1 Introduction

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1.1 Introduction

Sustainability is defined as ‘to endure’, but this definition does not properly capture the sense in which it is used globally to address how human activity impacts on societies, economics and the environment. The terms ‘sustainability’ and ‘sustainable development’ have increasingly appeared ‘on the radar’ of many industries (Leadbitter, 2002). They were first coined by the Brundtland Commission (formally the World Commission on Environmental and Development of the United Nations) in 1983. The Brundtland Commission defined “Sustainable Development” as the ‘social and economic advance to assure human beings a healthy and productive life, but one that did not compromise the ability of future generations to meet their own needs’. When related to food processing, this concept suggests that the process should:

i. be based on raw materials that can be produced on an ongoing basis without undue environmental, social or economic harm;
ii. not be reliant, in the long-term, on finite energy sources; and
iii. produce products that will not adversely affect human health.

Maintaining a sustainable food processing chain is now more important to food producers than ever before. With global inequalities becoming more
pronounced, ingredient costs climbing, and global change becoming a major political issue, food producers must now take the opportunity to address environmental concerns, social responsibility and economic viability when shaping their food processing techniques for the future. However, it must also be said that food processing faces numerous challenges in changing economic and environmental conditions. Therefore, new ways of meeting the needs of the present without comprising future viability have to be embraced by the food industry.

The achievement of rational energy use, sufficient food production, avoiding needless food waste and appropriate management of necessary environmental impacts underpins well-being, health and longevity for human populations and the world’s environment. There is perhaps a trend emerging in the agrifood sector to try to simplify the ‘sustainability question’. Indicators such as carbon footprint, energy audit and nutritional indices are variously used to support claims of sustainability, but these mono-dimensional methods cannot really address the complexity inherent in sustainability. An indicator of the sustainability of food systems such as the ratio of energy outputs in terms of the energy content of a food product (calories) to the energy input (energy required in food production and processing), with the latter being all the energy consumed in producing, processing, packaging and distribution, might be useful, but ignores the question of the value of the calories provided (and even whether these should be expressed on a raw or cooked basis). It also ignores the contribution of renewable energy to the energy inputs. The quantification of this metric might be regarded as essential for food producers looking to make a positive economic and environmental impact in the future, especially given that the food industry is one of the world’s largest users of energy, and considering this one index will only address one dimension of sustainability. Greenhouse gas emissions, which have increased remarkably in recent decades have resulted in global warming, perhaps the most serious problem that humankind faces today. Food production, preservation and distribution contribute greatly to total global greenhouse gas emission. These impacts are commonly described using carbon footprint, but such a measure provides no indication of the social or economic dimensions of sustainability, or even non-correlated environmental impacts. It is important that the food industry does not just focus on simple indicators of sustainability that are relatively easy to calculate, have appeal to governments and the public, but do not properly address the many dimensions of sustainability. The threat of limited food security has been highlighted globally by the coincidence of environmental degradation, economic growth, population increase and climate change. All these factors have impacted on the world food system (Headey and Fan, 2008). Questions about sustainability and corporate social responsibility are being seriously considered and implemented in many countries around the globe. Given that these highlighted concerns cause a considerable challenge
for food processors and technologists, there is a requirement for detailed industrially relevant information that addresses these challenges.

1.2 Key drivers for sustainable food processing

1.2.1 Food security

Food production and processing is essential to the global economy and to the health and welfare of its citizens. The core objective of global food security is to match the supply of food with the nutritional demand of the world’s burgeoning population (to reach 9 billion by 2050) in the most sustainable way possible (i.e. in a way that can continue for centuries). Through technological progression in food storage and transportation it has become possible to ensure that reliable food supply chains are operational all over the world. These food chains reflect a balance between the commodity value of food and the human right to nutrition. Unless these sometimes-contradictory pressures can be balanced, sustainable food supply and food security cannot be achieved.

1.2.2 Population health

It is difficult to envisage how to link processing to sustainability and then to health, but this is going to be a key driver in the future. The economic and social cost of supplying excessive amounts of processed food to limited sections of the global population will perhaps ultimately be the main driver of the transformation of our current food chains from being predominantly market driven (in terms of consumer spending and a desire for cheap food) to being sustainability driven, where the cost to national economies of providing the inappropriately processed food to a society is regarded as unacceptable, and we transition to eating geographically appropriate, higher quality foods. Societal demand for safe, traceable food also has the potential to impact on the types of food processing and ingredient redistribution that occurs in the food chain.

1.2.3 Social justice

The welfare and rights of humans (and animals) at all stages of the food chain (production, processing, distribution, consumption and waste management) are usually not thought of in terms of sustainability. Demand for large volumes of low cost, processed foods has implications for those supplying the raw materials and those consuming the products that emerge. In this book we will not consider these issues in detail, but as governments increasingly seek value for the farmer (in some parts of the world) and
acceptable health costs, social justice will become an increasingly important driver of food system sustainability.

1.2.4 Global change

While it is generally known that agricultural production is a significant greenhouse gas emitter it must also be recognized that food processing and the distribution sector contribute to emissions, via energy used in processing, transportation and also the emission from food waste dumped in landfills. As well as climate change, the knock on effect of change in water availability is also a significant driver for sustainable food processing. Changing global climates means that more innovation is required in cooling and refrigeration technologies to extend the shelf-life of perishable foods without using too much energy and more efficient water use. The potential impact of global change on water availability will present challenges to the food processing industries, particularly of developing countries, where natural drying methods are still employed.

1.2.5 Resource depletion

There are many resource depletion impacts arising from food consumption, some of which, while not directly caused by processing, are driven by processing because of demand for ingredients with specific characteristics on a year round basis. Within the whole food system depletions of water, soil, nutrients, air and water quality and energy are all quite obvious. Food processing, and the demand for processed food is one of the key drivers of resource redistribution around the globe in an agrifood context. The long-term sustainability of systems that extract soil nutrients, or cause erosion in one country, in order to provide processed food in another has to be questioned. While this book will not focus on these issues, it will address some of the tools available to evaluate them.

1.2.6 Environmental impact

For many consumers the impact of processing on the environment is not clear. Tools such as Life Cycle Assessment allow specialists to understand the interactions, and simplified outputs such as carbon footprint can be used to inform consumers. Society, and in many cases scientists are at the very early stages of understanding the real impacts (both direct, such as discharges to air, water and soil; and indirect, such as transport energy emissions) of food processing on the environment. However, as the environment is a key stakeholder in the sustainability concept (along with social, economic and productivity issues) it is clear that unwanted impacts need to
be minimised and reduced. The geographically distributed nature of modern food chains, with processing at their heart, mean that consumers are not always affected by the choices they make, but others elsewhere in the world are.

1.2.7 Eco-labelling

There are now hundreds of eco-labels in use around the world. These range from certification of the type of production (e.g. organic) through to certified origin or carbon footprint. At present few consumers seem to really understand what the labels mean and how they should be used. Retailers also seem to be struggling with how to use them, but it is clear that they are here to stay and will become a key driver of sustainability in the future. It remains to be seen how this impacts food processing.

1.3 Book objective

The overarching objective of this book on Sustainable Food Processing is to provide information to scientists and the industry that will assist in understanding and finding ways of increasing sustainability in the food industry, particularly that part focused on added value processing. Future developments must ensure more efficient food production, processing and distribution alongside responsible consumption to limit intake to ‘fair share’, to reduce waste and to mitigate future environmental and socio-economic concerns. With the estimated increase in food supply needing to rise by 70% by 2050 there will be more innovations in primary agriculture, food processing, supply chain infrastructure, public health and education. The focus has to be on meeting the demands of the present by not undermining our ability to produce more in the future. This requires attention to the current adverse environmental, social and economic impacts of food production, processing and supply through the exploitation of science and technology and a recognition that food processing, while founded in science, technology and engineering, has an impact on the environment and on society.

1.4 Book structure

The book is divided into four sections. Section One deals with principles and assessment of sustainability in the context of food processing. Section Two summarizes sustainability in various food processing applications within the food industry, Section Three considers sustainability in food manufacturing operations that are vital in food production systems and finally Section Four addresses sustainable food distribution and consumption.
1.4.1 Section One: Principles and assessment of sustainability

The concepts of sustainability, life cycle assessment and risk assessment in the food chain are approached from a food production system perspective. Sustainability is a complex concept, which involves judicious use of various resources as discussed in Chapter 2. Use of both renewable and non-renewable resources in food production systems has resulted in various environmental issues. Their impact on the sustainability of various food processing industries is dealt with in Chapter 3. Ensuring sustainability in food production systems requires a holistic approach to assess the impacts of a food product, process or service. Chapter 4 emphasizes the theoretical basis for Life Cycle Assessment in food production systems with specific examples from the food industry. Environmental impact assessment of food processing operations to produce food for an increasing world population without causing depletion of natural resources and severe pollution problems is highlighted in Chapter 5. Risk analysis in a food chain to reduce food related health issues along the entire food chain, and to ensure sustainability in food production, processing and consumption is covered in Chapter 6.

1.4.2 Sustainability and food processing applications

Application of sustainability concepts in various food processing sectors are detailed for various food processing operations used in the manufacture of a range of food products in terms of environmental issues and consequently on traditional and current efforts for dealing with sustainability issues. The application areas considered are dairy processing (Chapter 7), meat processing (Chapter 8), seafood processing (Chapter 9), fresh-cut fruit and vegetables processing (Chapter 10), food grain processing (Chapter 11), brewing (Chapter 12) and processed food industries (Chapter 13).

1.4.3 Sustainability in manufacturing operations

Food production systems require input from various allied industries involved in food manufacturing operations. Food packaging and storage operations are necessary for delivering safe food for consumers. Environmental impacts and sustainability issues related to packaging and ways to reduce environmental impacts are discussed in Chapter 14. Cleaning and sanitation within the food industry is an important operation with a significant impact on environment. Chapter 15 deals with the issues specific to the sustainability of cleaning and sanitization. The importance of cold chain management in food facilities needs to be considered when specifying and optimising sustainable food refrigeration systems and the need for effective cold management as discussed in
Chapter 16. Consumption of water and energy in the food processing sector is important. The food industry needs to reduce both the water and energy consumption for food manufacturing. Analysis of energy and water consumption and various strategies to reduce their use are presented in Chapters 17 and 18. Chapter 19 is devoted to the analysis of the types of waste arising from the food supply chain, the main causes of waste generation and its fate and reduction strategies.

1.4.4 Distribution and consumption of food

Food travelling greater distances is likely to be stored in greater volumes and the usual economies of scale will apply, with carbon emissions per kg of product possibly being lower as volumes/mass increases. Chapter 20 discusses the concept of both national and international food distribution. Chapter 21 outlines the need for sustainable food supply networks and the final chapter (Chapter 22) deals with the food security and consumption. Achieving sustainability in food consumption is vital to provide a good quality of life, while reducing the environmental, economic, social and political impacts of food production and consumption.

References

