Practical Use and Application of the Poultry Carbon Footprint Calculation Tool

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Introduction

The cumulative greenhouse gas (GHG) emissions from any human activity are commonly referred to as the carbon footprint. A report issued by the Joint Research Center (Steinfeild, Gerber, Wassenaar, Castel, & de Haan, 2006) defines the carbon footprint as a measure of the exclusive total amount of CO₂ emissions that are directly or indirectly caused by an activity or is accumulated over the life stages of a product. A carbon footprint involves not only CO₂ emissions, but also includes N₂O and CH₄ emissions, which are expressed in CO₂ equivalents (CO₂e). A CO₂e is the concentration of CO₂ that would give the same levels of radiative properties (the change in net irradiance at atmospheric boundaries between different layers of the atmosphere), as a given amount of CO₂ (World Research Institute, 2007). The CO₂e for a given substance is calculated over a specified time period and must be stated whenever a global warming potential (GWP) is stated. The GWP is a measure of how much a given mass of GHG is estimated to contribute to global warming. For example, GWP over 100 years for N₂O is 298. This means that the emission of 1 million tons of N₂O is equivalent to 298 million tons of CO₂ over 100 years. The GWP over 100 years for CH₄ is 25 (International Panel on Climate Change, 2006).

The Poultry Carbon Footprint Calculation Tool

The Poultry Carbon Footprint Calculation Tool was developed and designed specifically for poultry production farms. The tool can be used to estimate the greenhouse gas (GHG) emissions from pullet, breeder, and broiler grow-out farms. The GHGs that are assessed are carbon dioxide, nitrous oxide, and methane—the gases of

major concern in agriculture. The user-friendly calculation tool is an Excel spreadsheet into which the user will enter farm data to calculate a poultry production farm's annual carbon footprint.



The tool can be downloaded at http://www.poultry.uga.edu/extension/documents/GHGCalculationTool.xlsm. In order for the file to work correctly, please be sure to enable macros.

Introduction Page

The spreadsheet has an introductory page or tab (Figure 1), which informs the user of the capability and the uses of it. It provides specific directions on how to enter the information into the spreadsheet. This page also gives the growers options that can be used to reduce their energy use and subsequently to reduce their carbon footprint.

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| B41 | \cdot : $\times \checkmark f_x$ | | | | | * |
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| 2 | Carbon Footprint Estimation Toolkit For Poultry On-Farm Emissions | | | | | |
| 3 | carbon rootprint Estimation rootkit ror routing on-rarin Emissions | | | | | |
| 4 | This toolkit is designed to be used by poultry producers to estimate the greenhouse gas emissions from their p | ooultry farms | | | | |
| 5 | Instructions for Use | | | | | |
| 7 8 | To use this tool, go to the <i>Interface</i> worksheet by clicking on Interface (in green) tab at the bottom left corner of the screen. While on the Interface screen, please enter required data under Farm Information section as well as Energy Consumption section. Be sure to click on the cells labeled "click here" to select your option from the drop down menu. While selecting your region under Electricity consumption, you may click on the button labeled "See Map" to see the Regional and Sub-regional maps. Similarly, while you are done visiting the Maps page, you may click on the button labeled "Go Back to Main Screen" to return to the main (Interface) screen. As you enter data, the program starts calculating and updating results. Once all input data are entered, you will see the complete results for the current year. A series of recommendations designed to reduce energy consumption for your farm operation are listed. Now, you may see how implementing these recommendations will affect the numbers for the following year. Select as many recommendations as you would like and click on the button labeled "Show Projections" for the following year. They do not necessarily have to be implemented all at one time. Now you should see the numbers under Projected Year reflecting energy savings. NOTE: To protect the worksheet formulae from accidental modifications are not allowed in those areas. | | | | | |
| 9 | Recommendations Research have shown that no two poultry farms, has the exact same carbon footprint. As such, | | | | | |
| 10 | recommendations | | | | | |
| 11 | can only be made based on the specific farm and not based on the size of the footprint. | | | | | |
| 12 | The recommendations are designed to reduce energy use by reducing kilo-watt usage and LPG and diesel u These reductions will in turn result in a reduction in the carbon footprint of the farm. | use. | | | | |
| 13 | mese reasons with the such a reaction in the carbon to opinition the family | | | | | |
| 15 | Source of emission factors and global warming potential are IPCC 2006 Report and EFDB (emission factor da | ata base). | | | | |
| 16 | | | | | | |
| 17 18 | Definitions | | | | | |
| 19 | Demillions | | | | | |
| 20 | CO ₂ : Carbon dioxide | | | | | |
| 21 | CH ₄ : Methane | | | | | |
| 22 | N ₂ O <mark>: Nitrous Oxide</mark> | | | | | |
| - | Introduction Interface Comparison Chart Percentages Reg | ional Ma | ps | (+) | : • | |
| READY | | |] |] | | — + 70% |

Figure 1. The introductory page can be viewed by selecting the "Introduction" tab on the bottom left of the spreadsheet.

Interface Page

Farm Information and Energy Consumption

The "Interface" tab is the only page where the user can enter data into the tool. The user will need to select from the first drop-down box (Figure 2) the type of poultry (broiler, pullet, or breeder) they have. Based on the type of bird, appropriate boxes for that operation will be available for the user to input data. This information will determine the non-mechanical emissions. The non-mechanical emissions are those GHG emissions that occur from manure management and will depend on the type of poultry, the number of birds/flocks grown per year, and the type of manure management system that is used on the farm.

The user will next enter energy consumption information. Users have the options of entering LP gas, diesel, and/or natural gas. This will determine the mechanical emissions from the farm. These emissions occur from heating, incineration, diesel for tractors, generators, and other equipment on the farm. Users will also need to enter the amount of electricity used in kilowatt hours. Electricity is used for ventilation, lighting, feed motors, and water pumps, as well as other electrical equipment for daily bird management and house maintenance. The electricity use will be reflected in the "off-farm" source in the inventory.

After entering electricity usage, the user will select from another drop-down box the region of the United States where the farm is located (Figure 2). The region is based on the electricity grid from which the user receives service. The tool recognizes that different parts of the country generate electricity from a different mix of sources (nuclear, coal, hydroelectric, etc.) This is an important feature that enables users from different parts of the United States to use the tool. Each region has a different emission factor, so it is important that the user

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| А | В | С | D | E | F | G | Н | I | J K | L | |
| | Poultry GHG E | stimatio | | | | | | | | | |
| | | Scimatio | | | | | | | | | |
| | Farm Information | | | | | | | | | | |
| | Select type of birds \rightarrow | Broiler | s | Recomme | ndations | | | | | | |
| | # of Houses | 4 | M Install P | commonded At | tic Inlot System | | | | | | |
| | # of Birds per House | 29,500 | Install Recommended Attic Inlet System. | | | | | | | | |
| | # of Flocks per Year 6 6 | | | Enclose curtain openings with insulated walls. | | | | | | | |
| | # of Days to raise Flock | 49 | Replace tunnel inlet curtains with insulated doors. Install recommended circulation fans. Heating with either 40,000 BTU Radiantbrooders, tube radiants, or quad | | | | | | | | |
| | | | | | | | | | | | |
| | | Year | | | • | 0,000 BTO Radiar BTU pancake broc | | | 190 | | |
| | Energy Consumption | Current | Projected | | ulation fans. | s to pancake broc | ders and/or not | air iurnaces. | | | |
| | LPG (gal) | 3,000 | 1,257 | | | | and the second second second | | | | |
| | Diesel (gal) | 550 | 550 | | | ers and/or furnace | | • • | em. | | |
| | Natural Gas (ccf) | | - | | | brooders with spa | ~ | | | | |
| | Electricity (kWh) | 250,000 | 189,375 | | ~ | this with fluoresco | v . | | | | |
| | Select your region → See Map | SERC South | ith 🔤 🗸 | I Replace | Gas Incinerator | with Drum Comp | oster. | | | | |
| | Greenhouse Gas | SERC Sub-region Ur | | | Show Projectio | ons | Start | Over | | | |
| | GHG Emissions (metric to | SERC Tennessee Val SERC Virginia/Caroli | ley | - | | | | | | | |
| | | SPP North | | | | | Year | | | | |
| | | SPP South SPP Sub-region Unk | nown | | | | Projected Ye | | | | |
| | Emissions Categories | WECC California CO ₂ | CH4 | ear N ₂ O | CO ₂ e | CO ₂ | | N ₂ O | CO ₂ e | | |
| | On-farm sources: Mechanical | 602 | Crig | 1420 | 0020 | | | 1120 | 0028 | | |
| | on familisources, wicehanical | 6.35 | 0.04 | 0.01 | 6.40 | 6.35 | 0.04 | 0.01 | 6.40 | | |
| | Deisel Use | | 0.04 | 0.00 | 455.63 | 190.91 | 0.04 | 0.00 | 190.93 | | |
| | Deisel Use | 455.59 | | | | | | | | 2 | |
| | | 455.59 461.94 | | 0.01 | 462.03 | 197.26 | 0.05 | 0.01 | 197.32 | 1 | |
| | LPG Use | 455.59 461.94 | 0.07 | 0.01 | 462.03 | 197.26 | 0.05 | 0.01 | 197.32 | | |

Figure 2. The data input section of the "Interface" tab. The drop-down box for selecting the user's region is indicated.

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select the region of the country where the poultry operation is located. If users are unsure of the region they are in, they should click the "See Map" button (Figure 3a). This takes users to the "Regional Maps" page (Figure 3b), which allows them to determine which region they need to select. They can also select the "Regional Maps" tab at the bottom of the spreadsheet, which will also take them to the map.

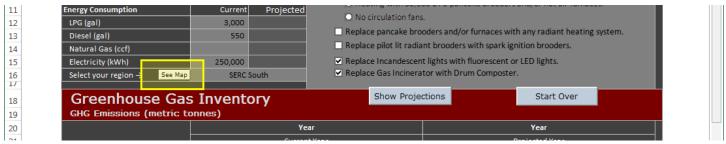


Figure 3a. The "See Map" button is indicated.



Figure 3b. Use the "Regional Maps" tab to determine the region to input under the energy consumption section of the "Interface" page.

Recommendations

The calculation tool also allows the user to choose house adjustments or renovations (Figure 4a) that will result in reductions in energy use and GHGs. This can be done by selecting recommendation options to reduce energy use in the "Interface" tab. The tool will show the user what the emissions would be if these adjustments were made on the farm. The recommendations selected will affect the electricity, LPG, and/or natural gas use projections. Therefore, changes in the GHG emissions will be reflected in the mechanical and off-farm emissions inventory.

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| 23 | $*$: $\times \checkmark f_x$ | | | | | | | | | | | | | |
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| | Poultry GHG Es | stimation | Tool | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Farm Information | | | Recommendations | | | | | | | | | | |
| | Select type of birds → | Broilers | 19 S (U. | Necommen | ioacions. | | tic Inlet System. | | | | | | | |
| | # of Houses | 4 | | Install Rev | commended. | Attic Inlet System. | | | | | | | | |
| | # of Birds per House | 29,500 | 1 | Enclose of | urtain onenin | es with insulated w | h insulated walls. with insulated doors. | | | | | | | |
| | # of Flocks per Year | 6 | | | | | | | | | | | | |
| | # of Days to raise Flock | 49 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | | | | | | |
| | | | | | | Install recommended circulation fans. • Heating with either 40,000 BTU Radiantbrooders, tube radiants, or guad | | | | | | | | |
| | | | | | | | | 201 | | | | | | |
| | Energy Consumption | Current | Projected | Heating with 30,000 BTU pancake brooders and/or hot air furnaces No circulation fans Replace pancake brooders and/or furnaces with any radiant heating system. Replace pilot lit radiant brooders with spark ignition brooders. | | | | | | | | | | |
| | UPG (gol) | 3,000 | | | | | | | | | | | | |
| | Diesel (gal) | 550 | | | | | | | | | | | | |
| | Natural Gas (ccf) | | | | | | | | | | | | | |
| | Electricity (kWh) | 250,000 | | Replace II | ncandescent | lights with fluoresc | ent or LED lights | | | | | | | |
| | Select your region → See Map | SERC South | h. | Replace 0 | las Incinerato | or with Drum Comp | | | | | | | | |
| | select your region -y | | s Inventory Show Proj | | | | actions Start Over | | | | | | | |
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| | Greenhouse Gas | | Y | 5 | how Project | uers. | | | | | | | | |
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| | Greenhouse Gas GHG Emissions (metric to | nnes) | Year Current Ye | ar. | | | Year Projected Ye | | COze | | | | | |
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| | Greenhouse Gas GHG Emissions (metric to Emissions Categories On-farm sources: Mechanical | nnes) co _l | Year Current Ye Cita | ar NgO | COze | | Year Projected Ye | | CO3e | | | | | |
| | Greenhouse Gas GHG Emissions (metric to Emissions Categories On-farm sources: Mechanical Deisel Use | nnes) CO ₁ 6.35 | Year Current Ye CHa 0.04 | ar N2O 0.01 | CO2e 6.40 | | Year Projected Ye | | CO3e | | | | | |
| | Greenhouse Gas GHG Emissions (metric to Emissions Categories On-farm sources: Mechanical Deisel Use LPG Use | CO2 6.35 455.59 | Year Current Ye CH4 0.04 0.04 | ar N2O 0.01 0.00 | CO2e 6.40 455.63 | | Year Projected Ye | | CO26 | | | | | |
| 67 89 0 1 2 3 4 5 6 7 8 | Greenhouse Gas GHG Emissions (metric to Emissions Categories On-farm sources: Mechanical Deisel Use LPG Use Total | CO2 6.35 455.59 | Year Current Ye CH4 0.04 0.04 | ar N2O 0.01 0.00 | CO2e 6.40 455.63 | | Year Projected Ye | | C0je | | | | | |

Figure 4a. Recommendations can be selected to see how emissions would be reduced.

After the user selects options from the "Recommendations" section, he or she should click the "Show Projections" button. The projected year fields of the "GHG Inventory" section will be populated with the estimated emissions (Figure 4b).

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| | Poultry GHG Es | timatio | n Tool | | | | | | | | |
| | Farm Information | | | | | | | | | | |
| - 3 | Select type of birds → | Broile | 15 | Recomme | ndations | d Attic Inlet System. | | | | | |
| - 1 | # of Houses | 4 | 4 | Contall Re | communited At | | | | | | |
| - 1 | IT of Birds per House | 29,500 | 29,500 | | | | | | | | |
| | # of Flocks per Year | 6 | 6 | Enclose curtain openings with insulated walls. Replace tunnel inlet curtains with insulated doors. | | | | | | | |
| - 1 | # of Days to raise Flock | 49 | 49 | Install recommended circulation fans. | | | ed doors. | | | | |
| - 1 | | | | | | | | | 144 | | |
| - 1 | | Year | Ê | | Contraction of the second s | 0.000 BTU Radia | | | 18D | | |
| - 1 | Energy Consumption | Current | Projected | Heating with 30.000 BTU pancake brooders and/or hot air furnaces. No circulation fans. | | | | | | | |
| | UPG (gal) | 3,000 | 1,257 | | | | | | | | |
| | Diesel (gal) | 550 | 550 | | | rs and/or furnaci | and the second second second | 1 | em, | | |
| | Natural Gas (ccf) | | | | | prooders with spi | the second second | | | | |
| - 1 | Electricity (kWh) | 250,000 | 189,375 | | | hts with fluoresc | | ę. | | | |
| | Select your region → See Map | SERC 30 | sith | Replace Gas Incinerator with Drum Composter. | | | | | | | |
| | Greenhouse Gas | Invento | ry | Show Projections Start Over | | | | | | | |
| | GHG Emissions (metric ton | ines) | | | | | | | | | |
| | - | | Year | | | | Year | | | | |
| | Emissions Categories | and the | Current Y | | | | Projected Ye | | | | |
| | | CO1 | 04 | N ₂ O | CO ₂ e | ¢01 | 04 | N ₂ O | CO26 | | |
| - 1 | On-farm sources: Mechanical | | | | | | | | | | |
| | Deisel Use | 6.35 | 0.04 | 0.01 | 6.40 | 6.35 | 0.04 | 0.01 | 6.40 | | |
| | LPG Use | 455.59 | 0.04 | 0.00 | 455.63 | 190.91 | 0.02 | 0.00 | 190.93 | | |
| | Total On-farm sources: Non-mechanical | 461.94 | 0.07 | 0.01 | 462.03 | 197.26 | 0.05 | 0.01 | 197.32 | | |
| | wm-tarm sources, Non-mechanical | | | | | | | | | | |

Figure 4b. The projected fields are calculated based on the selected recommendations.

Greenhouse Gas Inventory

The "GHG Inventory" section (Figure 5) on the "Interface" page shows users the sources of the emissions and also the amount of each GHG emitted. The inventory separates the emissions based on their source (mechanical, non-mechanical, and electricity use) and also on-farm and off-farm sources. It gives the total of each source and the total farm emissions. The inventory is divided into two sections, "Current Year" (the actual farm emissions) and "Projected Year" (the emissions based on the energy reduction options selected). All the emissions are represented as metric tonnes CO_2e . This inventory can be printed by selecting "Print" under the Excel file options.

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| 10 | | Year | | | ~ | 40,000 BTO Kadi | | | | | |
| 11 | Energy Consumption | Current | Projected | | · · | BTU pancake br | ooders and/or ho | ot air furnaces. | | | |
| 12 | LPG (gal) | 3,000 | 1,257 | | rculation fans. | | | | | | |
| 13 | Diesel (gal) | 550 | 550 550 Replace pancake brooders and/or furnaces with any radiant heating system. Replace pilot lit radiant brooders with spark ignition brooders. | | | | | | | | |
| 14 | Natural Gas (ccf) | | | Replace | pilot lit radiant | t brooders with sp | oark ignition broo | oders. | | | |
| 15 | Electricity (kWh) | 250,000 189,375 Replace Incandescent lights with fluorescent or LED lights. | | | | | | | | | |
| 16 | Select your region → See Map | SERC Sout | th | Replace | Gas Incinerato | r with Drum Com | iposter. | | | | |
| 18 | Greenhouse Gas | Inventor | v | | Show Projecti | ions | Star | rt Over | | | |
| 19 | GHG Emissions (metric to | | , | | | | | | | | |
| 20 | | | Year | ar | | | Year | Vear | | | |
| 20 | | | Current | | | Projected Year | | | | | |
| 22 | Emissions Categories | CO ₂ | CH4 | N ₂ O | CO ₂ e | CO2 | CH4 | N ₂ O | CO ₂ e | | |
| 23 | On-farm sources: Mechanical | | | | | | 0.14 | | | | |
| 24 | Deisel Use | 6.35 | 0.04 | 0.01 | 6.40 | 6.35 | 0.04 | 0.01 | 6.40 | | |
| 25 | LPG Use | 455.59 | 0.04 | 0.00 | 455.63 | 190.91 | 0.02 | 0.00 | 190.93 | | |
| 26 | Total | 461.94 | 0.07 | 0.01 | 462.03 | 197.26 | 0.05 | 0.01 | 197.32 | | |
| 27 | On-farm sources: Non-mechanical | | | | | | | | | | |
| 28 | Enteric fermentation | - | - | - | - | - | - | - | - | | |
| 29 | Manure management | - | 47.52 | 80.42 | 127.94 | - | 47.52 | 80.42 | 127.94 | | |
| 30 | Total | - | 47.52 | 80.42 | 127.94 | - | 47.52 | 80.42 | 127.94 | | |
| 31 | On-farm sources Total | 461.94 | 47.60 | 80.42 | 589.97 | 197.26 | 47.58 | 80.42 | 325.26 | | |
| | | | | | | | | | | | |
| 32 | | | 0.07 | 0.76 | 156.05 | 117.58 | 0.05 | 0.58 | 118.21 | | |
| 32 33 | Off-farm sources: Electricity used | 155.23 | 0.07 | | | | | | | | |
| 32 | Off-farm sources: Electricity used | 155.23 | 0.07 | | | | | | | | |
| 32 33 34 35 | Off-farm sources: Electricity used Farm Total | 155.23 617.17 | 47.66 | 81.19 | 746.02 | 314.85 | 47.63 | 81.00 | 443.47 | | |
| 32 33 34 35 36 | ` | | | 81.19 | 746.02 | 314.85 | 47.63 | 81.00 | 443.47 | | |
| 32 33 34 35 36 37 | ` | | | 81.19 | 746.02 | 314.85 | 47.63 | 81.00 | 443.47 | | |
| 32 33 34 35 36 | ` | | 47.66 | | 746.02 | 314.85 | 47.63 | 81.00 | 443.47 | | |

Figure 5. The Greenhouse Gas Inventory on the Interface page shows current and projected emissions.

Comparison and Percentage Charts

After the GHG inventory is calculated, the user will be able to view the comparison chart and the percentage chart in their respective tabs. The "Comparison Chart" page (Figure 6) will compare the GHG emissions from the current year and that of the projected year after the recommended changes have been made. The "Percentages" page (Figure 7) shows the percent difference after the recommendations are made. These charts can be printed for the users' record.



Figure 6. The "Comparison Chart" shows the differences in emissions from the actual data ("Current Emissions") and the emissions if the recommendations were made ("Projected Emissions").



Figure 7. The "Percentages" page shows the percent difference after the recommendations are made.

Applications

- This tool allows users to track their emissions from year to year in their operations.
- The "Recommendations" section of the tool allows the user to see where adjustments can be made on the farm to reduce emissions.
- The "Recommendations" section of the tool allows the user to reduce fuel costs if the recommendations are applied.
- The "GHG Inventory" section allows users to compare their current emissions per year with the projected emissions.
- The "GHG Inventory" section allows users to keep records of their year-to-year emissions, which they can use to track changes.

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