

MP GHG Inventory Training

Answers to Session 1 Agriculture homework

Agriculture: Livestock population homework

1. Complete the exercise from the training and estimate the sheep, goat and pig population for your jurisdiction in 2025.
 - a. Bring these to the next session and let us know if you had any challenges.

ANSWERS:

For the other livestock the total population in MP are:

- Sheep: 1 528 817
- Goats: 73 894
- Pigs: 99 527

Population of cattle, sheep, goats and pigs in all municipalities.

Please note the numbers differ slightly from the example given in the homework as the below table was calculated in excel and it uses all the decimal places.

Local municipality	Cattle population	Sheep population	Goat population	Pig population
Albert Luthuli	101 164	126 705	6 124	8 249
Bushbuckridge	219 414	274 811	13 283	17 890
Dipaleseng	12 986	16 264	786	1 059
Dr JS Moroka	144 256	180 676	8 733	11 762
Emakhazeni	15 865	19 870	960	1 294
Emalahleni	40 012	50 113	2 422	3 262
Govan Mbeki	48 313	60 511	2 925	3 939
Lekwa	40 217	50 371	2 435	3 279
Mbombela	100 261	125 574	6 070	8 175
Mkhondo	92 150	115 416	5 579	7 514
Msukaligwa	47 767	59 828	2 892	3 895
Nkomazi	96 772	121 204	5 858	7 890
Pixley Ka Seme	58 549	73 332	3 544	4 774
Steve Tshwete	34 586	43 318	2 094	2 820
Thaba Chweu	25 049	31 373	1 516	2 042
Thembisile	126 291	158 176	7 645	10 297
Victor Khanye	16 985	21 274	1 028	1 385
Province	1 220 637	1 528 817	73 894	99 527

2. Additional cattle, sheep, goat and pig population data:
 - a. Ask around and see if you can find any local data sources for municipal/district level livestock population.
 - b. For provincial participants ask around and see if there are any provincial data sources that show more detail for livestock population, or data that would allow you to:
 - i. Split livestock types into commercial and communal categories
 - ii. Split cattle data into dairy cattle and other cattle
 - c. Do you have any cattle feedlots in your jurisdiction? If so do you know how many cattle they generally have in a year?
 - d. Bring this information to the next session and we can discuss how we can use it.
3. Poultry population data:
 - a. Look at the following poultry data: <https://www.sapoultry.co.za/wp-content/uploads/2025/11/3Q2025-Provincial-distribution-report.pdf>
 - b. See if you can think of a way to use it (and any other proxy/driver data) to estimate poultry population for your jurisdiction. Try to make some estimates for 2025.
 - c. Some additional points to note with poultry data:
 - i. Poultry data can include chickens, ducks, geese, turkeys but the chicken are most important and there is not usually data on the others
 - ii. Chickens can be divided into layers (those that lay eggs) and broilers (which are those that are bred and used for meat). Data is often provided for both these two categories so you can keep these numbers separate.
 - iii. Take note of whether you are reporting the total number of chickens produced or the total alive on a particular day.
 - iv. Also think about how long a chicken lives for. See if you can find any information on this.
 - d. The above data looks mainly at commercial poultry farming.
 - i. Do a lot of households in your jurisdiction have chickens (or other poultry) at their houses for subsistence purposes? If so, we may need to think of ways to include these numbers.
 - e. Bring this information to the next session and we can discuss it and any challenges you may have had.
4. Additional livestock:
 - a. Are there any other important livestock types in your jurisdiction that we need to include?

ANSWERS:

For the chicken population data it is indicated this is census data so it is the number of chickens alive on a particular day. The report indicates the number for MP are:

- Broilers: 26 815 043
- Layers: 2 741 220

For the populations in the municipalities, you can estimate numbers from Figures 8 & 9 in the SAPA report. The figure gives a range, say 200 000 – 300 000, and you can use an average value (in this case $(200\,000 + 300\,000)/2 = 250\,000$). Also note though that the text gives the actual values for broilers in Lekwa and Victor Khanye. Following this approach give the below data per municipality:

Total for Mpumalanga		
Broilers	26 815 043	
Layers	2 741 220	
Municipality	Broilers	Layers
	<i>Avg number from paper</i>	<i>Avg number from paper</i>
Lekwa	7 080 000	0
Victor Khanye	8 910 000	2 500 000
Bushbuckridge	0	0
Chief Albert Luthuli	111 000	0
City of Mbombela	111 000	200 000
Dipaleseng	2 500 000	400 000
Dr JS Moroka	0	0
Dr Pixley Ka Isaka Seme	750 000	15 750
Emakhazeni	0	15 750
Emalahleni	0	40 000
Govan Mbeki	3 500 000	75 000
Mkhondo	0	75 000
Msukaligwa	750 000	0
Nkomazi	111 000	0
Steve Tshwete	1 500 000	750 000
Thaba Chweu	0	0
Thembisile Hani	350 000	0
Total	25 673 000	4 071 500

ANSWERS (continued):

You will notice that doing it this way leads to an underestimate of the MP broilers as the total of municipalities is 25 673 000, while the overall total for MP is given as 26 815 043. Similarly, this approach overestimates the layers for MP.

What you can do to adjust these numbers is calculate the fraction which each municipality contributes to the **estimated total** for MP (i.e. the total from all municipalities). For example, for layers Dipaleseng is estimated to have 400 000 layers which is 0.098 of the **estimated total** ($400\,000 / 4\,071\,500 = 0.098$). Now multiply this fraction by the actual MP total to get the adjusted value for your inventory ($0.098 * 2\,741\,220 = 269\,308$ layers).

The same approach can be applied to broilers but remember that you already know the actual numbers for Lekwa and Victor Khanye, so you leave those numbers out of the totals. So, the MP total for adjustment would then be $26\,815\,043 - (7\,080\,000 + 8\,910\,000) = 10\,825\,043$. The total from municipalities removing Lekwa and Victor Khanye is 9 683 000. The adjusted number for Nkomazi is $(111\,000 / 9\,683\,000) * 10\,825\,043 = 124\,092$. If this is corrected for each municipality and the values totalled, you will now see the totals from the municipalities matches the given value for MP at the top.

Total for Mpumalanga						
Broilers	26 815 043					
Layers	2 741 220					
Municipality	Broilers	Fraction	Broilers (final)	Layers	Fraction	Layers (final)
	<i>Avg number from paper</i>	<i>Fraction of remaining total</i>	<i>Adjusted to match MP total</i>	<i>Avg number from paper</i>	<i>Fraction of total</i>	<i>Adjusted to match MP total</i>
Lekwa	7 080 000		7 080 000	0	0.0000	0
Victor Khanye	8 910 000		8 910 000	2 500 000	0.6140	1 683 176
Bushbuckridge	0	0.0000	0	0	0.0000	0
Chief Albert Luthuli	111 000	0.0115	124 092	0	0.0000	0
City of Mbombela	111 000	0.0115	124 092	200 000	0.0491	134 654
Dipaleseng	2 500 000	0.2582	2 794 858	400 000	0.0982	269 308
Dr JS Moroka	0	0.0000	0	0	0.0000	0
Dr Pixley Ka Isaka Seme	750 000	0.0775	838 457	15 750	0.0039	10 604
Emakhazeni	0	0.0000	0	15 750	0.0039	10 604
Emalahleni	0	0.0000	0	40 000	0.0098	26 931
Govan Mbeki	3 500 000	0.3615	3 912 801	75 000	0.0184	50 495
Mkhondo	0	0.0000	0	75 000	0.0184	50 495
Msukaligwa	750 000	0.0775	838 457	0	0.0000	0
Nkomazi	111 000	0.0115	124 092	0	0.0000	0
Steve Tshwete	1 500 000	0.1549	1 676 915	750 000	0.1842	504 953
Thaba Chweu	0	0.0000	0	0	0.0000	0
Thembisile Hani	350 000	0.0361	391 280	0	0.0000	0
Total	25 673 000		26 815 043	4 071 500.00		2 741 220.00
<i>Total of missing values</i>	9 683 000					
<i>Total minus the two municipalities with known numbers</i>	10 825 043					

Additional optional exercises

5. Now that you have your cattle, sheep, goat and pig population data, look in the slide deck for the enteric fermentation CH₄ emission factors. See if you can work out how to estimate CH₄ emissions for these livestock for your jurisdiction.
6. Question 3.c.iii. asked about how long a chicken lives. This is because the emission factor is kg CH₄ per head per year. This assumes that the animal is producing CH₄ every day in that year. For short lived (<1 year) populations this may not be true. For example:
 - a. A poultry farm produces 110 000 birds annually but only 12 000 are present at one time.
 - b. Multiplying the total production (110 000) by the emission factor will overestimate emissions but using the census (once-off) data of 12 000 will underestimate.
 - c. The annual average population value is therefore used as this represents the average number of animals contributing emissions during the year.
 - d. Thus, if the chickens were alive for 50 days then, following the equation below, the annual average population in this example is $50 \times (110000/365) = 15068$.
 - e. See if you can calculate the annual average broiler chicken population in your jurisdiction.

Annual average population

$$= \text{Number of days alive} \times \left(\frac{\text{Number of animals produced annually}}{365} \right)$$