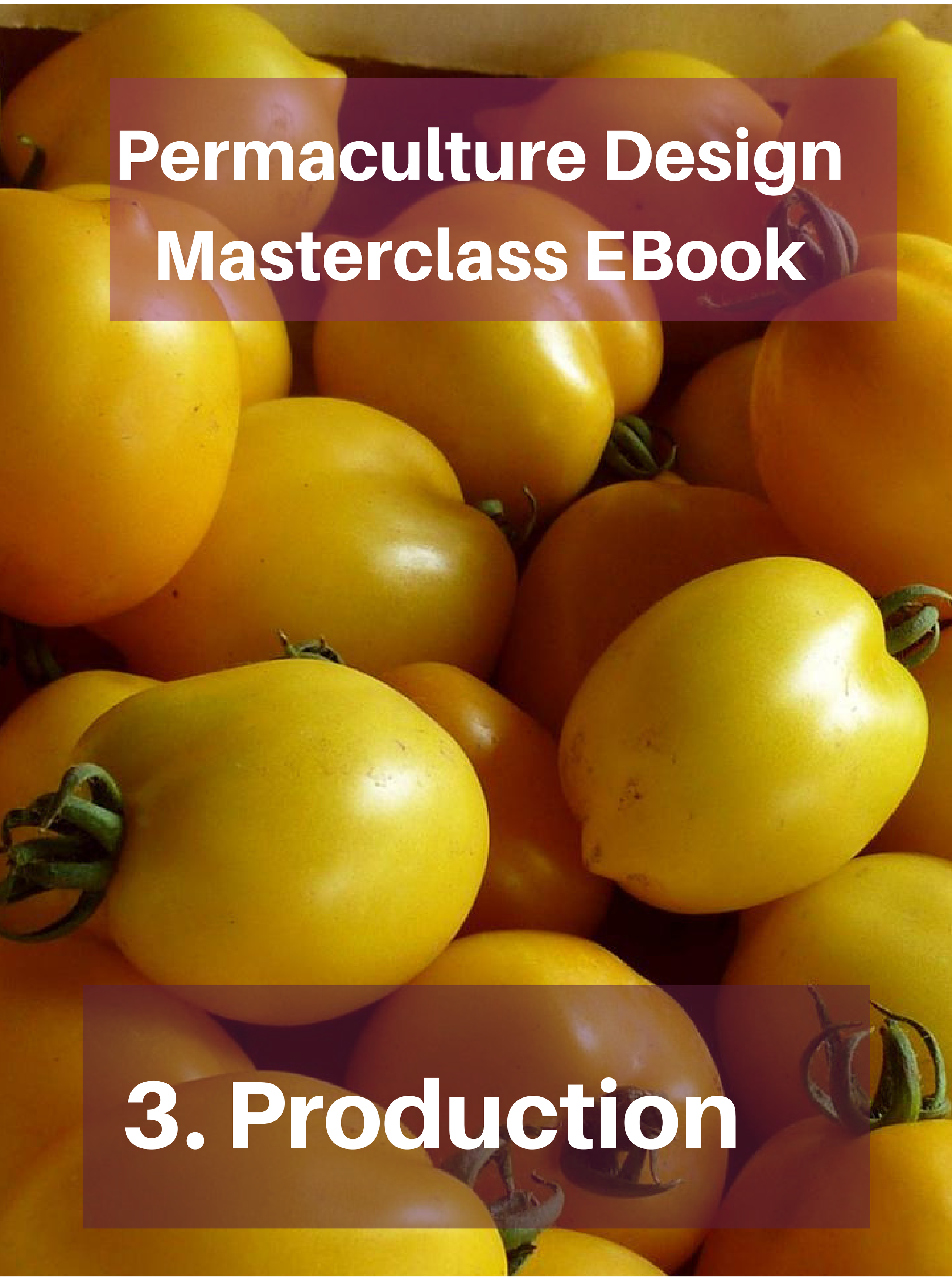
Agrifutures

Permaculture Design Masterclass EBook



3. Production

Agro-Ecology

Natural ecosystems have the ability to create a diverse and productive range of resources on a sustainable basis without any input of resources from people based on the productivity of balanced biological interactions.

If we manage these systems we can alter the productivity by making subtle changes to the composition of species or inputs into that system to swing the productivity of that ecosystem to resources of economic benefit to farming.

It is upon this basis that we can create truly sustainable organic farming systems. This creates a sustainable production through the healthy functioning of a farming altered ecosystem that replicate the form and function of a similar natural ecosystem.

A healthy and sustainable production system is achieved on an organic farm by incorporating a functional diversity within the production system modelled on that seen in similar natural systems. For a New Zealand grazing system the natural reference is that of a grassland savannah and understanding the healthy function of this ecosystem and the role grazers have in maintaining its sustainable fertility is an important consideration of organic farm design.

How Ecosystems Function

The organisation within an ecosystem is centred on producers that are able to convert carbon dioxide and water to sugars through photosynthesis and use these sugars in association with other nutrients absorbed through their roots to produce a complex array of biological molecules. It is upon theses producers that the food web of an ecosystem is based with the energy captured by the producers in the form of biological molecules passing onto those animals that consume them.

At a core functional level, ecosystems normally contain primary producers able to harvest energy from sunlight by photosynthesis and to use the energy to turn carbon dioxide with other inorganic chemicals in the organic building blocks of life. The consumers feed upon this captured energy, while decomposers not only feed on the energy, but also break up the organic matter into the inorganic constituents, for them to be used again by the producers.

Those interactions among the producers and organisms which consume and decompose are called trophic interactions, composed of trophic levels in the energy pyramid, and the most energy and mass are in the primary producers, at the base, while the higher levels of the pyramid, beginning with the primary consumers that feed on primary producers, the secondary consumers which feed on these, and so forth.

Together, the processes of matter cycling and energy transfer are essential in finding out ecosystem function and structure and defining the kinds of interactions between the environment and its organisms. It should also be noted most ecosystems have a wide array of species.

Biological Diversity and Resilience

Biological systems are organised as complex food webs based upon the ability of producers to photosynthesize and make sugars that can be added to other nutrients absorbed to make complex carbohydrates, proteins and fats. These that act as a food source for consumers by browsing of herbivores and in turn their consumption by predators.

In this way the energy first captured by the producers is transferred between many animals before being lost from that system and the nutrients returned.

Food webs within an ecosystem recycle matter and nutrients between living things and maximise the use of energy flowing through that ecosystem by transferring it between as many species as possible.

The functional diversity pf ecosystems make them resilient to changes, including pest outbreaks and impacts from one species becomes over populated. This is due to the moderating impact of the species interactions keeping processes in check and balance within an ecosystem. The more complex an ecosystem becomes the greater its resiliency.

Carbon Cycle

Carbon is the backbone of life on Earth. We are made of carbon, we eat carbon, and our civilizations—our economies, our homes, our means of transport—are built on carbon. We need carbon, but that need is also entwined with one of the most serious problems facing us today: global climate change. Carbon is both the foundation of all life on Earth, and the source of the majority of energy consumed by human civilization. Forged in the heart of aging stars, carbon is the fourth most abundant element in the Universe. Most of Earth's carbon—about 65,500 billion metric tons—is stored in rocks. The rest is in the ocean, atmosphere, plants, soil, and fossil fuels.

Carbon flows between the spheres of Earth in an exchange called the carbon cycle. Any change in the cycle that shifts carbon out of one reservoir puts more carbon in the other reservoirs. Changes that put carbon gases into the atmosphere result in warmer temperatures on Earth. Over the long term, the carbon cycle seems to maintain a balance that prevents all of Earth's carbon from entering the atmosphere (as is the case on Venus) or from being stored entirely in rocks. This balance helps keep Earth's temperature relatively stable, like a thermostat.

When we clear forests, we remove a dense growth of plants that had stored carbon in wood, stems, and leaves—biomass. By removing a forest, we eliminate plants that would otherwise take carbon out of the atmosphere as they grow. We tend to replace the dense growth with crops or pasture, which store less carbon. We also expose soil that vents carbon from decayed plant matter into the atmosphere. Humans are currently emitting just under a billion tons of carbon into the atmosphere per year through land use changes.

Regenerative Farming

Within a permaculture system the aim is to create functional diversity within a system and interconnect different functional elements.

Within a grazing system this comes down to looking after the health of the pastures that are grazed through dynamic movement of the livestock and allowing pasture plants to regrow to maturity before being grazed again, integration of tree crops and where necessary establishing tree crops on swales or extending production on dry ridges with keyline ploughing.

The permaculture designer develops a toolbox of is then presented with a diverse toolbox of options for selection ofof grazers, pasture grasses and herbs and tree crops to pattern systems in harmony with the landscape.

A re-consideration of animal numbers and species composition on mixed and cropping farms can also help in a range of ways to further the closed system. Cross-grazing of stock has been shown to be very effective in parasite and general pasture management; the benefits and limitations of different soil types and topography can be worked with more effectively. Crop residues may well be utilised by cattle. You look to create a healthy environment and you look at your farm in the context of the whole ecosystem.