ENGG941 Tutorial 2 : Ecological Footprint

Use the following background data for your calculation in this tutorial. Note that these equivalent factors can change from location to location and as data accuracy is improved.

Table 1: Equivalence factors (From "Ecological footprint calculators: technical background paper" by EPA Victoria, 2005)

Component	Equivalence factor
Cropland	2.17
Forest	1.35
Permanent pasture	0.47
Built-up land	2.17
Energy land	1.84
Marine (fishing ground)	0.06

1 hectare = 10,000 m^2: 1 GWh = 1000 MWh = 1000,000 kWh: 1 GJ = 1000 MJ = 1 KJ

1. Australian consumption of bananas per person is 10 kg/year (fresh banana and banana derived products). The average banana yield is 12 tonne/ha.year and the current population of Australia is 21 million people. If only cropland footprint is considered, calculate the banana ecological footprint for Australia.

2. The American Wind Energy Association estimates that the embedded energy required for producing and maintaining a wind turbine is 27 MWh per GWh of energy produced per year. Assume that this embedded energy is from a mix of fossil fuel and that the footprint of this energy is 161 gha/GWh. The built-up land for wind power is 0.6 ha per GWh produced per year. Calculate the ecological footprint of wind power.

3. Robert lives 20 km from the University of Wollongong. He commutes to Uni 5 times a week to attend classes by his Holden Ute. Petrol consumption of his Ute is 9 litres per 100 km. According to the Australian Green House Office, the greenhouse emission factor for each litre of petrol is 2.36 kg of CO_2. It is estimated that an additional 15% of the fuel is used to manufacture and maintain a vehicle and an additional 30% is used for the construction and maintenance of road infrastructure. It is estimated that cars use 86% of the 258,000 ha of road space in Australia (the rest is shared by buses, motorbikes and bicycles). In total, all Australians travel a distance of 72.4 billion km by car. The uptake of carbon by Australian forest is 1.3 tonne/ha. Calculate the ecological footprint for Robert car travel to and from Uni?
4. On average, each year Robert consumes 48 kg of fruit and vegetable, 36 kg of bread, 48 kg of rice and cereals, 72 kg of milk, 36 kg of cheese and butter, 24 kg of white meat (pork, poultry, etc), and 24 kg of red meat (beef, lamb, etc), 12 kg of fish, 12 kg of wine, and 1 kg of tea and coffee. The following table provide unscaled footprint data for each component. Calculate the ecological footprint of Robert diet (food only).

5.

Categories	Energy (m^2/kg)	Cropland (m^2/kg)	Pasture land (m^2/kg)	Sea (m^2/kg)
Fruit & vegetable	0.5	0.6		
Bread	2.0	2.4		
Rice & cereals	1.0	3.6		
Milk	1.0		20.0	
Cheese & butter	6.5		200.0	
White meat	8.0	22		
Red meat	8.0		300	
Fish				550
Wine	0.4	1.0		
Tea & coffee	7.5	17.7		

Note: Data extracted from *Chambers, N., Simmons, C., and Wackernagel, M. 2000. Sharing nature's interest: ecological footprints as an indicator of sustainability. London: Earthscan.*

6. Data provided by a utilities company show that the distribution 1 ML of water to end users in a typical city setting will result in the emission of approximately 370 kg of CO_2. The current average water consumption in Wollongong is 80 ML per day. The uptake of carbon by Australian forest is 1.3 tonne/ha. The atomic mass of C and O are 12 and 16 g/mole, respectively. Calculate the ecological footprint of water distribution for Wollongong?

   Drinking water supply to Wollongong is from Avon Dam. The lake area is 10.5 km^2 and the catchment of Avon Dam is 142 km^2. How does your result compare to the physical catchment required to supply drinking water to Wollongong?

7. The World Energy Council reports that processing virgin paper requires 25 GJ per tonne. If this energy is from a standard mix of fossil fuel, CO2 emission is 0.2 tonne of CO_2/GJ. In addition, the average energy required for the transportation of virgin paper is 69.3 kg CO_2/tonne. Assume that 1 ha of forest can produce 2.6 tonne of wood. In general, it takes 1.8 tonnes of wood to produce 1 tonne of virgin paper. A typical newspaper weighs 200 g.
   a. Calculate the ecological footprint of a newspaper?
   b. Recycled paper uses only 30% of the energy required for virgin paper production and transportation. Calculate ecological footprint of a newspaper made of 100% recycled paper.