

## Review

# The concept of sustainable agriculture: Global and African perceptions with emerging issues from Swaziland

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**This paper presents a review of literature in sustainable agriculture and related concepts, which entail economic, social and environmental considerations. It starts by introducing the concept of sustainable agriculture and the reasons behind its promotion in the modern day agriculture industry. The concept of sustainable agriculture is discussed together with the principles of sustainable agriculture and some concerns in agriculture. Changes which are a threat to sustainable food and fibre production include a decline in agriculture production, increasing fuel and transportation costs, increase in food prices, population growth, environmental degradation, climate change, flaws of global market, decreasing biodiversity, desertification, reduction in water supply and quality. Global and national development in agriculture through the use of irrigation water is highlighted as a technology advance in modern agriculture. Finally, this paper discusses anticipated future developments in as far as smallholder irrigation is concerned in Swaziland.**

**Key words:** Sustainability, agriculture, economic, social, environmental.

## INTRODUCTION

### Sustainability and agriculture development

#### *The concept of sustainable agriculture*

These days the word “sustainable agriculture” has become a main issue of dialogue or rather a buzzword among scientists and policy makers as a means to express their vision for better agriculture. According to Rehber and Grega (2008), the vision for better agriculture is based on the 1992 Rio Declaration on Environmental and Development, Chapter 14 of Agenda 21, adopted by the UN General Assembly, and on the 1996 Rome Declaration on World Food Security. The advances for better agriculture development have been due to the fact

that agriculture is proclaimed to have a significant contribution to the negative changes the world is currently experiencing in the natural environment. It has been observed that human activities around agriculture development have led to huge losses of soil through soil erosion, loss of organic matter and loss of the biotic capacity of soils to nurture plant growth, structural deterioration, compaction and hard setting, nutrient imbalance and leaching, salinity, and diminution of root zone-moisture characteristics, as manifested through reduced water holding capacity and infiltration, draughtiness or water logging (Chel and Kaushik, 2011). Secondly, the changes in land use for agriculture are attributed to climate change which increases temperatures and reduces water supply in soils therefore leading to reduced crop yields per hectare (ha). Furthermore, the changes in land use patterns have resulted in deforestation, desertification, overgrazing and pollution by fertilizers herbicides and pesticides. Jordan and Constance (2008) states that the current state of

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affairs is a result of revolutions that have been taking place in agriculture: human beings shifting from traditional farming methods to modern techniques of plant and animal production.

Therefore, since the publication of Agenda 21, agricultural sustainability has become a priority as the world strives to increase food production and enhance food security in an environmentally sound way, so as to contribute to sustainable natural resource management.

In view of the fact that sustainable agriculture is a direction not a destination, there is no universal definition of sustainable agriculture. Several authors and organizations worldwide give their own definitions of sustainable agriculture. Despite all the different definitions, all the authors agree with the fact that a sustainable agriculture project must be "capable of maintaining its productivity and usefulness to the society over the long run, it must be environmentally sound, resource-conserving, economically viable and socially supportive, and commercially competitive" (Dantsis et al., 2009; Lichtfouse et al., 2009). Chel and Kaushik (2011) regard agricultural sustainability as a societal goal to be pursued forever and for everyone. The concept of sustainable agriculture is guided by five principles (productivity, security, protection, profitability, and social justice) which are briefly discussed subsequently.

### ***Principles of sustainable agriculture***

**Maintenance and development of production and services (productivity):** Sustainable agriculture calls for appropriate land use and management practices for the achievement of increased yields and improved food production to feed the world population and to reduce poverty. According to Lichtfouse et al. (2009), farming systems should be able to reach economic viability, environmental protection and social justice through the use of fewer inputs without reducing the yields considerably. Therefore, this requires shifts to crops with higher yields or value, less inputs per unit of production, and higher standards of management in terms of technology and agronomic practices. This should then result in higher output per farmer and more job opportunities in the agriculture service sectors.

In addition, agricultural production technologies should be more carefully tailor made to local environmental conditions, and farming systems should be more flexible, more diversified and developed on a broader genetic base in order to increase input efficiency and value-added marketing.

**Reduction of production risk (security):** In the past, farmers believed that increasing agricultural inputs was the most effective way to raise yields and considered produce price as the primary factor in agricultural production (Ma et al., 2009). In order to reduce risk in

agriculture investment, now the emphasis is on higher economic efficiencies to increase agriculture production even under the conflict of higher price of inputs versus the low price of agricultural products. Therefore, farmers must be able to evaluate business, technical and market risks associated with their agricultural enterprise.

**Natural resources conservation and prevention of degradation (protection):** Sustainable agriculture emphasizes that agriculture production practices must work within the bounds of nature not against them. This entails matching land uses to the constraints of the local environment, planning for production not exceeding the biological potentials of the area, carefully limiting fertilizer, pesticides and other inputs to ensure that they do not exceed the capacity of the environment to absorb and filter any excess. Moreover, sustainable agricultural systems should maintain or improve ground water and surface water quality as well as regenerate healthy agricultural soils.

**Economic viability (profitability):** Since the concept of sustainable agriculture advocates for a healthy agro-ecosystem, it must be profitable to motivate those implementing it. Therefore, economic viability comprises profit maximization through proper selection of enterprises, sound financial planning, proactive marketing, risk management and good management. In addition, sustainable agriculture advocates for change of government policies in order to promote the economic viability of agricultural enterprises that are not a threat to the ecosystem.

**Social acceptability (social justice):** A sustainable agricultural system improves the quality of life of individuals and communities. There is no sustainability if an agricultural enterprise is ecologically sound and economically viable in the absence of social justice. Agricultural enterprise must fairly meet the basic food and fibre needs of human beings, must provide economic opportunities for both owner and neighbours in a community setting, must support self-determination, and ensure social equity for both current and future generations. Social acceptability must ensure that agriculture works within the bounds of the society, not against it. Indicators of such include equity, social mobility, social cohesion, empowerment, cultural identity, and institutional development.

### **Global concerns on modern agriculture development**

Since agriculture is the backbone for economic development in a majority of developing countries, issues

of its sustainability are vital for addressing some of the major current concerns in agriculture development worldwide. Included among the changes which are a threat to sustainable food and fibre production decline in agriculture production, increasing fuel and transportation costs, increase in food prices, population growth, environmental degradation, climate change, flaws of global market, decreasing biodiversity, desertification, reduction in water supply and quality, etc (Lichtfouse et al., 2009; Dantsis et al., 2009; Rehber and Grega, 2008). Developing countries are more affected by the challenges as food security is a growing challenge and it is also anticipated that developing countries will have a larger proportion of population growth. Therefore, it is very imperative for developing countries to engage in sustainable agriculture production in order to meet the food and fibre demand of their populations even with the changing weather conditions. The changes in weather conditions which involve the recurrent drought situations, especially in the South African region, continue to negatively impact economic development efforts by governments towards improved food security and smallholder agriculture development.

## **SMALLHOLDER AGRICULTURE DEVELOPMENT**

### **Africa: Strategies to improve smallholder production**

According to Panahi et al. (2009), agriculture is still the largest productive sector in the economies of both developed and developing countries since it is the source of most economic growth, employment and the largest contributor to export revenues. However, in Africa, the growth of agricultural production has been disappointing as the per capita agricultural productivity has remained stagnant for over 40 years (Panahi et al., 2009; Jama and Pizaro, 2008). This happens in a region where about two thirds of the population live in the rural areas and are smallholder farmers who are dependent on agriculture for livelihoods (Toenniessen et al., 2008). The reasons behind the poor performance of the agriculture sector in Africa as stated by scientists and researchers include, 1) policy and institutional failures; 2) economic and financial challenges; 3) declining investments, 4) the inability of technology and water resources to supply the growing demand; 5) poverty and rural income challenges; and 6) environmental factors and the sustainability factor. Kydd et al. (2004) further state that the disappointing performance in agriculture and the high poverty levels in Africa compared to other regions are due to poor governance, uncertain price of products, uncertain market opportunities, low rainfalls and small land under irrigation.

As a result of the poor performance of the agriculture sector, approximately half of the people living in rural areas are living in extreme poverty, earning less than

\$1/day, and one third are estimated to be undernourished.

Despite the poor agricultural performance, African countries still believe that with substantial investments and necessary support, smallholder farming can be productive and engage in competitive markets. Such support may include soil fertility improvement, improved seeds, market access, extension services, access to credit, improvement in weather forecasts, etc. According to Jama and Pizarro (2008), the promotion of improved agriculture performance through smallholder development can drive poverty in three broad dimensions, 1) the direct effects of increased agricultural productivity and income on the rural poor; 2) benefits of cheaper foods for both the urban and rural poor; and 3) agricultural contribution to economic growth and the generation of more opportunities in the farming sector. Therefore, many African countries have made huge investments in irrigated agriculture for smallholder development as a means to meet the demand for food that is coming up with the growing population. Panahi et al. (2009) stated that water management is critical for future growth and social wealth in both developed and developing countries. This is true given that within the agriculture sector, irrigated farming enhances value adding, farmer's income, and food security at global, national and at household level by rapidly meeting the rising demand for food at affordable prices.

### **The role of smallholder irrigation in sustainable agriculture**

Literature reviewed by Smith (2004) indicated that the contribution of irrigation, especially in smallholder irrigation schemes, can either be positive or negative depending on the management practices applied. The subsequent discussion concerns the contribution of irrigation towards the objectives of sustainable agriculture:

#### ***Improved agricultural productivity***

Where all conditions are favourable, irrigation can boost agricultural productivity in the following ways: It improves productivity by ensuring adequate water throughout the growing season, resulting in higher yields and high quality farm produce; securing a crop where rainfall is inadequate or too variable; allowing growth of multiple crops by making water available throughout the year and also cultivation of new crops or varieties for which market opportunities exist; improving the timeliness and /or crop duration, allowing area expansion and/or increased cropping intensities; enabling farmers to adopt timing of production to market demand and higher prices, to take advantage of good weather conditions, or to avoid

adverse weather conditions; facilitating multiple farm enterprises around livestock, crops and agro-processing; and raising farm household and hired labour productivity as a result of high output expectations.

### ***Reducing of production risk***

Since agriculture investment analyst's emphasis is now on higher economic efficiencies to increase agriculture production even under the conflict of higher price of inputs versus the low price of agricultural products. Irrigation can reduce production risks through reducing flooding, water-logging and soil salinization (if well designed); allowing farmers to diversify into high value crops or enterprises instead of specialization or the low-value subsistence diversification; enabling management of the micro-climate to reduce incidence of frost or low temperatures that damage crops; allowing the use of complementary inputs such as improved seeds and fertilizers thus reducing the risk of low yield and returns; offering increased, more continuous and more evenly spread farm employment and improved wages to landless and marginal households; and by improving security against impoverishment and the need to dispose assets or enter into debt by marginal households.

### ***Natural resources conservation and degradation***

Irrigation can impact the environment in the sense that poor designs, construction or operation and maintenance can have upstream or downstream impacts such as water-logging, salinization and groundwater pollution through increased usage of agro-chemicals. On the other hand, positive impacts of irrigated farming can increase farmers' ability to invest in land improvements that enhance sustainability, by reducing pressure on surrounding marginal areas. In addition, through the use of improved cultivars, agro-chemicals and the availability of irrigation water agricultural intensification can be expanded to marginal areas.

### ***Contribution to societal growth and poverty reduction***

Irrigation agriculture contributes to the empowerment, access to rights and improved quality of life for the rural poor. Through capacity enhancement on livelihood improvement, irrigated farming can increase access to decision making, and support independency, self-confidence and assertiveness. It also promotes and enhances the capability for collective action and participation in community activities. In addition, it improves households' ability to pay for utilities, goods and services like health and education. Households may also

derive multiple usage of water such as water for drinking, washing, homestead gardens and for livestock drinking.

With regards to infrastructure development, irrigation improves communication, market access, farm support services and eases transport of farm inputs and outputs. On the other hand, irrigation can worsen poverty if it involves land consolidation in which poor households lose rights to land or if it involves the displacement of labour by mechanization or extensive herbicide usage.

### ***Contribution to economic growth***

At community level, irrigation improves the productivity of assets (land and human capital). It also improves the ability of households to engage in high value crops, intensified livestock, and access to capital and market opportunities. Through improved productivity, irrigation increases income for both household and employed labour. It also stimulates the ease of farm input supply, output processing and distribution enterprises hence lowering the price of food. At national level, irrigation ensures investment in agriculture itself, it improves the supply of food, raw materials and exports (gain in foreign exchange), it realizes surplus capital and labour to the non-farming sector; and it stimulates demand for local goods and services.

### ***Sustainability of smallholder irrigation projects: Africa***

As a result of wide spread poverty in Africa, many of its countries have put smallholder agricultural development as a priority in all their development programmes. Since water is important for the productivity of a society and the livelihood of its members, many countries have promoted irrigation development over the years. The key objective is to ensure that irrigated agriculture adds value to the agriculture sector, increases farmers' income, and improves food security at household, national and global level in order to rapidly meet the rising demand for food at affordable prices (Panahi et al., 2009). Many of the irrigation projects have been supported by public funds, either national or international and implemented by state or government agencies who take charge of project management and other guarantee services.

Despite all the huge investments by the national and international stakeholders on smallholder irrigation, Yves le-gal et al. (2003), Manyatsi (2005), Fanadzo et al. (2010), Malaza and Myeni (2009) and Tapela (2008) reported that irrigation schemes are faced with the challenge of ensuring long-term sustainability. As a result, many of the irrigation schemes are not performing up to the expected standard hence continued decline in agricultural productivity, especially in the rural areas. The challenges range from technical level (maintaining and

replacing the hydraulic infrastructure, poor agronomic practices leading to low yields); to economic level (covering the long-term water costs, high debt, low farm income, market constraints and high input costs), social level to (conflicts, exclusions, and continued poverty), to ecological level (preserving water and soils under irrigation).

A study conducted by Fanadzo et al. (2010) in South Africa reported that smallholder irrigation schemes are performing poorly and have not yielded the intended objectives of increasing crop production and improving rural livelihoods. This has been attributed to limited knowledge of irrigated crop production. In addition, studies conducted in other African countries indicate that although irrigation plays a fundamental role in world food provision, up to date, it has performed below expectations in Sub-Saharan Africa (Garcia-Bolanos et al., 2011; Panahi et al., 2009). In Swaziland, Malaza and Myeni (2009) indicated that farmers under the Komati Downstream Development Project (KDDP) have a sustainability challenge which can be ascribed to combined factors including smallholder management practices, institutional capacities and external capacities. Furthermore, Manyatsi (2005) concluded that smallholder irrigation schemes in the country are far from addressing the livelihood security in the rural areas.

## AGRICULTURE IN SWAZILAND

### Overview of national context

The kingdom of Swaziland is a small landlocked country with a total area of 17,364 km<sup>2</sup>, located in South eastern Africa bordered by Mozambique to the east and the Republic of South Africa on all the other sides. Swaziland is located at latitude 31° 30' east of Greenwich and longitude 26° 30' south of the equator. The country is characterized and traversed by four agro-ecological zones (AEZs), namely Highveld, Middleveld, Lowveld and the Lubombo. Annual rainfall ranges from 500 to 1500 mm, with an average of 788 mm per annum (GOS, 2010).

Politically, the country is divided into four administrative districts, each administered by a Regional Administrator. There is Hhohho in the North West, Manzini in the centre (Midwest), Shiselweni in the south and Lubombo in the east. The districts are transgressed by the AEZs. The country's population is estimated at 1,126,000 inhabitants, with annual growth rate of 2% (CSO, 2010).

The total renewable water resources of the country are 4.51 km<sup>3</sup>/year, of which 42% originates from South Africa. Irrigation uses about 90 to 95% of the water resources in the country (Lankford, 2001). Efforts towards improvement of agricultural productivity especially under SNL are constrained by the lack of water. According to Mlilo et al. (2011), the cultivated area is estimated at

190,000 ha (178,000 ha is under annual crops and 12,000 ha is under permanent crops). Maize is the major crop in SNL because maize is the country's staple food.

However, there has been a noticed increase in the number of farmers in SNL growing sugar cane, especially those under irrigation.

The irrigation potential for the country, based on the physical land capability and water availability, is estimated at 93,220 ha. Mlilo et al. (2011) reported that about 50,000 ha of the irrigated land is used for sugar cane production. Over 84% of the irrigated land is in the Lowveld, with 15% in the Middleveld. Concerning the types of irrigation, the author stated that about 52% of the land is under surface irrigation, while 48% is on other systems (draglines, fixed sprinklers and centre pivots). About 4000 ha of the irrigated land is under smallholder farmers mostly managed schemes, and irrigated mainly by overhead methods.

### Smallholder irrigation in Swaziland

As a result of the importance of agriculture in Swaziland's economy, the government has prioritized water driven agriculture development programmes. It is anticipated that water will stimulate economic development by its contribution to the Gross Domestic Product (GDP) via agriculture export earnings and improved livelihoods of the people. Water development is critical in rural development because it promotes the development of other infrastructure like roads, electricity and potable water, communication and provision of better health and education for the rural poor.

Since the challenges of poor agriculture productivity are most felt in the rural areas, the irrigated agriculture development programmes are implemented in SNL. These are aimed to raise productivity and enable small scale Swazi farmers to convert from principally subsistence to commercial crop production (Terry, 2007).

Consequently, the government has made huge investments in constructing and operating dams as a means of mitigating poverty in the rural areas. Such investments include, firstly, the (KDDP) on the Komati River in the northern Lowveld, irrigating 7,400 ha and dependent upon the Maguga Dam which was completed in 2002. The second is the ongoing Lower Usuthu Irrigation Project (LUSIP) which will service 14,500 ha in the southern Lowveld.

Sugarcane is by far the dominant irrigated crop in the country, covering over 91% (more than 50,000 ha) of the harvested irrigated cropped area hence the largest single foreign exchange earner in the country (SADC, 2006). Therefore, the government is at the forefront in implementing irrigated agriculture development programmes with primary interest in the sugarcane industry of the country. Sugar cane is preferred because of its strong organizational structure and improved

irrigation facilities hence reduced risks. Thus it is able to attract the private banking sector to finance on-farm development based on the estimated market value of future production. Because of the organized structure, lenders are able to collect their loan repayments via the sugar mills which are the primary receipt point for sugar sales proceeds. However, the sustainability of smallholder irrigation schemes cannot be guaranteed given the fact that the viability of sugar cane has been adversely affected by changes to the European Union (EU) Sugar Protocol. This has been confirmed by Malaza and Myeni (2009) who reported that a majority of the smallholder farmers under KDDP are unable to pay their loans back and might be forced out of production. In addition, the authors stated that the problem will be exacerbated by the increase of internal conflicts within the farmers' associations as farmers are now becoming suspicious of their partners and committee members regarding financial security.

The implementation of smallholder irrigation schemes in the country has been viewed differently by some authors. Matondo in 2001 [cited in Lankford (2001)] argues that the success of the sugar sector and increasing area under irrigation does not necessarily imply a healthy food security situation for the country, hence a need to promote crop diversification to reduce the risk of over-reliance on an exported cash crop. The author suggests two options for smallholder irrigation in Swaziland, which is to continue to provide and support formal smallholder irrigation that is able to cultivate cash crops, and to support traditional small-scale irrigation focused on food security by rural people. On the other hand, Manyatsi (2005) alleges that the contribution of small scale irrigation is constrained by lack of policy on agriculture and irrigation, lack of financial resources, lack of proper training, lack of adequate market for produce, and lack of appropriate technology irrigated agriculture. Lankford (2001), concerned about the sustainability of smallholder irrigation schemes, stated that further developments should consider issues of technology selection and design for management; institutional support for smallholder irrigation, and lastly the long term economic analysis of the scheme.

### Future developments

According to the Swaziland National Development Strategy of 1995 (cited in Lankford, 2001), the following sites have been identified for future development of smallholder irrigation development projects:

1. "Along the Black Mbuluzi and White Mbuluzi Rivers in the Lowveld east of Vuvulane and along the Nkalashane River in the Lubombo region north of the Mbuluzi.
2. In the lower Mtilane basin and the lower Little Usuthu basin.
3. In the Mkhondvo basin in the middle reaches of the

Mkhondvo River and along the Ndlatane River.

4. The lower Great Usuthu basin (potentially the largest area of irrigable land) particularly in the Mabopheni area.
5. South of Ngwavuma River in the eastern Lowveld region (having the largest tracts of good to excellent soils), and also in the vicinity of the Ngwavuma's confluence with the basin of Nsongweni River and the upstream from its confluence with the Mantambe River".

The literature review reveals that smallholder irrigation has a potential of addressing the challenge of low agricultural productivity in the country, but its ability is constrained by some sustainability factors. Then there is a need to understand and address the issue of sustainability within smallholder irrigation projects to improve their viability and improve food security in the rural communities.

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