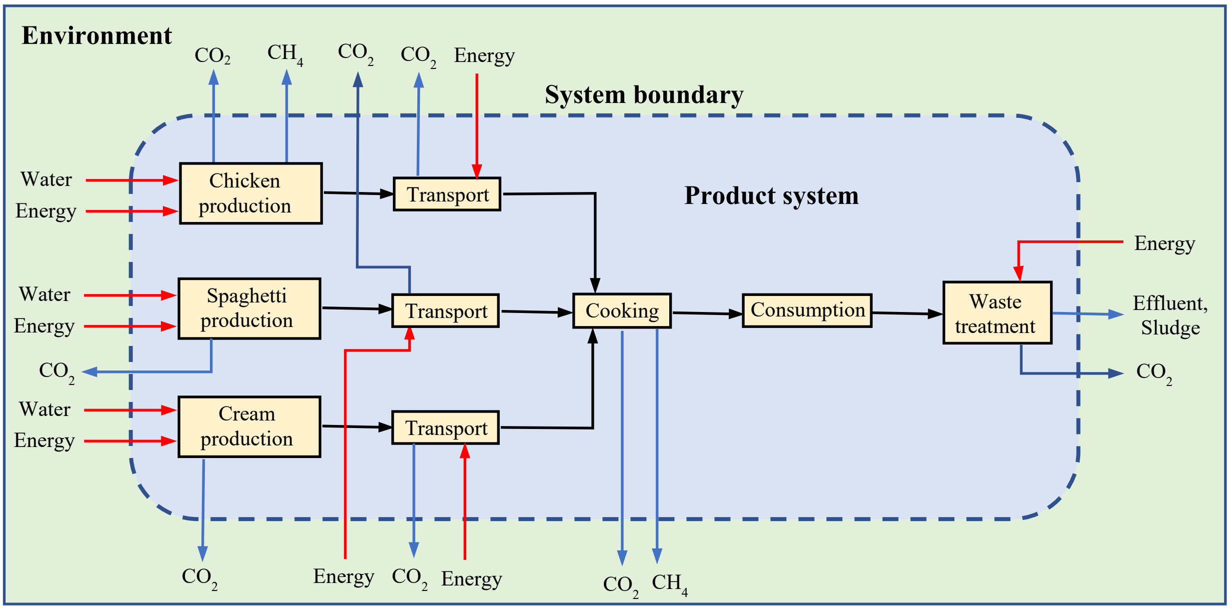
DSS5202 Sustainable Systems Analysis
Solutions to Assignment 1

Question 1

Functional Unit: 1 serving of Creamy Chicken Spaghetti (CCS)

Question 2

Production System Diagram



Question 3

Inventory Analysis

Reference value for product flows:

1. CCS: 1 serving
2. Chicken: 0.200 kg
3. Spaghetti: 0.100 kg
4. Cream: 0.050 kg

1. Production of Ingredients

1.1 Chicken production

Chicken:	0.20	kg of chicken
Water:	2000 L/kg × 0.20 kg = 400	L of water
Energy:	10 MJ/kg × 0.20 kg = 2	MJ of energy
CO_2:	6.9 kg/kg × 0.20 kg = 1.38	kg of CO_2
CH_4:	0.3 kg/kg × 0.20 kg = 0.06	kg of CH_4

1.2 Spaghetti production

Spaghetti:	0.10	kg of spaghetti
Water:	1200 L/kg × 0.10 kg = 120	L of water
Energy:	5 MJ/kg × 0.10 kg = 0.5	MJ of energy
CO_2:	4.8 kg/kg × 0.10 kg = 0.48	kg of CO_2

1.3 Cream production

Cream:	0.05	kg of cream
Water:	1500 L/kg × 0.05 kg = 75	L of water
Energy:	8 MJ/kg × 0.05 kg = 0.4	MJ of energy
CO_2:	0.05 kg/kg× 4.8 kg = 0.24	kg of CO_2

Total for Production of Ingredients

Water:	400 + 120 +75 = 595	L of water
Energy:	2 + 0.5 + 0.4 = 2.9	MJ of energy
CO_2:	1.38 + 0.48 + 0.24 = 2.1	kg of CO_2
CH_4:	0.06	kg of CH_4

2. Transportation

Total goods:	0.2+0.1+0.05 = 0.35	kg of goods
Energy:	0.1×0.35 kg = 0.035	MJ of energy
CO2:	0.05 kg/kg×0.35 kg = 0.0175	kg of CO2

3. Cooking

Food cooked:	0.35	kg of food
Energy:	5.14 × 0.35 kg = 1.8	MJ of energy
CO2:	0.286 kg/kg × 0.35 kg = 0.1	kg of CO2
CH4:	0.00714 kg/kg × 0.35 kg = 0.0025	kg of CH4

4. Consumption

Food consumed:	0.35	kg of food
Waste:	0.086 kg/kg × 0.35 kg = 0.030	kg of waste

5. Waste treatment

Waste treated:	0.030	kg
Energy:	18 MJ/kg 0.03 kg = 0.54	MJ of energy
Effluent:	1 kg/kg × 0.030 kg = 0.030	kg

Summary of Inventory Analysis

	Life Cycle Phase	CO2	CH4	Water	Energy
1	Production of Ingredients	2.10	0.06	595	2.9
2	Transportation	0.0175	0	0	0.035
3	Cooking	0.1	0.0025	0	1.8
4	Consumption	0	0	0	0
5	Waste treatment	0	0	0	0.54
	Total Life Cycle	2.2175	0.0625	595	5.277

Question 4

Life Cycle Impact Analysis

Global warming potentials (GWP)

1. Production of ingredients: 1.38 kg CO_2 + 0.06 kg CH_4 × 28 kg/kg + 0.48 kg CO_2 + 0.24 kg CO_2 = 3.78 kg CO_2 eq

2. Transportation: = 0.0175 kg CO_2 eq

3. Cooking: 0.1 kg CO_2 + 0.0025 kg CH_4 kg × 28 kg/kg = 0.170 kg CO_2 eq

   Total: 3.9675 kg CO_2 eq

Water consumption

1. Production of ingredients: 595 L of water

   Total: 595 L of water

Energy consumption

1. Production of ingredients: 2.9 MJ
2. Transportation: 0.035 MJ
3. Cooking: 1.8 MJ
5. Waste treatment: 0.542 MJ

   Total: 5.277 MJ

Summary of Impact Analysis

	Life Cycle Phase	GWP	Water	Energy
1	Production of Ingredients	3.780	595	2.9
2	Transportation	0.0175	0	0.035
3	Cooking	0.17	0	1.8
4	Consumption	0	0	0
5	Waste treatment	0	0	0.542
	Total Life Cycle	3.9675	595	5.277

Comments:

- Production of ingredients contributes the most significantly towards all the 3 impact categories.
- Cooking also contributes a significant amount to GWP.
- Waste treatment also consults a significant amount of Energy.

Question 5

Some major limitations are:

- The environmental impact of Energy consumption is not considered. Energy can be modelled as a product flow in the system and its environmental flows considered.

- Other gas emissions from the various processes have been omitted. These could also have significant impacts on the environments in other categories.