Variable Costs and Enterprise Budgets

AgroBrief

Rob Witte *June 2006* **Number 5**

This AgroBrief deals with variable costs and enterprise budgets. This is a small, basic subject of farm accounting that can be used as a means for both planning and evaluating performance of activities on a farm. This AgroBrief is the first of a series of AgroBriefs on Farm Management in general, and the economics of farming in particular. After describing the basics of farm economics (1) and enterprises (2) methods of calculating a crop budget (3) and a livestock budget (4) are given. The document is concluded with a short discussion on the use of enterprise budgets.

1. The farm as an economic unit

Farming is a productive activity. We use inputs, such as seeds, fertilizers, feed and labour. With them we produce valuable outputs, such as cereals, beans, eggs, milk and meat.

Input → **Farming activities** → **Output**

The value of the output should be more than what we used as inputs. This added value or surplus is called profit. Or, if we did not earn enough to pay for the inputs, we have a loss. For calculating profit or loss of an activity, we need to know the total value of all inputs (total costs), and the total value of all outputs (gross income). Profit is then calculated as the total value of all outputs minus the total value of all inputs:

Gross income - **Total costs** = **Profit (or Loss)**

2. Farm enterprises

Each farmer carries out several more or less independent activities. For example, on a farm we may find maize, sunflower, beans, a herd of cattle, and poultry. These individual activities within a farm are called farm enterprises. The focus of this AgroBrief is on calculations for such an individual enterprise. Types of enterprises we want to distinguish are:

- Annual crops (such as maize, vegetables etc.)
- Livestock
- Perennial crops and trees.

For each of these activities a budget can be calculated, and this budget shows us whether we make a profit.
For simplicity's sake we limit calculations regarding inputs to direct costs (also called variable costs). Direct costs occur only if something is produced since they vary according to the size of the enterprise. In vegetable production for example, the need for labour will increase when production increases. A larger area or higher yields require more labour in land preparation, seeding, weeding and harvest.

3. Crop budget

3.1 Gross Income

Gross income is calculated by multiplying the total quantity produced with the unit price.

Total Quantity	*	**Unit Price**	=	**Gross Income**

An example:

30 bags of maize were sold at $ 15 per bag. This results in a Gross Income of $ 450.

30	*	$ 15	=	$ 450

Besides maize cobs, the maize field also yielded straw. If the maize straw is a marketable product, its value should be calculated as well. 30 bundles of maize straw were produced, with a value of $ 1.00 per bundle. The Gross Income from straw is then $ 30.

30	*	$ 1	=	$ 30

For calculating the gross income you need to add up the incomes from the cobs and from the straw. The gross income adds up to $ 480.

Step by step for calculating gross income:

1. List the products intended for sale.
2. Estimate yields of each product.
3. Estimate the price for each product.
4. Multiply the estimated yield of each product with its price.
5. You now have the income for each product.
6. Add all incomes. This sum is the gross income.

		Quantity	
Yield of main product	Unit		X
Price per unit	Currency		Value yield
Quantity of by-product 1	Unit		X
Price per unit	Currency		Value by-products
Gross Income	Currency		Value yield + Value by-products

With the figures of the example given above:

		Quantity	
Maize Yield	Sacks	30	X
Price per sack	$	15,00	$ 450.00
Maize straw	Bundle	30	X
Price per bundle	$	1,00	$30.00
Gross Income	$		450 + 30= 480

3.2 Direct Costs

Direct costs are calculated in the same way as the gross income: Multiply the quantity with the unit price, and sum all costs. You may group costs according to activities, if you do not want to forget any costs:

- Land preparation
- Planting
- Growing
- Harvesting
- Other costs

For each group of activities, it may help to identify the costs involved in more detail. Here are some costs you may have to consider:

- Land Preparation: Herbicide, Ploughing, Harrowing, Labour, Machinery hire, Fuel and oil
- Planting: Seed, Fertiliser, Machinery Hire, Fuel and Oil, Insecticide, Herbicide, Labour
- Growing Costs: Herbicide or Weeding, Fertiliser, Insecticide, Fungicide, Irrigation, Electricity, Fuel/Oil, Machinery Hire, Labour
- Harvesting Costs: Harvester or Thresher Hire, Fuel and Oil, Labour
- Other Costs and Charges: Freight, Storage, Sundry Materials, Crop Levies, Crop Insurance, Interest, Administration

In the table below an example of calculations for direct costs of a maize crop is given. In the first column you note the phase in the cropping activities, in the second column you describe the item you bought. The third column gives the quantity, and the fourth column the unit used for calculating. The fifth column is used for the price per unit. The sixth column shows the calculations, and the seventh shows the outcome, in terms of costs.

Activity type	**Input type**	**Quantity**	**Unit**	**Unit price**	**Calculation**	**Value**
1	**2**	**3**	**4**	**5**	**6**	**7**
Land Preparation	Compound fertiliser	4	bags	$ 11.75	= 4*11.75	$ 47.00
	Triple super phosphate	2	bags	$ 13.65	= 2*13.65	$ 27.30
Planting	Seed	80	kg	$ 0.86	= 80*0.86	$ 68.80
Growing	Herbicide	2	litres	$ 7.75	= 2*7.75	$ 15.50
	Insecticide	2.5	litres	$ 20.70	= 2.5*20.70	$ 51.75
	Labour (weeding)	5	days	$ 2.00	= 5*20	$ 10.00
Harvesting	Labour (harvesting)	10	days	$ 2.00	= 10*2	$ 20.00
	Bags	30	piece	$ 0.60	= 30*0.60	$ 18.00
Other costs	Interest	20	%	$ 7.25	= 20*67.25/100	$ 13.45
Direct costs					Sum (47.00 to 13.45)	$ 271.80

Note that under other costs, we have included interest on a small loan for purchasing herbicides and insecticides. Interest is calculated as follows:

Interest rate (percentage)	/	**100**	*	**Amount borrowed**	=	**Interest due at pay-back**

If interest is 20%, and the amount borrowed is $ 67.25, the calculation for the interest due at pay-back is 20 divided by 100 (for percent) times 67.25

20 (%)	/	**100**	*	**67.25**	=	**13.45**

It is important to be systematic in always using the same column for the same type of information, because small errors in budget calculations may have large effects in the final outcome, since the figures are multiplied!

The same holds for unit prices: For example, imagine that insecticide was bought in a local shop in 5 small bottles of 1/2 litre (0.5 litre), that were sold at a price of 20.70 per bottle, while in the table below it is recorded as 2.5 litres at the price of 20.70 per litre: The real price per litre should have been 41.40, and total costs should not be 51.75, but $103.50. Therefore you always have to check and double-check whether the units and prices used in these calculations are the same as what you pay in the shop.

Based on the figures we have derived now, we can calculate an example of a gross margin:

Gross Output	-	**Variable Costs**	=	**Gross Income**

In the earlier example, gross output was calculated at $ 480.00. Variable cost is $ 271.80. So the gross margin is $ 208.20

$ 480	-	**$ 271.80**	=	**$ 208.20**

4. Animal husbandry budgets

For calculating animal budgets, we need to know the value of all animals, and how this value of the whole stock has increased or decreased in the year. Furthermore we need information on all sales of animal products. Finally we need an overview of all costs. If we know these, we can calculate the gross margin. We need to subtract the costs from the gross output. The gross output is the income from sales, the value of home consumption and the value of increases in the stock. We will take it step by step.

4.1 Valuation of stock

In animal production one form of “income” is the increase in the value of the living animals for which we care. Therefore we are interested in the closing valuation of a year minus the opening value of the year. This shows us the net increase or net decrease of the value of the stock.
In order to calculate the opening and closing values, we use a year as our time-frame. First, we need to know the herd composition at the beginning of the year and at the end of the year. Then, we need to

estimate the value (or price) of these herds. Calculate this value by multiplying the numbers of animals by their value.

Example: At the beginning of the year the number of animals is: 12 cows, 4 pregnant heifers, 5 yearling heifers, 7 female calves and one male calf. In our example the value of an animal is as follows: A cow is worth $ 80, a pregnant heifer $ 60, yearling heifers $ 40, female calves $10, male calves $ 6 and oxen $45. The value of the stock is calculated by multiplying the numbers of animals by their value.
At the end of the year, the numbers of animals are 14 cows, 3 pregnant heifers, 6 yearling heifers, 8 female and 2 male calves and 4 oxen.

In the table below all data on prices and numbers of animals can be written down, and their value can be calculated for each category separately. Note that a different value for the year-end can be written in the table in column 5

Herd composition	Value per animal	Number	Value	Value per animal	Number	Value
	(Start) $	start	start	(Year-end) $	Year-end	Year-end
Cows						
Pregnant heifers						
Yearling heifers						
Calves: female						
male						
Oxen						
Total						

With the figures from our example, the table is filled up as follows:

Herd composition	Value per animal	Number	Value	Value per animal	Number	Value
	(Start) $	start	start	(Year-end) $	Year-end	Year-end
Cows	80	12	960	80	14	1,120
Pregnant heifers	60	4	240	60	3	180
Yearling heifers	40	5	200	40	6	240
Calves: female	10	7	70	10	8	80
male	6	1	6	6	2	12
Oxen	45	4	180	45	4	180
Total			1,656			1,812

The increase in the value of stock is now:

Total Value at Year-end	**-**	**Total Value Start**	**=**	**Increase in Value**

Or in dollars from our example:

$ 1,812	**-**	**$ 1,656**	**=**	**$ 156**

4.2 Turnover

Besides the increase in value of the stock as calculated above, we need to have an overview of the value of the produce during the year. This value we get from adding the incomes from sales to the value of any home consumption. From this sum, we will subtract the costs in order to reach the turnover.

Some animals and especially milk will be sold, which have to be added to the budget as an income. Furthermore, a cow could be slaughtered for home consumption, and part of the milk is usually consumed by the family. The value of this home consumption must also be included in the Gross Margin calculations.

Example: Assume we sold 2 cows, 2 yearling heifers and 4 bull calves.

Calculated with the same prices as above, this results in

	Number	Price	Value
Cows	2	80	160
Yearling heifers	2	40	80
Bull calves	4	6	24 +
Value of animals sold			264

In the example, the family also sold milk, with a value of $ 1445. Therefore the total turnover is:

$ 264	**+**	**$ 1,445**	**=**	**$ 1,709**

4.3 Variable costs

Under the variable costs we place all the expense for animal production, such as

- feeds and feed supplements
- medicine
- fertilizers for fodder crops
- new animals purchased.

Now assume that the following items were purchased for the animal production of this year:

Fertilizers: triple phosphate at $ 98, ammonium nitrate at $180, corn-and-cob meal as a supplementary feed at a price of $ 180 and some extra milk for calf feeding at $ 79. Finally a number of miscellaneous costs were recorded, to a total of $ 220.

This adds up to variable costs of:

98	+	180	+	185	+	79	+	220	=	$ 762

We should also add “interest” here. The reason is that a certain value of money is not put in the bank, where it would earn interest. Instead this “money-value” is walking around on 4 legs.

The interest calculation is based on the average value of the herd. Therefore, calculate

Average value of herd	=	(Opening Value + Closing Value)	/ 2

and subsequently multiply this value with the interest as:

Interest	=	Average value of herd	X	Interest Rate	/	100

In the example given above, par.4.1

Average value of herd	=	(1656 + 1812) / 2 =	1734

If we continue to calculate with an interest rate of 20%, just as in the crop example, the interest would reach an amount of

Interest	=	1734	X	20	/	100 =	347

Now we finally calculate the total variable costs. We add 347 to the earlier calculated costs of 762.

347	+	762	=	1109

4.4 Gross margin calculation for animal production

In the table on next page, a summary of the calculations for the gross margin of animal production is given.

Gross Margin	=	Gross Output	-	Variable Costs

In the first calculation, the increase in the value of the herd is placed. The result is written in the last column (at letter C).

The second calculation sums up all sales of produce into a subtotal “Output” (letter F).

The third issue is a subtotal of the value of produce consumed on the farm, resulting in a subtotal “Home consumption” (letter I)

Calculation number 4 results in a total value of all products consumed or sold, by adding up the two subtotals “Output” and “Home Consumption”. This “Subtotal Turnover” (letter L) only shows the income side of the turnover within the year. The expenditures for buying new animals (letter M) still have to be subtracted from this subtotal. The result of this subtraction is again placed in the last column (letter N).

Gross output for the year is the fifth calculation which is obtained by adding the increase in herd/stock (C) value to the turnover (N).

Gross margin data-example animal production				
	Amount	**Calculation**	**Subtotals**	**Totals**
Closing value stock	A	(minus)		
Opening value stock	B			
Increase in value of stock [1]			C	
Output				
Value of animals sold	D	(plus)		
Milk	E			
Subtotal Output [2]			F	
Home consumption				
Animals	G	(plus)		
Milk	H			
Subtotal Home Consumption [3]			I	
Turnover				
Subtotal Output		(plus)	J	
Subtotal Home Consumption			K	
Turnover subtotal		(minus)	L	
Purchases of new animals			M	
Total turnover[4]		(plus C)		N
Gross output [5]		(minus)		O
Variable costs				P
Gross margin				Q

In the foregoing paragraph we calculated the variable costs. These are placed at letter P. We can now calculate the Gross Margin as explained in par 4.4. In the end of chapter 5 you can find all figures that we have used in this chapter.

Gross Margin (Q) = **Gross Output (O)** - **Variable Costs (P)**

5. How to use Variable Cost and Gross Margin calculations

Farmers or their advisors can use Variable Cost calculations in finding weak points and showing or predicting the possible effects once these points are improved.

The term “variable costs” already suggests the main use of this calculation: To calculate costs, and find out which of these costs are so high that it would be worthwhile to try to reduce them.

Cost saving

In the example on crop production, the biggest single input is seed. Seed was bought for $ 69 (see chapter 3). Let us assume that farmers traditionally plant 3 seeds in each hole. But suppose that maize will produce as much when only 2 seeds are planted per hole. This could save 1/3 of the seed costs. Instead of $ 69, one would pay $ 46. And the gross margin would be $ 231 instead of $ 208, assuming that the yield would not be affected. So saving on seed seems to improve the gross margin.
In looking for savings, it is wise to concentrate on the three highest costs.

Assessing risk

On the other hand, if in the same example the maize yield would be reduced by only 10 percent due to the lower seed rate (2 instead of 3 seeds per hole), this should alarm the farmer. Because in that case, gross output would be worth 435 instead of 480, gross margin would not be $ 231 as calculated in the last paragraph, but $ 186, which is lower than the $208 of the old example. So in that case the conclusion should be: Don’t gamble with lower numbers of seeds per hole.

Break-even

Based on the enterprise budgets, we can calculate a break-even price. The break-even price is the minimum price per unit that is required to cover all costs at the expected yield:

Break-even price	=	**Expected total costs**	/	**Anticipated yield**

The break-even price for maize, following from the example in chapter 3, can be calculated as follows:

Variable Costs	$271.80	
Expected yield	30 bags	
Break-even price	= 271.80/30	$9.06

Comparably, we can calculate a break-even yield. The break-even yield is the minimum yield a farmer needs in order to cover all costs at the expected price.

Break-even yield	=	**Expected total costs**	/	**Anticipated price**

From the same example, the following breakeven yield is calculated

Variable costs	$271.80	
Expected price per bag	$15.00	
Break-even yield	=271.80/15	18.12 bags

Choice of crop

Enterprise budgets are useful for deciding which crops or animals to start or to continue with. For example, a farmer with the right conditions to produce either sweet potatoes or cabbage needs to choose. After lots of calculations the Gross Margin for two crops is as follows:

Sweet potato: $ 1,790 – 378= $ 1,412

Cabbage: $ 16,000 - 1,630 = $ 14,370.

If he would produce cabbage instead of sweet potato, he would get a gross margin which is ten times as high as when producing sweet potatoes. This initially seems to be a good profit. Based on these figures alone the choice would probably be to produce cabbage. But how much money has to be invested? When producing sweet potatoes, an investment of $ 378 is needed, for cabbage this is $ 1,630. If you can access $ 1,630 a smart business person would go for the cabbage!

Assessing results

To assess whether your expectations were right, you could calculate budgets based on your expectations, before the start of the season. During the season you make notes of all expenditures and sales, and at the end you calculate the budget again, but with the real outcomes instead of expectations. Now you can check whether your expectations were met, you can probably see what went different than expected: Why did you spend more? Can you prevent this expenditure next time? Why was the yield higher/lower than expected? Will this continue year after year? You can compare with other farmers and form study clubs.

In this AgroBrief we skipped the fixed costs. Fixed costs do not vary with the level of input or output. They include repayments of loans on land and other investments, insurance taxes and depreciation. But on the longer term, farming is only viable if fixed costs too can be paid.

Gross margin data-example animal production				
	Amount	**Calculation**	**Subtotals**	**Totals**
Closing value stock	1,812			
Opening value stock	1,656	(minus)		
Increase in value of stock				156
Output				
Value of animals sold	264			
Milk	1,445	(plus)		
Subtotal Output			1,709	
Home consumption				
Animals	80			
Milk	25	(plus)		
Subtotal Home Consumption			105	
Turnover				
Subtotal Output			1,709	
Subtotal Home Consumption		(plus)	105	
Turnover subtotal			1,814	
Purchases of new animals			120	
Total turnover		(minus)		1,694
Gross output		(plus)		1,850
Variable costs				1,109
Gross margin		(minus)		741

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- http://agribiz.netfirms.com/cropbud.htm; http://agribiz.netfirms.com/sheepbud.htm for examples of crop budget and sheep budget calculation sheets on-line
- http://agalternatives.aers.psu.edu/farmmanagement/enterprise/enterprise_budget_analysis.pdf for Printable Crop and Animal Budget Formats

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AGROMISA, KNOWLEDGE CENTRE FOR SMALL SCALE SUSTAINABLE AGRICULTURE

Postal address: Agromisa Foundation, P.O. Box 41, 6700 AA Wageningen, The Netherlands
Visiting address: Duivendaal 8, 6701 AR Wageningen, The Netherlands
Telephone/Fax: ++ 31 317 412217 / 419178
E-mail: agromisa@agromisa.org
Banking: Bank account: 1172793 BIC or SWIFT code: pstbnl21 IBAN: NL52PSTB0001172793