Figure 1: The Linear Approach to Food

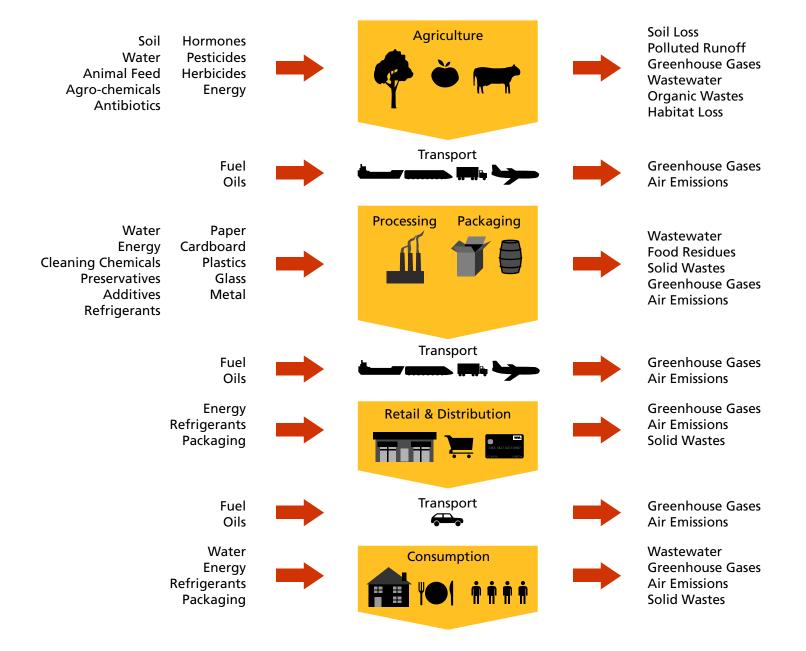


Figure 2: Vicious Cycles: The Hypothesis

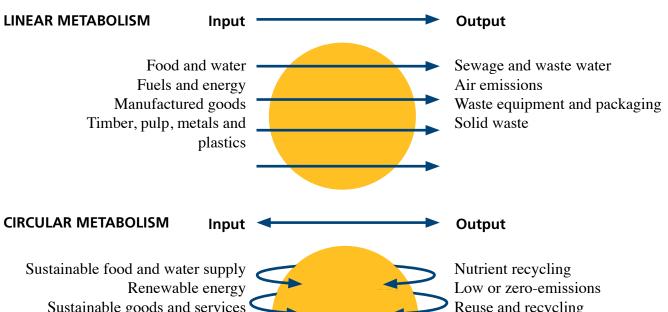
- 4 Negative environmental, social and economic impacts are a direct result of the physical and organisational structure of modern industrial food, energy and water and sanitation systems. These systems have a linear structure: it is assumed that at one end there is an unlimited supply of energy and raw materials (which there isn't), while at the other the environment has an infinite capacity to absorb pollution and waste (which it can't).
- 3 If these warning signs are ignored and the provision of basic needs remains fossil-fuel intensive and continues to produce large amounts of greenhouse gas emissions, the security of food, water and energy supplies will increasingly be in danger as crises relating to these basic needs become more widespread, severe and prolonged during the next few years.

- **5** The inevitable result is resource shortages on the one hand and solid waste, climate change and air pollution problems on the other
- 1 In recent years simultaneous crises relating to food prices, energy costs, climate change, biodiversity loss, the financial system and water shortages have made lives and livelihoods more difficult in all countries
- 2 It is crucial that we understand the root causes of these problems, the links between them and accept that these events need to be seen as a wake up call

6 These impacts and risks can be reduced significantly if there is a transformation from industrialised to sustainable food, energy and water systems that are based on a different set of concepts and values. 7 These concepts include ecological architecture and design, eco-communities, permaculture, agro-ecology, the carbohydrate economy, proximity principle, food sovereignty and cooperative structures. The values that are of importance include ecoliteracy, equity, limits, permanence and sustainability (rather than sustainable development).

- 9 We identify and where possible quantify the benefits associated with circular systems in several case studies. These benefits include: large reductions in fossil fuel use and greenhouse gases; increased food, water and energy security; increased employment; reduced farm and household costs and increased income; local environmental improvements; and strong, resilient and self-reliant communities.
- **8** Key targets such as minimising greenhouse gas emissions and fossil fuel use, increased food, energy and water security and improved quality of life can be achieved through a shift from linear to sustainable circular systems.

Figure 3. Settlements with a linear and a circular metabolism



Source: adapted from Girardet, H (1996) The Gaia Atlas of Cities: New Directions for Sustainable Urban Living. Gaia Books Ltd., London

Sustainable goods and services Timber and pulp from sustainable fibres Reuse and recycling Composting and Biogas Systems

Figure 4. A composting and biogas system to provide food; household and farm energy needs; fertiliser for crops and trees; and construction materials

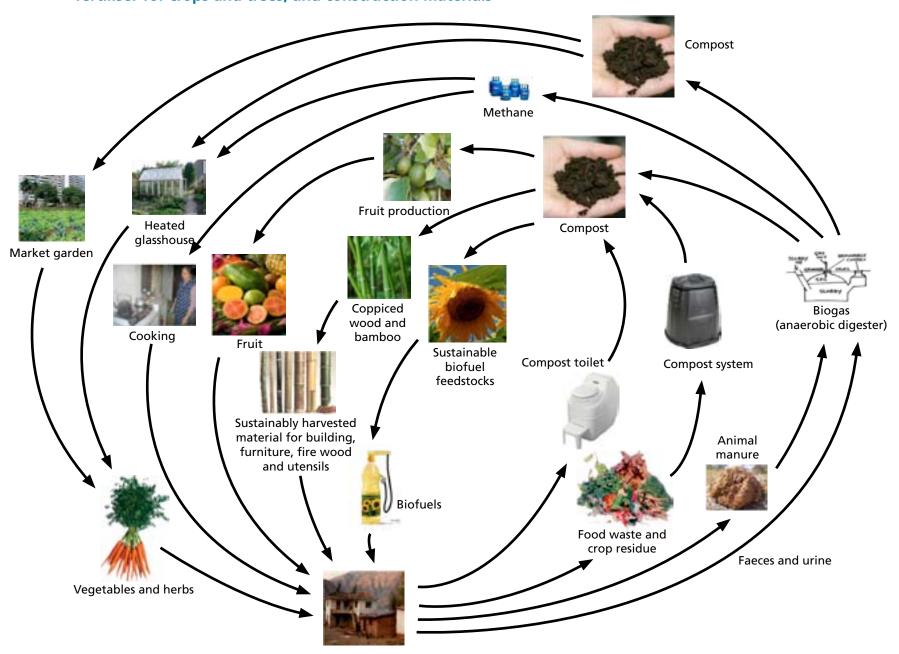


Figure 5. Sustainable water systems, greening the landscape and the production and processing of natural fibres and honey in Ecuador

Notes: Severe erosion caused by over-grazing and the clearance of vegetation to produce charcoal makes livelihoods and food production increasingly difficult. These photographs are from projects on the Ilalo mountain area near Quito in Ecuador. To harvest rainwater, trenches are dug across contours in the landscape (2) as well as ditches to collect runoff from roads (3). These are linked in a network of trenches and storage pools (4). This, together with rainwater collected from roofs (5) provides water to irrigate the trees, plants and grasses that have been reintroduced (6).

Alpaca and llama are now able to graze (8) and there is sufficient water for herb, flower and vegetable beds (7). The animal manure (10) together with green manures, mulch, compost and biogas fertilizer improves soil structure, fertility and water-retention. Alpaca and llama hair comes in many colours, but can also be dyed using

natural plant dyes (13). The fibres are spun (15) and woven (16) into clothes and other fabrics (17). Bees (18) can also be introduced to produce honey and beeswax (19) and to pollinate plants and fruit trees.

In many places rainwater collection, storage and use can be totally based on gravity - where water flows into a series of pools then to areas requiring irrigation. If this is not possible, solar, wind or hand pumps are used. Water can be channelled to where it is required, connected to drip irrigation and sprinkler systems and piped under roads and paths. Settlement tanks are used to reduce blockages and trap valuable nutrients. These are cleared as required and the sediment used as compost on nearby beds.

