

‘global hectares’. The details are provided in their paper and include the following six human activities that require mutually exclusive productive land:

1. Growing crops for food, animal feed, fiber, oil and rubber requires the most productive land of all. There are 1.5 billion ha (1.3 cultivated, 0.2 unharvested) with an equivalent productive factor of 2.1 gha/ha.
2. Grazing animals for meat, hides, wool, and milk requires pasture land. There are 3.5 b ha with an equivalence factor of 0.5. The metabolic needs for 5 major classes of livestock are estimated and the needs met from feed and crop residues are subtracted.
3. Harvesting timber for wood, fiber, and fuel requires natural forest and plantations. There are 3.8 b ha with an equivalence factor of 1.3. Production estimates are made for a number of kinds of forests
4. Marine and freshwater fishing requires productive fishing grounds. Coastal waters provide 95% of marine catch (2.0 b ha and inland waters add 0.3 b ha) with an overall equivalent productive factor of 0.4.
5. Accommodating infrastructure for housing, transportation, industrial production, and hydroelectric power requires built-up lands. This is the least well documented but estimated to be 0.3 b ha with an equivalent productive factor of 2.2.
6. Burning fossil fuels requires land to sequester enough emissions to avoid an increase to atmospheric CO<sub>2</sub>. Oceans handle about 35% , thus forests must sequester about 65%. Sequestering by forests is a weighted average for 26 forests biomes. The equivalence factor is 1.3.

To aggregate the impact components, they adjust the land and sea areas according to their bioproductivities and multiply each land use category by an equivalence factor. These factors scale each area in proportion to its maximum potential yield and the global average each year is assigned a value of 1. In 1997 the global average human demand was 2.3 global hectares of productive land equivalent per person. The highest was for the US with 9.7, the UK used 5.4 and Germany used 4.7 global hectares per person. The average existing global biocapacity in 1997 was 1.9 global hectares per person (Wackernagel *et al*, 2002).

There has to be equilibrium (balance) between the resources used and the wastes produced; if they are not balanced the global system is not operating in a sustainable manner. Their current estimates indicate that our global community started to overshoot the planet’s available resources sometime in 1980.

Our collective economies, societies, and resource uses have all been experiencing exponential growth since the Industrial Revolution, pushing them ever closer to critical thresholds. At the present time we are using 20% more resources than are globally available on a sustainable basis.