

05 Gross Margin Exercise: Millet in Senegal

Introduction

Welcome to the gross margin exercise. This will be done in the field of crop production. The example is based on real data from millet production in Senegal. The first step of data collection on the farm has already been done and the data per plot is given. The current task is to convert the collected data into a gross margin per hectare and year. Since the example is based in Senegal, the currency is the CFA franc. However, this exercise can be done by anyone and is not limited to people from Senegal.

Procedure

The procedure of this training video is as follows:

1. **Introduction:** An introduction is given to the example and the calculation.
2. **Exercises:** You should do individual exercises to train the gross margin calculation. This leads us to the second step, which is your own participation. The video will show a stop sign along with exercises to be calculated. Please stop the video manually and use this opportunity to practise on your own without skipping. Sometimes hints are given or additional hints are given by skipping a second if necessary.
3. **Check and Correction:** Once you have completed the calculation, you can start the video again and see the results and explanations step by step until the next exercise appears.

Data Collection

The data for this example calculation is shown in this picture and it is assumed that we have collected this data during a previous farm visit with the students. This sheet will also be available next to the video for downloading and use in the calculation. The basics are the same as in the previous example of potato growing. We are growing millet on a 3.1 hectare plot in 2024. The students collected data from soil preparation to harvesting and selling directly on the farm. For a better overview, all data related to fertiliser have been coloured green, while all chemical applications for crop protection have been grouped in red.

Exercises

Exercise 1: Understanding Gross Margins

Task: Remember the three units in which gross margins are calculated. Also, think of the first step in the calculation. When you have finished, you can start the video again and see if your answer was correct. Please stop the video now.

Answer: Gross margins are calculated per hectare, per year, and in local currency. Own factors such as labour, land, and capital are not included in this basic gross margin calculation. And the first step to start with is the calculation of gross output.

Exercise 2: Calculating Gross Output

Task: Calculate the gross output of the millet production in the example. A clue is given by the fact that you need to divide the sales by the size of the plot to get the yield per hectare. If you cannot solve the problem, use the next hint. When you are ready to calculate, stop the video.

Hint: Use the table at the bottom of your data sheet to find information about yields and prices.

Calculation:

- **Field Sales:** 430 kilograms per hectare at 500 francs per kilogram.
- **Market Sales:** 263 kilograms at 550 francs per kilogram.
- **Own Consumption:** 50 kilograms at 500 francs per kilogram.

Result: The total gross output is 384,650 francs per hectare per year.

Exercise 3: Calculating Seed Costs

Task: Calculate the first part of the total variable costs. This is the total cost of seed per hectare. Stop the video now until you have finished.

Solution:

- **Seeds Used:** 4 kilograms per hectare at 1000 francs per kilogram.
- **Result:** Total cost of seed is 4000 francs per hectare.

Exercise 4: Calculating Fertilizer Requirements and Costs

Task: Calculate the amounts of pure nutrient requirements (N, P₂O₅, K₂O) used per one hectare of millet/sorghum production. Use the next slide to get a hint about the nutrient removal data.

Hint: Information about the nutrient removals is available in the PDF file using the crop "Sorghum and Sorghum, grain + straw." The unit is 10 decitons, so it can be changed to the unit of one deciton easily by dividing by ten. These data are from different sources, so an optimal solution is not given. A small adjustment can be made based on your own experience. This example uses the row Sorghum hybrid 3 tons per hectare. Stop the video now and calculate the nutrient requirements.

Calculation:

- **Nitrogen:** 1.8 kg per deciton for grain + 1 kg per deciton for straw.
 - **Yield:** 7.43 decitons of grain and straw each (1:1 ratio).
 - **Total N Requirement:** Multiply the content by the yield.

Phosphorus and Potassium: Same approach as nitrogen.

- **Results:** Balanced nutrient requirements are 17.8 kg of nitrogen, 3.7 kg of phosphorus, and 3 kg of potassium per hectare.

Exercise 5: Calculating Pure Nutrient Prices

Task: Calculate the pure nutrient prices per kilogram of N, P, and K. If you need a hint, wait for the next slide.

Hint: NPK contains 15% nitrogen, 15% phosphorus, and 15% potassium. Urea contains only nitrogen at 46%. Stop the video now and do the maths. When you have finished, you can start again and check the results.

Calculation:

- **Nitrogen (Urea):** 270 CFA per kilogram / 46% content = 586.96 francs per kilogram.
- **Phosphorus and Potassium (NPK):** Subtract nitrogen cost from 290 francs per kilogram and divide the result by 30% (15% P + 15% K), then divide by two.
- **Results:** 336.59 francs per kilogram for both phosphorus and potassium.

Exercise 6: Calculating Total Fertilizer Costs

Task: Insert the nutrient requirements and prices of pure nutrients in the Gross Margin form and calculate the proportional variable costs for fertilizer. Stop the video now and start again when you finish the total variable cost for fertilizer.

Result: Total fertilizer costs are 12,703.01 francs.

Exercise 7: Calculating Chemical Costs

Task: Calculate the used sprays and chemicals (Herbicide and Fungicide) in this production process per hectare and year. Stop the video now, calculate, and start the video again when you are finished.

Result:

- **Herbicides:** 15,000 francs per hectare.
- **Fungicides:** 10,000 francs per hectare per year.
- **Total Cost:** 25,000 CFA.

Exercise 8: Calculating Service Costs

Task: Calculate all hired and external services in this production process per hectare per year. Stop the video now, calculate, and start the video again when you have finished.

Result:

- Hired labour is used for crop protection, soil preparation, sowing, fertilising, harvesting, and ploughing. The cost per hour is between 500 and 700 francs. Only ploughing is paid for a full hectare. The hours used multiplied by the cost per hour gives a total of 65,000 francs for the total cost of the service.

Exercise 9: Calculating Other Variable Costs

Task: Calculate all the other variable costs of this production process per hectare and year. Stop the video now, calculate, and start the video again when you have finished.

Result:

- The only other variable cost used in this example is the fuel for the machines. This is an amount of 30,000 francs, which is also the total of the other variable costs.

Exercise 10: Summing Up Total Variable Costs

Task: Sum up all proportional variable costs calculated in this example. Stop the video now, calculate, and start the video again when you have finished.

Result:

- **Total Seed Cost:** 4000 francs
- **Fertiliser Cost:** 12,703.01 francs
- **Chemical Costs:** 25,000 francs
- **Service Costs:** 65,000 francs
- **Other Variable Costs:** 30,000 francs
- **Total Variable Costs:** 136,703.01 francs

Final Exercise: Calculating Gross Margin

Task: Calculate the gross margin. Do this and then finish the video by correcting yourself.

Result: The gross profit of 384,650 francs is reduced by the total variable costs, which are 136,703.01 francs. The final result is 247,946.99 francs as the gross margin per year and per hectare of millet grown in Senegal.

ANNEX 1: Data collection on the farm

Input/Output in crop production (for one parcel)

Farm: <i>Senegal Example</i>	Parcel name: <i>Atlantic side</i>
Size: <i>3,1</i> ha	Year/season: <i>2024, March</i>
Crop(s) and Variety: <i>Millet</i>	

Inputs/Costs

Date	Name/purpose/use of input	Quantity	Unit (size)	Price per unit	Seed	Fertil./Manure	Chemicals	Fuel/Electr	Transport	Hired lab/serv.	Other	Total	Family lab.	unit
30.07.2023	<i>Ploughing by tractor</i>	<i>3,1</i>	<i>ha</i>	<i>55.800</i>				<i>30.000</i>		<i>55.800</i>		<i>85.800</i>	<i>4 hours</i>	
02.08.2023	<i>Soil preparation</i>	<i>46,5</i>	<i>hours</i>	<i>700</i>						<i>32.550</i>		<i>32.550</i>		
04.08.2023	<i>Seeding labour</i>	<i>31</i>	<i>hours</i>	<i>500</i>						<i>15.500</i>		<i>15.500</i>	<i>6 hours</i>	
	<i>Seeds</i>	<i>12,4</i>	<i>kg</i>	<i>1.000</i>	<i>12.400</i>							<i>12.400</i>		
30.08.2023	<i>Fertilizer application (NPK)</i>	<i>18,6</i>	<i>hours</i>	<i>500</i>						<i>9.300</i>		<i>9.300</i>	<i>2 hour</i>	
	<i>Fertilizer NPK</i>	<i>620</i>	<i>kg</i>	<i>290</i>		<i>179.800</i>						<i>179.800</i>		
15.09.2023	<i>Herbicide application (labour)</i>	<i>15,5</i>	<i>hours</i>	<i>500</i>						<i>7.750</i>		<i>7.750</i>	<i>2 hour</i>	
	<i>Herbicide spray</i>	<i>2</i>	<i>liter</i>	<i>11.625</i>			<i>23.250</i>					<i>23.250</i>		
05.10.2023	<i>Fertilizer application (NPK)</i>	<i>18,6</i>	<i>hours</i>	<i>500</i>						<i>9.300</i>		<i>9.300</i>	<i>2 hour</i>	
	<i>Fertilizer NPK</i>	<i>310</i>	<i>kg</i>	<i>290</i>		<i>89.900</i>						<i>89.900</i>		
25.10.2023	<i>Herbicide application (labour)</i>	<i>15,5</i>	<i>hours</i>	<i>500</i>						<i>7.750</i>		<i>7.750</i>	<i>2 hour</i>	
	<i>Herbicide spray</i>	<i>2</i>	<i>liter</i>	<i>11.625</i>			<i>23.250</i>					<i>23.250</i>		
08.11.2023	<i>Fungicide application (labour)</i>	<i>15,5</i>	<i>hours</i>	<i>500</i>						<i>7.750</i>		<i>7.750</i>	<i>2 hour</i>	
	<i>Fungicide spray</i>	<i>5</i>	<i>liter</i>	<i>6.200</i>			<i>31.000</i>					<i>31.000</i>		
19.12.2023	<i>Fertilizer application (UREA)</i>	<i>18,6</i>	<i>hours</i>	<i>500</i>						<i>9.300</i>		<i>9.300</i>	<i>2 hour</i>	
	<i>Fertilizer (UREA)</i>	<i>150</i>	<i>kg</i>	<i>270</i>		<i>40.500</i>						<i>40.500</i>		
02.02.2024	<i>Harvesting (labour)</i>	<i>93</i>	<i>hours</i>	<i>500</i>						<i>46.500</i>		<i>46.500</i>	<i>8 hours</i>	
Total for parcel:					<i>12.400</i>	<i>310.200</i>	<i>77.500</i>	<i>30.000</i>	<i>0</i>	<i>201.500</i>	<i>0</i>	<i>631.600</i>	<i>30 hours</i>	
Total per ha:					<i>4.000</i>	<i>100.065</i>	<i>25.000</i>	<i>9.677</i>	<i>0</i>	<i>65.000</i>	<i>0</i>	<i>203.742</i>	<i>10 hours</i>	

Yield (Please list the harvesting days)

Date	Remarks	Quantity	Unit (t, kg, etc.)
02.02.2024	<i>Sold from the field</i>	<i>1333,0</i>	<i>kg</i>
02.02.2024	<i>Sold at the market</i>	<i>815,3</i>	<i>kg</i>
02.02.2024	<i>Home consumption</i>	<i>155,0</i>	<i>kg</i>
Total:		<i>2303,3</i>	<i>kg</i>
Total per ha:		<i>743</i>	<i>kg</i>

Use of yield (Please list when yield was sold, given away, lost, etc.)

Date	Use of yield *)	Quantity	Unit	Price/Value	Revenue
02.02.2024	<i>Sold from the field</i>	<i>1333,0</i>	<i>kg</i>	<i>500</i>	<i>666.500</i>
02.02.2024	<i>Sold at the market</i>	<i>815,3</i>	<i>kg</i>	<i>550</i>	<i>448.415</i>
02.02.2024	<i>Home consumption</i>	<i>155,0</i>	<i>kg</i>	<i>500</i>	<i>77.500</i>
Total:				<i>1.192.415</i>	
Total per ha:				<i>384.650</i>	

*) specify: sold as..., sold to..., kept for seed, home consumption, given as gift, lost, etc.

ANNEX 2: Side calculation pure nutrient prices

Side calculation: Pure Nutrition Prices													
Applied amount of fertilizer			Price per kg	Price total	% N	% P2O5	% K2O	kg N	kg P2O5	kg K2O	Price/ kg N	Price/ kg P2O5	Price/ kg K2O
300	kg	NPK	290	87000	15%	15%	15%	45	45	45	586,96	336,59	336,59
150	kg	Urea	270	40500	46%			69	0	0	586,96		
								kg/ha	114,00	45,00	45,00		

ANNEX 3: Side calculations nutrient requirements

$$\begin{array}{|c|} \hline \text{Contents} \\ \hline \text{kg/dt} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Yield} \\ \hline \text{dt/ha} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Removal} \\ \hline \text{kg/ha} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Requir.} \\ \hline \text{kg/ha} \\ \hline \end{array}$$

Main : Side Crop - Rat 1 : 1

N	Main crop	1,80	x	7,43	=	13,37	=	13,4	When side products are not removed from field, the balanced nutrient requirement is higher then requirements for tubers only, since there are losses to be considered for Nitrogen concerning both grow ing requirements and side crop rotting: Requirement factor > 1 and Utilisation of N in side crops < 100%	
	+ Side crop*	1,00	x	7,43	=	7,43	=	7,4		
	= Nutrient requirements (if side crops are removed from field)									20,8
	- Nutrient return from side crop					40,0%	-	3,0		
	= Balanced nutrient requirements (if side crops are not removed)									17,8

P₂O₅	Main crop	0,50	x	7,43	=	3,72	=	3,72	When side products are not removed from field, the balanced nutrient requirement is equal to requirements for tubers only, since there are no losses to be considered for Phosphate concerning grow ing requirements and side crop rotting: Requirement factor = 1 and Utilisation of P2O5 in side crops = 100%	
	+ Side crop*	0,30	x	7,43	=	2,23	=	2,23		
	= Nutrient requirements (if side crops are removed from field)									5,9
	- Nutrient return from side crop					100%	-	2,2		
	= Balanced nutrient requirements (if side crops are not removed)									3,7

K₂O	Main crop	0,40	x	7,43	=	2,97	=	3,0	When side products are not removed from field, the balanced nutrient requirement is equal to requirements for tubers only, since there are no losses to be considered for Phosphate concerning grow ing requirements and side crop rotting: Requirement factor = 1 and Utilisation of K2O in side crops = 100%	
	+ Side crop*	2,00	x	7,43	=	14,86	=	14,9		
	= Nutrient requirements (if side crops are removed from field)									17,8
	- Nutrient return from side crop					100%	-	14,9		
	= Balanced nutrient requirements (if side crops are not removed)									3,0

ANNEX 4: Completed Gross Margin calculation

Gross Margin Calculation for:		Millet (Example of Senegal)		
		Senegal		
Gross output	Unit	Quantity	Currency/Unit	CFA
Total yield	kg	743		
Sold from the field	kg	430,0	500	215.000
Sold at the market	kg	263,0	550	144.650
Home consumption by farm	kg	50,0	500	25.000
Total gross output				384.650,00
Proportional variable costs				
Seed / Planting	Unit	Quantity	Currency/Unit	Currency
Costs for seeds	kg	4,00	1.000	4.000
Total seed costs				4.000,00
Fertilizer	Unit	Quantity	Currency/Unit	Currency
N (Nitrogen)	kg	114,00	586,96	66.913,04
P ₂ O ₅ (Phosphorus Pentoxide)	kg	45,00	336,59	15.146,74
K ₂ O (Potassium Oxide)	kg	45,00	336,59	15.146,74
Total fertilizer costs				97.206,52
Chemicals	Unit	Quantity	Currency/Unit	Currency
Herbicide	ha	1,00	15.000	15.000
Fungicide	ha	1,00	10.000	10.000
Total chemicals costs				25.000,00
Services	Unit	Quantity	Currency/Unit	Currency
Hired labour for crop protection	hours	15,00	500	7.500
Hired labour for soil preparation	hours	15,00	700	10.500
Hired labour for seeding	hours	10,00	500	5.000
Hired labour for fert. application	hours	18,00	500	9.000
Hired labour for harvesting	hours	30,00	500	15.000
Hired service ploughing by a tractor	ha	1,00	18.000	18.000
Total services cost				65.000,00
Other variable costs	Unit	Quantity	Currency/Unit	Currency
Fuel for machinery		1	30.000	30.000
Total other variable costs				30.000,00
Total variable costs				221.206,52
Gross Margin				163.443,48