Sustainability

A Biological Perspective

Encouraging students to engage in the challenges and complexity of sustainability, this text considers not only the theories underlying sustainability, but, more importantly, how theories are translated into practice and the difficulties of achieving this in the world in which we live. This pragmatic focus gives students a greater understanding of the practice of sustainability and highlights the challenges involved. Models and theories are illustrated throughout with real-world examples to help students move away from the abstract and connect with genuine issues.

The text begins by focusing on sustainable production and consumption and how they are related. The role of tools such as modelling and sustainability indicators are explored, and extended into the fields of stakeholder participation, livelihoods and evidence-based policy. The final chapter explores the interconnections between apparently disparate subjects, including ecology, environmental science and economics, and the importance of taking an interdisciplinary perspective.

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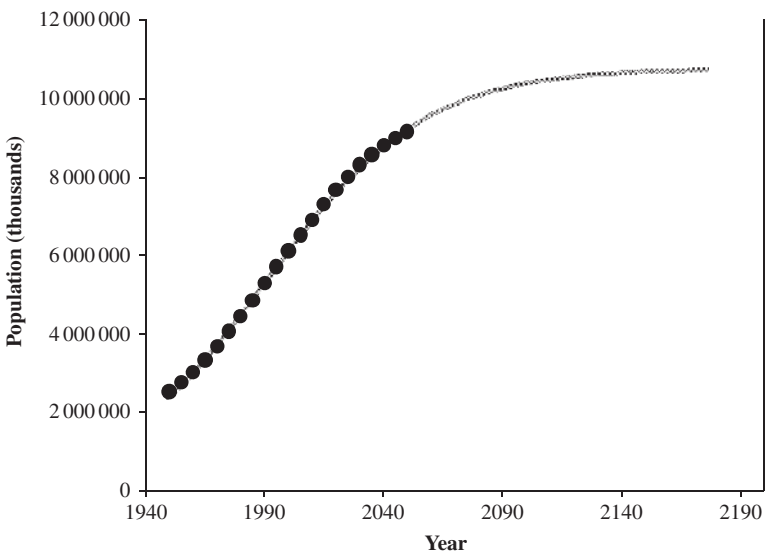
Preface

At the time of writing this book, towards the end of the first decade of the twenty-first century, the human race is facing many challenges. It can almost be said that we are facing a 'Perfect Storm'. On the one hand we have a growing population. The United Nations estimates that global populations will continue to increase, as shown in the following graph.



Latest global population trend as predicted by the United Nations (black dots) and a fitted logistic curve. (Source of data: esa.un.org/unpp.)

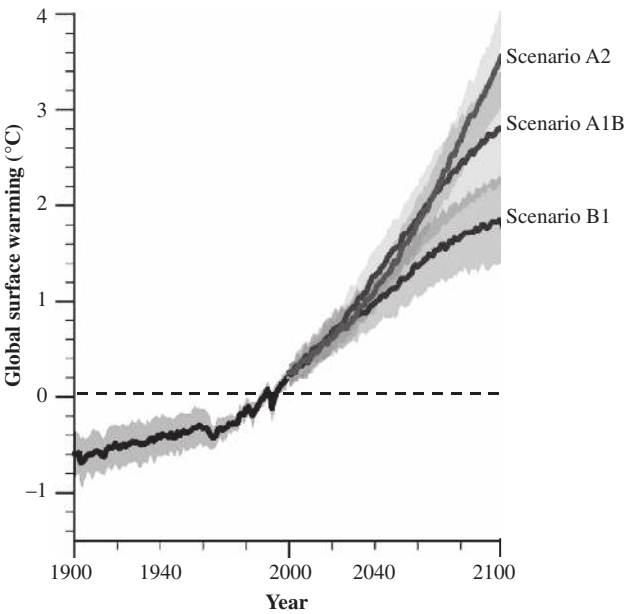
There is a levelling of population around 11 billion towards the turn of the twenty-first century, but not enough data as yet to suggest

whether this will eventually decline. Hence the fitting of a logistic curve which delivers a levelling rather than an eventual decline. More on that form of population curve later in the book, but what we do know is that those people need food and water to live. Yet the UN is concerned about global increases in food prices and in 2009 it has been estimated that the world's hungry have surpassed one billion, with 265 million of them in sub-Saharan Africa, an increase of almost 12% relative to 2008 (www.un.org/issues/food/taskforce). If we are struggling now then how will it be possible to feed the population 30 years from now? With water supply the situation is little better. The World Water Council estimates that 'water stress' (the balance between withdrawal and replenishment) is 'very high' in many parts of the world and we already face a water crisis and an increase in tensions as populations compete for the resource (www.worldwatercouncil.org). This is not only a matter of water supply for human consumption and sanitation. It has been estimated that it takes the following 'water footprints' to produce these goods:

- *16 000 litres to produce 1 kilo of beef*
- *140 litres to produce 1 cup of coffee*
- *120 litres to produce 1 glass of wine*
- *23 000 litres to produce a leather bag*
- *900 litres to produce 1 kilo of corn*
- *3000 litres to produce 1 kilo of rice*
- *1000 litres to produce 1 litre of milk*
- *1350 litres to produce 1 kilo of wheat*

(Water at a crossroads, Dialogue and Debate at the Fifth World Water Forum, Istanbul 2009; available at www.worldwatercouncil.org)

If the increasing demands for food and water while we are struggling to meet these demands now is not enough to worry about, we also have to put human-induced climate change into the mix. The following graph has been based on Figure 10–4 in Chapter 10 of the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Meehl *et al.*, 2007). It shows the predicted trends in global surface warming (change over average) until the year 2100. The three scenarios (A1B, A2 and B1) are based upon assumptions as to how the human race will respond to the challenge in the coming years.



The trends are ominous. All three scenarios suggest that global temperatures will steadily increase. The 'fuzziness' around each of the lines is intended to provide a range of estimates for each year. The A2 scenario provides the 'worse case' of the three in the graph, and is characterised by a fragmented world of independently acting, self-reliant nations and increasing population. Scenario A1B is that of a more integrated world, with a balanced emphasis on a range of energy sources rather than a continued reliance on fossil fuels. It also assumes that the population will reach 9 billion in 2050 and then decline rather than remain stable, as suggested by the logistic curve presented earlier. Scenario B1 is the 'best case' of the three in the graph and assumes an integrated and ecologically friendly world with the same population trend as A1B (i.e. eventual decline), but a major emphasis on promotion of cleaner technologies and global, rather than regional, solutions to global warming. But even here we will still witness an increase in global temperature over the next 100 years. Thus I'm afraid the bad news is that even if we do act now we are still faced with not only limiting the damage we do for future generations, but having to cope with the damage that has already been wrought. No one can say with any certainty what the repercussions will be in different places of the globe, but there is no doubt that changes will occur, including sea-level rise (resulting in the salinisation of soil),

changes in agricultural patterns and redistribution of fresh-water sources.

Hence the phrase 'Perfect Storm'; an increasing population in parallel with an increase in global temperatures and the need to provide food and water for all these people when we are struggling to do that now. As a result there has never been a greater need for us to understand the changes we are bringing about and how we can best cope with them. That is the Holy Grail of sustainable development.

But while the above is often the way in which the importance of sustainable development (or sustainability) is portrayed as a means of allowing future generations to have access to adequate resources, we do have to bear in mind the positives. Food and water are vital for life, but humans also speak of the quality of that life; the need for a reasonable income, education, health care and recreation. We all want a long and healthy life and we all want to enjoy that life. Sustainability is about making these things a reality and thus inevitably we have to take a broad view spanning the social sciences and economics. Unfortunately, sustainability can have a bad press, as it is all too often equated with the rhetoric of doom and gloom, as I've used at the start of the Preface, and to some extent this is understandable, as it has to reflect a warning of the dilemmas we face, but this can go hand in hand with a feeling of joylessness and severity. It seems that sustainability is only associated with bad news and preaching about what we can't do rather than what we can. I hope this book, while not having all the answers, can at least map the territory and help point to a positive way forward.

The aim of this book is to help make the often messy and imprecise visions of sustainability accessible to natural scientists. Sustainability is more than just science, but science, and in particular biology, does nonetheless have a vital role to play. Thus the intended readership for the book comprises undergraduate students in biology, particularly ecology, environmental science, natural resource management (e.g. agriculture and forestry) and also the physical sciences (particularly chemistry and engineering). While the focus is upon a biological perspective towards sustainability, it is simply not possible to exclude social and economic concerns, and sustainability is about the overlap between all these perspectives. Thus, while the book is not intended primarily for students of the social sciences, they may find it useful as an introductory supplement alongside other texts. Also, in line with the very ethos of sustainability, the book takes a global perspective, drawing upon examples from many

countries – developed and developing. Sustainability is not about 'us and them' but 'all'.

If the book encourages young scientists at the start of their careers to partake in the human race's striving for sustainability, then I will have deemed it to be a success. We will sorely need them.

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