

Antonella Vastola *Editor*

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Preface

This book focuses on the challenges to implement sustainability in diverse contexts such as agribusiness, natural resource systems and new technologies. The project arose from the editor's experience during the International Edamus M.Sc. course on "economics of quality for sustainable development"—the School of Agricultural, Forestry, Food and Environmental Science (SAFE), University of Basilicata, is a partner of the Edamus Mundus Programme. The exchange of ideas and the experience with students from all continents led to the idea to gather in one volume the experiences of researchers at the SAFE of the University of Basilicata in Southern Italy.

Basilicata's production system is mainly based on the agricultural sector and exploitation of natural resources. However, in recent years, it has witnessed industrial development driven by the discovery of oilfields. SAFE research took up the challenge posed by market competition to create value through the sustainable use of the region's renewable and non-renewable resources. Moreover, due to its unique geographical position in the middle of the Mediterranean basin, Basilicata is an excellent field laboratory for testing sustainable solutions adaptable to other Mediterranean areas.

The book offers a broad, multidisciplinary approach to identifying and testing different solutions tailored to the economic, social and environmental characteristics of the region and the surrounding areas. The volume is a collection of multidisciplinary case studies involving SAFE researchers and their scientific partners. It is intended as a stimulating contribution to the debate on the development of sustainable techniques, methods and applications for the Mediterranean regions. Last, but not least, a global event like Expo 2015 represents a unique opportunity to present the volume.

The book consists of three parts, with agro-food systems examined in Part I, natural resource systems and the environment in Part II and new technologies in Part III.

The first part includes the case studies related to experiences in the agro-food system. The first article addresses food security in the southern Mediterranean,

providing readers with an overview of important factors to achieve more inclusive, integrated and efficient food systems. Thus, after setting the scene, the next two articles deal with crop production from the twin angles of sustainability and healthy food production. The next five articles are case studies related to livestock production typical of the Mediterranean including goats, sheep but also buffaloes and Podolian cattle. The focus is on a more sustainable rearing method but also on enhancing the products obtained from the milk of these species; the last article in this group describes the innovative uses of donkey milk. This is followed by two studies dealing with sustainable agricultural practices in protecting traditional crops in southern Italy from disease: the cherry tomato and the PGI-labelled Sarconi bean. To follow, there is the experience of the Turkish Cypriot community's adoption of pomegranate farming. Last, but not least, is a contribution on the role of women in the wine industry.

The second part explores issues relevant to the sustainability of natural resource systems and the environment. The first four case studies analyse the effects of climate change and the use of non-renewable resources in relation to the region of Basilicata. Of considerable interest is the case study on the allocation of oil royalties from the presence of oilfields that have to coexist with the extensive agricultural and forestry resources of the region. The next article addresses the role of soil variability on potential groundwater pollution and recharge in a Mediterranean agricultural watershed. The last three articles discuss biodiversity from original standpoints such as the use of native grasses for turfgrass, hypogeous fungi and the role of grazing for biodiversity conservation on a Nature 2000 network site.

The third part pools experiences in the use of new technologies such as geographical information systems as a tool for landscape modelling and three-dimensional analysis; satellite technologies to apply precision farming; technologies for extending the shelf life of fresh fruit and vegetables; cost-effective and non-invasive geophysical techniques for near-surface investigation; the use of electrolysed water as the disinfecting agent in the food industry.

I wish to thank my colleagues Michele Perniola and Severino Romano, as former and current SAFE Head, who believed in and supported the idea and its execution. I would like also to thank all the authors, with special thanks going to Aysen and Fabio who joined the team despite everything. Finally, I would like to express my gratitude to Fabio Massimo and Nicolò for their unwavering encouragement and for sharing the “sunny and cloudy” moments during the realisation of this book.

Potenza, Italy
January, 2015

Antonella Vastola

Introduction

Sustainability and Sustainable Development: The Background and the Current Perspectives

The roots of the concept of sustainability can be found, according to various scholars, in two contributions, both published in 1972: a book by Meadows et al., namely *The Limits to Growth*, which modelled the dynamics of the human presence on the planet, and an article by Goldsmith et al., *A Blueprint for Survival*, which forecast “*the breakdown of society and the irreversible disruption of the life-support systems on this planet*” without profound social changes. Both agreed that “*if current trends are allowed to persist*” (Goldsmith et al. *ibidem*) the actual growth model is bound to collapse within a century and that a consensus has to be found at the global level involving governments, the private sector and public opinion leaders. Such statements underline the fact that sustainability, defined literally as the ability to maintain or support and, more broadly, as the ability to continue a certain behaviour indefinitely, can be used as a key concept for the definition of development models to be pursued.

Since the 1980s the term *sustainability* has been applied to the human capacity to live on the planet. It was the energy crisis in the 1970s which underlined the fragility of global economic development, after which awareness of sustainability issues began to grow slowly. In 1987, the UN World Commission on Environment and Development (WCED), commonly known as the Brundtland Commission, gave in its report *Our Common Future* the first—and most widely quoted—official definition of sustainable development, which “*... is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*”. This broader definition emphasises the importance of people’s aspirations for a better life, of global preservation and the essential relevance of future generations to the goals of current actions.

From this definition there emerged the widely accepted idea that sustainable development is based on three pillars: economic, social and environmental.

Economic sustainability concerns the capacity of an economy to support a certain level of economic production. Environmental sustainability is the ability of the environment to support a certain level of natural resource extraction rates. Finally, social sustainability is related to the ability of a social context to function at a certain level of social well-being and harmony.

At this point, a final remark has to be made to clear the field for all the following considerations that will be based, directly or indirectly, on the concept of sustainable development. Indeed, as many scholars have noted, the Brundtland Commission did not define sustainability but stated a definition of sustainable development as the “solution” to the problem of sustainability.

In 1992 in Rio de Janeiro, the UN Conference on Environment and Development defined the so-called Agenda 21, which is a broad action plan to implement sustainable development on a global, national and local level with the widest involvement of local stakeholders. Agenda 21 included 40 separate chapters, setting out actions related to the social and economic dimensions of sustainable development (e.g. poverty, health, demographics), conservation and management of natural resources (e.g. air, forest, water, chemicals), strengthening the role of major groups (e.g. women, young people, the elderly, NGOs, farmers) and means of implementation (e.g. information, training, international cooperation, finance).

In 2001, the UNESCO’s Universal Declaration on Cultural Diversity added a fourth pillar: culture, as an element that shapes economic development and people’s behaviour. The UNESCO initiative is twofold: one side focuses on the development of the cultural sector itself (e.g. creativity, cultural tourism, heritage), while the other deals with the proactive role that culture should have in shaping public policies—first of all, those regarding education followed by the environment, science and so forth.

In more recent years, due in particular to the financial crisis that has had global repercussions, albeit of different intensity between countries and industries, the concept of sustainable development as well as the set of tools to approach it has changed. In 2005, the UN World Summit which led to the definition of the Millennium Development Goals (MDGs) restated that development is a central goal in itself and that sustainable development calls for a convergence between the three pillars of economic development, social equity and environmental protection. The driving principles are: reducing poverty and hunger, improving health and well-being and creating sustainable production and consumption patterns.

The literature underpinning the MDGs identified a series of requirements for sustainable development: equity, poverty alleviation, a better use of non-renewable resources and integrating economic, environmental and social issues in decision making. Finally, a last but not least consideration—while the challenge of sustainable development is a shared one, countries have to adopt different strategies to advance sustainable development goals.

Given that the MDGs are only valid until 2015, in 2012 the Rio+20 Conference with the report *The Future We Want* proposed a set of sustainable development goals (SDGs) that updated MDGs to the 2015–2030 scenario.

Box 1. Sustainable Development Goals—*The Future We Want*

- Goal 1. End poverty in all its forms everywhere.
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3. Ensure healthy lives and promote well-being for all at all ages.
- Goal 4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all.
- Goal 5. Achieve gender equality and empower all women and girls.
- Goal 6. Ensure availability and sustainable management of water and sanitation for all.
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.
- Goal 10. Reduce inequality within and among countries.
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 12. Ensure sustainable consumption and production patterns.
- Goal 13. Take urgent action to combat climate change and its impacts.
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
- Goal 17. Strengthen the means of implementation and revitalise the global partnership for sustainable development.

Recent years have witnessed a rising global alert due to the steady increase of global warming, mainly caused by increases in greenhouse gas (GHG) emissions generated by production systems as well as lifestyle models with too high an impact on the environment. Rio+20 reaffirmed that the ultimate objective under the United Nations Framework Convention on Climate Change is to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The stable functioning of earth systems is a precondition for a decent level of global development. This means that for the SDGs to be feasible, they have to take into account the effects of increasing human pressure on the planet (the human population is expected to top nine billion by 2050), like water shortages, extreme

weather, deteriorating conditions for food production, ecosystem loss, ocean acidification and sea level rise. These are real dangers that could threaten development and trigger humanitarian crises across the globe (Griggs et al. 2013).

A criticism of the system proposed by SDGs is the large number of goals, rising from six MDGs to 17 SDGs. This would not appear to simplify the framework of measures adoptable. This consideration holds especially if one thinks of the set of indicators that must be put in place. Indeed, another criticism levelled at the MDG/SDG complex is the appropriateness of indicators measuring actions and hence the assessment of their effectiveness. Managing the sustainable development process requires a much strengthened evidence base and the development and systematic use of robust sets of indicators and new ways of measuring progress. Taking into account these considerations, Griggs and colleagues (2013) proposed to set a medium-term horizon and some provisional targets (less ambitious than the SDGs) to accomplish. Results achieved with respect to these targets should be quantified in order to review them and to achieve the expected results in 2030.

It seems that the latest UN Secretary-General's synthesis report *The Road to Dignity by 2030* (2014) is going in the above-mentioned direction. In presenting the vision for the post-2015 sustainable development agenda, the 17 goals have been rearranged in a focused and concise manner that enhances the necessary global awareness and allows implementation at the country level. The report proposes a set of six essential elements underpinned by rights, with people and the planet at the centre.

Box 2. Sustainable Development Goals—*The Road to Dignity by 2030*

1. Dignity: to end poverty and fight inequality.
2. People: to ensure healthy lives, knowledge and the inclusion of women and children.
3. Prosperity: to grow a strong, inclusive and transformative economy.
4. Planet: to protect our ecosystems for all societies and our children.
5. Justice: to promote safe and peaceful societies and strong institutions.
6. Partnership: to catalyse global solidarity for sustainable development.

Given this scenario, the basic commitment is related to the capacity to act with solutions that lead to an inclusive growth for all countries and all communities. Particular attention is given to planetary needs in terms of climate stability, biodiversity loss and unsustainable land use. This means that, to implement a sustainable agenda, finance, technology, science and investments in capacities should be included, while to monitor and review implementation, the report proposes the use of new and non-traditional data sources, enhancing data capacity, availability, disaggregation, literacy and sharing.

Since the beginning of the new millennium, as evidenced by the above framework, the concept of sustainable development has been closely linked to that of well-being. In the last decade the economic crisis has affected all countries, albeit to a varying degree. This has shown that the measurement of welfare or well-being cannot be reduced to a single indicator such as Gross Domestic Product (GDP). Many scholars

and international organisations have been involved in drawing up a measure that does not use only economic performance to assess the wealth and social progress of a country. Although this issue lies somewhat beyond the scope of this analysis, it is instructive to see that it is closely linked to sustainability. In its final remarks, the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP)—generally referred to as the Stiglitz-Sen-Fitoussi Commission (created in 2008 on the French government’s initiative)—did not identify a new indicator but, on the contrary, drafted a set of 12 recommendations (Stiglitz et al. 2009), three of which deal with sustainability: (1) GDP is “an inadequate metric to gauge well-being over time particularly in its economic, environmental and social dimensions, some aspects of which are often referred to as *sustainability*” (ibidem, p. 8); (2) environmental sustainability—including the destruction of resources and the risks of climate change—is a component of growth; (3) well-being has a multidimensional nature which involves material living standards (income, consumption and wealth) but also health, education, the quality of governance, social networks, the environment (present and future conditions) and insecurity (economic and physical aspects).

Sustainability in the Agro-Food System

Agriculture has a vital role to play as the planet’s food provider, but it also uses a wealth of non-renewable resources. This makes it one of the best fields to study the application of sustainable development.

Given the current high levels of hunger and malnutrition—805 million chronically hungry people in the period 2012/2014—and increasing food demand—over nine billion people will have to be nourished in 2050—the challenge for agricultural production coincides with the goals of sustainable development. Food security is achieved “*when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life*” (FAO 1996).

The linkage between the goal of food security and the path towards a sustainable development model is evident: in order to achieve a decent level of nutrition for all people, responsible environmental stewardship is required as well as greater equity in food management. This applies to agricultural and food systems at global, national and local levels.

A recent FAO report states “*sustainable agriculture must nurture healthy ecosystems and support the sustainable management of land, water and natural resources, while ensuring world food security. To be sustainable, agriculture must meet the needs of present and future generations for its products and services, while ensuring profitability, environmental health and social and economic equity. The global transition to sustainable food and agriculture will require major improvements in the efficiency of resource use, in environmental protection and in systems resilience*” (FAO 2014). The above-mentioned report sets out five key principles that balance the social, economic and environmental dimensions of sustainability: (1) improving efficiency in the use of resources; (2) conserving, protecting and enhancing natural ecosystems; (3) protecting and improving rural livelihoods and social well-being;

(4) enhancing the resilience of people, communities and ecosystems and (5) promoting good governance of both natural and human systems.

As emphasised in the FAO reports and by several other international institutions, the different components of sustainability cannot be considered separately because they are strongly interrelated and need to be analysed using an integrated, holistic approach given the complexity of agro-food systems. This means considering the close interdependence of different aspects of food production and consumption.

A review of different reports about the sustainable path of agro-food systems suggests that, regardless of the perspective of the analysis, the main goals of a sustainable agro-food system concern: (a) sustainable production systems; (b) sustainable consumption guidelines; (c) biodiversity protection; (d) combating climate change; (e) developing local economies and small-scale production. Last but not least, each goal must be set and pursued as part of an overall strategy that takes all the other elements into account simultaneously.

Without exploring every single goal in depth, it would be useful to highlight some of their aspects. Given that the food production model concerns both industrial production as well as small and medium-scale production systems, sustainable food production is facing a challenge that can be summarised with the statement “*in order to grow, agriculture must learn to save*” (FAO 2013a). This means that, given the increasing food demand, the effects of climate change and the competition for resources such as land water and energy, farmers around the world have to look at a new paradigm: sustainable crop production intensification (SCPI) which “*produces more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services*” (FAO *ibidem*). An example of this paradigm is conservation agriculture, which minimises tillage, protects the soil surface and sows crops in rotations that enrich the soil; moreover, it helps to reduce water needs by 30 % and energy costs by up to 60 %. With regarding to water management, the SCPI paradigm requires the use of precision technologies for irrigation and farming practices that use ecosystem approaches to conserve water. To increase crop productivity, a best practice is minimisation of chemical fertilisers, given the impact that nitrates and phosphates have in terms of GHGs.

Today more than ever the paradox of food is increasingly evident: on the one hand, there are people who are overweight or obese—2.1 billion across the world—and whose social cost is \$2 trillion each year, and on the other there are one billion people suffering from hunger and another two billion suffering from micronutrient deficiencies. In all countries, especially in the developed world, and in those that are experiencing new conditions of well-being, a sustainable consumption model must be developed from the concept of sustainable diets.

Box 3. Sustainable Diets

Sustainable diets are those diets with low environmental impacts, which contribute to food and nutrition security and to healthy lives for present and

(continued)

future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy, while optimising natural and human resources (FAO 2010).

The spread of a food model that is based on sustainable diets allows the conservation of biodiversity to be enhanced through the raw materials that are used as ingredients. Moreover, it can provide nutrient recommendations to consumers and have positive effects on their awareness vis-à-vis the positive repercussions of an environmentally sustainable food chain.

The last, but not the least, effect of the above-mentioned food paradox is the increasing phenomenon of food losses and waste. Recent estimates indicate that each year approximately one-third of all food produced for human consumption in the world is lost or wasted (FAO 2013b). The phenomenon occurs in both high- and low-income countries. In the first case, the food is largely wasted at the consumption stage while in low-income countries, it is lost mostly during the early and middle stages of the food supply chain.

Food waste represents an evident inefficiency and a missed opportunity to improve global food security, but also to mitigate environmental impacts and resource use. Given that the food and agriculture sectors together generate 30 % of total GHGs, appropriate solutions have to be found. In developed countries, programmes are under way to increase consumer awareness of food waste and energy use in food products, as well as regulations mandating reductions in organic waste management. In low-income countries, options include promoting low-cost farm storage facilities as well as upgrading transport and processing facilities (FAO 2011).

The search for better food chain efficiency is another key element of the sustainable development model. The importance of logistics systems, their management and how they can improve sustainability lies at the heart of the recent concept of green logistics. The premise is that optimisation of logistic operations across the supply chain has positive results in terms of: reduction of post-harvest losses, savings in energy, reduction of the environmental footprint and more competitive market positioning. In order to remain competitive, agro-food agents need rapid access to emerging technologies and, in addition, to be profitable their activities have to meet environmental standards and regulations, as well as deal, directly or indirectly, with consumers.

To define the elements of sustainability and a framework for assessing trade-offs and synergies among all dimensions of sustainability, an international reference tool has been developed, the Sustainability Assessment of Food and Agriculture system (SAFA). SAFA is an assessment of economical, environmental, social and governance sustainability. The field of application is the entire food supply chain from the site of primary production (agriculture, fisheries, forestry) to the retail outlet. Its main purpose is to support effective sustainability management of a company or production site.

The SAFA framework identifies four dimensions of sustainability: good governance, environmental integrity, economic resilience and social well-being. For each of these four dimensions, SAFA outlines essential elements of sustainability through 21 high level themes (Fig. 1). These are applicable at any level of development, for instance at the national level, or commodity-specific. The themes are further divided into 58 sub-themes that are tailored to food and agriculture supply chains and thus are not well suited for policy development (FAO 2013c).

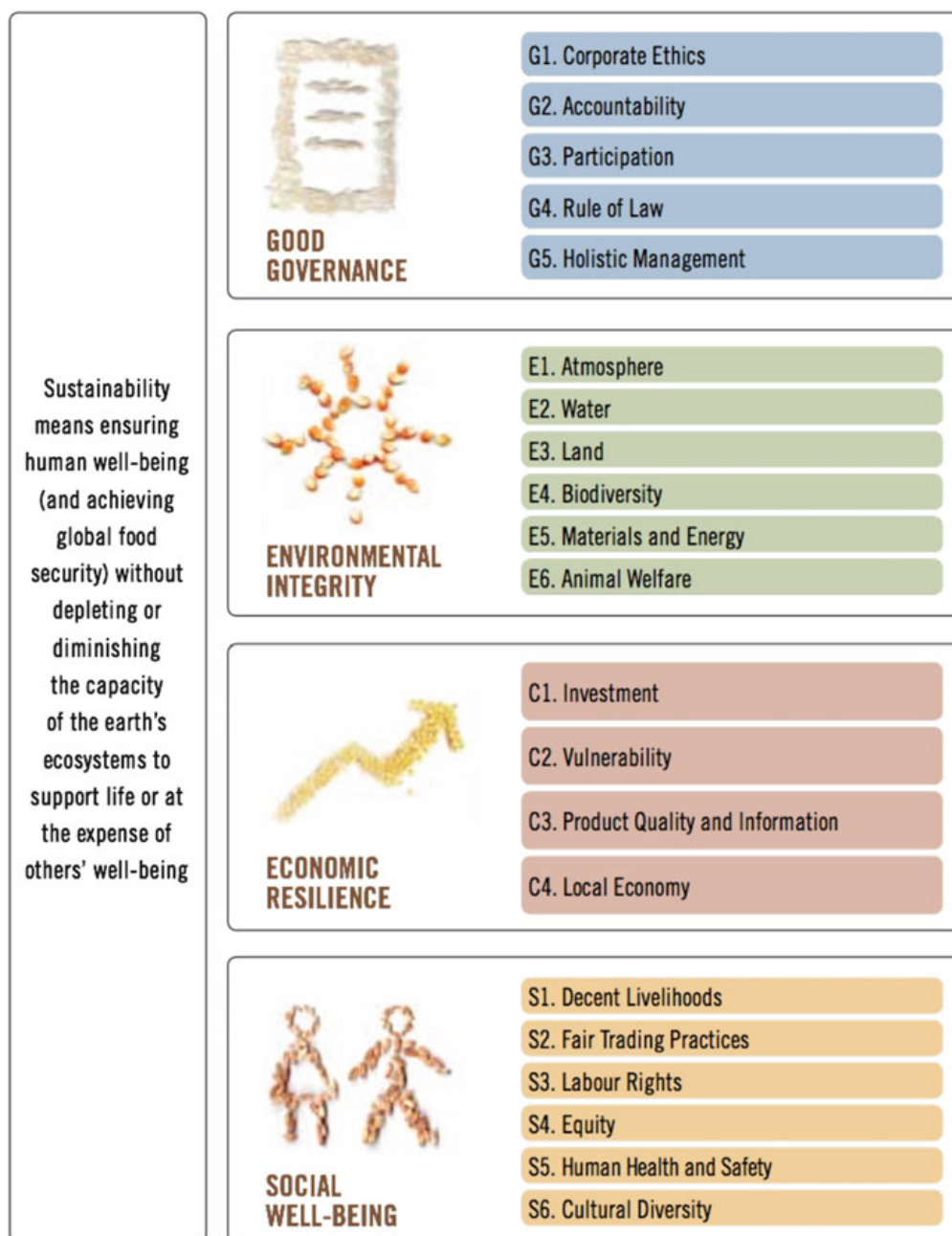


Fig. 1 SAFA sustainability pillars and themes (FAO 2013)

The different types of indicators within the SAFA system have varying weight in terms of their likelihood to fulfil the sub-theme objective. The SAFA system has a five-scale rating for the performance of indicators to which colours are attributed: red/orange/yellow/green/dark green are used, respectively, for unacceptable/limited/moderate/good/best levels of performance, corresponding to percentage scores from: 0–20/20–40/40–60/60–80/80–100. The SAFA sustainability performance ratings of a company are represented by the polygon (the thick black line) that connects theme performance following a traffic light colour code: best/good (green), needs improvement (yellow/orange) or unacceptable (red) as illustrated in Fig. 2.

The SAFA methodology is partly rooted in international metrics such as ISO 14040 (2006), the standard for Life Cycle Assessment (ISO 2009), and the ISEAL Code of Good Practice. The SAFA system provides a framework for improving the understanding of what a sustainability claim covers in practice and for comparing different production systems. It is also a useful quality assessment tool to identify performance of hotspots related to all aspects of sustainability within a company.

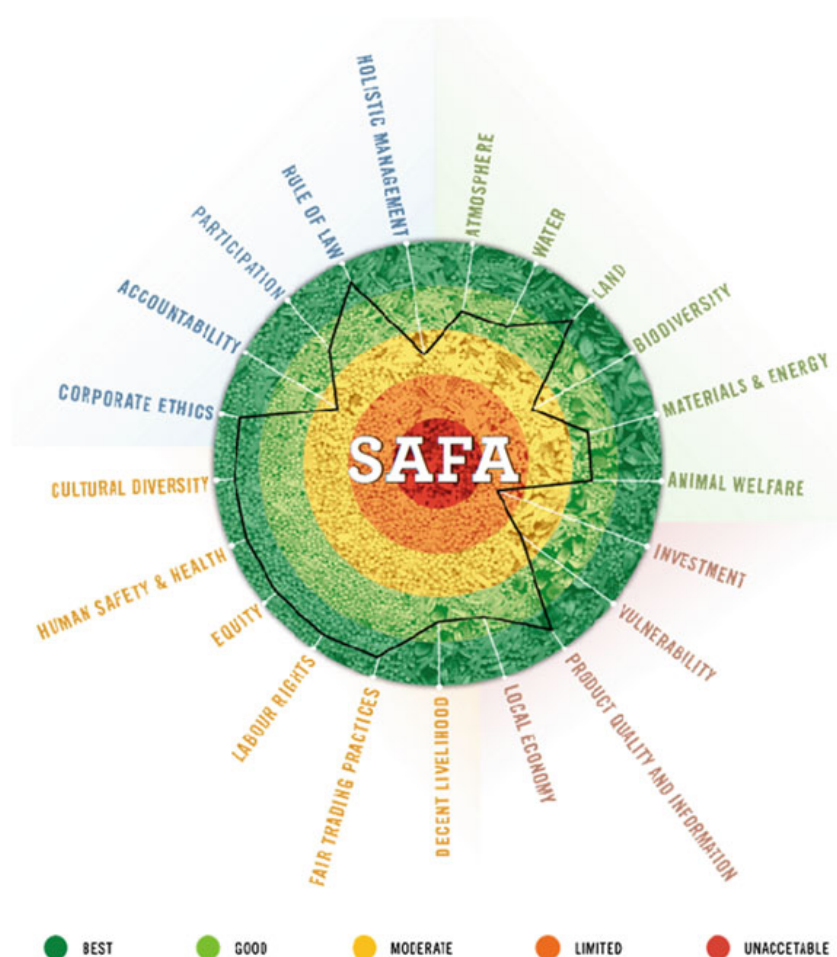


Fig. 2 SAFA sustainability polygon (FAO 2013)

Some final considerations have to be made on the cost of shifting to a more sustainable production model. As experienced in recent decades, the trade-offs between achieving a certain level of well-being, food security goal and environmental objectives often result in a negative-sum game, because of inappropriate policies and inadequate governance systems. On the production side, major costs are those including investments and operating expenses, but also opportunity costs related to income loss during the transition phase. The problem of delayed returns on investments is a significant barrier to achieving sustainability across all sectors. Risk and transaction costs are other significant elements during the transition to more sustainable systems. Transaction costs are those related to each stage of the business—e.g. transportation, communication and coordination activities. Various studies have reported that sustainable production systems require more coordination activities, for example in managing common-property natural resources, or in coordinating post-harvest, processing, storage and marketing activities. Natural market risks—e.g. volatility, the prices of raw materials, the supply of energy resources, sudden and catastrophic climate events—impact on most of the variables that affect the path towards sustainability.

The consumption system is facing a similar set of costs. The cost concerning the uncertainty of the quality of the goods purchased is of particular importance. Often the communication of sustainability features of the good is not effective and is made less efficient by the large number of claims that emphasise the “greening” of many products and which often deceive the consumer. A dietary model that considers the cradle-to-grave scenario has to be linked to the investment costs for the technology for disposal or re-use but also the cost of public action in terms of information. Finally, the effects of these behaviours are verifiable only in the medium-long run, which may cause a degree of disaffection of the consumer/citizen in continuing with equitable action.

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