World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:10, No:6, 2016

An Extended Model for Sustainable Food and Nutrition Security in the Agrifood Sector

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Open Science Index, Nutrition and Food Engineering Vol:10, No:6, 2016 publications.waset.org/10004606/pdf

***Abstract*—**The increased consumer demand for environmentally friendly production and distribution practices and the stricter environmental regulations turned environmental aspects into important criteria in business decision-making. On the other hand, Food and Nutrition Security (FNS) has evolved dramatically during the last decades in theory and practice serving as a reference point for exchanging experiences among all agents involved in programs and projects to fostering policy and strategy development. Global pressures make it more important than ever to gain a better understanding of the contribution that agrifood businesses make to FNS and to examine ways to make them more resilient in an increasingly globalized and uncertain world. This study extends the standard three-dimensional model of sustainability to include two more dimensions: A technological dimension and a policy/political dimension. Apart from the economic, environmental and social dimensions regularly used in sustainability literature, the extended model will accurately represent the measures and policies addressing food and nutrition security.

***Keywords*—**Food and nutrition security, sustainability, food safety, resilience.

I. Introducing Sustainability and Sustainable Production

SUSTAINABILITY is, at its base, a modern term describing something that has always been at the heart of any concept of resource use and material production: the need to balance steadily growing production with the fact that some, or all, of the used resources are taken from a finite quantity which, in the best case, replenishes itself at a rate lower than the rate of use or in the worst case, is not replenished at all. The first applications of sustainability in a form resembling its modern definition were in the forestry sector, from where only a short step leads to agriculture and, more broadly, to food production in general.

Sustainability as a term can be defined in a number of ways, most of which are connected to the notion of sustainable development, however, sustainability can be considered to extend to other areas not necessarily directly related to the growth-economy foundations of sustainable development. A number of respected encyclopedias and dictionaries define sustainable, and by derivation its noun "sustainability" as "able to be maintained at a certain rate or level" or "able to be upheld or defended" (Oxford) or "of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged" (Merriam-Webster).

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From those definitions, it is easy to connect sustainability and sustainable acting as being related to the maintenance (in the broad sense of the word) and use of a resource, which is most often a physical, material resource, but can also, have immaterial qualities.

Traditionally, the first uses of the word "sustainability" are attributed to a German accountant, mining administrator and forestry manager, Hans Carl von Carlowitz, who has introduced the first ideas of sustainable management of a resource in his book Sylvicultura oeconomica, oder haußwirthliche Nachricht und Naturmäßige Anweisung zur wilden Baum-Zucht, published in the year 1713 [1], [2]. Further development of human civilisation through the industrial revolutions and breakthroughs has seen the topic of sustainability come up at different times, but it took until the middle of the 20th century for sustainability to reappear in the focus of the global discussion. The growing and easily observable toll of an unchecked and relentless growth and development, and the first signs of using up finite resources, such as the oil crises of the 1970s and 1980s, have further contributed to increased awareness of and orientation towards sustainable ideas, as have more and more common environmental crises and disasters, very often caused by anthropogenic direct action or indirect influence through depletion of resources and alteration of ecosystems. Agendas such as the Club of Rome "Limits to Growth", spearheaded by Dennis Meadows [3], or the UN-appointed World Commission on Environment and Development (WCED), popularly also known as the "Brundtland Commision", who have delivered probably the most well-known definition of sustainable development in their report "Our Common Future", published in 1987 and welcomed by the UN General Assembly. Sustainability refers to- as the definition given by the United Nations Brundtland Commission- in meeting the wants and needs of the present day world without sacrificing the well-being of the future generation. This definition indicates that it is extremely vital to preserve the natural habitat and the environment as well as the resources available such as water, natural gas or the rare earth materials like cadmium or in fact any sort of resources without sacrificing the organizations profitability as organizations are not really interested in greening their business unless combined with economic benefits [4]. Another definition describing the principles of sustainable development also highlights the goal of better living for people. It states for sustainable development, there must be a safe, healthy environment, resources must be used efficiently and environmental issues must be taken into account across various sectors. The

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principles are then further explained in how they are to be measured. Healthy environment is measured through life expectancies and CO_2 emissions from industries, transportation, households, agriculture and waste. Using resources efficiently is measured through energy and water consumption and waste. This definition is vague in how sustainable development is going to be achieved. It only gives broad areas that are the focus of sustainable development. On the other hand, it gives specific ways in how sustainable development can be measured.

More modern developments in the area of sustainability have included a system of distinction between weak and strong sustainability, which is again connected to the issue of limited resources, with weak sustainability being associated with resources which can be substituted by other, usually man-made resources, and strong sustainability being associated with resources where no such substitution is possible. Another area of development addressing the topic of finite resources and non-renewable resources is re-use and the concept of closed-circle economies – here, the use of a certain resource is extended, in the optimal case, to its absolute use limits through returning resources as close as possible to their raw form and re-introducing them into the production stage (the best example being all forms of raw material recycling), re-using resources at the consumption stage if they are still usable according to pre-determined indicators or using resources in a different capacity at some stage in the value chain (here, increased use of by-products in the sustainable food industry would come to mind). In general, both current developments and historic facts define the idea of sustainability being a struggle against the issue of limited resources – through reducing their use and at the same time optimizing this use as far as possible.

Sustainability in itself is a strongly holistic principle: there is no easy way to exclude any area of modern life and development from sustainability, or find a techno-socio-political dimension that is not affected by the ideas of sustainable development or does not include those ideas in itself. In order to see and create a connection between sustainability and food production/the food industry, an observer does not have to go far beyond the very beginnings of sustainability. Although the first ideas for sustainable management and development came from the forestry sector, the food production (especially if one looks at 18th-century approaches and standards) also dealt with the need for optimal use of finite resources and the, almost even stronger, need to make sure that these resources, or at least the conditions required to create the resources, remain available for repeated use. Simply said, the very nature and basic characteristics of the food production sector push all successful actors to act in a sustainable way.

In the course of this discussion, it is important to understand that sustainability, as shown above, is a developing, dynamic term and field, with the recognition, aims and goals of sustainability constantly changing depending on the current state of discourse in the public and in the academic and legislative communities, the developments undertaken in the latter usually influencing the ideas adopted by the former. Applied to concrete terms and developments, this means that new developments and the up-taking of new ideas in sustainability research, as well as the introduction of new provisions and guidelines by legislative bodies, will reflect on the perception and understanding of sustainability by the general public and, through that, on the way sustainability is interpreted and understood. With regard to the different dimensions of sustainability and their link to fulfilment of different requirements of the public, it can be argued that there are several main factors influencing the ongoing development and the public understanding of sustainability.

II. Understanding Sustainability in the Agrifood Sector

The Agrifood industry has a significant economic and political importance. It is a highly regulated and protected sector in the EU, with significant implications for sustainability such as the fulfilment of human needs (20% of household expenditures), provision of employment (8,3%) and economic growth (4.4% of GDP), and impacts on the natural environment [5]. Of the 283000 food companies in Europe, over 99% are Small and Medium Enterprises (SMEs). These SMEs generate almost half of the industry's food and drink turnover and employ over 61% of the workforce.

The agrifood chain sector is responsible for a large environmental impact [6]-[8]. It is currently heavily dependent on non-renewable energy resources and on the use of chemicals for profitable production [9]. In this situation, a new and more sustainable approach to food production has been developing supported by integrated and efficient production systems, allowing the transformation of agricultural products and delivery to final consumers with a lower use of natural resources, and with lower pollution levels [10]. In Europe, the agrifood sector is responsible for about 30 % of all carbon emissions from economic activities [11]. Within this sector, it has been estimated that agriculture contributes about 49 % of the GHG emissions from the food supply chains of the EU, consumer preparation and food consumption accounts for 18% and manufacturing for 11% of emissions. Reducing emissions from food transport has been a significant trend among retailers through using logistical arrangements such as backhauling and pooling to improve efficiency [12]. A generic input/output model summarizing the environmental impact of Agrifood supply chains is introduced in Fig. 1.

In the centre, we have the supply chain operations. At each stage, we have different types of inputs necessary for operations such as growing, processing and transporting while on the other side we have the outputs as the unavoidable externalities which are growing as inputs increase.

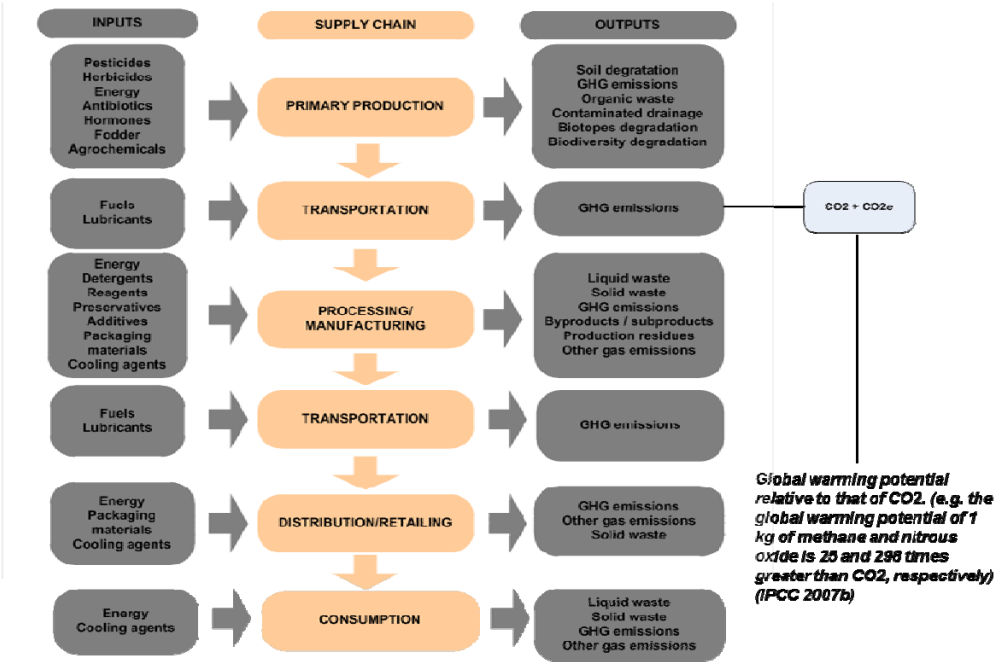


Fig. 1 An input/output model for the environmental impact of Agrifood supply chains

A. Primary Production

Looking at the roots of the development of sustainability in the food industry we can observe that the earliest driving factors for food sustainability were related to the production which puts those factors at an early stage in the value chain, being connected to primary and secondary production of food items. The first of those factors can be described as the perception of a certain food item coming from environmentally sustainable production, with the definition of "environmentally sustainable" being connected to physical indicators describing the individual processes of production as well as the use (or abstinence from using) non-natural supplements during the production process.

B. Food Manufacturing

Sustainable food manufacturing is connected to a sufficient and sustainable raw material flow (of a specific quality); the optimal use of resources (raw materials, energy and other); and the smallest environmental impact as possible. Sustainability may also be related to maintaining a local production and through this have an impact on local income and employment opportunities. Across the EU, locally produced food is attracting much attention from consumers. The number of primary producers and entrepreneurs having ventured into the production of foods and drinks is steadily increasing. By far, such products are produced in small scale facilities thus the market access is quite limited in a geographic perspective. The local products are playing an important role in binding the local communities together, and this pattern is found in all regions of Europe. Furthermore, there are numerous examples of networks being formed by the local producers and very often with the purpose of pushing the local food products further into the market. Due to their nature, the local products are dependent on the climatic conditions, production traditions, and consumption patterns. There are several examples of quality management schemes targeting local food production. Such schemes typically promote local food chains.

C. Distribution and Retailing

If we move along the value chain towards the consumer, the next important factor related to sustainability is the issue of sustainable transport of the goods. This factor is primarily connected to the environmental dimension of sustainability, but on a secondary level also to social and economic indicators. The connection to the environmental dimension is easily made, as shorter and more efficient transport routes decrease environmental pollution by transport means, while the economic and social dimensions are reflected through lower costs of transport as well as the promotion and encouragement of local and regional products.

Moving even farther along the value chain, the next identified factor is one that has risen in importance in more recent times and where the accompanying indicators are still being developed. For the purposes of this paper, we will name this factor sustainable retail of food items. This factor is more strictly related to the social and economic dimension, which also helps to explain its relatively late emergence, while the environmental dimension plays only a secondary role. Sustainable retail of food items primarily focuses on way the goods are put on the consumer market, some of the underlying trends being a shift from large supermarkets back towards small scale retail, such as smaller organic food stores, farmer´s markets and food items being sold directly at their place of production (in the form of farm shops). Other business concepts in this line are supermarkets with a social responsibility profile (e.g. where goods not sold today are

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given away by closing hours), or shops where you can return the packaging for recycling. Sustainability in retailing may also be based on retailers that take an active approach to increase the overall sustainability of the retail chain. In this coherence sustainability may refer to organic products, or products that have a reduced environmental impact.

D. Consumption and Consumers' Concerns

Growing environmental, social and ethical concerns as well as increased awareness of effects of food production and consumption on the natural environment have led to increased pressure from consumer organisations, environmental advocacy groups, and policy makers to agrifood companies to deal with social and environmental issues related to their supply chains within product lifecycles, from 'farm to fork' [13]-[20]. Stakeholders demand corporate responsibility to go beyond product quality and extend to areas of labour standards, health and safety, environmental sustainability, non-financial accounting and reporting, procurement, supplier relations, product lifecycles and environmental practices [21], [22]. Sustainable supply chain management expands the concept of sustainability from a company to the supply chain level [23] and should provide companies with tools for improving their own and the sector's competitiveness, sustainability and responsibility towards stakeholder expectations [24]. Principles of accountability, transparency and stakeholder engagement are highly relevant to sustainable supply chain management. The impact of consumer demand to the environmental efficiency of the agrifood sector is given in Fig. 2. In response to stakeholder pressures for transparency and accountability, agrifood companies need to measure, benchmark, and report sustainability performance of their supply chains, whilst policy makers need to measure the performance of sectors within the supply chain context for effective target setting and decision-making.

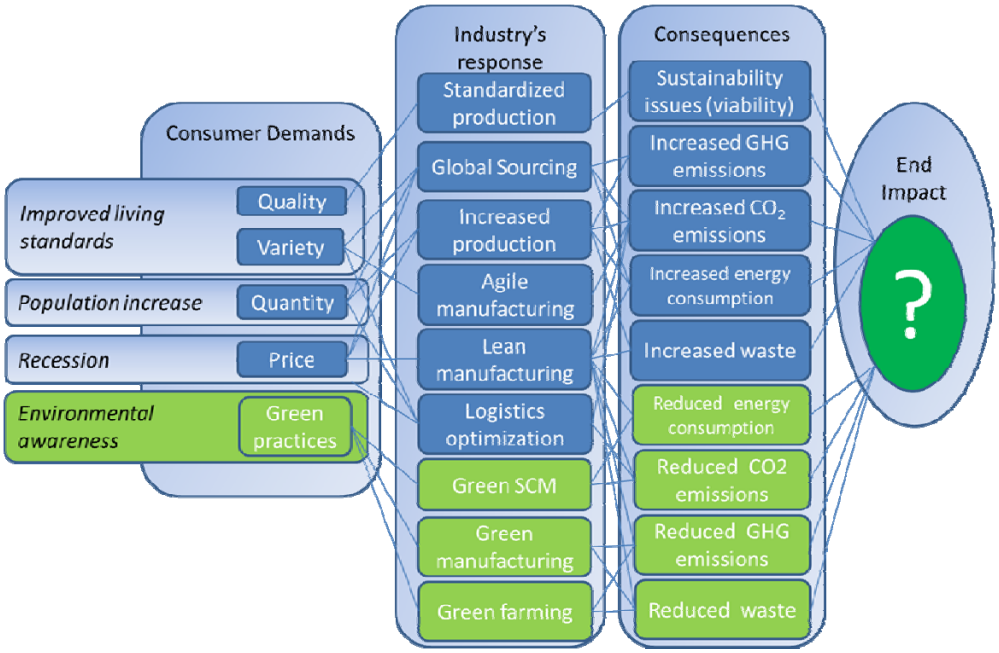


Fig. 2 Consumer demands and impact on environmental efficiency

Consumer demands push the Agrifood supply chains to increase quality of products (e.g. EU and perfect/same shape fruits & vegetables) while pushing prices down, for example by designing leaner logistics operations thus leading to green logistics paradoxes (increasing efficiency in logistics decreases environmental effectiveness) contrary to other sectors, e.g. TQM in the automotive manufacturing.

Other issues that are created by consumer demands include the need for increasing quantities and varieties in the product ranges. With all these increases we can think back to Fig. 1 of inputs/outputs in the SC and realise that more products would require more fuel, more pesticides, and the production of more emissions. There are many examples we can identify and they point to key issues of un-sustainability; looking at how production efficiency can work wrongly for the environment, a typical example is agostinis (a type of crustacean that is used to make scampi – a seafood delicacy) fished in the North Sea by UK Scottish fishermen, sent to Vietnam for processing (cleaning by hand), then taken back to the UK (Whales) for packing and distributing in the UK (mainly England) and the rest of Europe. These operations augment the environmental impacts - first locally, at the point of production or processing, and then globally.

III. Food and Nutrition Security and Sustainability

By 2075, the United Nations' mid-range projection for global population growth predicts that human numbers will peak at about 9.5billion people. This means that there could be an extra 2.5 billion mouths to feed by the end of the century, a period in which substantial changes are anticipated in the

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wealth, calorific intake and dietary preferences of people across the world. Such a projection presents mankind with wide ranging social, economic, environmental and political issues that need to be addressed today to ensure a sustainable future for all. Global population growth, coupled with increasing affluence and urbanisation trends, leads to growth in global demand for food and changing patterns of consumption, with a direction towards the meat and dairy sectors. This will require a 70% increase in food production, challenging a natural resource base that is already under significant strain. It will also require major increases in investment in an era of economic crisis and austerity. Moreover, rising populations with improved living standards in emerging economies will result in absorbing higher quantities and better qualities of food, thus decreasing the flows towards the EU. On the other hand, the issues of affordability, equal access, and availability of quality foods to all Europeans are being re-addressed under the prism of the deepest economic recession of the last seventy years which radically decreased the income of a significant part of the EU population, having direct impact on their food consumption habits. Increasing nutrient deficiency, undernourishment and obesity due to diets largely based on cheap, and heavily processed food are some of the impacts of recession on the EU food consumption landscape.

Increased demand for energy, rising energy prices, demographic changes due to internal and external immigration, the competition with biofuel crops in land use, as well as climate change are highlighting the need for a wider uptake of sustainable practices in agriculture and food supply chains; a greener and socially conscious approach on managing the total food system is essential in order to meet current and future threats to food security and environmental resilience.

The total food system needs to be transformed in order to secure the long-term food supply. The pathway is variable, might be radical and coordinated action at many levels by multiple stakeholders is needed in order to establish the conditions required to move global growth of food supply towards a more sustainable track. This will require major changes in terms of regulations, markets, consumer preferences, food perception, pricing and measurement of profit and loss.

Food and nutrition security is achieved when adequate food (quantity, nutritional quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life [25]. The four pillars of FNS include:

- availability, which refers for the need for enough adequate food to be produced and efficiently distributed,
- access, which refers to the ability to produce one's own food or have the purchasing power to buy it
- utilization and quality: food must be adequate for utilization from a nutritional, sanitary, sensory and socio-cultural point of view; this pillar can also address issues of intra-household distribution
- stability; a pillar that refers to security of access and incorporates issues of price stability, securing incomes for vulnerable populations, as well as the need to ensure the long term sustainability of FNS.

Availability of food as well as feed and fiber is highly relevant for the growing number of million-inhabitant cities across Africa and Asia, as the migration from rural to urban environments will have a strong impact on agricultural production, food processing, food demand and overall access to food. In the EU, the rural-urban dimension is more related to an ageing farmer's generation, lack of employment opportunities in rural areas, and uncompetitive small farms. Therefore, it is necessary to consider the rural-urban dimension of FNS for local conditions. For the EU this would include addressing the CAP system in its present outline as the CAP includes support schemes for agricultural production and for rural development initiatives.

In some parts of the world like the EU it is not the access to food that is the major challenge; rather it is the over-availability of food that has an impact on nutrition security. In other parts of the world the challenge of nutrition security is more linked to a limited availability and variability of food items and/or increased levels of agricultural and post-harvest losses, leading to malnutrition or under-nutrition. This paradox highlights the importance of devising policy measures that are context specific. In the case of the EU the possible set of policies to face over-nutrition ranges from production quality-focused mechanisms, fiscal measures to information and education measures, with the aim of favouring healthier diets. On the other side, policies related to under-nutrition make reference to measures aimed at increasing agricultural production and improving its preservation and processing, to reduce food losses. To address these issues, policies should be developed not only at the production level, i.e., at the farm and business levels, but should consider a community-based approach that includes the vertical and horizontal relations in the food system and the impacts also on environment and society.

The Global Food Security Strategic Plan 2011-2016 [26] lists the following main drivers underlying the challenge of ensuring food security, for the EU and globally:

- Global population growth, coupled with demographic change, increasing affluence and urbanisation, will lead to growth in demand for food and changing patterns of demand – rising affluence is associated with increases in food consumption, especially of meat and dairy products.
- Global climate changes may lead to floods, heat waves and droughts, as well as to changes in the distribution and/or severity of pests and diseases (including moulds and zoonotic infections) with potentially severe impacts on food production and animal welfare.
- Environmental impacts of farming and food: negative impacts can include increasing water and land use, soil erosion and degradation, loss of biodiversity, as well as greenhouse gas emissions and water pollution.

- Key resources for agriculture are limited, notably land, fresh water and energy, but also sources of other inputs such as mineral phosphate (an essential plant nutrient).
- Social drivers include urbanisation, demographic change, issues of land tenure, governance and international security, changing patterns of consumer needs, preferences, choices, tastes, habits and practices affecting the demand for and consumption of different foods and patterns of waste.
- Economic drivers include issues of trade, land tenure, food markets and their volatility, supply and distribution, regulation, affordability and accessibility (particularly in the developing world) with associated globalisation.

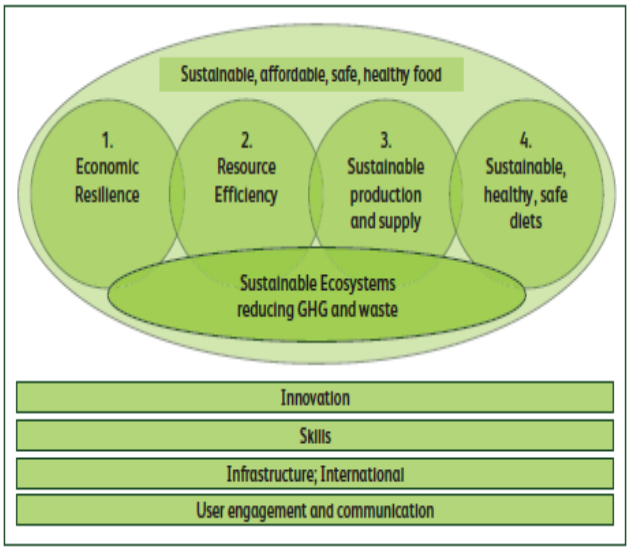


Fig. 3 Global Food Security programme themes [25]

Global food shortages do not consequently constitute the foremost challenge for future food security. The main challenge instead involves working incrementally towards enhancing sustainability of the global food system. Achieving sustainability within the long global supply chain that encompasses different countries and numerous participants and stakeholders is not an easy task. Moreover, there are numerous uncertainties and constraints and a number of sustainability drivers that must be tackled on time in order to produce the 70% more food that will be needed to feed the world in 2050. The local food supply chains of individual countries should be integrated into a smoothly operating global food supply system.

The increase in aggregate agrifood demand, and particularly in the consumption of resource intensive foodstuffs, is directly responsible for the rising ecosystem-level pressures on land, water and other natural resources used in the production of food. The global agriculture sector is extremely resource intensive. The global production of food occupies nearly one quarter of all the habitable land on earth. It is responsible for more than 70% of fresh water consumption, for 80% of deforestation, is the largest single cause of species and biodiversity loss and produces more than 30% of global greenhouse gas emissions. It continues to represent the single greatest cause of land-use change [27].

Climate changes and resource scarcity will definitely affect agricultural production in the EU and globally, and can lead to increased productivity in some areas and reduced or ended production in other. Having access to production resources and technologies that are developed for (climate-) smart agriculture can play a crucial role in securing FNS in Europe, Asia and in Africa. Technologies such as mechanization, modern seeds and livestock breeds and wireless solutions for climate-smart agriculture are considered some of the means to be applied to offset the negative consequences of climate changes. But resource scarcity for food and feed production is not only the result of climate changes, also political decisions on land use, access to farm land and energy sources may have a strong impact on the productivity of agriculture in EU and globally and opportunities for income generation from farming – positively and negatively.

The global population is forecasted to be 9 billion people by 2050 and the need for sufficient amounts food will imply that agricultural production must increase at least 70 % compared to the present production level, but if crops for bioenergy purposes are included then crop production needs to be expanded even more. This calls for an urgent need of intensification the agricultural products. This can be achieved by alone or in combinations of more resource-intensive and productive agrifood systems, applying new technologies or by specialization, trade, collaboration, and by developing new business models for small farms, family farms and small businesses in the agrifood sector. Sustainable agriculture can potentially affect food security and nutrition through the following intensification pathways:

- Making food available through production;
- Reducing the real cost of food by increasing the supply of food. The composition of production also matters, since this affects the availability and prices of different foods with their varying nutrients;
- Generating incomes for farmers and those working land as labourers allowing access to food; and through
- Providing incomes to others in the rural economy from linkages in production and consumption that create additional activity and jobs.

IV. Introducing a Five-Dimensional Model for Integrating FNS with Sustainability

While the economic, environmental and social dimensions are used throughout sustainability/sustainability development literature, an extension of this model is needed in order to accurately represent the measures and policies addressing food and nutrition safety (Fig. 4).

The policy/political dimension, represents the need for sustainability to be reflected in the policy-making process as well as current legislature. This approach follows ideas about political sustainability developed by other researchers [28], [29] but diverges in the assumption that political sustainability cannot be seen as a separate dimension, but should rather be considered as an underlying "layer" of measures, actions and

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guiding principles underlying the other four dimensions. The caveat here is that even though ongoing development of sustainability supports the move from considering policy sustainability as a separate topic towards implementing policy sustainability in all areas of modern life, this diffusion might also lead to actors from other dimensions giving policy sustainability only a secondary priority or even outright ignoring it – effectively, turning "everyone's responsibility" into "no one's responsibility". With this caution being put forward, the authors still feel the necessity of introduction political/policy sustainability into this model for the sake of obtaining a more complete representation of the system.

Each of the rest of four dimensions of sustainability (environment, economy, technology and society) consists of two main sub-factors (e.g. society's sub-factors are Culture and Population), and that each sub-factor can be described and analysed according to a number of parameters. For Culture such parameters could include gender issues, dietary habits and tradition.

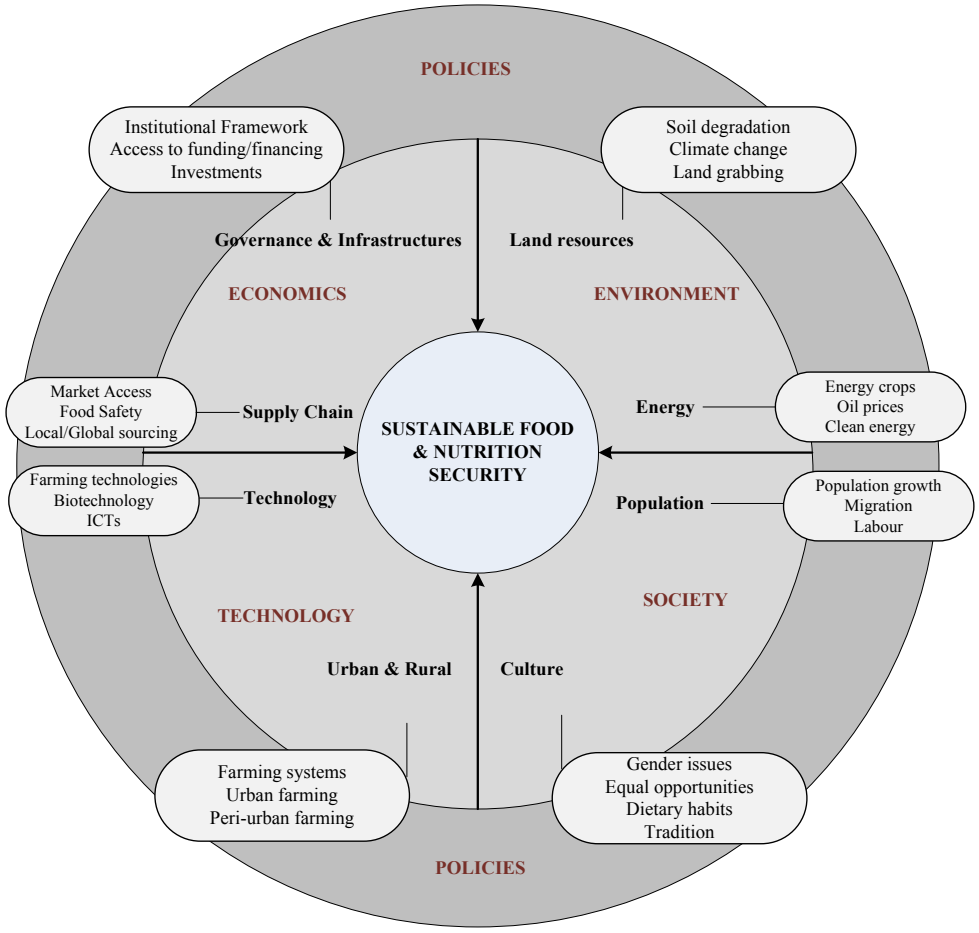


Fig. 4 A five-dimensional model for integrating FNS & Sustainability

The technological dimension is representing user-artefact interactions and the "simple" use of technological items and item combinations to increase the sustainability, but especially the environmental performance of a certain process. The roots of this idea can be traced to the early stages of Ecological Modernisation Theory where technological innovation and advancement was seen as a way to tackle environmental challenges. Although this approach has been criticized as being potentially oversimplified and technocentric [30], the author has decided to use it for the technological dimension with the understanding that potential shortcomings regarding economic and social issues will be offset by addressing the social and economic dimensions of sustainability as separate categories. The second perceived criticism of the technological dimension revolves around the potential complications arising from the need to separate the technological dimension as a separate level from the use of technological artefacts in order to improve sustainability performance across the other three dimensions. Here, a possible solution lies in the separation of the use of technology as a necessity to achieve increased sustainability performance as opposed to the idea of achieving sustainability by a particular technology as a means in itself. If a management perspective is taken, this separation can also be explained through the three "traditional" dimensions of sustainability representing a "market pull" approach to achieving sustainability through the use of technology, while

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technological sustainability might represent "technology push" conditions.

The role of the agrifood industry stakeholders (i.e. producers, processors, etc.) is to maintain a balance between the 8 sub-factors (covering the 4 dimensions of sustainability considered in the model) for achieving resilience in a sustainable FNS context. Resilience in food systems means that the food systems can adapt and transform themselves in such a way that no matter what the future looks like, they can still produce enough healthy food to which everyone has access, avoid environmental damage, and contribute to livelihood generation [31]. In the context of the Sustainable FNS model, resilience is taken to mean ability of agrifood industry stakeholders to overcome shocks and not suffer long-term adverse consequences. This implies that stakeholders are able to withstand or overcome adverse shocks, recover and continue to transform them. Shocks are never static, but change over time and some may not be anticipated at all. Common shocks that have direct effects on FNS include: conflicts and displacement of people; climate change variability; food price variability; natural, and health disasters. Resilience considerations will need to factor potentially adverse shocks at farm and community levels since they may require different response instruments at different scales.

The agrifood stakeholders' choice of production and income generation is influenced by a number of factors of which the stakeholders have only limited control of. Such factors are presented in the Model and are considered as relevant in a local, national and global scale. Each factor may influence the stakeholders in more ways. In the example of Land resources, issues of land grapping, soil degradation or climatic changes will impact land availability for farming. Similarly, for Technology, GM crops, farm machinery, knowledge and access to information (IT) are important factors for the technology level applied from a stakeholder. Furthermore, the farmer's choice is influenced by supply and demand for food, feed, fiber, and aquatic products, and opportunities for alternative ways of generating incomes on farms. Access to markets, adequate information, and knowledge and technologies all play a strong role in driving the farmer's choice of production. Therefore, it is a key issue to empower the farmer with an enabling environment including the farm's business partners (i.e. the community) and necessary infrastructure and resources for fostering contribution to sustainable FNS.

In the past, the promotion of sustainable agriculture has focused on minimizing the impacts of agriculture on the environment, and many stakeholders have felt, and continue to feel, that this "robs" them of already limited opportunities for growth. The challenge will be to develop and scale up a sustainability landscape approach that takes these concerns into account. Agreements between producers, manufacturers and retailers on the 'right' balance of priorities within a local or regional setting assure an impact on a local and regional view which, in turn, may result in a global reach. Eventually, food security, nutrition security, food safety, energy, carbon footprint, water footprint, cultural identity, demographics, urbanization etc. are all representing sustainability concerns within the five major dimension of sustainability.

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Open Science Index, Nutrition and Food Engineering Vol:10, No:6, 2016 publications.waset.org/10004606/pdf