Mass balance – also known as a material balance – is an accounting of material entering and leaving a system. Fundamental to the balance is the conservation of mass principle, which states that matter can not be created nor destroyed. The term budget or balance is determined by identifying major inputs and outputs to the Earth–atmospheric system. Climatologists and hydrologists have resolved the quantities involved in the flows of energy and mass and these are summarized at the global scale in Tables 38 and 39 – cubic meters for water and energy in watts per metre squared. Local scale energy and mass budgets can be established for Earth phenomena, such as lakes, ice sheets, glaciers, cities, land cover units and biological systems.

See also: ENERGY FLUX, HYDROLOGICAL CYCLE

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ENVIRONMENTAL CHANGE

Environmental change includes those changes that occur naturally in response to forcing factors operating over a range of timescales, those changes consequent upon human activity including those recent changes often described as global climate change. The period since the end of the major ice age known as the Pleistocene has seen the greatest alteration of the Earth's surface by humans. This has been most obvious on the land surfaces but scientific measurements have made clear that the oceans have also been changed, for example, by the addition of pollutants and by the inroads on whale and fish populations. The findings of palaeoecology, historical ecology and environmental history have given great depth to this story of the last 10,000 years, making possible some general findings as well as much local and regional detail.

In order to periodize that long stretch of time, it is convenient to think of human cultures as having been dominantly of the hunter-gather type until about 8000 BC, with replacement of these people by pre-industrial agriculture until c. 1750 AD. The 'industrial revolution' then penetrates to most parts of the planet (including the atmosphere) and is still present except that many of the human activities with environmental linkages accelerate after about 1950. Hunter-gatherers were once thought to be 'children of nature' and to have virtually no ecological effects. This view has been greatly challenged, especially by the realization that many such people had control of fire at the landscape scale and that many ecosystems could be burned by people possessing intimate knowledge of them: Australia, North America and sub-Saharan Africa are good examples.

The role of agriculture in altering both ecosystems and genotypes is obvious in areas such as the great irrigated areas of the world, both those of antiquity (e.g., Mesopotamia, Nile and Indus) but research shows that less intensive systems such as shifting agriculture and pastoralism also exert lasting influence upon ecosystems even if the human populations move on. Once coal- and oil-powered machinery becomes available, change is certain: the colonial impress upon many ecosystems (especially but not exclusively in the tropics) has been enormous, especially where a plantation economy was introduced, for example, for sugar in the West Indies or rubber in Malaya. Steam power meant that new technologies and new ideas were disseminated by the colonists to even very remote places. The process of population growth meant that even in an environment-conscious age such as the post-1950 period, the impacts have been enormous: the development of the tropics has accelerated and the emissions of has undergone an exponential increase. The new result is that few if any places on Earth can be said to be totally 'natural': at the very least there is likely to be some chemical which is widely disseminated through the oceans (as when DDT turned up in the body fat of penguins), or there is fallout from the atmosphere, as when lead from motor fuels accumulated in the Greenland ice-sheet or radioactive fallout from weapons resting contaminated the tundras of the high Arctic. Once the oceans and the atmosphere are involved then any adverse impacts are likely to be shared by everybody: the nature of the currents of the one and the air mass movements of the other ensure that effects are spread widely across the globe.

See also: CULTURES, DEFORESTATION, GREENHOUSE EFFECT, PALAEOECOLOGY, POPULATION GROWTH

Further reading

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