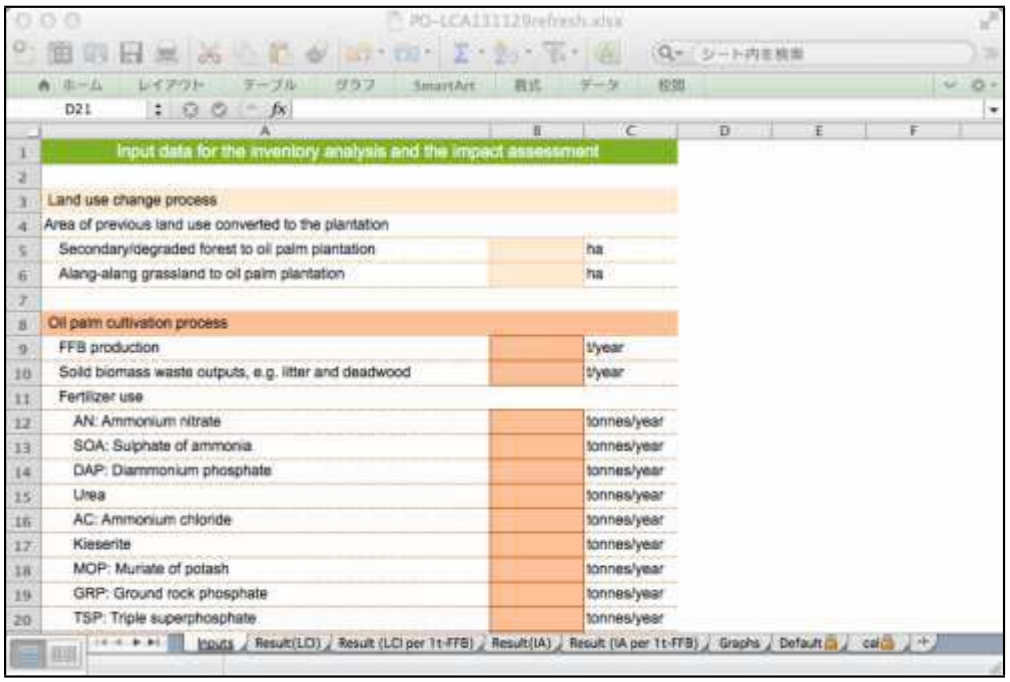
The Practical Manual for the Palm Oil LCA Spreadsheet

(Initial Draft)

December 2013

1. Contents of the spreadsheet

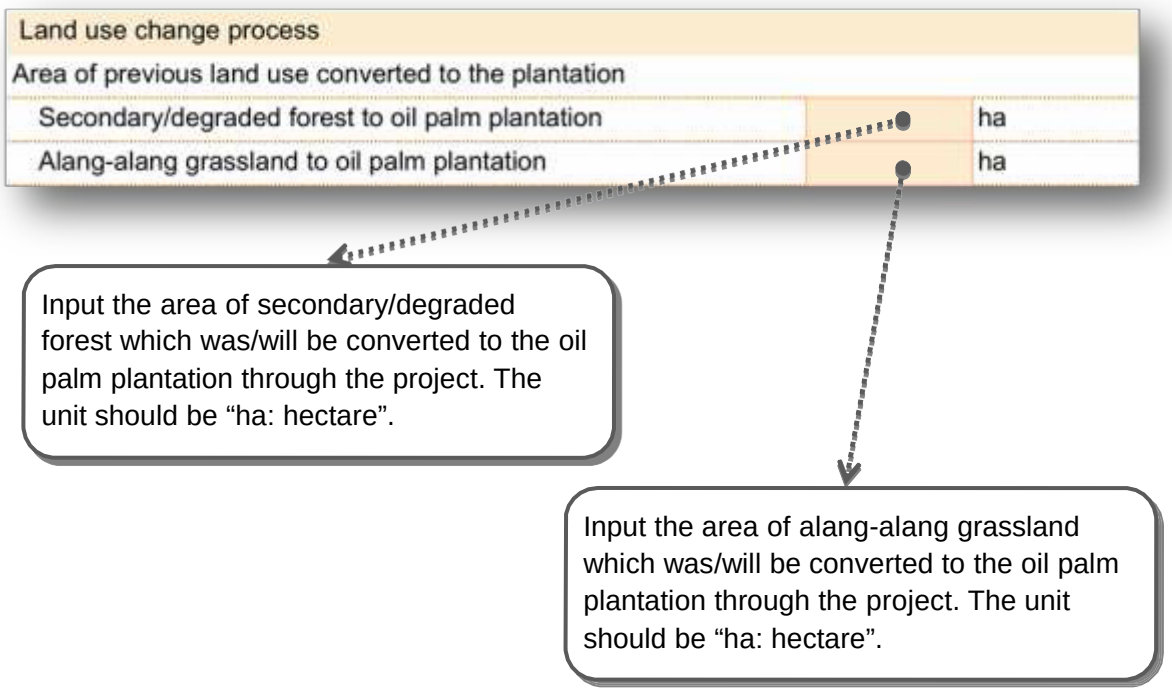
Name of sheet	Outline
Inputs	- All the necessary data will be inputted in this sheet. - Data will be separately inputted by processes.
Result (LCI)	- One of the results. After completing “Inputs” sheet, the lifecycle inventory will be automatically established.
Result (LCI per 1t-FFB)	- One of the results. The lifecycle inventory (per 1 ton of FFB) will be automatically established.
Result (IA)	- One of the results. The impact assessment, including global warming, acidification and eutrophication, will be automatically done.
Result (IA per 1t-FFB)	- One of the results. The impact assessment (per 1 ton of FFB), including global warming, acidification and eutrophication, will be automatically done.
Graphs	- One of the results. Graphs of the inventory and the impact assessment will be automatically created.
Default	- Provides necessary fixed data for calculation of emissions etc. No need for project participants to modify this sheet.
cal	- Intermediate calculation sheet for the inventory and the impact assessment. No need for project participants to modify this sheet.



2. Procedure of data input - Explanation of the “Inputs” sheet -

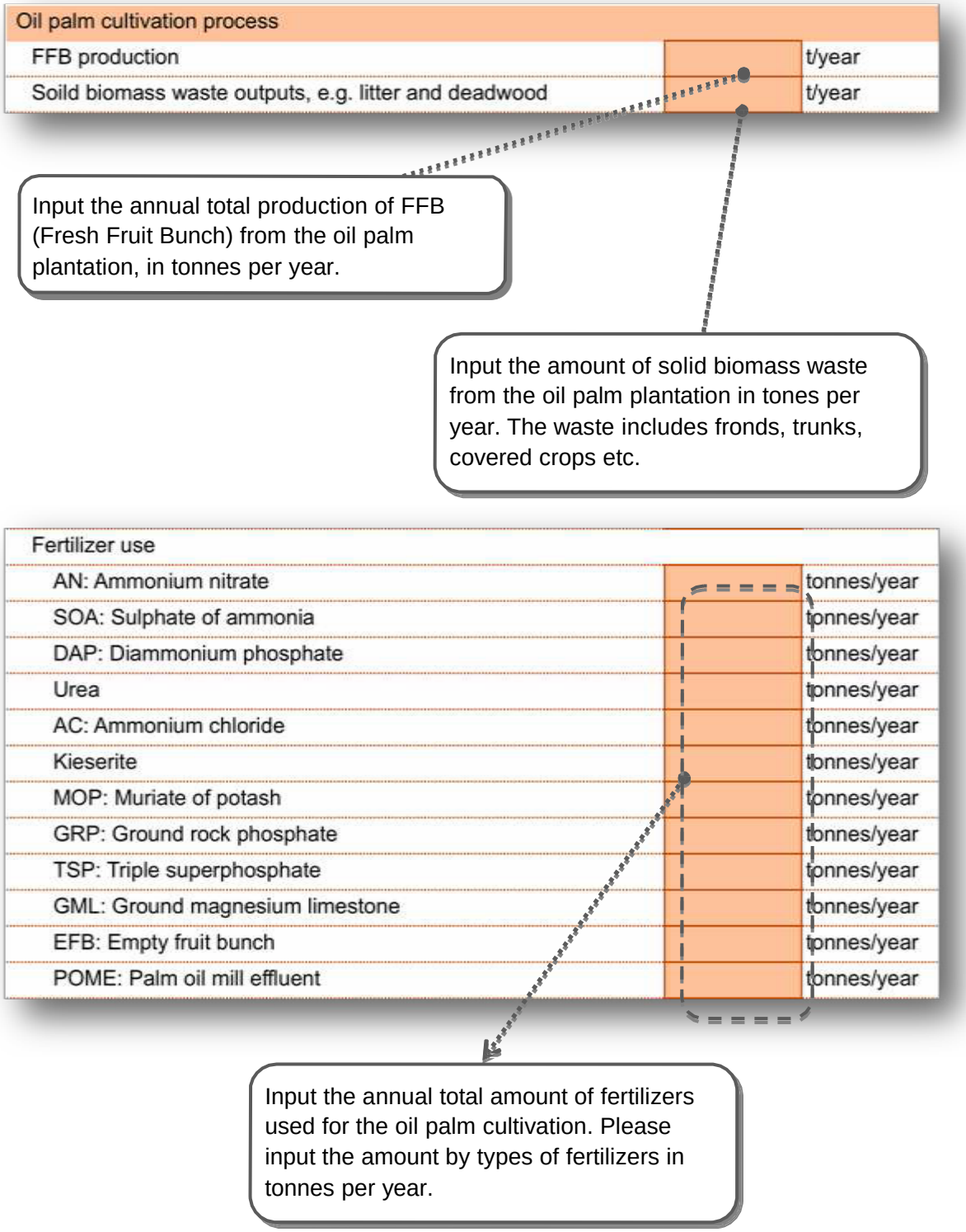
2.1 Land use change process

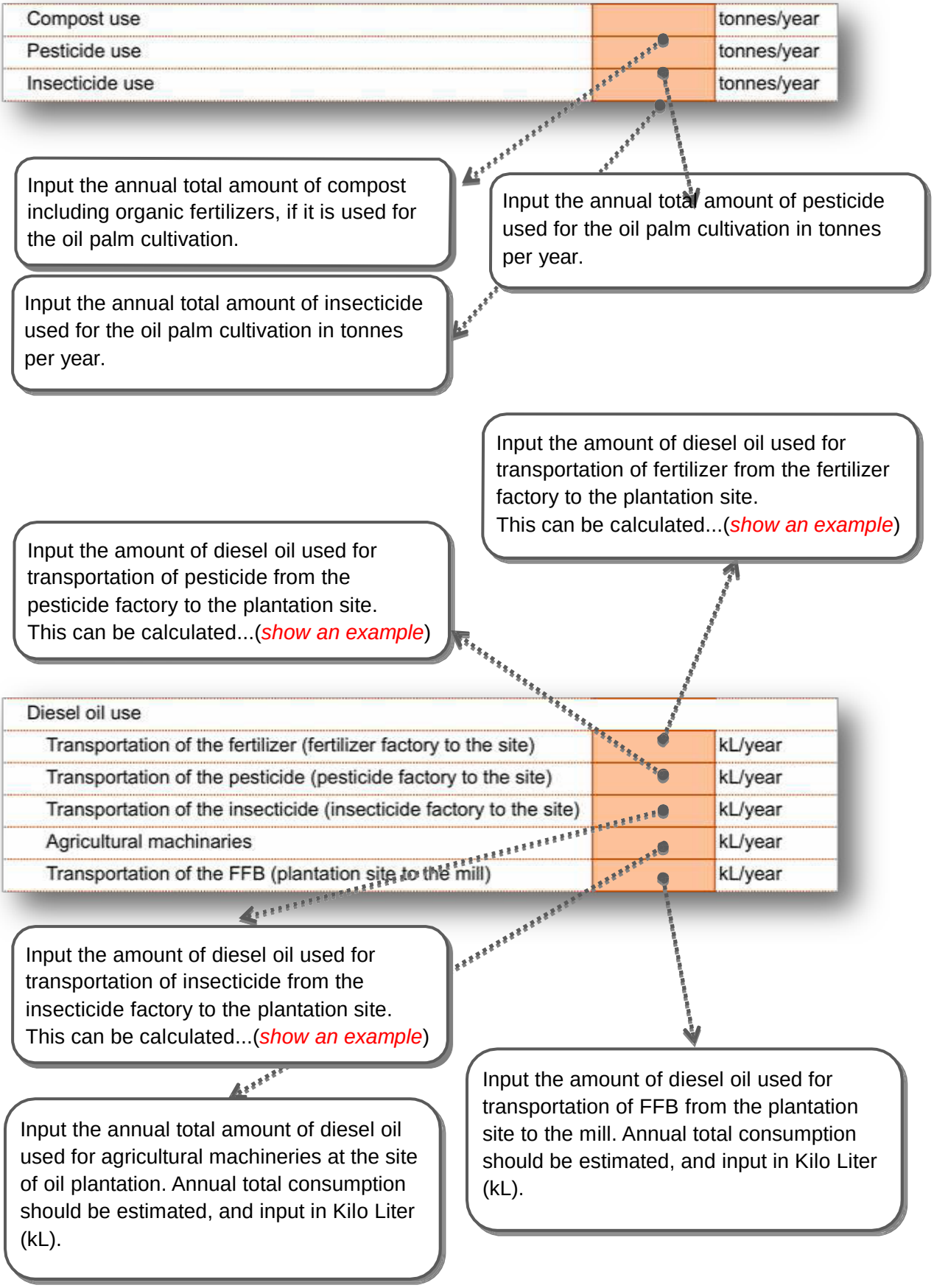
“Land use change process” includes changes of the land use through the project development. The transformation can be from previous land types, such as secondary/degraded forest or alang-alang grassland, to the oil palm plantation. As a result of land use change, carbon in the soil/vegetation is converted to CO_2 and emitted to the air, or CO_2 is sequestered in the soil/vegetation.



2.2 Oil palm cultivation process

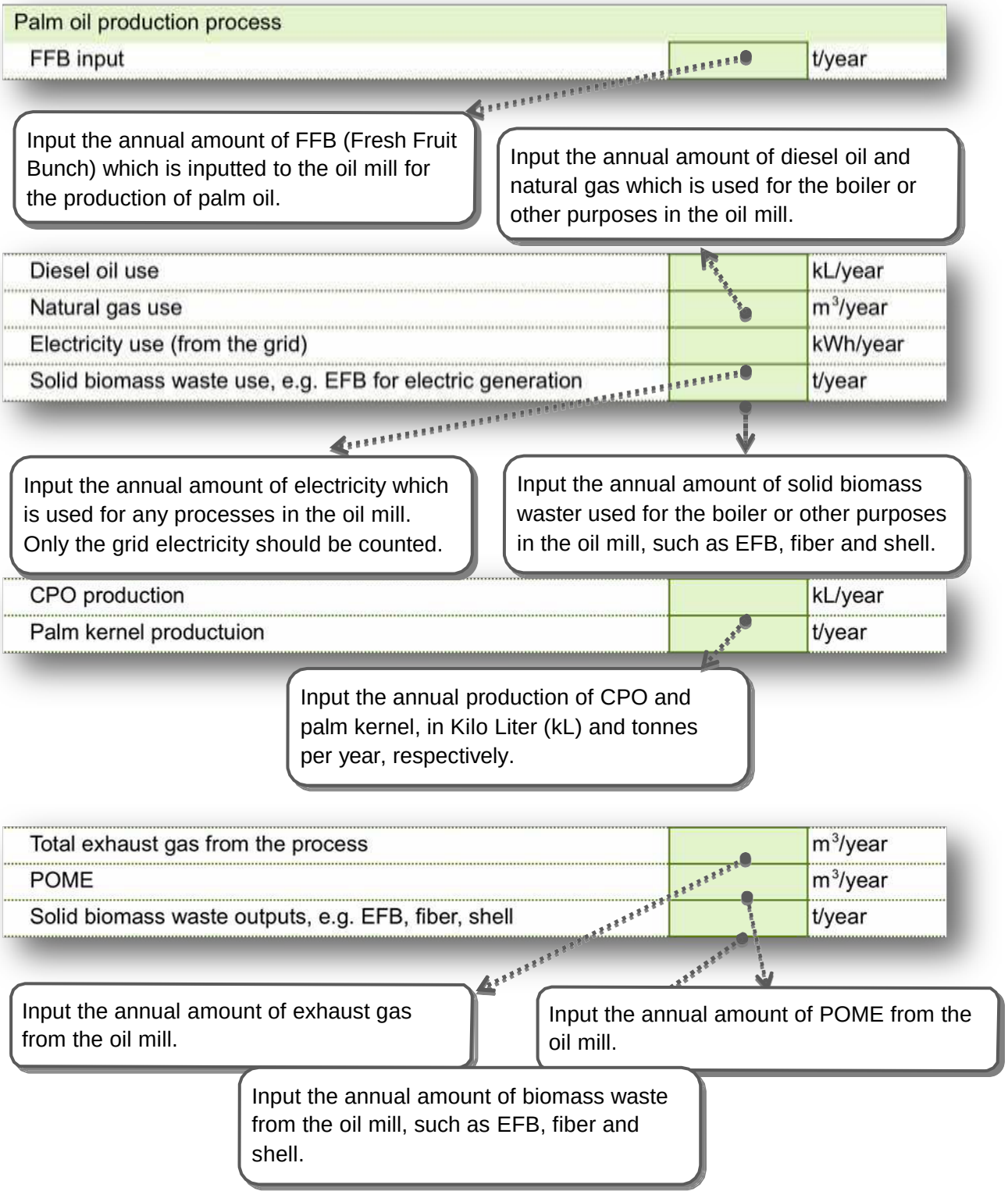
The process includes activities related to cultivation of oil palm, such as fertilizer application, pesticide and insecticide use. Diesel oil use for transportation of FFB and other materials are also included in the process.




Compost use
tonnes/year
Pesticide use
tonnes/year
Insecticide use
tonnes/year
Input the annual total amount of compost including organic fertilizers, if it is used for the oil palm cultivation.
Input the annual total amount of pesticide used for the oil palm cultivation in tonnes per year.
Input the annual total amount of insecticide used for the oil palm cultivation in tonnes per year.
Input the amount of diesel oil used for transportation of fertilizer from the fertilizer factory to the plantation site.
This can be calculated...(show an example)
Input the amount of diesel oil used for transportation of pesticide from the pesticide factory to the plantation site.
This can be calculated...(show an example)
Diesel oil use
Transportation of the fertilizer (fertilizer factory to the site)
kL/year
Transportation of the pesticide (pesticide factory to the site)
kL/year
Transportation of the insecticide (insecticide factory to the site)
kL/year
Agricultural machinaries
kL/year
Transportation of the FFB (plantation site to the mill)
kL/year
Input the amount of diesel oil used for transportation of insecticide from the insecticide factory to the plantation site.
This can be calculated...(show an example)
Input the amount of diesel oil used for transportation of FFB from the plantation site to the mill. Annual total consumption should be estimated, and input in Kilo Liter (kL).
Input the annual total amount of diesel oil used for agricultural machineries at the site of oil plantation. Annual total consumption should be estimated, and input in Kilo Liter (kL).

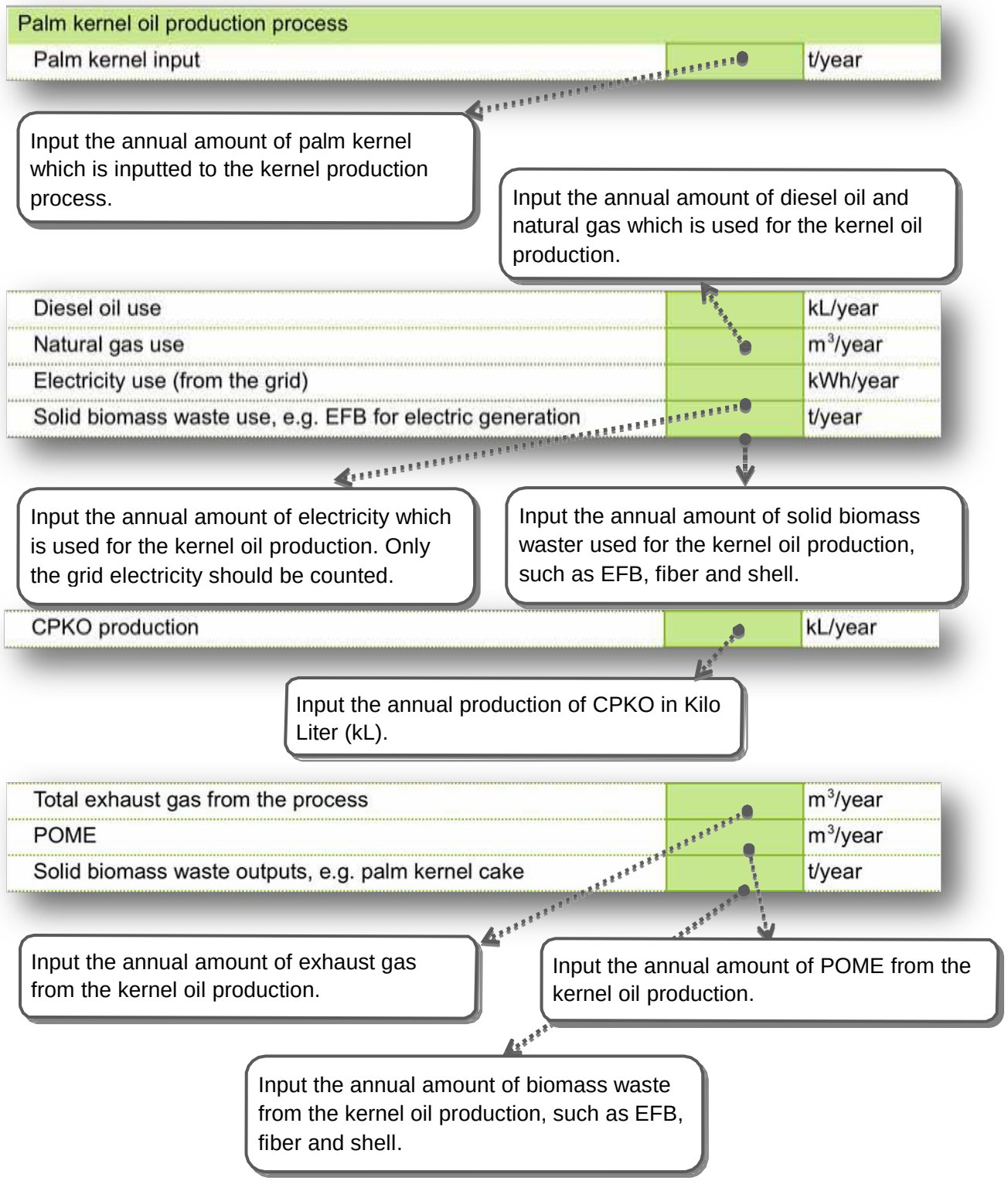
2.3 Palm oil production process

The process includes activities related to palm oil production, such as energy use, discharge of wastes.



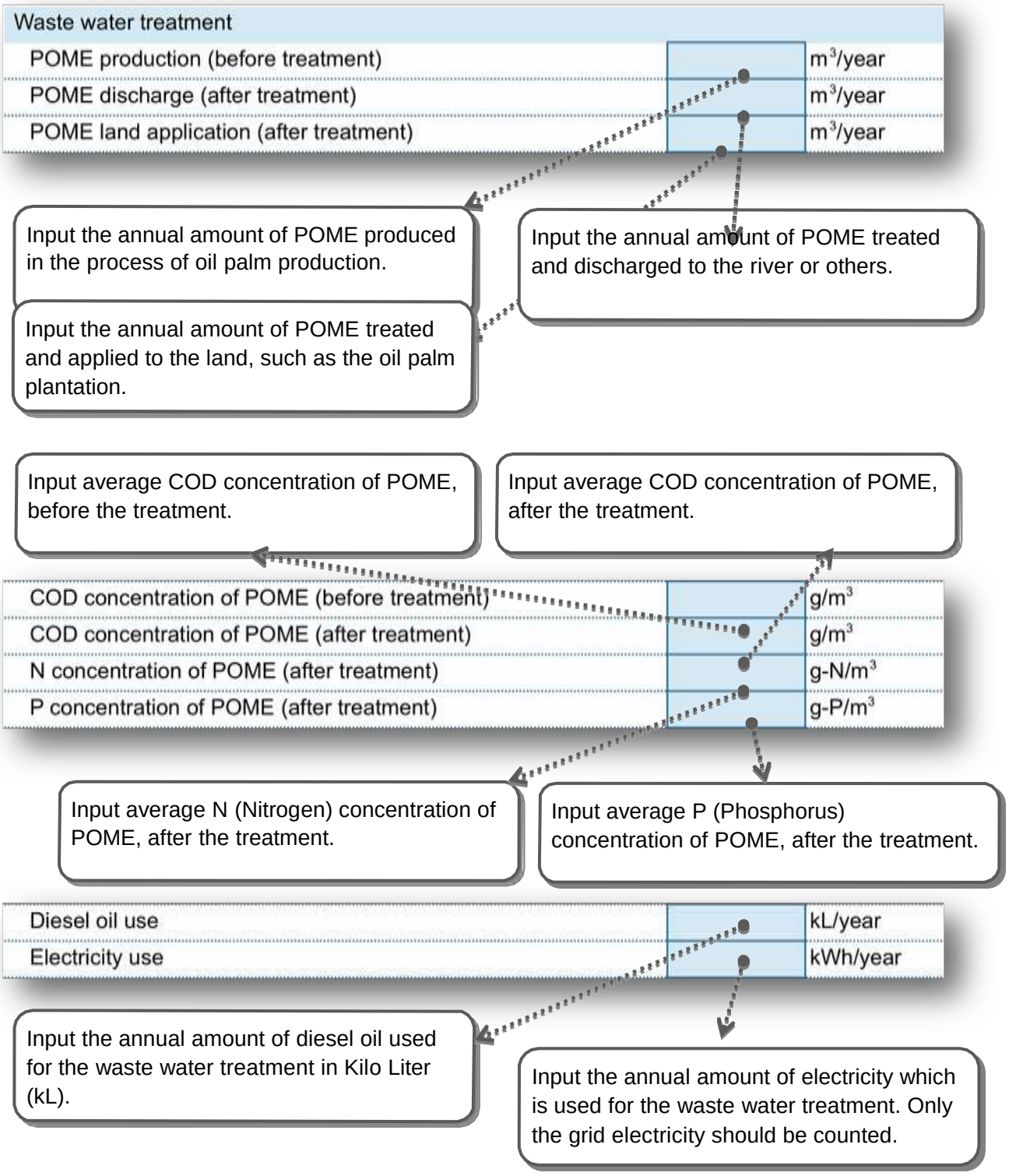
2.4 Palm kernel oil production process

The process includes activities related to palm kernel oil production only. If it is not possible to separate the necessary data from “Palm oil production process”, this process and “Palm oil production process” should be combined with.



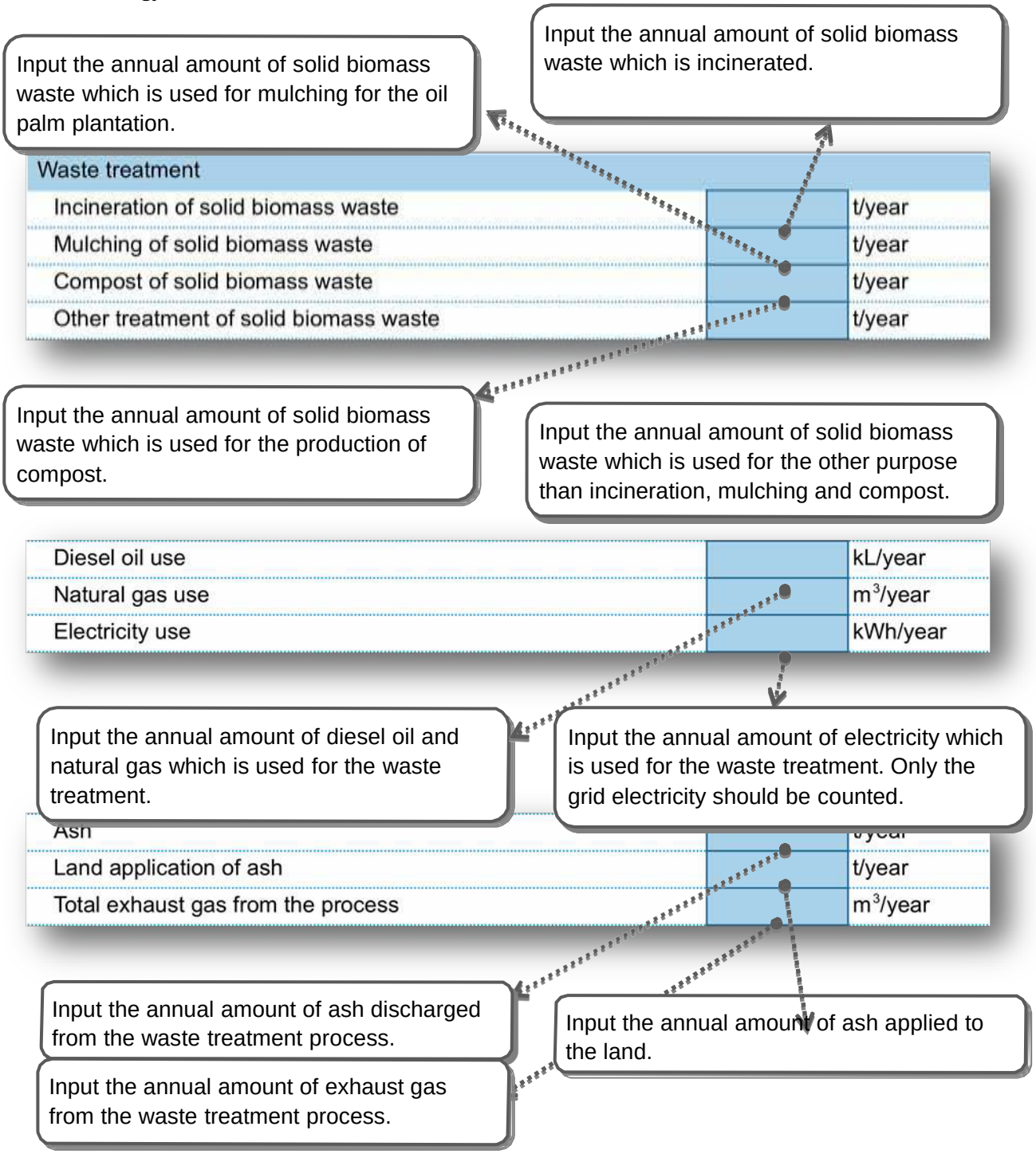
2.5 Waste water treatment

The process includes activities related to waste water treatment, such as POME treatment (such as aerobic/anaerobic treatment) and associated energy uses. (*Methane recovery and energy uses should be included in this process, but not yet included in the spreadsheet*)



2.6 Waste treatment

The process includes activities related to waste treatment, such as incineration, mulching, compost and associated energy uses.



3. Results

3.1 The sheet “Result (LCI)”

Life Cycle Inventory (inputs per year)

Life Cycle Inventory (outputs per year)

Life Cycle Inventory (outputs per year (e.g. CO_2 equivalent))

		CO_2	CH_4	N_2O	SO_2	NOx	N	P	COD
		ton-CO_2eq	ton-CO_2eq	ton-CO_2eq	ton-SO_2eq	ton-SO_2eq	ton	ton	ton
Land use change process	Direct	-17,105.9	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	-17,105.9	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
Oil palm cultivation process	Direct	3,233.5	10.9	4,583.5	4.8	14.4	0.0E+00	0.0E+00	0.0E+00
	Indirect	10,084.1	205.1	801.2	5.3	6.3	1.4E-03	5.3E-09	1.1E-04
	Total	13,317.5	216.0	5,384.8	10.1	20.7	1.4E-03	5.3E-09	1.1E-04
Palm oil production process	Direct	0.0	10,352.3	1,645.3	187.8	63.3	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	10,352.3	1,645.3	187.8	63.3	0.0E+00	0.0E+00	0.0E+00
Palm kernel oil production process	Direct	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
Waste water treatment	Direct	0.0	236.3	0.0	0.0	0.0	2.0E+00	0.0E+00	1.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	236.3	0.0	0.0	0.0	2.0E+00	0.0E+00	1.0E+00
Waste treatment	Direct	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
Total	Direct	-13,872.4	10,599.5	6,228.9	192.6	77.7	2.0E+00	0.0E+00	1.0E+00
	Indirect	10,084.1	205.1	801.2	5.3	6.3	1.4E-03	5.3E-09	1.1E-04
	Total	-3,788.4	10,804.6	7,030.1	197.9	84.0	2.0E+00	5.3E-09	1.0E+00

3.2 The sheet “Result (LCI per 1t-FFB)”

Life Cycloe Inventory per 1 ton of FFB (inputs per year)

Life Cycloe Inventory per 1 ton of FFB (outputs per year)

Life Cycloe Inventory per 1 ton of FFB (outputs per year (e.g. CO_2 equivalent))

		CO_2	CH_4	N_2O	SO_2	NOx	N	P	COD
		kgCO_2eq/t-FFB	kgCO_2eq/t-FFB	kgCO_2eq/t-FFB	kgSO_2eq/t-FFB	kgSO_2eq/t-FFB	kg/t-FFB	kg/t-FFB	kg/t-FFB
Land use change process	Direct	-60.9	0.0	0.0	0.0	0.0	0.00E+00	0.00E+00	0.00E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.00E+00	0.00E+00	0.00E+00
	Total	-60.9	0.0	0.0	0.0	0.0	0.00E+00	0.00E+00	0.00E+00
Oil palm cultivation process	Direct	11.5	0.0	16.3	0.0	0.1	0.0E+00	0.0E+00	0.0E+00
	Indirect	35.9	0.7	2.9	0.0	0.0	4.8E-06	1.9E-11	3.8E-07
	Total	47.4	0.8	19.2	0.0	0.1	4.8E-06	1.9E-11	3.8E-07
Palm oil production process	Direct	0.0	36.8	5.9	0.7	0.2	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	36.8	5.9	0.7	0.2	0.0E+00	0.0E+00	0.0E+00
Palm kernel oil production process	Direct	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
Waste water treatment	Direct	0.0	0.8	0.0	0.0	0.0	7.2E-03	0.0E+00	3.6E-03
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	0.8	0.0	0.0	0.0	7.2E-03	0.0E+00	3.6E-03
Waste treatment	Direct	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Indirect	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
	Total	0.0	0.0	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00
Total	Direct	-49.4	37.7	22.2	0.7	0.3	7.2E-03	0.0E+00	3.6E-03
	Indirect	35.9	0.7	2.9	0.0	0.0	4.8E-06	1.9E-11	3.8E-07
	Total	-13.5	38.5	25.0	0.7	0.3	7.2E-03	1.9E-11	3.6E-03

3.3 The sheet “Result (IA)”

Life Cyclce Impact Assessment

		Global warming ton-CO_2eq	Acidification ton-SO_2eq	Eutrophication ton
Land use change process	Direct	-17,106	0	0.0E+00
	Indirect	0	0	0.0E+00
	Total	-17,106	0	0.0E+00
Oil palm cultivation process	Direct	7,828	19	0.0E+00
	Indirect	11,090	12	1.5E-03
	Total	18,918	31	1.5E-03
Palm oil production process	Direct	11,998	251	0.0E+00
	Indirect	0	0	0.0E+00
	Total	11,998	251	0.0E+00
Palm kernel oil production process	Direct	0	0	0.0E+00
	Indirect	0	0	0.0E+00
	Total	0	0	0.0E+00
Waste water treatment	Direct	236	0	3.0E+00
	Indirect	0	0	0.0E+00
	Total	236	0	3.0E+00
Waste treatment	Direct	0	0	0.0E+00
	Indirect	0	0	0.0E+00
	Total	0	0	0.0E+00
Total	Direct	2,956	270	3.0E+00
	Indirect	11,090	12	1.5E-03
	Total	14,046	282	3.0E+00

3.4 The sheet “Result (IA per 1t-FFB)”

Life Cyclce Impact Assessment (per 1 ton of FFB)

		Global warming kgCO_2eq/t-FFB	Acidification kgSO_2eq/t-FFB	Eutrophication kg/t-FFB
Land use change process	Direct	-60.9	0.0	0.0E+00
	Indirect	0.0	0.0	0.0E+00
	Total	-60.9	0.0	0.0E+00
Oil palm cultivation process	Direct	27.9	0.1	0.0E+00
	Indirect	39.5	0.0	5.2E-06
	Total	67.3	0.1	5.2E-06
Palm oil production process	Direct	42.7	0.9	0.0E+00
	Indirect	0.0	0.0	0.0E+00
	Total	42.7	0.9	0.0E+00
Palm kernel oil production process	Direct	0.0	0.0	0.0E+00
	Indirect	0.0	0.0	0.0E+00
	Total	0.0	0.0	0.0E+00
Waste water treatment	Direct	0.8	0.0	1.1E-02
	Indirect	0.0	0.0	0.0E+00
	Total	0.8	0.0	1.1E-02
Waste treatment	Direct	0.0	0.0	0.0E+00
	Indirect	0.0	0.0	0.0E+00
	Total	0.0	0.0	0.0E+00
Total	Direct	10.5	1.0	1.1E-02
	Indirect	39.5	0.0	5.2E-06
	Total	50.0	1.0	1.1E-02

3.5 The sheet “Graphs”