The CGIAR Research Program on Climate Change, Agriculture and Food Security Mitigation Option Tool (CCAFS-MOT): Guidelines for users

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Correct citation (guidelines)

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Correct citation (tool)

Nayak D, Feliciano D, Vetter S, Hillier J. 2016. The CGIAR Research Program on Climate Change, Agriculture and Food Security Mitigation Option Tool (CCAFS-MOT). (Available **online** at: https://ccafs.cgiar.org/mitigation-options-tool-agriculture, or search for "CCAFS-MOT" using a search engine.)

Acknowledgment

The views expressed in this document cannot be taken to reflect the official opinions of these organizations.

Contents

Acronyms

CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CCAFS-MOT	Climate Change, Agriculture and Food security Mitigation Options Tool
CH_4	Methane
CO_2	Carbon dioxide
$kgCO_2e/ha$	Carbon dioxide equivalent per kilogram per hectare
$kgCO_2e/kg$ product	Carbon dioxide equivalent per unit of product
EZ	Ecological zone
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gas
N_2O	Nitrous oxide
SCS	Soil carbon sequestration
SOC	Soil organic carbon

1. Introduction

The Climate Change, Agriculture and Food Security Mitigation Options Tool (CCAFS-MOT) is an Excel tool to support policy advisors and agricultural extension services on the choice of management practices that reduce greenhouse gas emissions (GHG) without risking crop yields. It integrates several empirical models to estimate GHG emissions from rice, grassland, cropland, and livestock systems, and to provide information about the most effective mitigation options. The CCAFS-MOT estimates GHG emissions and carbon sequestration in terms of carbon dioxide equivalent per kilogram per hectare (kgCO$_2$e/ha) and carbon dioxide equivalent per unit of product (kgCO$_2$e/kg product). Users select the baseline management practices for the specific system and obtain an array of mitigation options ranked according to the mitigation potentials. The aim of the tool is to accommodate a range of users, from experts to non-experts, depending on objectives and issues such as time constraints and information available. The tool is being developed by researchers from the University of Aberdeen, in partnership with CCAFS, the International Centre for Tropical Agriculture, and the Gund Institute for Ecological Economics at the University of Vermont. Feedback from users helps the developers to ensure that the tool is working properly and that it provides accurate and relevant information to support decision making.

CCAFS-MOT starts with a "**Welcome"** page with information about the tool, instructions, organizations involved in the project, worksheets protection (locking and unlocking), and license. In case the message "**Security Warning**" appears (figure 1), please click **Enable Content** and read the instructions in the "**Welcome**" page to start working with the tool.
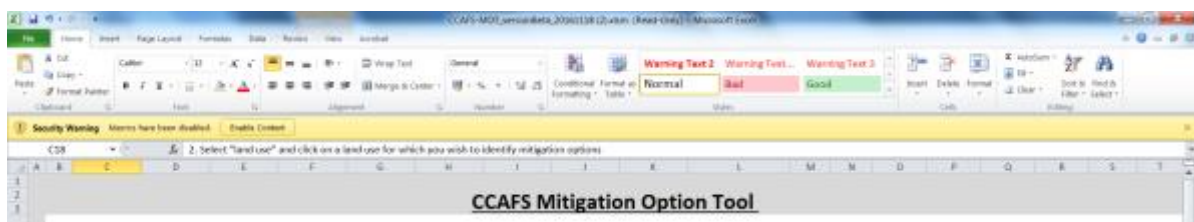

Figure 1. Security warning message.

The tool has four **main data input sections**, each on a separate sheet. The sections are:

- **General input** (country, climate, soil details, land use change, and ecological zone)
- **Crop** (type, yield and residue, tillage, cover crop, type and amount of organic fertilizer, whether the duration is more or less than 20 years, synthetic fertilizer, and where the fertilizer is produced)
- **Rice** (type, yield and residue, specific climate categorization, baseline management, soil management, and details on organic and synthetic fertilizer used)
- **Grassland** (grazed, un-grazed, type, yield and residue, details on baseline management practices, soil, and details on organic and synthetic fertilizer used)
- **Livestock** (type, production system, body weight, and product).

These worksheets are locked to prevent users from accidently deleting or overwriting equations and calculations. The password to unlock them is "**CCAFS**."

A **Glossary** worksheet contains definitions of concepts and mitigation options used in the tool.

2. Data entry

The user can use **simplified input** option, if data are not available, or input specific data by selecting **detailed input** from the drop down menu. Different colors are used to indicate actions by the user:

Color key

(blue)	Blue: To choose from the drop down menu
(pink)	Pink: To input data; a default value might be provided, but this can be changed with specific data
(gray)	Gray: Options or default values for the "simplified input" or
GO	Green: To go to the next step.

SCROLL DOWN ↓ messages reminds the user to scroll down the spreadsheet in order to insert the data and to check the results.

3. General input worksheet

3.1 Region

Users select the **country** and the **climate** and indicate in the drop down menu whether the climate is **arid** or **semi-arid**. For the climate section, there are six available options (temperate continental, temperate oceanic, subtropical moist, subtropical dry, tropical moist, and tropical dry). These climate categories should match with the categories of the map below (figure 2). This map is inserted in the worksheet "**Maps**" tool and can be reached by clicking the green cell **Go to climate map**. Climate selection is important because it influences GHG emission estimates.
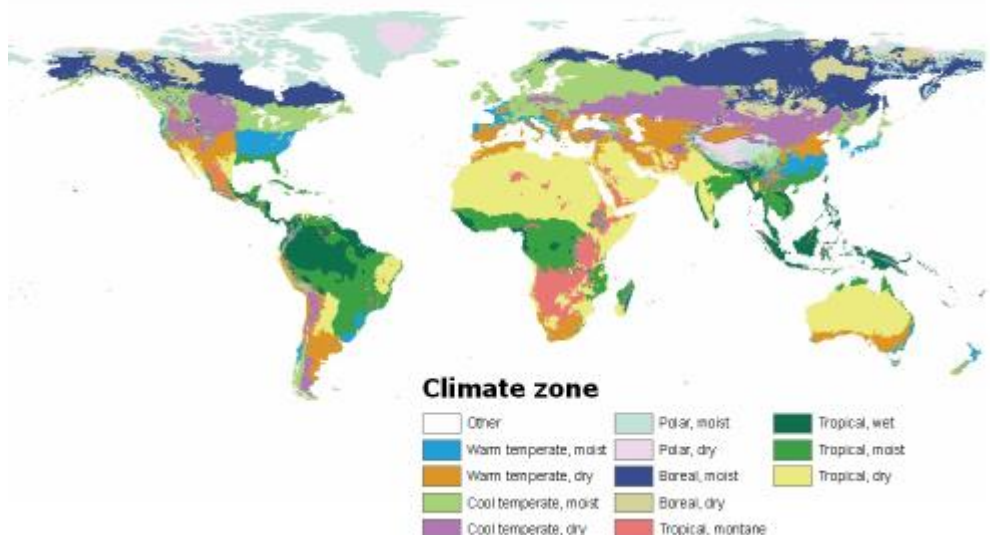

Figure 2. World Climate Classification.

Source: IPCC (1997).

3.2 Soil

Users select **simplified input** when soil data are not available or **detailed input** if the detailed information about soil characteristics (soil texture, soil organic C, soil N content, soil pH, bulk density) is available. For the simplified input option, users only have to select between three types of

predefined soil characteristics (light soil, medium soil, or heavy soil). The remaining variables (soil texture, soil organic C, soil N content, soil pH, and bulk density) will automatically be inserted. For the "detailed soil input" option, users have to select between **coarse**, **medium**, and **fine** for soil texture and to insert data for percentage of soil organic carbon (SOC), soil pH, and bulk density. Guidance on soil texture (figure 3) and soil organic C in % (figure 4) can be found in the worksheet "Maps":

Figure 3. Soil textures.

Source: Fischer et al. (2008).
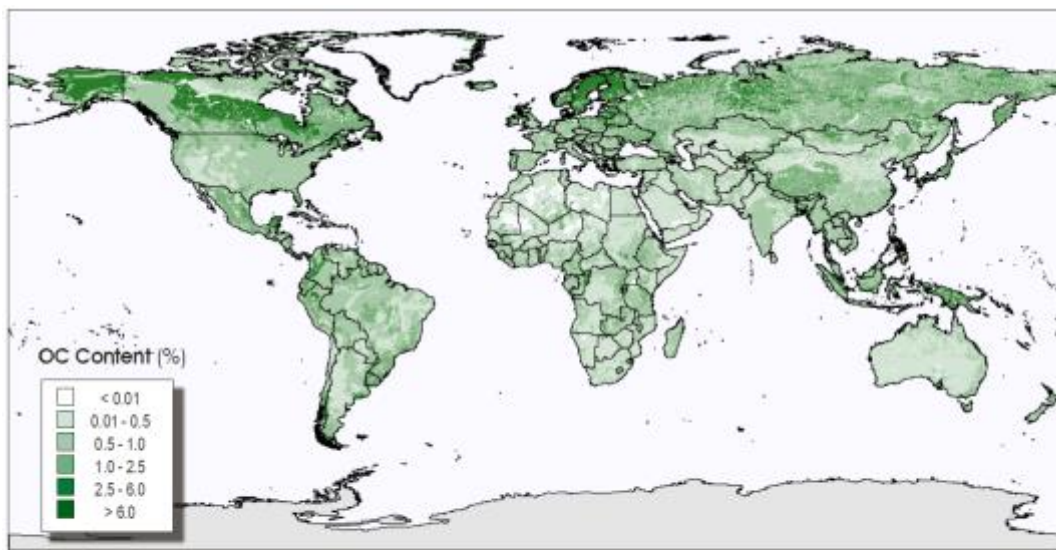
Figure 4. Global SOC estimates and the harmonized world soil database.

Source: Hiederer and Köchy (2011).

From the drop down menu, users select the specific land use change between Forest to Grassland, Forest to Arable, Grassland to Arable, or Arable to Grassland. Users indicate for how long the change has taken place - if "**less than 20 years**" or "**more than 20 years**." In case there is no land use change, select "**No**." From the drop down menu users should also select the type of ecological zone where the change occurred: Forest, Rain Forest, Deciduous Forest, Shrub land, Steppe, Boreal coniferous forest, Boreal tundra woodland, or Boreal Mountain.

The Food and Agriculture Organization of the United Nations' (FAO) Global Ecological Zones framework for 2000 was first published by Simmons (2001), who defines an ecological zone as:

> a zone or area with broad yet relatively homogeneous natural vegetation formations, similar (not necessarily identical) in physiognomy. Boundaries of the EZs approximately coincide with the map of Köppen-Trewartha climatic types, which was based on temperature and rainfall. An exception to this definition are "Mountain systems", classified as one separate EZ in each Domain and characterized by a high variation in both vegetation formations and climatic conditions caused by large altitude and topographic variation.

Finally, select land use (crop, rice, grassland, and livestock) from the drop down menu and click "**go to the selected land use**" (figure 5).

Figure 5. Data requirements for simplified input option (baseline management practices).

4. Crop worksheet

In the **General Input** page, users should select **Crop (excluding rice)**, from the "Select land use" drop down menu to input data on baseline management practices and to obtain GHG emission estimates and mitigation options. In the cropland section, users select **crop type** from the drop down menu and insert a value for **crop yield** (kg/ha). Crop types are shown in table 1.

Table 1. Crop types and category

Crop	Category
Alfalfa	Other
Apple	Tree crop
Barley	Grain
Beans, dry	Legumes
Cassava	Tuber crop
Chick peas	Legumes
Coconuts	Tree crop
Clover	N-fixing forage
Coffee	Tree crop
Cow peas, dry	Legume
Cotton	Other
Maize	Grain
Millet	Grain
Oats	Grain
Oil, palm fruit	Tree crop
Peanut	Beans & pulses
Plantain	Tree crop
Potato	Tuber crop
Rice	Rice
Rubber, natural	Tree crop
Rye	Grain
Sorghum	Grain
Soybean	Legumes
Spring wheat	Grain
Sugar cane	Grass
Tea	Tree crop
Tomato	Tomato
Tree Crop	Tree crop
Vegetable	Vegetable
Vegetables, fresh nes[1]	Vegetable
Wheat	Grain
Winter wheat	Grain
Other grain	Grain
Other legume	Legumes
Other N-fixing forage	N-fixing forage
Other Non-N-fixing forage	Non-N-fixing forage
Other root crops	Root crop
Other tuber crop	Tuber crop
Other	Other
None	None

[1] Including inter alia: bamboo shoots (*Bambusa spp.*); beets, chards (*Beta vulgaris*); capers (*Capparis spinosa*); cardoons (*Cynara cardunculus*); celery (*Apium graveolens*); chervil (*Anthriscus cerefolium*); cress (*Lepidium sativum*); fennel (*Foeniculum vulgare*); horseradish (*Cochlearia armoracia*); sweet marjoram (*Majorana hortensis*); oyster plant (*Tragopogon porrifolius*); parsley (*Petroselinum crispum*); parsnips (*Pastinaca sativa*); radish (*Raphanus sativus*); rhubarb (*Rheum spp.*); rutabagas (swede) (*Brassica napus*); savory (*Satureja hortensis*); scorzonera (*Scorzonera hispanica*); sorrel (*Rumex acetosa*); soybean sprouts; tarragon (*Artemisia dracunculus*); and watercress (*Nasturtium officinale*). Other vegetables are not identified separately because of their minor relevance at the international level. Because of their limited local importance, some countries report vegetables under this heading that are classified individually by the FAO.

In the crop page, users have to indicate whether plant **residues** are <u>burned</u> or <u>not burned</u>. The next step is to select current **crop management practices** (i.e., <u>tillage</u>, <u>cover cropping</u>, and <u>duration of the implementation of the practice</u> "more than 20 years" or "less than 20 years") from the drop down menus. Users must indicate whether **organic fertilizer** (compost, manure, or residue) is <u>incorporated</u> or <u>not incorporated</u>. Users also need to specify the **type of organic fertilizer** incorporated. In the case of compost, the options are <u>compost zero emissions</u>, <u>compost fully aerated production</u>, and <u>compost non-fully aerated production</u>. In the case of **manure application**, the options are <u>pig farm yard manure</u>, <u>cattle farm yard manure</u>, <u>sheep farm yard manure</u>, <u>poultry layer manure</u>, <u>broiler/ turkey litter</u>, <u>cattle slurry</u>, <u>pig slurry</u>, <u>separated pig slurry-liquid part</u>, and <u>separated pig slurry-sold part</u>. In the case of **residue**, the **options** are <u>green manure</u>, <u>straw</u>, and <u>other</u>. Users need to indicate the **amount of organic fertilizer** in the slide bar in kg per hectare and indicate whether the practice has been implemented for more than 20 years or less than 20 years (using the drop down menu). There are two options for data input of synthetic fertilizer application: "**simplified input**" and "**detailed input**." If the "simplified input" option is selected, users indicate in the slide bar the amount of N applied (Urea, Super phosphate, Muriate of potash/Potassium Chloride) in kg per hectare (figure 6). Users should also indicate the **origin of the fertilizer** (<u>Europe</u>, <u>China,</u> or <u>Other</u> "region") in the drop down menu. If the "detailed input" is selected, several options for synthetic fertilizer are available, and in the slide bar to indicate the amount applied in kg per hectare. Users also need to **select the use of nitrification inhibitor**; the options are <u>no inhibitors</u>, <u>nitrification inhibitors</u>, or <u>polymer-coated fertilizers</u> (figure 7).

List of synthetic fertilizers:

- Ammonium bicarbonate
- Ammonium nitrate
- Ammonium sulfate
- Ammonium sulfate nitrate
- Anhydrous ammonia
- Calcium ammonium nitrate
- Calcium nitrate
- Compound NPK
- Diammonium phosphate
- Limestone
- Monoammonium phosphate
- Muriate of potash/potassium chloride
- Phosphate/rock phosphate
- Potassium sulfate
- Super phosphate
- Triple super phosphate
- Urea
- Urea ammonium nitrate solution.

To obtain the results, users click on **"go to results"** to obtain results on GHG emissions (results showed in a table) and mitigation options to reduce GHG emissions (results showed in a graph).

Figure 6. Interface showing the option "simplified input" for synthetic fertilizer.

Figure 7. Interface showing the option "detailed input" for synthetic fertilizer.

5. Rice worksheet

In the **General Input** page, users should select **Rice**, from the "**Select land use**" drop down menu to input data on baseline management practices and to obtain GHG emission estimates and mitigation

options. In the Rice section, data input follows the same steps explained above for crop (section 4). Users select management by inserting **rice yield in kg per hectare** and indicate whether **rice residues are burned or not burned** using the drop down menu. Users are required to specify the specific **rice climate zone** (i.e., warm-arid and semi-arid tropic, warm sub-humid tropics, warm humid tropics, arid and semi-arid tropic with summer, warm sub-tropics with summer rainfall, warm sub-humid subtropics with summer rainfall, or warm/cool subtropics with summer rainfall) from the drop down menus. These climates are specific for Asia. If the assessment of GHG emissions and mitigation potential are required for another region of the globe, the climate zone that most resembles Asia's should be selected (see figure 8).
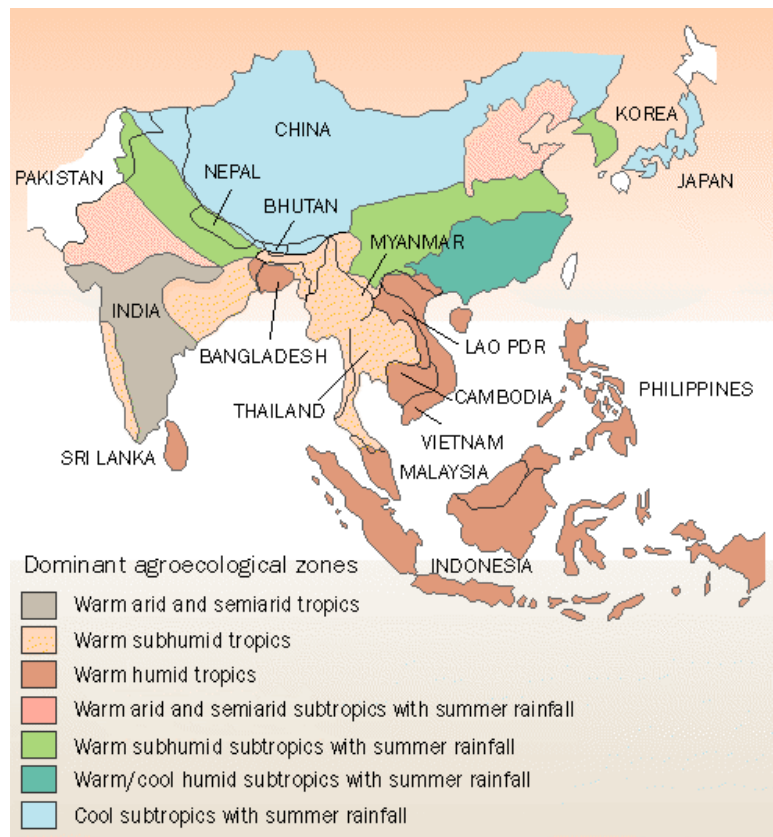
Figure 8. Climatic classifications of Asian rice fields.[2]

In addition, users have to indicate **crop duration** in number of days, using the slide bar provided. The **water regime** should be selected from the drop down menu. The options are deepwater, multiple drainage, single drainage, rainfed-wet season, rainfed-dry, and unknown. Users also need to indicate the **pre-water regime** (i.e., flooded, long drainage, short drainage, two drainage, or unknown) from the drop down menu. An explanation of the different water regimes and pre-water regime is provided below.

Wetland rice is flooded for a significant period of time and can be divided into (1) irrigated, (2) rain-fed, and (3) deep water rice systems. Irrigated systems are subdivided into (1.a) continuously flooded and (1.b) intermittently flooded. Intermittently flooded rice can be further divided into (1.a.1) single drainage and (1.a.2) multiple drainage water management.

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[2] Available at http://oregonstate.edu/instruct/css/330/four/index2.htm

- **Continuously flooded:** fields have standing water throughout the rice-growing season and may only be dried in preparation for harvest and seeding (pre-water regime).
- **Rainfed rice systems**: the water regime only depends on rainfall. This category can be subdivided into wet rainfed rice systems (flood prone) and dry rainfed rice systems (drought prone). In wet rainfed systems, the water level may rise up to 50 cm during the cropping season. In dry rainfed systems, drought periods occur during every cropping season.
- **Deepwater rice** is subdivided into fields inundated with water depths between 50 and 100 cm and fields with water depths greater than 100 cm.

Regarding the **pre-water regime**, Nayak et al. (2015) reclassify irrigated water regimes in three categories: continuous flooding, mid-season aeration with single drainage, and intermittent irrigation with multiple-drainage (two drainages). Intermittent irrigation has been further classified as long drainage, when the field is kept waterlogged after drainage; and short drainage, when the field is kept moist after drainage.

For remaining data inputs in rice management, see section 4 ("Crop worksheet") and follow the same steps.

6. Grassland worksheet

In the **General Input** page, users should select **Grassland**, from the "**Select land use**" drop down menu to input data on baseline management practices and to obtain GHG emission estimates and mitigation options. In the Grassland section, users select **grassland type** (i.e., clover, grass-clover mix, perennial grass, other nitrogen-fixing forage, other non-nitrogen-fixing forage, or none) from the drop down menu, and follow the same steps mentioned in the "crops" and "rice" sections above (sections 4 and 5). For the assessment of GHG emissions and mitigation potential for grassland and livestock together, users select the option **grazed** after the "**go to results**" button. If this option is selected, users need to indicate the **livestock type** that is, dairy cow, beef cattle and dairy followers, small ruminants dairy (e.g., goats and sheep), small ruminants for meat (e.g., goats and sheep), or pigs or poultry) from the drop down menu and the **livestock production system** (i.e., grazing system, mixed farming system, other, or urban). For a definition of the different livestock systems, see below. After selecting livestock type, users should indicate the **body weight** of the animal (in kg) and select a **product** (milk, meat, or eggs) in order to obtain GHG emissions per kg of product. If the user has no information about body weight, a default value is provided.

Herrero et al. (2013) define the livestock production systems as:

- **Grassland-based systems** are those in which more than 90% of dry matter fed to animals comes from rangelands, pastures, annual forages, and/or purchased feeds, and less than 10% of the total value of production comes from non-livestock farming activities. In addition, more than 10% of the dry matter fed to animals is produced on the farm and in which annual average stocking rates are less than 10 temperate livestock units per hectare of agricultural land.
- **Mixed farming systems** are those systems in which more than 10% of the dry matter fed to animals comes from crop by-products or stubble, or more than 10% of the total value of production comes from non-livestock farming activities.
- **Other**: mainly for pigs and poultry.
- **Urban**: mixed irrigated systems.

7.   Livestock worksheet

In the **General Input** page, users should select **Livestock** from the "**Select land use**" drop down menu to input data on baseline management practices and to obtain GHG emission estimates and mitigation options. In the Livestock section, users select the <u>livestock type</u> from a range of options that is, <u>dairy cow</u>, <u>beef cattle and dairy followers</u>, <u>small ruminants dairy</u> (e.g., goats and sheep), <u>small ruminants for meat</u> (e.g., goats and sheep), <u>pigs</u>, or <u>poultry</u>. After selecting livestock type, users should select the **livestock production system** (i.e., <u>grazing system</u>, <u>mixed farming system</u>, <u>other</u>, or <u>urban</u>) from the drop down menu and insert the animal's **body weight** (in kg). If the user has no information about body weight, a default value is provided. For a definition of the different livestock systems see below. Users should select a **product** (<u>meat</u>, <u>milk</u>, or <u>eggs</u>) for an assessment of kgCO$_2$e/kg of product. Finally, users should click on "**go to results**" to obtain GHG emission estimates and suggested mitigation options for livestock.

- **Grassland-based systems** are those in which more than 90% of dry matter fed to animals comes from rangelands, pastures, annual forages, and/or purchased feeds, and less than 10% of the total value of production comes from non-livestock farming activities. In addition, more than 10% of the dry matter fed to animals is produced on the farm and in which annual average stocking rates are less than 10 temperate livestock units per hectare of agricultural land.
- **Mixed farming systems** are those systems in which more than 10% of the dry matter fed to animals comes from crop by-products or stubble, or more than 10% of the total value of production comes from non-livestock farming activities.
- **Other**: mainly for pigs and poultry according to Herrero et al. (2013).
- **Urban:** mixed irrigated systems.

8.   Interpreting the results

8.1 GHG emissions

The CCAFS-MOT estimates GHG emissions in kgCO$_2$e/ha and in kgCO$_2$e/kg product.[3] It also shows GHG emissions in the case there is land use change in the form of deforestation following by burning. These results are presented below, and shown graphically in figures 9 and 10.

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[3] Carbon dioxide equivalent (or "CO$_2$e") is a term for describing different GHGs in a common unit. For any quantity and type of GHG, CO$_2$e signifies the amount of CO$_2$ that would have the equivalent global warming impact.

Total GHG emissions

		GROSS GHGs	NET GHGs + SOC + LUC
per Area	kg CO_2eq ha^{-1}	2737.5	3509.7
per Yield	kg CO_2eq kg^{-1}	0.912	1.170

Emissions from deforestration if the forest was burned:
336744 kg CO_2eq ha^{-1}

SCR

Figure 9. Total GHG emissions in kgCO$_2$e/ha and in kgCO$_2$/kg product.

Main Results

GHG emissions due to current management practices (emissions per ha)
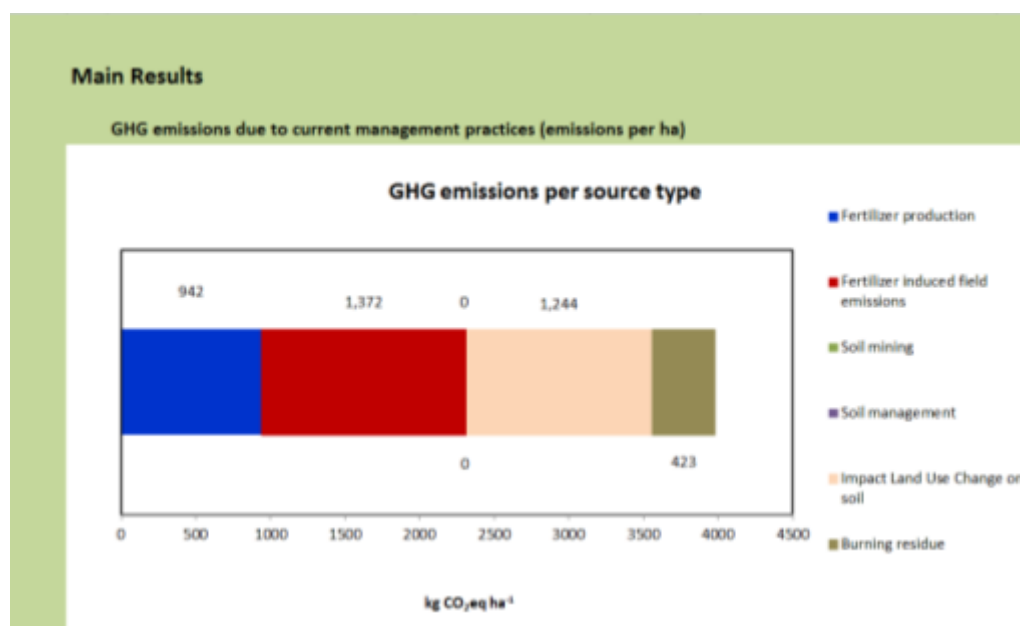

Figure 10. Total GHG emissions from crop production disaggregated by source of emissions.

To find more detailed results, users need to scroll down the spreadsheet. The signs **SCROLL DOWN** ↓ appear as a reminder (see table 2 for an example).

Table 2. Disaggregated emissions by source and by GHG type (CO_2, CH_4, N_2O, soil carbon sequestration [SCS]) and total GHG emissions in kgCO_2/ha and kgCO_2e/kg product

GHG emissions						
Baseline					**Total**	
	CO_2	CH_4	N_2O	SCS	CO_2eq	CO_2eq
	[kg CO_2eq ha^{-1}]	[kg CO_2eq ha^{-1}]	[kg CO_2eq ha^{-1}]	[kg CO_2eq ha^{-1}]	[kg ha^{-1}]	[kg kg^{-1}]
Fertilizer production	234.86				234.86	0.12
Fertilizer-induced field emissions	142.24		531.69		673.93	0.34
Soil mining			0.00		0.00	0.00
Soil management				0.00	0.00	0.00
LUC - effect on soil				0.00	0.00	0.00
Burning residue		0.00	0.00		0.00	0.00
Total GHG (Fertilizer)					908.79	0.45
Total GHG (Fertilizer + Soil mgmt +LUC)					908.79	0.45

Note: LUC = land use change.

8.2 Mitigation options

Figure 11 provides information on several mitigation options with the potential of reducing GHG emissions. For example, the option "Optimal N application" is the mitigation option with highest technical mitigation potential (-2076.61 kgCO_2e/ha), and the polymer-coated fertilizer is the mitigation option with lowest technical mitigation potential (-0.06 kgCO_2e/ha). The negative sign indicates that the mitigation potential of each individual mitigation practice can be subtracted from the total GHG emissions estimated by the CCAFS-MOT (e.g., GHG emissions in figure 11).
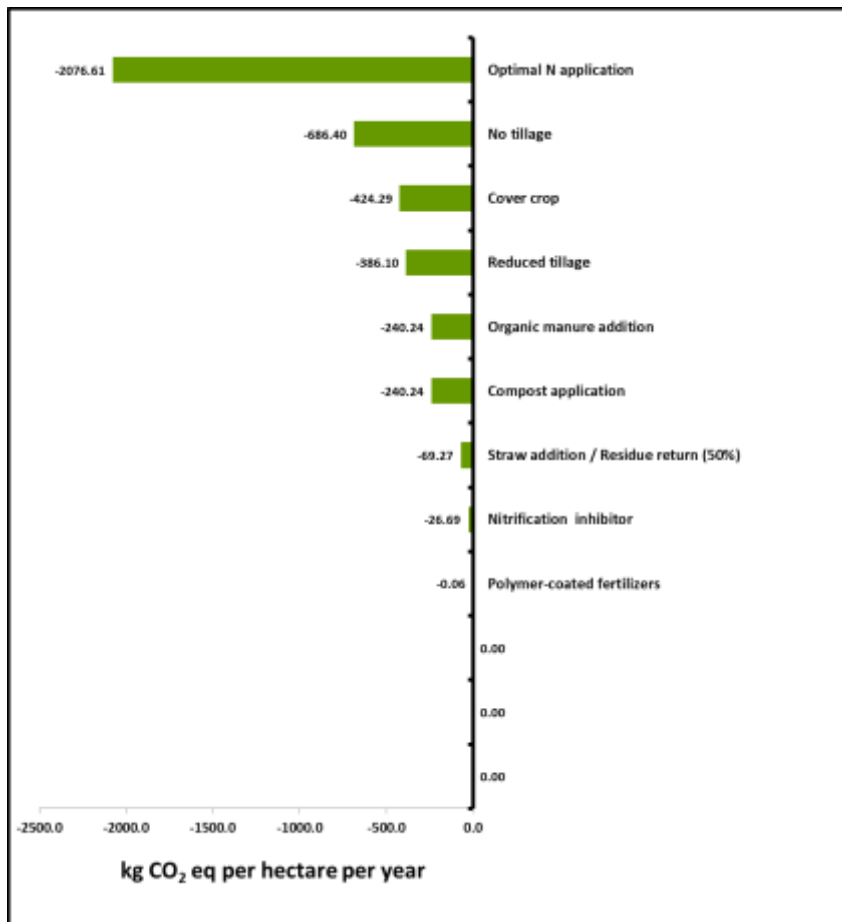
Figure 11. Mitigation options and mitigation potentials.

Apart from the mitigation option suggested in figure 11, the tool also suggests a range of agroforestry systems that can be implemented in cropland, taking into account suitability. These systems are "Homegarden," "Boundary planting," "Alley cropping," and "Other agroforestry systems." Figure 12 shows the sequestration potential of those systems in terms of soil carbon sequestration and above-ground carbon sequestration. The agroforestry systems included in the CCAFS-MOT can be defined as:

- **Homegardens**: Integrated tree-crop-animal production systems that are established on small parcels of land surrounding homesteads. This land use system comprises numerous woody species in close, multistoried association with herbs, annual and perennial crops, and livestock all managed on the same piece of land.
- **Boundary planting**: Windbreaks and live fences are two common examples of boundary plantings. The primary function of a windbreak (or shelterbelt) is to protect an area from wind damage. Other functions include provision of products (e.g., fruits), animal fodder, wildlife habitat, and other economic and farm products. Live fences are classified under this category.
- **Alley farming** or **hedgerow intercropping**: Planting of trees or woody shrubs in two or more sets of single or multiple rows, with agronomic, horticultural, or forage crops cultivated in the alleys between the rows. Intercropping systems are classified under this category.
- **Other agroforestry systems**: Other agroforestry systems not included in the definitions above.
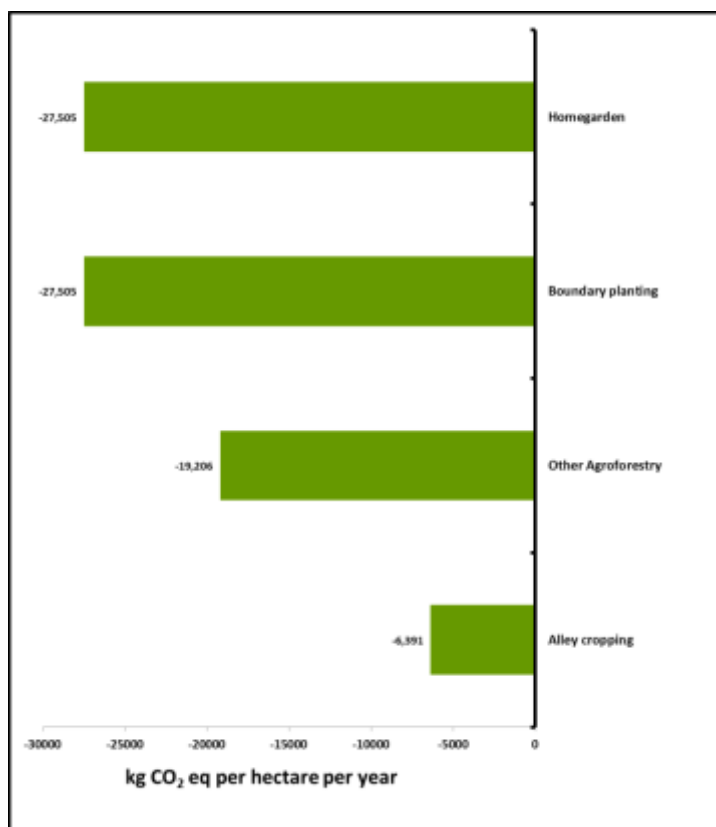
Figure 11. Agroforestry systems and carbon sequestration potentials.

The results on mitigation options and potentials are presented in more detail in Table 3, as is the effect of the mitigation options on **crop yields** (see columns 8 and 9).

Table 3. Detailed information about mitigation potential

Mitigation practice	Δ N2O (kg CO₂eq ha⁻¹)	Δ SOC with mitigation (kg CO₂)	Δ Biomass C accumulation	Δ GHG emissions due to fertilizer production (kg CO₂eq)	Δ GHG emissions due to fertilizer field applic. (kg CO₂eq)	TOTAL (kg CO₂eq kg⁻¹)	Effect on yield (%)	Effect on yield estimate for	
Optimal N application	-932.36	0.00	0.00	-704.19	-567.48	**-2204.02**	n.a.	n.a.	n.a.
Nitrification inhibitor	-73.72	0.00	0.00	0.00	0.00	**-73.72**	n.a.	n.a.	n.a.
Polymer-coated fertilizers	-0.06	0.00	0.00	0.00	0.00	**-0.06**	n.a.	n.a.	n.a.
Best technology	0.00	0.00	0.00	0.00	0.00	**0.00**	n.a.	n.a.	n.a.
Optimal N application + Best technology	-932.36	0.00	0.00	-704.19	-567.48	**-2204.02**	n.a.	n.a.	n.a.
Reduced tillage	0.00	-386.10	0.00	0.00	0.00	**-386.10**	n.a.	n.a.	n.a.
No tillage	0.00	-686.40	0.00	0.00	0.00	**-686.40**	n.a.	n.a.	n.a.
Cover crop	0.00	-424.29	0.00	0.00	0.00	**-424.29**	n.a.	n.a.	n.a.
Compost application	0.00	-240.24	0.00	0.00	0.00	**-240.24**	n.a.	n.a.	n.a.
Organic manure addition	0.00	-240.24	0.00	0.00	0.00	**-240.24**	n.a.	n.a.	n.a.
Straw addition / Residue return (50%)	222.31	-75.94	0.00	0.00	0.00	**146.37**	n.a.	n.a.	n.a.
Alley cropping	0.00	-2419.08	-3971.92	0.00	0.00	**-6391.00**	164.29	Other	Global
Boundary planting	0.00	-10717.67	-16786.92	0.00	0.00	**-27504.58**	164.29	Other	Global
Homegarden	0.00	-10717.67	-16786.92	0.00	0.00	**-27504.58**	164.29	Other	Global
Other Agroforestry	0.00	-2419.08	-16786.92	0.00	0.00	**-19206.00**	164.29	Other	Global

9. Maps

In the worksheet **Maps**, several maps with relevant information (climate zones, Asian rice climate classification, SOC) for general data input are provided as well as guidance on soil texture.

10. Glossary

The worksheet **Glossary** contains several definitions, including mitigation options for crop, rice, and livestock mitigation options.

References

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