non cash = increase in herd value; no information available on milk to calves and home consumption)

B Milk sales + stock sales – stock purchases
\(\text{M 19721.52} + 2600 – \text{nil} = \text{M 22321.52}\)
### Exercise 17

1 a  

\[
\begin{array}{ccc}
10 \times 800 &= 8000 \\
4 \times 600 &= 2400 \\
5 \times 400 &= 2000 \\
4 \times 100 &= 400 \\
1 \times 60 &= 60 \\
4 \times 550 &= 2200 \\
\end{array}
\]

\[
\begin{array}{ccc}
12 \times 800 &= 9600 \\
2 \times 600 &= 1200 \\
6 \times 400 &= 2400 \\
6 \times 100 &= 600 \\
2 \times 60 &= 120 \\
4 \times 550 &= 2200 \\
\end{array}
\]

\[
\begin{array}{ccc}
\hline
& + & + \\
M 15060 & M 16120 & \\
\end{array}
\]

1 b Average herd value 

\[
\frac{15060 + 16120}{2} = 15590
\]

2 a  

\[
\begin{array}{ccc}
10 \times 1 &= 10 \\
4 \times 0.8 &= 3.2 \\
5 \times 2.5 &= 2.5 \\
1 \times - &= - \\
4 \times 1.2 &= 4.8 \\
\end{array}
\]

\[
\begin{array}{ccc}
12 \times 1 &= 12 \\
2 \times 0.8 &= 1.6 \\
6 \times 0.5 &= 3 \\
2 \times - &= - \\
4 \times 1.2 &= 4.8 \\
\end{array}
\]

\[
\begin{array}{ccc}
\hline
& + & + \\
21.3 & 22.6 & \\
\end{array}
\]

2 b Average number of LU 

\[
\frac{21.3 + 22.6}{2} = 21.95 \rightarrow 22 LU
\]

3 a Cows: 

\[
\begin{array}{ccc}
1 \times 800 &= 800 \\
1 \times 600 &= 600 \\
1 \times 400 &= 400 \\
3 \times 60 &= 180 \\
\end{array}
\]

\[
\begin{array}{ccc}
\hline
M 1980 & \\
\end{array}
\]

3 b Animals purchased: 

two pregnant heifers at M 650 = M 1300

3 c Animals slaughtered for home consumption: 

one cow at M 800 = M 800

3 d Milk produced 22500 L \times M 0.43/L = M 9675

4 Closing value less Opening value 

M 16120 – M 15060 = M 1060

Sales less Purchases 

M 1980 – M 1300 = M 680

Slaughtering for home consumption = M 800

Total milk produced = M 9675

\[
\begin{array}{ccc}
& + \\
\hline
\text{Gross output} & M 12215 \\
\end{array}
\]

5 a Kg corn and cob meal per year
3 kg × 11 cows × 365 days = 12045 kg

5 b Price is 75% of the maize price
0.75 × M 0.20 = M 0.15 per kg

5 c 12045 kg × M 0.15/kg = M 1806.75

6 Average herd value × rate of interest
M 15590 × 0.07 × 1 year = M 1091.30

7 Milk for calf feeding 1000 L × M 0.43/L = M 430

8 a 15 ha × 7 bags amm.nitrate/ha = 105 bags amm. nitrate
15 ha × 3 bags triple super/ha = 45 bags triple super

b Amm.nitrate 105 bags × M 14.95/bag = M 1569.75
   Triple super 45 bags × M 16.25/bag = M 731.25

9 Miscellaneous

Minerals  M 35 × 22 LU = M 770
Veterinary M 25 × 11 cows = M 275
A.I. M 10 × 11 cows = M 110
Dip M 35 × 22 LU = M 770

10 a Gross output
   M 12215
Total variable costs 5c + 6 + 7 + 8b + 9
   M 554.05
   +
Gross margin
   M 4660.95
Exercise 18

1. a  1-1-20..
   4 × 550 = M 2200
   5 × 350 = M 1750
   7 × 85 = M 595
   1 × 50 = M 50
   4 × 400 = M 1600

   14 × 750 = M 10500
   3 × 550 = M 1650
   6 × 350 = M 2100
   8 × 85 = M 680
   2 × 50 = M 100
   4 × 400 = M 1600

   M 15195 + M 16630

   1 c Increase in herd value is M 16630 less M 15195 = M 1435

   1 d  2 × M 750 = M 1500
         1 × M 350 = M 350
         4 × M 50 = M 200

   M 2050

   1 e \( \frac{12 + 14}{2} = 13 \times 1500 \times M0.43/L = M 8385 \)

   1 f Increase in herd value
   M 1435

   Sales  M 2050
   Purchases  M 550

   Sales less Purchases  M 1500
   One cow for home consumption  M 750
   Value of the milk produced  M 8385

   Gross output  M 12070

   1 g Gross Output – Variable Costs = Gross Margin
   So the variable costs are the difference between gross output and gross margin.

   2 a  100 LU × 215 days × 6.5 kg/LUD = 139750 kg -----> 140 ton

   b  140 ton × 100/80 (due to losses) = \( \frac{175 \text{ ton}}{10 \text{ ton/ha}} = 17.5 \text{ ha} \)

   2 c  1 Opportunity costs.
   2 The most appropriate way of costing is by using the opportunity costs (and not the production costs).
3 a  
\[
\begin{align*}
2 \times 65 &= M 130 \\
1 \times 45 &= M 45 \\
1 \times 25 &= M 25 \\
2 \times 15 &= M 30 \\
1 \times 125 &= M 125 \\
1 \times 550 &= M 550 \\
1 \times 45 &= M 45 \\
1 \times 150 &= M 150 \\
1 \times 250 &= M 250 \\
\hline 
&M 1350 \text{ which is Total New Value}
\end{align*}
\]

3 b  
\[
\frac{135 - 0}{4} = M 337.50
\]

3 c  
\[
\frac{7}{100} \times \frac{60}{100} \times M 1350 = M 56.70 \\
\frac{10}{100} \times M 1350 = M 135
\]

d  
\[
\begin{align*}
\text{Cost of depreciation} &= M 337.50 \\
\text{Cost of interest} &= M 56.70 \\
\text{Cost of maintenance} &= M 135 \\
\text{Total Fixed Costs} &= M 529.20
\end{align*}
\]

Exercise 19

1 A  The main reason why we subdivide the farm business into farm enterprises is to know the contribution of each of the enterprises to the overall result of the farm.

1 B  We want to know the input per farm enterprise. It is difficult to allocate the total costs to the different enterprises. For this reason we divide the total costs into a variable part and a fixed part, because the variable costs are easy to allocate to the individual enterprises.

1 C  Gross Margin = Gross Output - Variable Costs.

The use of this type of calculation is to have an idea about the contribution of each of the enterprises to the overall result of the farm.

1 D  Some costs may be variable on one farm, while the same costs are fixed on the other farm.
For example harvesting costs: Farm A has regularly employed labour while Farm B has casual labour.

2 A  The opportunity costs of an input are equal to the return the farmer would have obtained if that input were put into its best alternative use.
Examples: family labour if alternative employment is possible; milk for calf feeding; maize used as stockfeed.

2 B a  Calculated interest - paid interest (800-450) = M 350

Calculated costs family labour = M 900
Profit/Loss or Net Farm Income = M 300 (negative)

\[
\begin{align*}
\text{Management + Investment Income} &= M 950
\end{align*}
\]

2 B b  Profit/Loss = Gross Output - Total Costs = M 300 (negative)
3 Tractor ‘A’

\[
\begin{align*}
\text{a} & \quad \frac{25000 - 5000}{10} = 2000 \\
\text{b} & \quad \frac{25000 + 5000}{2} \times 10\% = 1500 \\
\text{c} & \quad 25000 \times 2\% = 500 \\
\text{d} & \quad 3 \times 800 \text{ (hours)} = 2400 \\
\end{align*}
\]

\[
\begin{align*}
\text{M} & \quad 6400 \\
\text{M} & \quad 7850
\end{align*}
\]

e The total annual fixed costs of tractor ‘A’ are lower than those of tractor ‘B’. The difference is M 1450 per year. So we should recommend tractor ‘A’ as being the cheapest.

4 a 80 LU \times 200 \text{ days} \times 6 \text{ kg DM/LU} = 96000 \text{ kg} = 96 \text{ ton} \\
b 10 \text{ ton DM/ha} – 20\% \text{ losses} = 8 \text{ ton/ha} \\
c 100/25 \times 6 \text{ kg DM} = 24 \text{ kg maize silage}

Exercise 20

1 a rectangular part = 400 \times 100 \text{ m} = 40,000 \text{ m}^2 \\
triangular part = \frac{1}{2} \times 400 \times 300 \text{ m} = 60,000 \text{ m}^2 \\
Total area = 100,000 \text{ m}^2 (= 10 \text{ ha})

b \quad A^2 + B^2 = C^2; \quad (400)^2 + (300)^2 = C^2 \\
\quad 160,000 + 90,000 \text{ m}^2 = C^2; \quad C = \sqrt{250,000} = 500 \text{ m}

c 50 \text{ kg seed in one bag; 10 ha} \times 25 \text{ kg/ha} = 250 \text{ kg} = 5 \text{ bags}

d 1 \text{ kg seed} = 1000 \text{ g} = 1000 \div 0.4 = 2500 \text{ seeds} \\
\quad 25 \text{ kg seeds per ha gives} 25 \times 2500 = 62,500 \text{ seeds per ha.}

e 80/100 \times 62500 \text{ seeds/ha} = 50,000 \text{ plants per ha}

f area for one seed, 62,500 seeds on 10,000 \text{ m}^2 (\text{one hectare}) \\
so one seed per 0.16 \text{ m}^2 \\
\quad 0.75 \text{ m} \times ‘X’ \text{ m} = 0.16 \text{ m}^2; \quad ‘X’ = \frac{0.16 \text{ m}^2}{0.75 \text{ m}^2} = 0.213 \text{ m}

2 a 10 \text{ ha} \times 6 \text{ bags/ha} = 60 \text{ bags in total (one bag is 50 kg)}

b Compound fertilizer 10-20-10-10

<table>
<thead>
<tr>
<th>component</th>
<th>element</th>
<th>%</th>
<th>kg/100 kg fert.</th>
<th>kg/300 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>N</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Phosphate</td>
<td>P</td>
<td>20</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Potassium</td>
<td>K</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Sulphur</td>
<td>S</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>
c 6 bags/ha × price/bag = cost per hectare

3 a \(20 \times 50 \text{ cm} = 1000 \text{ cm} = 10 \text{ metres}\)

\[
c = \frac{400 \text{ L}}{20 \text{ nozzles} \times 1 \text{ L per nozzle per minute}} = 20 \text{ minutes}
\]

b \(4 \times 250 \text{ ml} = 1000 \text{ ml} = 1 \text{ L}\)

d \(400 \text{ L in 20 minutes is equal to 20 L per minute; so 500 L will take 500 L ÷ 20 L per minute = 25 minutes.}

This means that in 25 minutes the farmer has to cover 1 ha = 10,000 m\(^2\). The working width of the machine is 10 m; to cover 10,000 m\(^2\) the sprayer has to travel 10,000 ÷ 10 = 1000 m = 1 km.

One km in 25 minutes is equal to 60 ÷ 25 = 2.4 km/hour.

e \(400 \text{ L} ÷ 500 \text{ L} = 0.8 \times 2.5 \text{ kg weed killer has to be put in one tank which is 2 kg.}\)

f \(\frac{10 \text{ ha} \times 500 \text{ L water per ha}}{400 \text{ L per tank}} = 5000 ÷ 400 = 12.5; \text{ hence the farmer has to go the 400 L per tank field 13 times} \times 35 \text{ minutes per tank} = 455 \text{ minutes}

\[
12.5 \times 20 \text{ minutes for spraying} = 250 \text{ minutes}
\]

\[705 \text{ minutes (about 12 hours)}\]

g \(\text{Weed killer } 10 \text{ ha} \times 2.5 \text{ kg/ha} \times M 10/\text{kg} = M 250\)

\(12 \text{ hours} \times M 11/\text{hour} = M 132\)

\[\text{Total} M 382\]