

# Towards sustainable food production

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**Piližota, Vlasta**

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## **Towards sustainable food production** *In memory to academian Dragutin Fleš (1921. – 2005.)*

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V. Piližota \*

*University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek,  
Franje Kuhača 20, 31000 Osijek, Croatia*

### **Summary**

Sustainable development could be defined as meeting 'the needs of the present generations without compromising the ability of future generations in meeting their needs' (Baldvin, 2009). There are several related principles of sustainable food production, but probably the most central, is not to use resources faster than they renew. As the food is one of the most important human needs there is a need to pay attention to food production from all aspects among which the most important are food safety or healthy products, high nutritious food (to meet all consumers' nutritious demands), permanent high standard food supply, reduction in energy consumption, minimizing resource inputs, using renewable energy and packaging materials, whenever possible, as well as high standards in working environment and continuous employees' education.

*Keywords:* sustainability, sustainable food production, sustainable food chain

### **Introduction**

Sustainable food system is one that provides healthy food to meet current food needs while maintaining healthy eco-systems that can also provide food for generations to come with minimal negative impact to the environment (APHA - American Public Health Association). Sustainability became a high priority issue in all areas of interest and activities of the human kind, and growing awareness of environmental issues is affecting our lifestyles. Because food is part of the lives of millions of consumers each day, all players in food chain have a critical responsibility to create positive environmental change. Given the central role of food supply and the emotional relationship that modern mankind still has to its food, sustainability is seen as a value which has to be maintained throughout food supply chains. The food chain sector is responsible for a large environmental impact at present. It is currently heavily dependant on non-renewable energy resources (fossil fuels) and on the use of chemicals for efficient production. Sustainability seeks to reduce energy costs and to protect the environment. Seeking to reduce energy costs and to protect the environment, companies are exploring “green” manufacturing practices (eco-friendly products,

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\* vlasta.pilizota@ptfos.hr

eco-friendly packaging, organic and fair treatment of employees and suppliers), installing technologies (energy-efficient equipment) to help to reduce energy usage and costs and sustainable/renewable packaging (reusing and less material) applications, or engineering innovative processing methods (Nachay, 2008).

Choosing raw materials that are sourced or produced in ways that minimally affect the environment is a step that companies can take to become “green”. If consumers continue to purchase products that are promoted as eco-friendly or sustainable, the companies will continue to produce more of these products as well as invest in corporate sustainable/environmental practices (Nachay, 2008). The complexity of modern food systems, also, invokes a variety of ethical implications which emerge from contrasts between ideals, perceptions and the conditions of technical processes within food systems, and the concerns connected to this (Zollitsch et al., 2007).

In the changing environment in which Europe’s agri-food industries must prosper, in the 21<sup>st</sup> century, new knowledge-based food systems are required that are profitable at all levels, are environmentally sustainable, can cope with emerging climate changes and that, in the circumstances now arising, are energy efficient.

### *Sustainable development*

There are many definitions of sustainable development. One is well known as the Brundtland “Mantra”: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”, emphasized in the report '**Our Common Future**', by former Norwegian Prime Minister Gro Harlem Brundtland (former Chair of the World Commission on Environment and Development), and also known as the **Brundtland Report**, from the United Nations World Commission on Environment and Development (WCED) that was published in 1987, and laid the groundwork for the convening of the 1992 Earth Summit and the adoption of Agenda 21, the Rio Declaration and to the establishment of the Commission on Sustainable Development.

An oft-quoted definition of sustainable development is defined in the report as: "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" In addition, key contributions of *Our Common Future* to the concept of sustainable development include the recognition that the many crises facing the planet are *interlocking crises* that are elements of a single crisis of the whole and of the vital need for the active participation of all sectors of society in consultation and decisions relating to sustainable development (Brundtland, 1987).

Also, another definition: "*Sustainability is an economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations*" is given by Paul Hawken, an environmentalist, entrepreneur, journalist, and

author (Hawken, 1993). Hawken, believes that "*we need a design for business that will ensure that the industrial world as it is presently constituted ceases and is replaced with human-centered enterprises that are sustainable producers.*" Avoiding stormy rhetoric, Hawken thoughtfully reviews ecological theories and disasters and insists that "ecology offers a way to examine all present economic and resource activities from a biological rather than a monetary point of view." Calling for a restorative economy, he proposes rational, achievable goals: stop "accelerating the rate that we draw down capacity"; refrain from "buying or degrading other people's environment"; and avoid displacing "other species by taking over their habitats." This noteworthy study should kindle debates within the business community."

Sustainable advancement and development in relation to a nation is the process of making living, that area of land and/or water more useful or profitable for mankind. The life sickness affects over 30 % of global socio-economic and sustainable development turnover by way of healthcare, food and energy, agriculture and forestry. This percentage impact will grow with biotechnological developments which are increasingly improving the efficiencies of production processes in all spheres of life. This therefore implies that biotechnology occupy a very strategic position in the socioeconomic advancement and sustainable development of the nation in particular and the world at large. Scientific advances through the years have relied on the development of new tools to improve socio-economy such as health care, agricultural production, and environmental protection (Okonko et al., 2006).

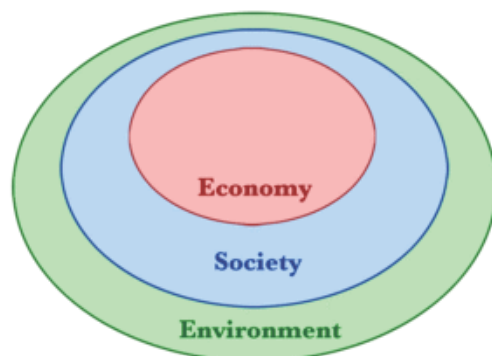
As applied to the food industry it may be said that..."*sustainable food system*" is one that provides healthy food to meet current food needs while maintaining healthy eco-systems that can also provide food for generations to come with minimal negative impact to the environment (Clark, 2010). Sustainable development is also a key phrase used by politicians, economists and environmentalists.

### *Food Industry*

European food sector is the largest manufacturing sector in Europe which transforms 70 % of EU's agricultural raw materials and employs over 4 million people. Development of Europe's food sector will have major impact on job creation, well-being and welfare in Europe. Croatia is a part of that sector. Consumer demand for different food products has changed in important ways over the last thirty years. For example, in both developed and developing countries, increasing per capita incomes, demographic shifts, urbanisation, smaller family units, and other life style changes have increased the demand for processed and imported food and individual portions and packaging. Throughout the world these changes have had a profound impact on the production and consumption of food. Also, there have been significant structural changes in the

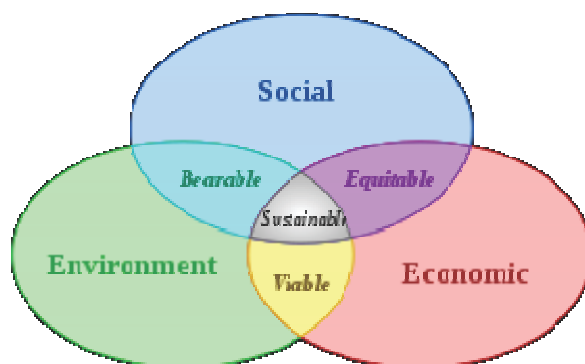
food production systems and processing industry. These changes have reflected a number of issues including mentioned consumer demands, concentration and competition in the international food market, farm policy and programmes, technological developments, and public and private attitudes towards, for example, food safety, nutritional labelling and environmental concerns (Consumers internat., 2007). As a result of these rapid changes and their effects, consumers and governments are becoming increasingly concerned about the way in which agri-food sector is organised. The recent BSE outbreaks in Europe and developments in the application of genetically modified organisms, increasing environmental concerns and the growing power of multinational companies have resulted in an emerging global debate about agricultural practices and food production. Consumer concerns about food safety and quality, animal welfare and the environment are leading some governments to outline new visions for future agri-food policies in recognition of the need for reforms, but there is still a long way to go. Industrial food production focuses on economic efficiency, reliability and consistency, and market demand. Current systems of manufacturing, preservation, storage, processing, packaging, transportation and distribution, and retail are not necessarily sustainable. There is careless use of natural resources and waste of food raw materials. Policy or markets may favour unsustainable patterns of production and there is an inequitable remuneration of actors in the system. Much remains to be done to optimise the efficient use of non-renewable energy resources, recycled raw materials and to ensure that the use of packaging contributes less to problems of recycling.

It is clear, from many studies, that many food chains are lacking in sustainability, in its three dimensions; environment, social and economical sustainability.



**Fig. 1.** A representation of sustainability showing how both economy and society are constrained by environmental limits (Ott, 2003)





**Fig. 2.** Scheme of sustainable development: at the confluence of three constituent parts (Adams, 2006; UCN, 2006)

Environmental concern, social responsibility and economic viability are commonly identified as the three pillars of sustainability. With global inequalities becoming more pronounced, food costs climbing and global warming becoming a major political issue, food producers are simultaneously cast as perpetrator and potential healer. Meeting the needs of the present without comprising the future has to be taken into account by the food industry without undermining bottom line balance sheets, and the right balance between environmental, economic and social factors is needed (Coomber, 2008).

### *The Food Supply Chain*

The food supply chain now accounts for 20 % of total global energy expenditure. It is highly dependent on fossil fuels and on average three times more energy is put into food than is actually produced. It also accounts for a quarter of all highway transport in the EU and has a water use average of 3.500 L/day per capita, while 1.5 billion people in the world still do not have access to safe drinking water. The Food Supply Chain (Fig. 3) is changing constantly, as technological innovations in farm production, food processing, storage and delivery systems evolve, and processors and retailers respond to consumer demands and expectations, and to economic, social and cultural circumstances (Downey, 2006). Although there are now global food chains there is no global body to consolidate the testing of all products. At the moment we have no harmonisation of labelling across countries and we have no validation process. Manufacturers now have the unenviable task of meeting the social demands with greater environmental and economic challenges. As investors

increasingly look to the methods behind manufacturing, assisted by new measuring techniques, developing the practices and technologies to create a sustainable and traceable food supply chain is becoming essential.

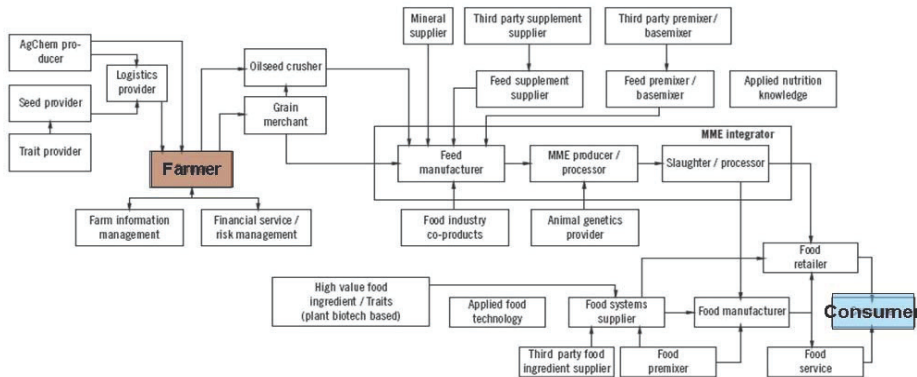


Fig. 3. Food (Chain) Network (Sciehefer, 2008)

For some, sustainability is still a luxury, but for others it is the difference between choosing a product or passing it over. The sooner manufacturers catch on to this and communicate habits with customers the more likely they are to win over the new breed of ethical consumer.

In the food industry, finding the right technology is just half of the battle. Although there are the technologies, they are not always taken up by the industry, there is a lot of confusion about sustainability because it means different things to different people. We can spend a lot of time developing new technologies that will help the symptoms but won't tackle the actual problem (Coomber, 2008).

#### *Some of the main threats to general food production*

The very notion of a sustainability transition, with its concern for humankind and the planet, reflects a process of globalization or interconnectedness, emerging forms of governance, and changing institutions and values. Most of these trends will work toward a sustainability transition, but not everywhere. Favorable shifts in investment, income, and job opportunities in some parts of the interconnected world are accompanied by the loss of jobs elsewhere, unpredictable withdrawals of capital, and a deepening divide in needed skills and innovation, all adding new sources of instability for the world's poor (Kates and Parris, 2003).

The biggest concern for general food production is a threat to agricultural land due to large-lot residential development, especially in developed and developing countries. The land area developed into ex-urban homes and rural land grew several times faster than the population growth rate. Urbanization is transforming domestic markets of developing countries into the main source of the global agri-food system. The finest farmer land and crop lands are disappearing faster than ever before. Europe will continue to lose considerable amounts of agricultural land in the coming decades, which is already happening in well developed regions. Besides, larger farmers no longer can find adequately skilled personnel for their production. In addition to the economic importance, the activities of the food industry are directly related to food security, which is still a major challenge in terms of human development pointing out to a dual responsibility of the industry. Social factors also influence trends in rural areas. One example is that the profits of a sale of arable land is often more than property owners can earn from their agri-production in that same year. Also, many children of farmers are choosing careers outside of agriculture, leaving no one to operate family farms (the number of people needed to produce food and maintain the land has decreased drastically) (Piližota, 2009 - UNIDO Analysis based on different sources, 2007/2008).

### *Sustainable agriculture*

There is prediction that by 2050 the global population will grow to 9.2 billion people, and demand for agricultural products is expected to double. In the intervening years, the agri-food system will face increasing constraints and volatility driven by resource scarcity and climate change, raising the risk of production shortfalls.

“Global food production is a classic case of a system without coordination. No one intends their decisions to result in a system that is unsustainable. No one wants polluted estuaries or impoverished rural regions. Individuals make the best decisions possible, but they are doing so in a system that is critically fragmented. The pattern of falling commodity prices and production consistently driven beyond environmentally sustainable levels is repeated again and again, from corn, to coffee, to forest products, to fish” (Sustainable Food Lab website).

Sustainable farming requires a global commitment. If developed countries are serious about pursuing sustainable farming at home, they must also ensure that their trading partners can do the same, regardless of their ability to support it through public finances. It is thus essential to look into the scope for transferring resources from developed to developing countries for this purpose (Consumers international, 8 October 2007).

Many scientists, farmers, and businesses have debated how to make agriculture sustainable. Sustainable agriculture uses ecological principles to farm, hence the prefix agri- to farm and ecology- the science of the relationship between

organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will satisfy human food and fiber needs, make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls, sustainable, sustain the economic viability of farm operations, enhance the quality of life for farmers and society as a whole, over the long term (Wikipedia).

Sustainable agriculture should: a) optimize the use of resources to improve farm productivity and eliminate the use of unnecessary resources; b) support increased farm productivity, improving crop yields and nutritional quality to meet existing and future global business growth; c) preserve and maintain soil fertility, water and air quality and biodiversity within the agricultural activities; d) enable local farming communities to protect and improve their well-being and environments; e) integrate approved and credible science and technology, where applicable; and f) comply with governmental laws, regulations and industry standards (PepsiCo, 2009).

### *Environment*

In developing new systems of crop production and livestock, central importance has to be the environmental component, including the implications of emerging climate change.

The daunting challenge involved in striking the optimum balance between the economic dictates of competitive farm production systems and the protection of Europe's rich heritage of natural and cultural resources, allied to the sustainability of rural regions, points to the concept of envisaging the environment as a *virtual economic entity*, within which a dynamic range of competing developmental, environmental, and social pressures have to be systematically accommodated, without the demands of one sector impacting unduly on others.

### *Waste utilization*

Waste in the food chain is another major obstacle for increased sustainability. Over 200 million tonnes of food waste is produced in Europe each year. Recent European studies show that about 20 % of perfectly edible foods are lost as waste and the figures are much higher if non-edible waste is included. On a global dimension, waste is probably the major sustainability problem, as an important consideration for sustainability is the economical efficiency of the food chain. The socio-economic dimension of sustainability implies fairness in the transaction in the food chain and justice in the availability of affordable foods. It is feared by many that the present global economic crisis will aggravate the situation for the poorest in the world considerably, counteracting the improvements which have been made in the first part of the Millennium.

Agricultural research has pointed out a number of possibilities for more resource efficient primary production, but there is still globally a lack of political will to strongly promote more sustainable production methods.

The trend in the world today is to convert waste into useful products through the manipulation of microorganisms and to recycle waste product as much as possible and the role of microorganisms in waste utilization has been studied extensively by several authors. Some workers have thus explored ways of minimizing the environmental hazard posed by the gari industry effluent, not just by getting rid of it but by converting it to useful products. Waste utilization is another approach in waste management practice. Waste utilization is an ecologically safe and economically efficient method of waste management since; the waste is not treated spending money or disposed off in the landfill causing pollution. Therefore to manage food wastes, the general pathways of industrial-food waste generation should be reduced, recycled or reused and what is left must be treated and disposed of in an environmentally acceptable way. If a process is not environmentally friendly, it should be redesigned such that it becomes so and where a process cannot be redesigned, then it is necessary to reconsider whether it should be undertaken at all (Okonko et al., 2009).

### *Energy issues and Emerging Technologies*

Energy issues are clearly of major import for Europe's agri-food industries and rural economies. Energy efficiency is of central importance in designing new farm production systems. Bio-energy generation could potentially make an important contribution to off-setting income losses in agriculture. However, early attention needs to be given to minimising the environmental impacts of intensive, mono-cultural energy-crops production.

Emerging technology is a general term used to denote significant technological developments that broach new territory in some significant way in their field. Emerging technologies are those technical innovations which represent progressive developments within a field for competitive advantage.

It's been a while that 'Pinch Technology' has been extensively employed all over the world to improve energy efficiency of various processes, as well as in food processing. One of the major application of Pinch Technology is for configuration of Energy Efficient Combined Heat and Power (CHP) cogeneration systems. Optimization of CHP systems is the area which offers maximum scope for energy cost savings in any industry, so that the overall energy consumption of the process is minimized.

Pinch Technology was introduced by Linnhoff and Vredeveld in 1979. It represents a set of thermodynamically based methods that guarantee minimum energy levels in design of heat exchanger networks, and use 'Pinch Analysis' to represent the application of the tools and algorithms of Pinch Technology for studying industrial processes. Food processing plants utilizing the information

obtained during the Pinch Analysis of the process can design energy efficient processing. This can help in creation of sustainable food supply chain.

### *Food for Life*

Developing appropriate technologies and highlighting their safety is of paramount importance. A number of efforts are being made to build platforms which track the whole of the food supply chain. One of the most prevalent is the European Technology Platform Food for Life which aims to bring together key stakeholders to create a delivery strategy from farm to fork.

The ETP Food for Life published its Vision Document in June 2005 and its Strategic Research Agenda (SRA) in September 2007. Extensive consultations were held with all relevant stakeholders across Europe both in face-to-face meetings and through web-based consultations (ETP, 2005).

The European Technology Platform on Food for Life seeks to deliver innovative, novel and improved food products for, and to, national, regional and global markets in line with consumer needs and expectations through an effective integration of strategically-focussed, trans-national, concerted research in the nutritional-, food- and consumer sciences and food chain management. These products, together with recommended changes in dietary regimes and lifestyles, will have a positive impact on public health and overall quality of life ("adding life to years"). Such targeted activities will support a successful and competitive pan- European agro-food industry having global business leadership securely based on economic growth, technology transfer, sustainable food production and consumer confidence.

### **Conclusions**

There are many challenges that need to be overcome to address the problems and develop and promote sustainable food production. Firstly, there is no generally agreed definition of sustainable food production - especially from a consumer perspective.

What is urgently needed is to define what sustainable food production means, and from that evolve a contemporary and coherent policy which can be used in all the regions in its own right but also when working with more specific topics. Also mapping perceptions of 'sustainable food production', linking this to cultural differences, and consumption patterns will be a priority in the future. Sustainability should bring together experts from all points in the supply chain to explore the opportunities afforded by sustainable produce industry practices. It is a way to add value, improve efficiencies and invest in the long-term for future generations. Sustainability does have a global dimension but the efforts for improvements must be made on the local scale, by each country, company and individual.

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