



January 8th, 2020

Prof. Tiago Domingos (resp.)

[answer each of the five groups in separate sheets]

1) (4/20)

a) Consider the following unit processes:

Unit process 1 - Components A and B are inputs to produce a component C.

Unit process 2 - Component C and a new component D are the input for producing two components E and F.

Unit process 3 - Component E and a new component G are the inputs to produce component H.

i) Draw the flowchart corresponding to the integrated product system. Use boxes to represent unit processes and arrows to represent component flows. Include the letters representing each component in the flowchart.

Assume that components A, C, F, G and H are materials and B, D and E are electricity. Assume the following quantities:

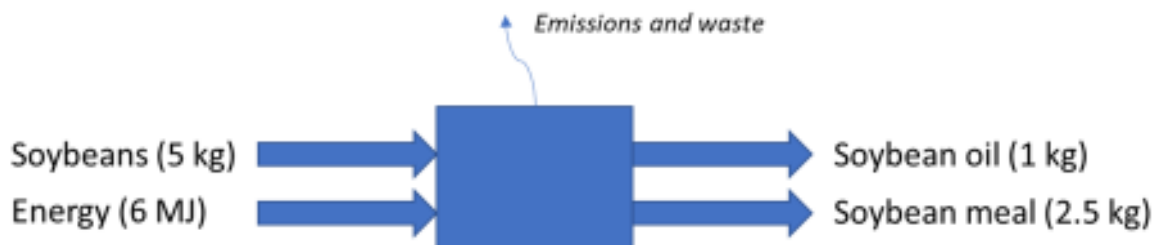
Producing 1 kg of C requires 1 kg of A and 0.5 kWh of B.

Producing 1 kWh of E and 0.5 kg of F requires 4 kg of C and 2 kWh of D.

Producing 1 kg of H requires 2 kWh of E and 0.5 kg of G.

ii) Assume that the reference flow for the product system is 1 kg of H. Quantify all flows in the flowchart in relation to this reference flow. Considering the entire product system, how much electricity is required for the delivery of 1 kg of H? Assume that the allocation factors of C and D to E and F are all 50%.

b) Consider the following multifunctional unit process:



i) Assume that, using economic allocation, the production of 4 kg of soybeans is allocated to soybean oil and that the unit price of the oil is 5 €/kg oil. What is the unit price of the soybean meal (€/kg meal)?

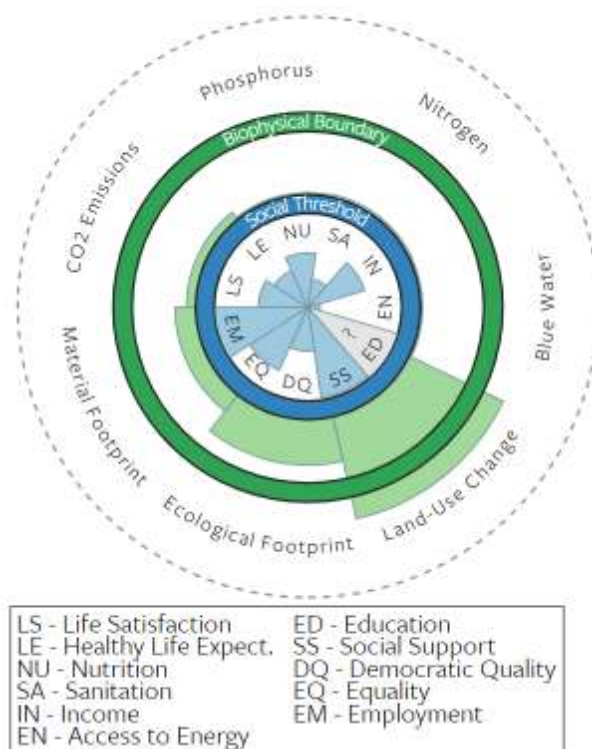
ii) Assume that soybean meal is only used as animal feed. Assume also that you were conducting a comparative life cycle assessment study to determine which had lower global warming potential: soybean meal or concentrate animal feed. Indicate and justify one option for the reference flow that you would use in this study.

2) (4/20)

Explain the thermodynamic underpinning of humanity's existence on Earth and how economic growth is related to humanity's impact on Earth (max. 300 words).

3) (4/20)

- a) Identify and describe briefly two of the main criticisms made to the ecological footprint.
- b) In the Planetary Boundaries framework and the Safe and Just Space there are two types of boundaries defined, the social boundaries and the environmental/planetary boundaries. Although both are called boundaries, they are essentially different. Can you explain the basic difference between these two types of boundaries?
- c) Below you have a Doughnut from the Planetary Boundaries of Uganda (<https://goodlife.leeds.ac.uk/countries/>).
 - i) List the positive aspects of Uganda, based on this figure.
 - ii) List the negative aspects of Uganda, based on this figure.

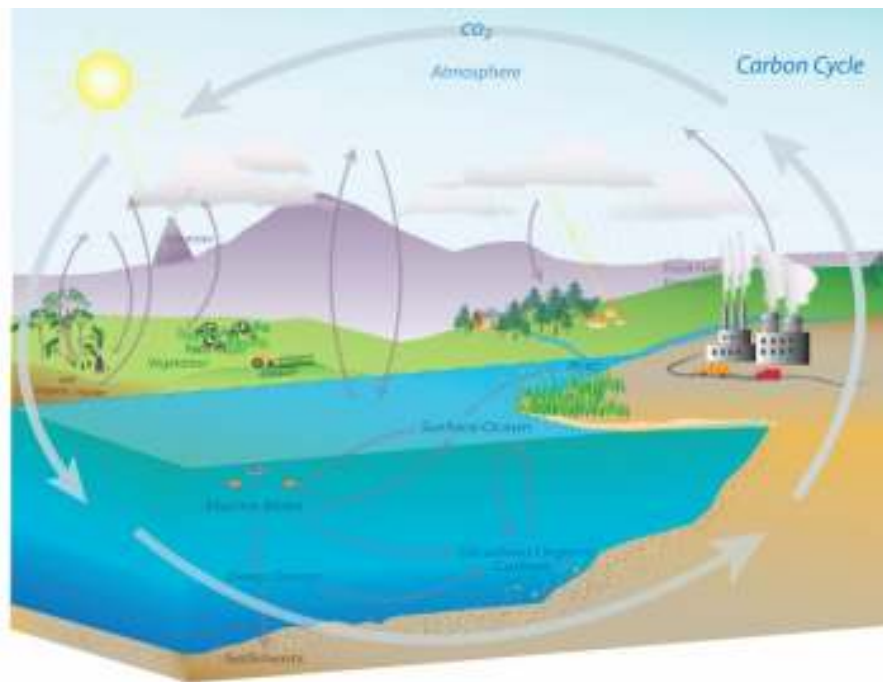


4) (4/20)

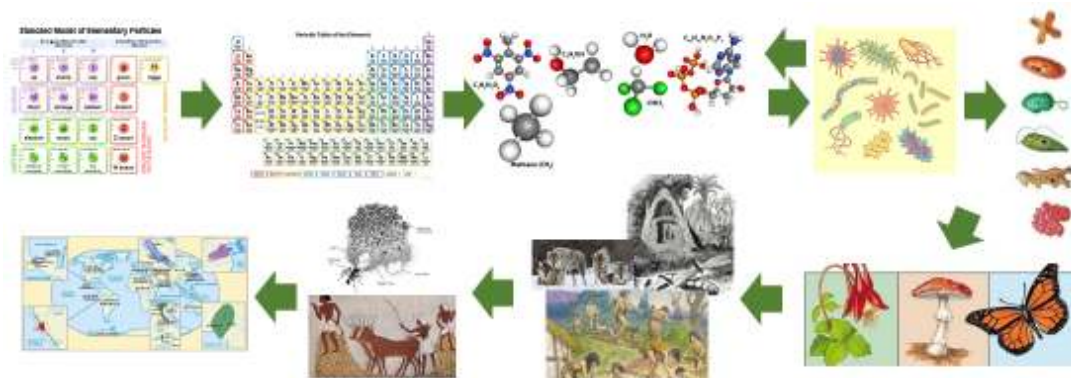
- a) "Large herbivores shape the structure and function of landscapes and environments in which they occur. They directly and indirectly affect other animal species throughout the food web, including their predators and smaller herbivores, and modify abiotic processes involving nutrient cycles, soil properties, fire regimes, and primary production." (Ripple et al. 2015).
 - i) Through their ecological role, large herbivores deliver several ecosystem services. Name two examples and justify their contribution to human well-being.
 - ii) Which of these indicators of biodiversity change – change in extinction risk or change in population abundance - would be more efficient to monitor the capacity of large herbivores in an ecosystem to provide regulating ecosystem services? Justify.
- b) Rather than seeing wildlife friendly farming [land sharing] and land sparing as mutually exclusive options for land management, it should be recognized that both offer different, and sometimes complementary advantages" (Fischer et al. 2008). In a few sentences, explain why protected areas may be necessary to conserve biodiversity in fine-grained, low-intensity farming landscapes.

5) (4/20)

Let us think of the carbon cycle with a Big History perspective.



Write a brief description of the history of this cycle based on the kits of building blocks (shown below) that summarize paths of the complexification we see in the universe. In particular, describe the importance of specific elements of these kits for the existence and dynamics of the carbon cycle (max. 300 words).



Notes

1. The exam has duration of 2.5 h.
2. All statements must be justified.
3. Wrong statements are valued negatively.
4. Synthesis, presentation and clarity are valued positively.