GrowAsia

Grow Asia Counter
User Manual

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GrowAsia

Contents

1. Introduction

The Grow Asia Counter allows users to estimate their greenhouse gas emissions of different agricultural management scenarios for cocoa, coffee, tea, corn, rice, potatoes, and vegetables/horticulture.

The following factors of agricultural systems are evaluated in terms of their greenhouse gas emissions:

- Tillage and other soil management practices,
- Nutrient management practices,
- Liming,
- Crop residue burning and decomposition,
- Pesticide and herbicide use,
- Agroforestry practices,
- Fossil fuel use,
- Rice irrigation (for paddy rice).

Greenhouse gas emissions are presented in terms of total annual emissions of carbon dioxide equivalents (tonnes of CO_2e) and annual emissions per unit of yield (tonnes of CO_2 per tonne of product).

The tool allows users to view their greenhouse gas emissions based on their current practices (scenario 1) and what their greenhouse gas emissions would be if they changed their management practices (scenario 2).

Through a series of questions, the Counter will help you view these emissions. It will be helpful if you have accurate information in hand before starting to fill in data.

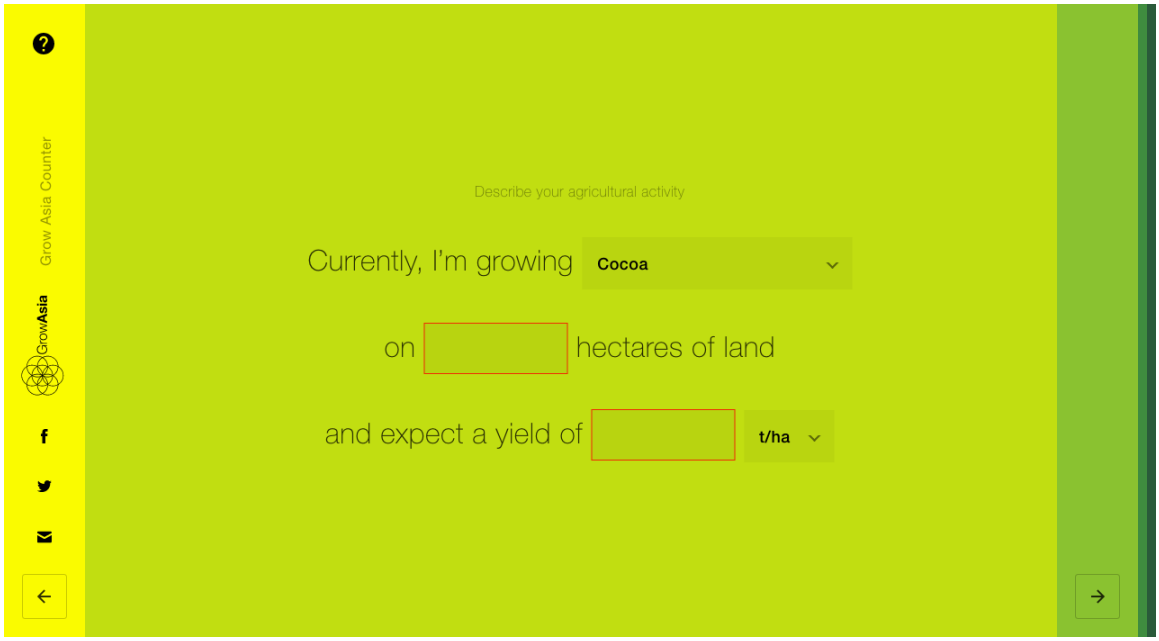
2. Area Selection

In this tool, geography plays - primarily through its influence on soil carbon content - a role in greenhouse gas emissions from agricultural activities. Soils in different areas of the region have different soil organic carbon contents. Furthermore, the relative impact that different soil management activities (such as tillage) have on the soil carbon content varies by an area's particular climate (temperature and precipitation level).

The first screen you will see allows you to select the country, then region, where your agricultural area is located. You can use the map or the dropdown list to select your country and region. Once you have chosen both of these, you can proceed to the next page.

3. Describe Your Agricultural Activity

On this page you will be asked to provide information on what you grow, how large your land is and your expected yield per hectare. The land area and expected yield options are both mandatory: you cannot proceed without providing a value.



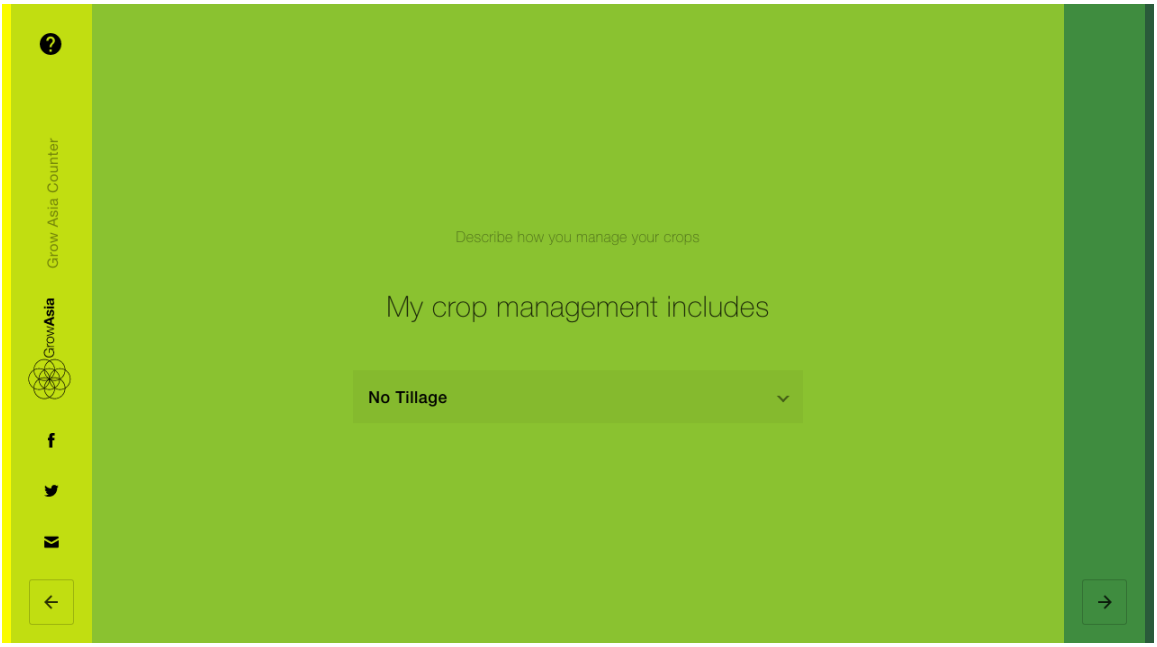
The type of crop is an essential input which will influence the rest of the agricultural management questions in this tool. For instance, the practices for growing paddy rice will be very different from those for growing corn. These different practices, in turn, have different greenhouse gas emission impacts.

The area of land cultivated influences the total volume of greenhouse gas emissions. As an example 100 hectares of potatoes cultivated will likely have substantially smaller emissions than 1000 hectares of potatoes cultivated assuming all the same management practices are applied.

Finally, the expected yield will be used to inform the emissions per unit of yield results.

4. Tillage Practices

On this page you will be asked to provide your tillage practices. The type of tillage practice has an impact on soil carbon content. Intensive tillage practices lead to lower carbon contents in the soil than low intensive or no tillage systems. If tillage practice changes from scenario 1 to scenario 2, it could lead to either emissions or removals of atmospheric carbon dioxide depending on the change adopted.



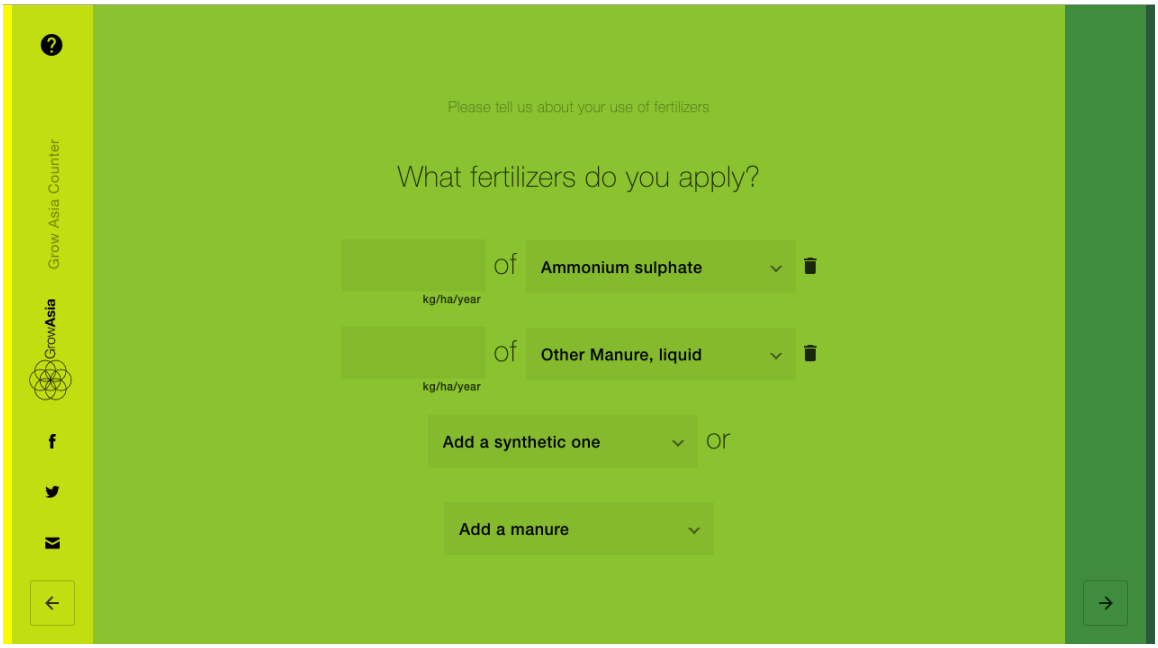
The tillage options are defined by the 2006 IPCC Guidelines[1] as the following:

- **No tillage** – Direct seeding without primary tillage, with only minimal soil disturbance in the seeding zone. Herbicides typically used for weed control.
- **Minimal/shallow till** - Primary and/or secondary tillage but with reduced soil disturbance (usually shallow and without full soil inversion). Normally leaves surface with >30% coverage by residues at planting.
- **Full tillage** - Substantial soil disturbance with full inversion and/or frequent (within year) tillage operations. At planting time, little (e.g., <30%) of the surface is covered by residues.

[1] 2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories, Volume 4 Agriculture, Forestry and Other Land Use, Chapter 5.

5. Fertilizers

On this page we will ask you what types of fertilizer you use. You can select multiple organic and synthetic fertilizers. After selecting each one, you will then be asked how much of that fertilizer you use.



Synthetic nitrogen fertilizer options include the following: urea, ammonia, ammonium sulphate, mono-ammonium phosphate (MAP), di-ammonium phosphate (DAP), ammonium nitrate, and calcium ammonium nitrate.

Animal manure fertilizer includes the following categories: poultry litter, liquid; poultry litter, dry; other manure, liquid; and other manure, dry. Other manure includes manure from other animals, including cattle, sheep, horse, swine and goat.

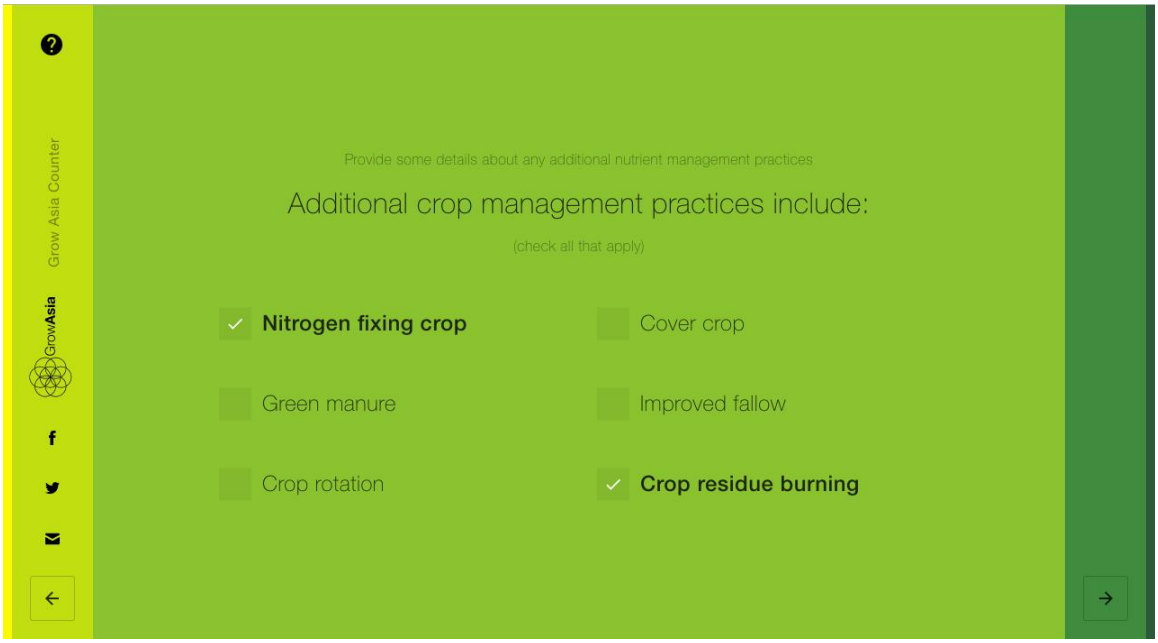
Fertilizer use can lead to emissions of the greenhouse gases - nitrous oxide (N_2O) and carbon dioxide (CO_2). When nitrogen-based fertilizers are applied to soils, it enhances the naturally occurring nitrification and denitrification chemical processes, which produce N_2O as a by-product. Furthermore, emissions occur through the volatilization (in other words, conversion to a gas) of nitrogen, in the form of ammonia (NH_3) and nitrogen oxides (NO_x). Finally, the production of different synthetic fertilizers leads to emissions as well.

The use of fertilizers also impacts soil carbon content and, therefore, emissions from soil when management practices change. Applying synthetic and animal manure fertilizers lead to greater carbon, in the form of biomass in crops. A portion of this biomass will most likely be returned to the soil after harvest, thereby enhancing soil carbon content. In addition, application of manure directly adds carbon to the soils.

When the fertilizer applied is urea, additional emissions are released through hydrolysis. Hydrolysis is defined as the chemical reaction which breaks down a compound, in this case urea, in the presence of water. One of the products of the urea hydrolysis is bicarbonate (HCO_3^-), which in turn becomes CO_2.

6. Additional Crop Management

You will only see this question if you work on potatoes, vegetables, horticulture or upland rice. Simply tick all the options that apply to you.



In addition to tillage and fertilizer use, various crop management practices have an impact on the carbon content in agricultural soils in terms of their contribution of carbon, in the form of biomass, to the soil or removal of carbon from the soil.

Additional crop management practices impacting soil carbon content include:

- Use of **nitrogen-fixing crops,** which convert atmospheric nitrogen into organic compounds. The nitrogen-fixing crops raise the nitrogen content of the soil benefiting all crops and increasing growth, and with growth, carbon in the soil.
- Use of **green manure,** which involves growing plants specifically for the purpose of then incorporating them into the soil to function as fertilizer once they die.
- **Crop rotation** is the practice of varying the cultivation of different crops to maintain soil fertility, among other reasons.
- **Cover crops** are planted for the specific purpose of protecting soil, in particular its structure and fertility.
- **Improved fallow** is land resting from cultivation, which is planted with vegetation designed to protect and enhance soil fertility.
- **Crop residue/rice straw burning** is the practice of burning the remaining organic material, such as stalks and leaves, in the field after harvest.

It is important to note that these crop management practices are not mutually exclusive. For example, nitrogen-fixing crops can be a form of green manure.

In addition to its impact on soil management emissions, whether or not crop residues are burned has impacts on greenhouse gas emissions resulting directly from the combustion of materials and from the decomposition of remaining crop residue. It is assumed in this tool that crop residue decomposition is equal to 0 when crop residue is burned.

Note that crop residues produce nitrous oxide emissions through direct emissions and leaching/run off but not through volatilization.

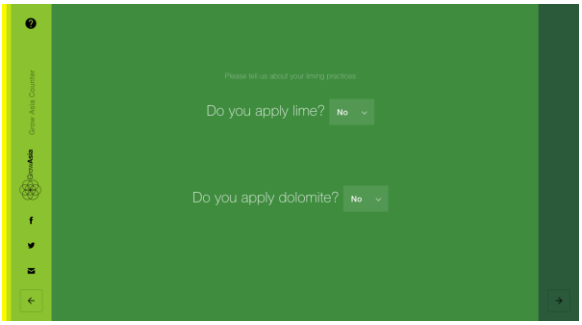
7. Agroforestry Practices

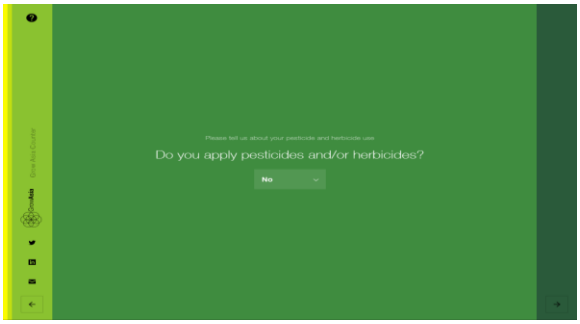
On this page you indicate whether or not you use any agroforestry practices. The application of agroforestry practices in crop systems removes carbon dioxide (CO_2) from the atmosphere by sequestering it in new plant biomass. Examples of agroforestry practices include (but are not limited to) the following practices:

- **Shade trees** which are trees planted with broad canopies to provide needed shade for such crops as coffee and cacao.
- **Windbreaks** which are linear plantings of trees and shrubs around cultivated areas.
- **Alley cropping** is planting rows of trees at wide spacings with a companion crop grown in the alleyways between the rows.

8. Liming Practices and Pesticide and Herbicide Use

On these two pages you will be asked about your liming and dolomite practices, as well as your pesticide and herbicide use. If you use any of them, we will also ask how much you use.





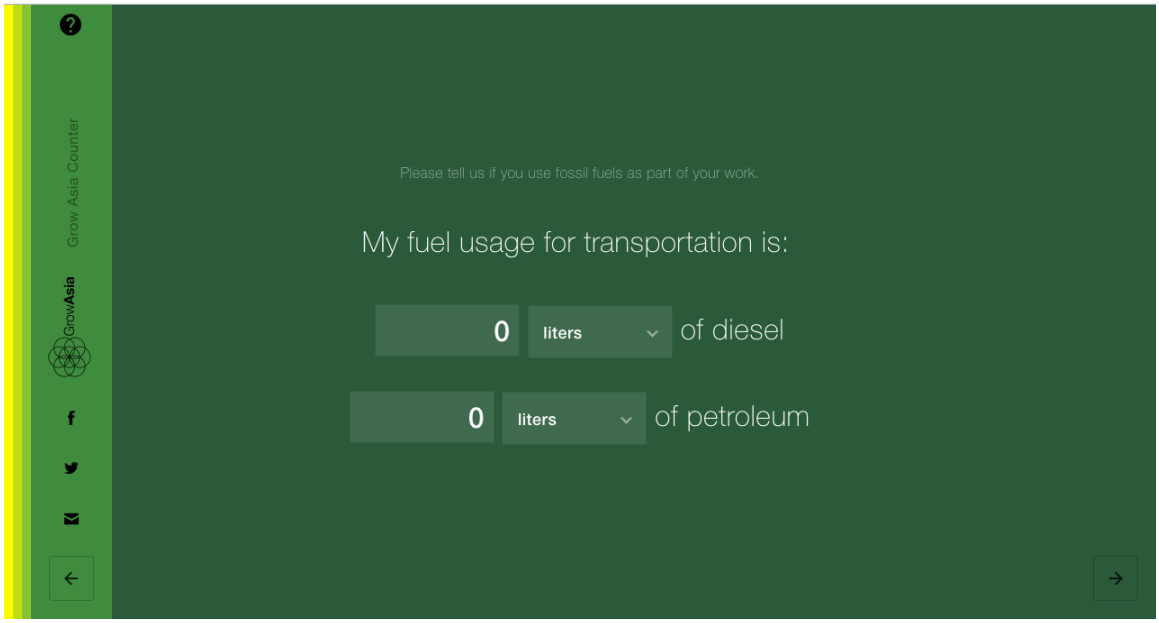
The application of lime (e.g., calcic limestone ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) to soil is a source of carbon dioxide (CO_2) emissions as a result of the dissolution of the carbonate lime.

Pesticide and herbicide emission calculations are based on Bellarby et al. (2008)[2] that estimated that the application of agrochemicals, including pesticides and herbicides, results in greenhouse gas emissions from fossil fuel and energy use in farm operations and production of chemicals for agriculture to range of 180-3,700 kilograms of carbon dioxide equivalents (CO_2-eq) per km^2. The mean value for this range (1,940 kg CO_2-eq/km^2) is used. This is equivalent to an emissions value for pesticide and herbicide use of 19.4 kg CO_2/ha.

[2] Bellarby, J., Foereid, B., Hastings, A., and Smith, P. (2008). Cool Farming: Climate impacts of agriculture and mitigation potential. Greenpeace. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&sqi=2&ved=0ahUKEwjPnOHS2YLOAhUI_IMKHXZcB1MQFggcMAA&url=https%3A%2F%2Fwww.organicconsumers.org%2Fsites%2Fdefault%2Ffiles%2Fcool-farming-full-report.pdf&usg=AFQjCNHFVVfb02FtSeGG97uMTjOVNND6Rw&sig2=Pfw6tb4RTI6NyHQ3OU0cpQ&bvm=bv.127521224,d.amc

9. Fossil Fuel Use

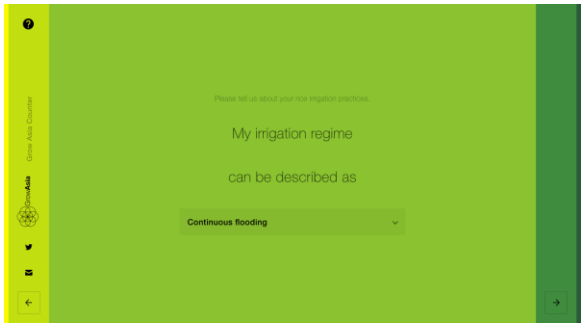
You will be asked a series of questions about how you use fossil fuels in your agricultural activities, like transport, irrigation and other purposes.

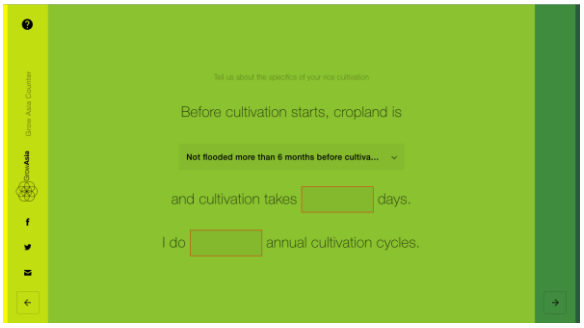


The combustion of fossil fuels is one of the most well-known sources of carbon dioxide (CO_2) emissions in the atmosphere. The amount consumed and the type of fossil fuel (in this tool, diesel and petroleum) used influences the amount of emissions.

10. Paddy Rice Specific Questions

If you grow rice in paddy fields, you will see a few different screens. First we will ask you about your irrigation processes. Then you will be asked for more specifics about your rice cultivation. The number of cultivation days and the number of annual cultivation cycles are mandatory fields.

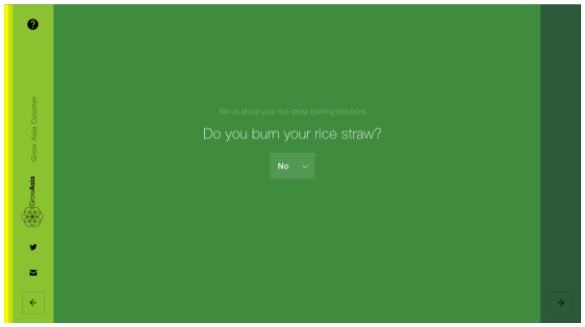


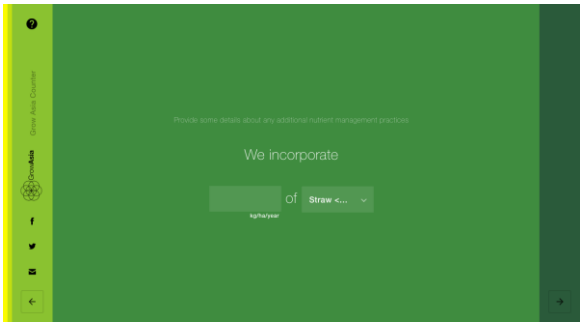


When rice fields are flooded, anaerobic decomposition (in other words, decomposition in the absence of oxygen) of organic material takes place. A byproduct of this anaerobic decomposition is methane (CH_4), a greenhouse gas. A key variable impacting the amount of methane released is the type of irrigation regime used during cultivation.

In addition to the specific irrigation regime applied, the flooding regime used prior to cultivation, length of cultivation, and the number of cultivation cycles all influence methane emissions.

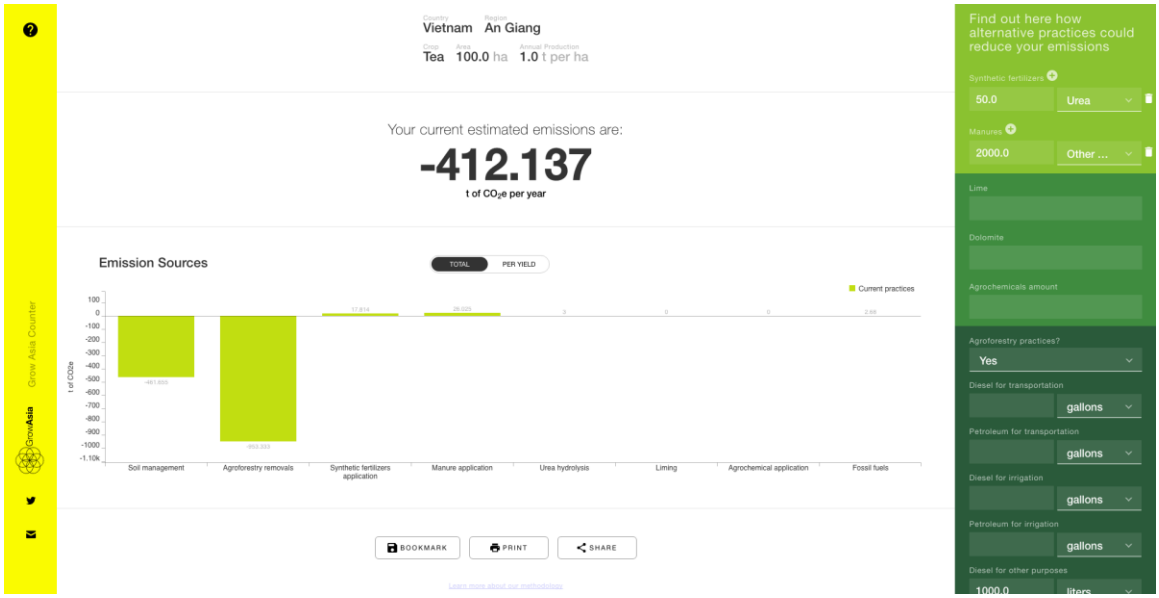
The application of rice straw and the timing of this application, as well as the application of compost, farm yard manure, and manure, also has an impact on the methane emissions resulting from flooding. You will be asked to fill in this information on this page. The organic material from these applications will lead to greater CH_4 emissions. You will also be asked if you burn rice straw. The combustion of rice straw has impacts on greenhouse gas emissions resulting directly from the combustion of materials.





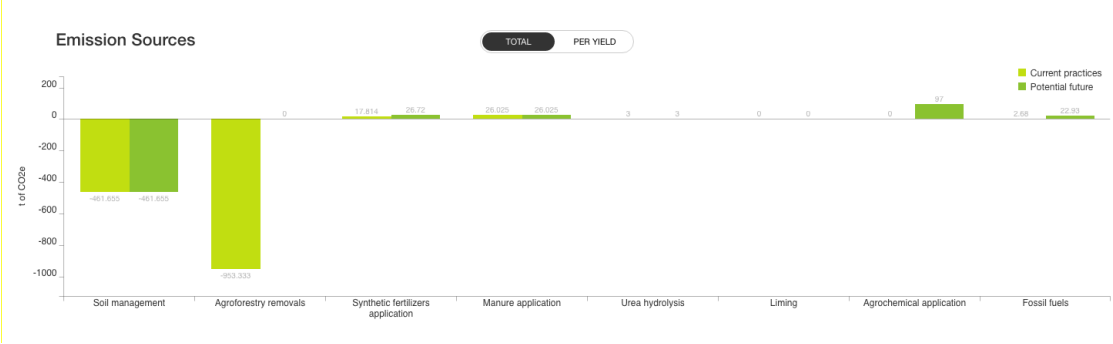
11. Analysis Page

After completing these questions, you will be presented with your results.



Based on user input on the previous pages, annual greenhouse gas emissions are calculated in terms of tonnes of carbon dioxide equivalent (CO_2e). CO_2e is used to present the emissions of different greenhouse gases in a common unit. It is calculated for any given greenhouse gas based on its global warming potential (GWP), which is a measure of how much energy the emissions of 1 unit (e.g., 1 tonne) of gas will absorb over 100 years in comparison to the emissions of the same quantity (1 tonne) of carbon dioxide. Annual emissions are presented in terms of total emissions from the agricultural system being analyzed, and in terms of emissions per unit of yield (CO_2e per tonne of product).

On the right sidebar, the user can change their agricultural practices in potential future scenarios to estimate how they would impact their emissions. Both current practices and future potential practices will appear in the bar graph to allow users to compare the two scenarios (as shown below).



Users have multiple options to save and share their results. Each analysis has a unique ID, so if you want to return to your analysis you simply need to save the URL. You can do this by clicking the save button or bookmarking the page (ctrl/cmd + d). You can also print the results as a pdf file, or they can be shared via Linkedin, Twitter, or email.

BOOKMARK PRINT SHARE

Annex 1: Checklist of Information Needed to Calculate Total Emissions

- ☐ Country and region where cultivation occurs;
- ☐ Crop cultivated;
- ☐ Hectares of land cultivated;
- ☐ Expected yield, in kilograms or tonnes per hectare per year;
- ☐ Tillage practices. Options include full tillage, minimal shallow tillage, or no tillage – *not applicable for cacao, coffee, tea, and paddy rice;*
- ☐ Whether or not the following crop management practices are applied: nitrogen fixing crop, green manure, crop rotation, cover crop, improved fallow, and/or crop residue burning – *not applicable for cacao, coffee, tea, and paddy rice*;
- ☐ Type and amount applied of different nitrogen-containing synthetic fertilizers, in kilograms per hectare per year;
- ☐ Type and amount applied of animal manure, in kilograms per hectare per year;
- ☐ Whether or not there are any agroforestry practices (e.g., shade trees, windbreaks, alley cropping, etc.) – *not applicable for paddy rice*;
- ☐ Amount of lime or dolomite applied, in kilograms per hectare per year;
- ☐ Amount of pesticides and/or herbicides applied, in kilograms per hectare per year;
- ☐ Type (petroleum and diesel) and amount of fossil fuels, in liters or gallons per hectare per year.

For paddy rice, the following additional information is needed:

- ☐ Type of irrigation regime applied during cultivation. Options include continuous flooding, intermittent flood (1 aeration), intermittent flooding (multiple aerations), rainfed: deep water potential, rainfed: drought-prone, or rainfed: regular;
- ☐ Type of flooding regime used prior to cultivation. Options include flooded for more than 30 days before cultivation, not flooded less than 6 months before cultivation, or not flooded more than 6 months before cultivation;
- ☐ Number of cultivation days per cycle;
- ☐ Number of cultivation cycles per year;

- ☐ Amount applied, in kilograms per hectare per year, of different soil management practices. Options include compost, farm yard manure, green manure, straw applied less than 30 days before cultivation, or straw applied more than 30 days after cultivation;
- ☐ Amount of rice straw burned, kilograms per hectare per year.

Annex 2: Frequently Asked Questions and Answers

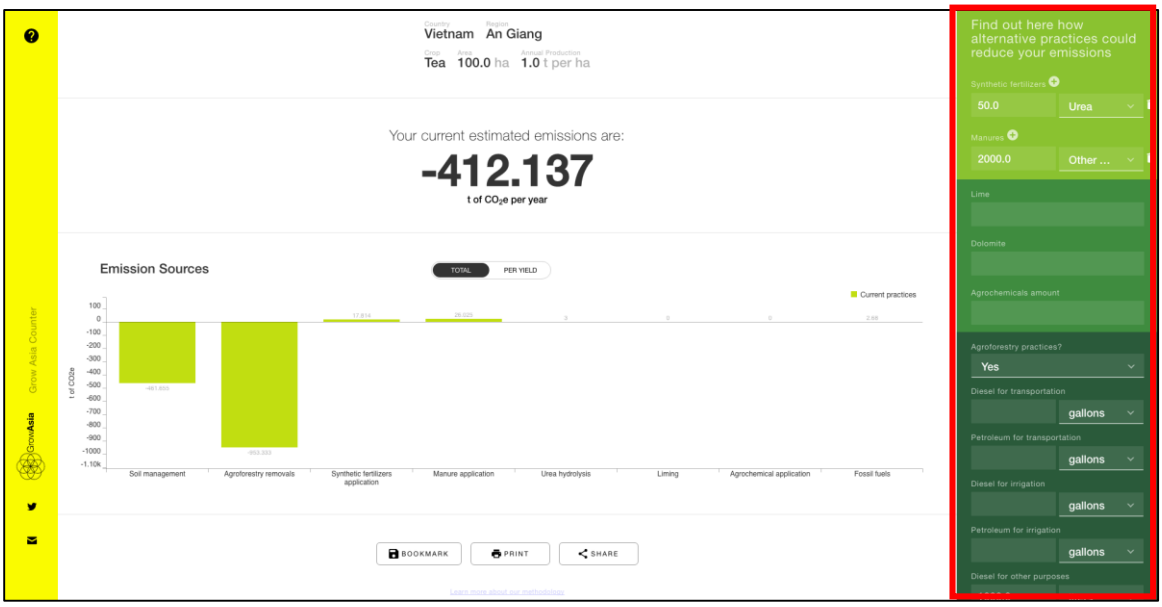
1. **Can I save and share the results calculated by the Grow Asia Counter?**

   Yes. Users have multiple options to save and share their results. Each analysis has a unique ID, so if you want to return to your analysis you simply need to save the URL. You can do this by clicking the save button or bookmarking the page (ctrl/cmd + d). You can also print the results as a pdf file, or they can be shared via Linkedin, Twitter, or email.

2. **Can the information entered in the Grow Asia Counter be edited?**

   As you go through the initial questions on your current management practices, you have the option of editing your responses on previous questions by clicking the back arrow on the lower left-hand side of the screen ← . Once you have reached the final page showing emissions reduced, it is not possible to edit the original information entered. If you need to edit the information at this point, it will be necessary to start over and go through the questions again.

   When evaluating the impacts of alternative management practices on overall emissions, you have the option of editing the information entered on the right sidebar of the final page (outlined in red below). When numeric inputs have been altered on this sidebar, the icon ⟲ gives users the option of reverting back to their original input value.



3. **Where can I find more information about the Grow Asia Counter's methods and data?**

   A comprehensive description of methods and background data used to produce estimates of greenhouse gas emissions or removals generated by the Grow Asia Counter can be found by clicking the "methodology and data used" link at the bottom of the welcome page and the results page. A link to this methodology document is also available in the pop-up windows that appear when you click on the Question Mark icon  at the upper left corner of each page.

4. **Which greenhouse gases (GHGs) are accounted for in the Grow Asia Counter?**

   The Grow Asia Counter estimates carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) impacts, and converts and reports in tonnes of carbon dioxide equivalent (t CO_2 e).

5. **How are greenhouse gas emissions and removals reported?**

   Greenhouse gas emissions and removals are reported in two ways: 1) total annual emissions/removals for the agricultural system being analyzed (tonnes of carbon dioxide equivalent), and 2) annual emissions/removals for each tonne of yield (tonnes of carbon dioxide equivalent per tonne of product).

6. **What information do I need to complete the analysis?**

   Annex 1 of the User Manual provides a comprehensive checklist of all the information that you need to calculate greenhouse gas emissions or removals.

7. **Can the Grow Asia Counter summarize emission calculations for multiple analyses?**

   There is currently no option to summarize emission calculations for different analyses, aside from the user manually summing the emissions using their own spreadsheet or calculator.

8. **How do I estimate the greenhouse gas emissions and removals from a multi-crop system?**

   You should run a separate analysis on the Counter for each crop being cultivated and sum within your own spreadsheet. To prevent double counting of emissions/removals, ensure that the inputs into the multiple analyses do not overlap. For example, if you are cultivating both corn and vegetables, you will run the analysis once for corn and

separately for vegetables. If you only know fossil fuel use for the entire multi-crop system, rather than for each crop, you could divide the fossil fuel consumption between the two analyses equally.

9. **How do I estimate the greenhouse gas emissions and removals from a system that falls into more than one region?**

   You should run separate analyses on the Counter for the areas that fall into the different regions and sum the emissions using your own spreadsheet or calculator. For example, if you have 100 hectares in region A, and 200 hectares in another region B, you will run one analysis for region A and another analysis for region B. To prevent double counting of emissions/removals, ensure that the inputs into the multiple analyses do not overlap.

10. **Can I calculate emissions per cultivation cycle, rather than per year, using the Counter?**

    The Counter is currently only programmed to calculate annual emissions.