The Concept Sustainable Agriculture: Challenges and Prospects

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Abstract. Agriculture has changed dramatically, especially since the end of World War II. Food and fibre productivity raised due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. Sustainable agriculture is a subject of great interest and lively debate in many parts of the world. Most agriculturalists agree that the concept of sustainable agriculture is of paramount importance to the sustainability of our biosphere and its ever increasing human population. This paper is an effort to identify the ideas, practices and policies that constitute concept of sustainable agriculture.

1. Introduction
Sustainable agriculture is a subject of great interest and lively debate in many segments of the world. The debates stem largely from differing viewpoints as to what is sustainable agriculture [1-5]. Sustainable agriculture is defined as a system that, “over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fibre needs; is economically viable; and enhances the quality of life for farmers and society as a whole”[1, 6, 7]. From this statement numerous definitions emerged but the concept surrounding agricultural sustainability remains the same. Also sustainable agriculture is defined as a commitment to satisfy human food and fibre needs and to enhance the quality of life for farmers and society as a whole, now and into the future. Consequently, there is that no brief, universally acceptable definition of sustainable agriculture has yet emerged. This is because sustainable agriculture is viewed more often as a management philosophy rather than a method of operation [8], and as such acceptance or rejection of any definition is linked to one’s value system [9]. But regardless of its precise definition, most agriculturalists agree that the concept of sustainable agriculture is of paramount importance to the sustainability of our biosphere and its ever increasing human population. Sustainability hinges on a combined focus on environmental changes and their impact on society (people), the environment (planet) and economic value (profit) known as the ‘Triple Bottom Line (TBL)’. Increasingly it is being recognised that people, profit and the planet dimensions are interlinked and an important challenge for public and private policy is to take them jointly into account (Figure 1) [7].

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Agriculture has changed dramatically, especially since the end of World War II. Food and fibre productivity raised due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. Agriculture is highly susceptible to climate variability and its related effects. Food security and maintenance of sustainable ecological balance are major challenges for thinkers, researchers, conservationists and policy makers. Sustainable agriculture should be taken as an eco-system approach, where soil-water-plants-environment-living beings live in harmony with a well balanced equilibrium of food chains and their related energy balances. The goal is to address environmental issues of natural resource management to sustain significant increases in farm productivity through the efficient use of land and other resources and provide better economic returns to individuals and contribute to the quality of life and economic development. It is essential that innovative technologies are used to ensure sustainable agriculture and productivity using, modern irrigation systems, improved varieties, improved soil quality and conserving the environment using resource conservation technologies [2]. Although these changes have had many positive effects and reduced many risks in farming, there have also been significant costs. Prominent among these are topsoil depletion, groundwater contamination, the decline of family farms, continued neglect of the living and working conditions for farm labourers, increasing costs of production, and the disintegration of economic and social conditions in rural communities. Sustainable agriculture emerged as part of a growing critique of the negative environmental consequences of unquestioned modern farming methods [4]. Even thought, the concept of sustainable agriculture is still new, however, the issue for sustainable agriculture is gathering increasing support and acceptance within mainstream agriculture. Not only does sustainable agriculture address many environmental and social concerns, but it offers innovative and economically viable opportunities for farmers, consumers, policymakers. This paper is an effort to identify the ideas, practices and policies that constitute our concept of sustainable agriculture. The challenges to agriculturalists circulate around the abilities of agricultural engineers to develop and implement new technologies that will allow the farmers to maintain and increase yields of agriculture products while increasing ecological efficiencies.

2. Environmental Perspective
Increasingly, the idea of sustainability agricultural has come to be associated with the maintenance of environmental quality both on and off the farm. One of the environment related activities is modern commercial agricultural systems, characterized by intensive tillage and cropping practices, and high
rates of mechanization and chemical input use have resulted in excessive amounts of soil erosion and nutrient loss, impairing the productive capacity of soil resources and placing greater emphasis on the use of purchased inputs [2]. Such systems of agriculture are increasingly regarded as unsustainable. In these cases, sustainability is defined as the preservation of the productive capacity of the land resource. Another environment-related interpretation of sustainability concerns the effect of agriculture on the natural environment beyond the farm gate and apart from the productivity of cropland. Pollution of surface and ground water resources due to transport of chemical fertilizers from farm fields are two commonly expressed concerns related to sustainable agriculture. Loss of species' habitat and reduction in biological diversity are also concerns of those with an ecological orientation toward sustainability. In contrast to the concerns about reduced productive capacity, this ecological perspective on sustainability suggests that natural resources should be protected in their own right, and should not be placed at risk by agricultural activities which are not environmentally friendly [10].

3. Economic and Social Perspective

In addition to ensuring long term food production and environmental quality, the concept of sustainability is also applied to producers and rural communities. For many analysts, the sustainability of agriculture can be described by assessing the economic returns of farming [11]. In commercial economies, farms which are unable to generate sufficient profits, because of low farm product prices, reduced yields, higher costs of production, or other reasons, that are not self staining. Consequently, a requirement of agricultural sustainability is the sustainable agriculture existence of economic returns which are sufficient to sustain farm businesses, and to adequately reward producers [12]. Also a broader interpretation of sustainable agriculture extends the farm viability concept to the maintenance of rural community systems. This view holds that prospects for environmentally friendly agriculture which is efficient in its production of food and fair in its distribution of benefits are greatest when agriculture functions within a healthy rural community system which supports local decision-making and stewardship values [13]. The idea of equity transcends food, environment and producer objectives, and is frequently adopted as the central characteristic to define sustainable agriculture. For many, the preservation over time of productive capacity, or environmental integrity, or family farming represents a fundamental element of sustainability. Hence intergenerational equity in agriculture refers to the protection of the rights and opportunities of future generations to derive benefits from resources which are in use today [4]. Agricultural practices which diminish long term prospects for food production or impair water quality or other natural resources, regardless of their short term benefits, are not considered sustainable. Equity concerns are not limited to safeguarding the future of agriculture. The principle has been applied to describe the rights of less advantaged groups in society to basic food supplies, and to the opportunities and resources required to farm in ways which enhance prospects for sustainability [14]. Thus, intragenerational equity refers to the fair and equitable distribution of benefits from agriculture among and between countries, regions or social groups.

4. Challenges and Prospective

This study has explored several techniques of sustainable agriculture, including interpretations of the sustainability concept, alternative methods of pursuing sustainability in the practice of agriculture, and analytical options for assessing the performance of food production systems in the face of changing conditions [15]. Agricultural practices should be consistent with certain principles of sustainability, including the preservation of the productive capacity of soil and the avoidance of off-farm pollution and environmental degradation. Yet, the literature suggests that the adoption of more environmentally friendly farming practices should be adopted. However, the benefits of sustaining agriculture accrue not only to farmers, but also to societies generally, now and in the future. Also, sustainable agriculture is not just an analytical question, defined in terms of environmental quality, productivity, sufficiency or whatever, but it is also a philosophy toward farming. By its nature, the concept is goal oriented and value loaded. However, it is unlikely that all goals and values associated with sustainable agriculture will be achievable simultaneously, or even sequentially. For example, should farmers be required, or
even expected, to adopt practices which would yield environmental benefits at the possible expense of economic viability? Notwithstanding the value of analytical procedures in providing information, much future action in pursuing agricultural sustainability will be determined by decisions and trade-offs made among and between goals, both individual and societal [11]. Again, much of the thinking regarding sustainable agriculture has been done in the context of the 'supply side' of the food production equation. Analysts have sought to assess the productive capacity of land and the impacts of various phenomena in order to measure the potential for food production. While much is now known about the implications of such supply side factors as soil erosion and land conversion, the more important and intractable questions may be on the demand side of agriculture. For example, world population growth, or rapidly increasing demand for food because of improvements in income may have a far greater impact on the ability of agriculture to meet demands for food than do the biophysical limits to production. Consequently, understanding of the prospects for sustainable agriculture globally requires further progress in forecasting, and perhaps dampening, future levels of demand [11, 16]. This is complicated by uncertainties regarding population growth, and even more so by several factors such as government policies which affect access to foreign markets, and the role of regional agricultural systems in supplying food aid in the developing world. Finally, there is a need to better understand the nature of agricultural system response to disruptions of all types in order to anticipate how agriculture might be affected by various changes in the future [17]. In addition, the impacts of some forces, such as climatic warming, on the prospects for sustaining food production have typically been predicted with some bold assumptions on how farmers, or the agricultural system generally, will respond to changed conditions. For example, it is often assumed that technological innovation will allow agriculture to continue to achieve high outputs of food, or that farmers operating in an altered climate will know precisely how best to adapt to new opportunities for food production, and that they will do so. In reality, little is known about the processes of response and adjustment in agriculture, particularly at the aggregate scale [11, 14, 16]. Improved understanding of these adaptive processes in agriculture would enhance assessments of agricultural sustainability and improve prospects for achieving it.

5. Conclusion
Agriculture has changed dramatically, especially since the end of World War II. Food and fibre productivity raised due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. New policies for ensuring the sustainability of agriculture will be crucial if we are to meet the demands of improving yields without comprising environmental integrity or public health. Given emerging pressures and resource constraints, agricultural policies need to help meet the objectives of poverty reduction, agricultural production and environmental sustainability. A major challenge is to create policies, institutions and technologies that make the goals more compatible.

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