

Imperatives for an agricultural green economy in South Africa

AUTHORS:

Constansia Musvoto¹
Karen Nortje¹
Benita de Wet¹
Brian K. Mahumani²
Anton Nahman²

AFFILIATIONS:

¹Natural Resources and the Environment, Council for Scientific and Industrial Research, Pretoria, South Africa

²Natural Resources and the Environment, Council for Scientific and Industrial Research, Stellenbosch, South Africa

CORRESPONDENCE TO:

Constansia Musvoto

EMAIL:

CMusvoto@csir.co.za

POSTAL ADDRESS:

Natural Resources and the Environment, Council for Scientific and Industrial Research, PO Box 395, Pretoria 0001, South Africa

DATES:

Received: 21 Jan. 2014

Revised: 10 May 2014

Accepted: 12 May 2014

KEYWORDS:

agriculture; green economy; principles; environment; climate change

HOW TO CITE:

Musvoto C, Nortje K, De Wet B, Mahumani BK, Nahman A. Imperatives for an agricultural green economy in South Africa. *S Afr J Sci.* 2015;111(1/2), Art. #2014-0026, 8 pages. <http://dx.doi.org/10.17159/sajs.2015/20140026>

Globally, there are social, economic and environmental challenges related to sustainable development; these challenges include climate change, the need to feed a rapidly increasing population, high rates of poverty and environmental degradation. These challenges have forced us to rethink the way in which development takes place, resulting in the emergence of the concept of a 'green economy'. A green economy results in improved human well-being and social equity, while significantly reducing risks to the environment. It is based on principles which integrate social, economic and environmental considerations. South Africa has adopted the principle of green economic growth, and agriculture is one of the sectors that will drive this growth. Agriculture could address some of the sustainable development problems, but there are challenges related to resource availability, environmental impacts of agriculture and climate change. For agriculture to support a green economy it has to be productive, contribute to economic growth and not undermine the environment, social and cultural systems. The information base and policies required to support a green economy in general, and/or an agriculture-supported green economy have not yet been developed, as the green economy is an emerging concept in South Africa as well as globally. The generation of such information requires analysis and synthesis of green economy principles and agricultural imperatives into generic principles and practices for facilitating agriculture's contribution to the green economy. In this paper, we conduct this analysis and synthesis and highlight the defining aspects of an agricultural green economy.

Introduction

Since the global financial crisis of 2008, and in particular in the lead up to the June 2012 United Nations Conference on Sustainable Development (Rio+20), the term 'green economy' has featured prominently in international discourse on environment and development. A green economy has been defined as 'one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'¹. A green economy is also characterised as being low-carbon, resource efficient and socially inclusive. Such an economy aims to reduce carbon emissions and pollution; enhance energy and resource use efficiency; and prevent biodiversity degradation and the loss of ecosystem services.² In the context of South Africa, emphasis is also placed on the potential of a green economy to promote social equity and improve human well-being, through addressing poverty and historical inequalities.

The prominence of the debate on the green economy in the last few years has been attributed to the belief that such an economy could provide a win-win solution for overcoming the current global climate, financial and other crises.³ In South Africa, greening the economy in a socially inclusive way has become particularly important because of high levels of unemployment, as well as the carbon intensity of the economy.⁴ South Africa can be considered to be one of the global front runners in engaging with the concept of a green economy. For example, in 2010, the country defined a New Growth Path, which aims to generate a more inclusive and greener economy through both macroeconomic and microeconomic interventions. As part of the New Growth Path, a Green Economy Accord was signed in 2011, through which the country committed to a green economy and job creation partnership involving government, business community, trade unions and civil society.

In developing countries, including South Africa, agriculture is a crucial sector for driving the green economy. Globally, some 60% of terrestrial land and 70% of the available fresh water is used for agriculture, and 40% of the world's population is directly dependent on the agricultural sector for their livelihoods.⁵ A greener agricultural sector potentially offers solutions to some of the social, economic and environmental challenges that humans are currently faced with, such as achieving food security for a rapidly expanding population, lowering the risk of climate change and meeting the increasing demand for energy in the face of dwindling reserves of fossil fuels.⁶ Agriculture is a significant contributor to African economies as it employs 65% of Africa's labour force and accounts for 32% of gross domestic product (GDP).⁷ Agriculture in Africa is therefore integral to sustaining livelihoods, reducing poverty and contributing to economic growth and development. In a 2012 report, the Commission on Sustainable Agriculture and Climate Change recommended making sustainable, climate-friendly agriculture central to green growth.⁸

Agriculture alone cannot be expected to drive green economic growth and poverty reduction at all levels. As an inherently resource-intensive primary sector, agriculture's contribution to GDP will always be small relative to its use of land, water and other resources. However, a sustainable agriculture sector is critical to food security and livelihoods, which suggests that greening of the agricultural sector is a key component of a green economy, alongside other sectors. Furthermore, relative to other sectors, agriculture's contribution to national GDP may seem small, but at a local level the contribution could be significant. For example, primary agriculture contributes about 3% to South Africa's GDP,⁹ while its contribution to local economies in some areas is much higher. Agriculture contributed 25% to the economy of the Greater Sekhukhune district in the Limpopo Province in 2012.¹⁰ Experiences from other African countries also highlight the importance of agriculture to local economies.¹¹ In addition, as mentioned above, despite its relatively low contribution to GDP, the agriculture sector is important in terms of employment, and therefore for the provision of livelihoods and reduction of poverty.

Both smallholder and commercial agriculture could contribute to a green economy and contribute to employment and poverty reduction. In South Africa, agriculture currently employs 709 000 people.¹² However, it is estimated that around 8.5 million people are directly or indirectly dependent on agriculture for their employment and income.¹³ Although employment in the agriculture sector has been on the decline in the last decade,¹⁴ South Africa's National Planning Commission (NPC) estimates that agriculture has the potential to create 1 million jobs by 2030, with the majority of these jobs being in the smallholder sector.¹⁵ The NPC asserts that agriculture has the potential to expand if the necessary environment can be created, and that job creation is achievable with successful land reform, employment creation and strong environmental safeguards. According to the NPC, expanding commercial agriculture has the potential to create 250 000 direct jobs and a further 130 000 indirect jobs, and this job creation would be achievable through specific agriculture sub-sectors in which both expansion in production and value addition are sustainable. Job creation could also occur through small-scale agriculture. The NPC also argues that 300 000 employment opportunities can be created through better utilisation of land in the former homeland areas, with a further 326 500 potential employment opportunities upstream and downstream of the agricultural sector.¹⁵

Job creation in the context of agriculture is also connected to agro-processing, as a robust agriculture sector linked to markets would expand agroprocessing opportunities. The NPC's National Development Plan and the Department of Trade and Industry's Industrial Policy Action Plan both highlight the important role of the agriculture sector in creating employment, specifically in the processing sector.^{15,16} According to South Africa's Industrial Policy Action Plan,¹⁶ the food-processing sector – with about 171 000 employees – is the largest manufacturing sector in employment terms. Furthermore, agroprocessing contributed 30% of the total real output of South Africa's manufacturing sector in 2012.¹⁷

Among the key sectors expected to drive South Africa's green economy are agriculture; food production and forestry; resource conservation and management; clean energy and energy efficiency; sustainable waste management; and sustainable transport and infrastructure.¹⁸ Although the identified sectors are well established, the information base and policies required to support a green economy have not yet been developed, as the green economy is an emerging concept, both in South Africa and globally. South Africa's plans for and commitments to a green economy (such as the Green Economy Accord) outline the priorities and commitments for a green economy in broad terms. However, what is lacking is the detail to guide the implementation of the identified priorities. In considering initiatives for transitioning to a green economy supported by agriculture, it is imperative to take cognisance of all relevant South African policy and legislation relating both to agriculture and the green economy, because agricultural initiatives that could potentially be linked to the green economy should be supported by existing policy and legislation. Furthermore, initiatives which align with legislation and policy, which provide the enabling conditions for sustainable agriculture, present opportunities for a green economy.

Both the United Nations Environment Programme (UNEP) and the United Nations Economic Commission for Africa (UNECA) highlight the importance of creating an enabling policy and implementation environment for achieving a transition to a green economy. According to UNECA¹⁹, a clear, predictable and stable policy environment can create the confidence required to stimulate private investment. UNEP²⁰ highlights that enabling conditions for a green economy include national regulations, policies, subsidies and incentives, as well as international market and legal infrastructure, trade and technical assistance. It is essential that governments create the enabling policies and conditions for a green transformation.¹⁹ Although the green economy is explicit about enhancing human well-being, it should not be assumed that a green economy spontaneously brings about the systems required for stable social systems that can sustain economic growth and foster improvements in human well-being. Hezri and Ghazali²¹ highlight that social sustainability is not a given benefit in the transition to a green economy, as focusing on green growth does not automatically

lead a community to sustainability pathways. Social sustainability considers questions of governance, voice and participation within decision-making.²¹ However, given the fluidity of the concept of social sustainability, it is an elusive ideal to attain and should be consistently addressed in the implementation of a green economy.

In the case of South Africa, apart from general statements of intent, there are no formal instruments of any kind specifically designed to ensure that the green economy becomes a reality. However, there is a number of agricultural and environmental regulatory instruments which are relevant to a green economy; among them the *Conservation of Agricultural Resources Act (CARA) 43 of 1983*, *Sustainable Utilisation and Protection of Agricultural Resources (SUPAR) Bill (2003)* and the *National Environmental Management Act 107 of 1998*. Although agriculture has been identified as one of the sectors that should support the green economy transition in South Africa, currently there is a paucity of information to support green economy policymaking and implementation. The information base required to adequately inform and guide the transition to and implementation of an agricultural green economy is lacking. This situation is also the case for the rest of the African continent. The lack of information is problematic in regard to both the overarching green economy and specific sectors, including agriculture. The generation of this critical information requires appropriate analysis and understanding of both green economy principles and agricultural imperatives. This understanding is vital for building generic principles and practices for enabling and supporting agriculture's contribution to the green economy.

In this article, we review key green economy principles and agricultural imperatives in South Africa, and examine the agricultural and green economy aspects that should be considered in defining the parameters of agriculture as a sector which can support a green economy. In this way we provide critical information for enabling and supporting the contribution of agriculture to the green economy in South Africa and the rest of Africa, and also inform the research and analysis that should go into the development of policy and implementation instruments for an agricultural green economy.

South African and African commitment to a green economy

Many African countries, including South Africa, have adopted the principle of green economic growth, based on a green economy. Over the last few years, African leaders have, through various joint decisions and pledges, expressed their commitments to green economic growth. One such commitment is the Bamako Declaration on the Environment for Sustainable Development (June 2010), adopted by African ministers of environment.²² In this declaration, ministers recognised the need to take advantage of the opportunities provided by a growth and development trajectory that embraces a green economy model. Another example is the Seventh African Development Forum held in Ethiopia in October 2010. At this forum, representatives called on African governments to

*prioritize and promote a green economy as a vehicle for addressing the challenges of climate change impacts on ecosystem sustainability and harnessing the opportunities provided by its vast and diverse ecosystems and natural resources.*²³

It has also been recognised that there is a need to ensure that the adoption of a green economy takes into account the particular social and development imperatives of African states. At a meeting of African Union heads of state and government held in Equatorial Guinea in June 2011 (in the context of negotiations for the United Nations Conference on Sustainable Development), it was decided that member states would be urged to 'ensure that Africa's interests on the green economy issues within the context of sustainable development and poverty eradication, and institutional frameworks for sustainable development are defined and taken into account'²⁴ [Decision on Africa's preparations for the United Nations Conference on Sustainable Development]. At the Fourth Special Session of the African Ministerial Conference on the Environment held

in Bamako in September 2011, African environment ministers adopted a decision on the green economy in the context of Africa, outlining African views and perspectives on the subject.²⁵ The Bamako Ministerial Conference also decided to

*welcome the green economy as offering new opportunities to advance the achievement of Africa's sustainable development objectives and to recognize that the green economy is a means to achieve Africa's objectives of sustainable development, employment creation, economic growth and poverty.*²⁵

In South Africa, green economic growth has been prioritised as one of the key economic drivers in the country's Medium Term Strategic Framework 2009–2014. One of South Africa's priorities in developing a green economy²⁶ is the creation of 'green' jobs. Green jobs are defined as work in agricultural, manufacturing, research and development, administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Green jobs include those that help to protect ecosystems and biodiversity; reduce energy, materials and water consumption through high efficiency strategies; decarbonise the economy; and minimise, or altogether avoid, generation of all forms of waste and pollution.¹⁸ Recently, South Africa's Department of Environmental Affairs and UNEP produced the South African Green Economy Modelling report, which assessed national targets and the effects of investing in a green economy in South Africa.²⁷

Principles of a green economy

A transition to a green economy requires changes within all sectors of the economy. For any sector to support a green economy, it is necessary to first understand the basic functioning of that sector. This understanding is crucial for ensuring that the sector is aligned to operate in a way which is compatible with the principles and objectives of a green economy. In the lead up to Rio+20, several organisations (the Green Economy Coalition²⁸, the Stakeholder Forum BioRegional and Earth Charter²⁹, International Chamber of Commerce³⁰ and a number of others) attempted to develop a universal set of green economy principles. The United Nations Department for Economics and Social Affairs identified and consolidated the most common green economy principles, from a review of eight published sets of principles, as follows³¹:

1. *The Green Economy is a means for achieving sustainable development.*
2. *The Green Economy should create decent work and green jobs.*
3. *The Green Economy is resource and energy efficient.*
4. *The Green Economy respects planetary boundaries or ecological limits or scarcity.*
5. *The Green Economy uses integrated decision-making.*
6. *The Green Economy measures progress beyond GDP using appropriate indicators/metrics.*
7. *The Green Economy is equitable, fair and just – between and within countries and between generations.*
8. *The Green Economy protects biodiversity and ecosystems.*
9. *The Green Economy delivers poverty reduction, well-being, livelihoods, social protection and access to essential services.*
10. *The Green Economy improves governance and the rule of law. It is inclusive, democratic, participatory, accountable, transparent and stable.*
11. *The Green Economy internalises externalities.*

These principles highlight that the focus of the green economy is not simply on the link between the economy and the environment (as the

term 'green economy' might imply). Instead, the principles place as much emphasis on the social as on the economic and environmental dimensions of sustainable development. The principles highlight that in the green economy context, the economy has to be conceived in a broader sense than that recognised by neoclassical economics, as including a range of formal and informal economic activities involving reproduction, production, distribution, exchange and consumption.³² The economy also has to be conceptualised as extending beyond the cash economy into a wider set of linked social and material processes including labour, work, material flow, energetic exchange and value creation.³³ Green economy principles highlight the strong linkages between social and economic systems. Economic sociology emphasises that the economy is socially embedded, and according to the concept of socio-materiality, the social and the material are considered to be inextricably related – there is no social that is not also material, and no material that is not also social.³⁴

Agriculture as a driver of the green economy

The United Nations Economic Commission for Africa (UNECA)¹⁹ acknowledges that most African economies are highly dependent on natural resources, and argues that a pathway to a green economy requires capitalising on natural capital and exploiting opportunities for industrial growth. Agriculture is a sector that is highly dependent on natural resources, and as such has a significant role to play in the green economy. The crucial role of agriculture in the green economy has also been highlighted by the United Nations Food and Agriculture Organization (FAO) in a concept note prepared for the Rio+20 conference:

*As the single largest sector using 60% of the world's ecosystems and providing livelihoods for 40% of today's global population, the food and agriculture sector is critical to greening the economy. There will be no green economy without agriculture.*⁵

The key role of agriculture in African economies has been affirmed by African heads of state and governments in their declaration of 2014 as the Year of Agriculture and Food Security in Africa. The high-level focus is meant to encourage countries to increase food security, reduce poverty, promote economic growth and create wealth through agricultural improvement.³⁵

Agricultural production has to expand to meet rising demands for food and other commodities for a burgeoning human population, expected to reach 9 billion by 2050. The required agricultural expansion entails increasing output per unit area and/or increasing the land area under agriculture. Given the fact that it is a growing sector, agriculture will inevitably play an important role in the green economy, although there will clearly be a need to reduce the environmental impacts of agriculture. In addition, agriculture is largely a rural activity, and agriculturally based green economy initiatives therefore present real opportunities for addressing rural poverty. This opportunity is particularly important because poverty disproportionately affects rural areas. Globally, of the 1.4 billion people living in extreme poverty (defined as those living on less than USD1.25/day) in 2005, approximately 1 billion (or around 70%) lived in rural areas.³⁶ In South Africa, poverty rates (based on the food poverty line) are higher in rural (30.7%) than in urban areas (11.9%).³⁷

Agriculture is particularly relevant to the green economy in developing countries, as it holds the potential to address some of the problems of poverty and rapid urbanisation which occur in many countries, including South Africa. It has been noted that agriculture can contribute to poverty reduction in rural areas. The World Bank estimates that GDP growth from agriculture generates at least twice as much poverty reduction as any other sector.³⁸ Green economic initiatives in the agricultural sector therefore have the potential to transform the lives of a large number of people. Currently, 65% of people in developing countries are involved in agriculture, of whom 1.3 billion are small farmers who could benefit from improvements in agriculture and the associated economy it supports.³⁹

It has been documented by UNEP⁴⁰ that during the transition to a greener agriculture sector (a requirement for agriculture to support a green economy), food production in high-input industrial farming may experience a modest decline, while triggering significant positive responses in more traditional systems run by small farmers. This projection lends significant potential strategic importance to the role of small-scale farmers in the transition to a green economy supported by agriculture in South Africa. A green economy based on agriculture has the potential to impact on a significant proportion of South Africa's population. South Africa's 2011 census results show that 2.9 million households in South Africa (20%) were involved in agriculture, mainly subsistence and smallholder farming, with the largest percentage of agricultural households located in KwaZulu-Natal (25%), the Eastern Cape (21%) and Limpopo (16%) Provinces.⁴¹ These households could potentially participate in the green economy through agricultural activities. Experiences from other developing countries highlight the central role of small-scale farmers in the green economy. UNEP reports that in Uganda, 85% of the population was engaged in agriculture, mainly small-scale organic agriculture, contributing 42% of the national GDP and 80% of the export earnings in 2005/2006.⁴² In Cuba, public policies supported urban organic agriculture in Havana, resulting in 350 000 new well-paying jobs (out of a total workforce of 5 million), 4 million tons of fruits and vegetables produced annually in Havana (a tenfold increase in a decade).⁴²

Rapid urbanisation and increasing urban poverty are pressing issues for developing countries, including South Africa. In 2001, 56.2% of the national population of South Africa lived in cities, increasing to 60% in 2009, with an expected increase to 70% by 2024.⁴³ This rapid urbanisation poses challenges in the form of urban sprawl, which destroys agricultural land and increases the demands for energy, water and food. Furthermore, rapid urbanisation has transferred rural poverty problems into urban areas – a problem which has manifested throughout the world and which continues to grow. Ravallion^{44(p.16)} reports that 'among those living on no more than [USD]1 a day, the proportion found in urban areas rose from 19% to 24% between 1993 and 2002'. One of the manifestations of urban poverty is food insecurity. Food insecurity is high in the urban areas of southern Africa and South Africa.⁴³

A 2010 UN report notes that raising agricultural production (in particular in food-deficit countries), while at the same time improving the livelihoods of smallholder farmers and preserving ecosystems, would contribute to rural development and slow the trend towards urbanisation and the attendant stress it places on public services in urban areas.⁴⁵ Agriculture-based green economy initiatives could offer an alternative to the migration to urban slums by providing opportunities for sustainable livelihoods in rural areas. However, it must be borne in mind that although agricultural green economy initiatives could potentially reduce rural poverty, in many situations, agricultural production is not high and/or sustainable enough to drive poverty reduction by itself. The potential of agriculture-based green economy initiatives to improve human well-being should therefore be grounded in reality, as an agriculture-supported green economy will not automatically improve social and economic conditions. Some of the challenges are discussed in the following section.

Challenges of agriculture in supporting green economic growth

While agriculture presents opportunities for supporting green economic growth, there are challenges which must also be acknowledged. These include the scarcity of resources to support agricultural production, especially for poor rural farmers; the relatively low market values of agricultural commodities, and therefore the limited potential for low levels of agricultural production to impact on local economies; the impacts of agriculture on the environment; and changing climatic conditions.

In South Africa, a major challenge for agriculture's ability to expand production to meet the food security needs of a growing population and to support a green economy is the rising scarcity and degradation of land, soil and water resources. Although South Africa has a relatively large total land surface area (122 million ha), only about 14 to 16

million ha, or around 11% of the total, is arable (i.e. suitable for crop production), excluding the area under commercial forestry. Furthermore, 'soil erosion and degradation of agricultural land through overexploitation and inappropriate and unsustainable farming methods pose a threat to the country's food security'^{27(p.8)}. The rate of land degradation is high, estimated at 70%, with potential negative implications for food production.⁴⁶

Furthermore, South Africa has a relatively low annual rainfall, and a rapidly increasing demand for water, exacerbated by poor water quality in some areas, such that demand is expected to exceed the available supply by 2025.²⁷ Other factors potentially exacerbating these issues include changing climatic conditions and government's commitment to mandatory blending of biofuels in the liquid fuels market in South Africa,²⁶ for which the potential impacts on food security, land use, carbon emissions and water use need to be carefully assessed.

The number of farms and the land area being used for crop production in South Africa has declined significantly since the 1990s,⁴⁷ but there has been no corresponding decline in overall production. The World Wide Fund for Nature asserts that this discrepancy points to an intensification of production entailing increased water use for irrigation, increases in the use of fuel, agrochemicals, fertilisers and mechanisation, as well as a growing dependence on genetically modified seed. This increase in intensity, particularly where it is not managed properly, is causing cumulative damage to soil fertility, increasing erosion, contaminating water sources, producing toxic effects on biota and on people working on farms, weakening the resilience of ecosystems and contributing to climate change.

The New Partnership for Africa's Development (NEPAD) noted with concern the environmental degradation caused by agriculture in many parts of Africa. NEPAD indicated that, in many places, environmental degradation and unsustainable exploitation of natural resources threatened to reduce the future productivity of agriculture and natural resources, and that a major challenge for African countries was to ensure that agriculture does not degrade the underlying natural resource base.⁴⁸ Similar concerns have been expressed by the Millennium Ecosystem Assessment. According to the Millennium Ecosystem Assessment⁴⁹, two-thirds of the earth's ecosystem services are in decline. The resources humans depend on for much of the world's food supply are finite, declining and, in some cases, disappearing. Fresh water is becoming scarcer, land is degraded and ecosystems are in decline. Farming practices must be adapted to manage natural resources wisely and conserve biodiversity and ecosystem services if agricultural production is to increase in the face of increasing demands, climate change and limited resources.⁵⁰

The environmental impacts of agriculture are not limited to large-scale commercial agriculture. Small-scale farming, although it utilises lower levels of inputs and little machinery, also has adverse effects on the environment. According to the FAO⁵¹, in Africa, soil degradation caused by poor agricultural practices, among other issues, is undermining the very resources on which African farmers depend for their survival. In South Africa, soil degradation has been reported to be most severe in many communal croplands and grazing lands,⁵² where small-scale agriculture is practised. South Africa has grappled with land degradation caused by agriculture for many decades, and the negative environmental consequences of agriculture have been widely documented.⁵³⁻⁵⁶

The contribution of the agricultural sector to climate change is significant. Agriculture is an emitter of greenhouse gases associated with land-use change, fertiliser use and enteric fermentation among livestock. Globally, agriculture accounts for around 15% of global greenhouse gas emissions. Agriculture will have to reduce these emissions substantially and contribute to climate change mitigation if it is to contribute to a green economy.

For agriculture to support a green economy, the many environmental problems associated with the sector have to be addressed. Plans for the green economy recognise this need. At South Africa's Green Economy

Summit held in 2010, there was an acknowledgement that, according to the definition of green jobs:

*Some of the employment opportunities in agriculture, forestry and fisheries cannot be classified strictly as 'green' as they can be environmentally damaging. For the sector to become sustainable more capital and knowledge must be directed towards improved natural resources management.*⁴⁶

In addition, so-called green jobs (in the agricultural and other sectors) will in many cases require technically skilled labour. The question remains whether South Africa can meet this skills requirement,⁴ and thus fulfil the promise of green job creation and poverty alleviation.

Changing global conditions and climate change

Although agriculture could potentially contribute to a green economy in South Africa, changing climatic conditions present challenges both for the sector as a whole and, particularly, for green economy initiatives premised on agriculture. Climate change projections for South Africa indicate increased temperatures across the country, an increase in precipitation in some parts of the country and a decline in precipitation in other parts, as well as increases in the magnitude and frequency of extreme events such as floods and droughts.⁵⁷ These changes have implications for ecosystems and their capacity to provide services such as water and for crop production and yields⁵⁸⁻⁶⁰; implications which will in turn affect the country's food security. Climate change is already threatening the ability of some rain-fed agriculture-dependent regions to maintain levels of agricultural production and food security, and is destabilising markets.⁴⁵ Climate change poses a threat to agriculture-based green economy initiatives, especially in southern Africa, where it is estimated that yields from rain-fed agriculture could be reduced by up to 50% between 2000 and 2020.⁶¹

Based on the variation in the direction and magnitude of changes in climate across South Africa, Gbetibouo et al.⁶² show that there is spatial differentiation in the vulnerability of South Africa's farming sector to climate change, with vulnerability intrinsically linked with level of socio-economic development. The most vulnerable provinces were found to be areas of low socio-economic development, i.e. largely rural areas, with a high share of small-scale farmers who rely on rain-fed agriculture, characterised by a high level of soil degradation and low levels of employment, among other factors. While agriculture-based green economy initiatives present opportunities for poor rural areas, the high vulnerability of these areas to climate change should be considered and planned for accordingly. Changing global climatic conditions will result in unpredictable availability (as a result of wide variation in growing conditions and extreme weather events), quality and price of agricultural products, which will affect profitability and thus sustainability of agriculture-based green economy initiatives.

It is important to ensure that risks and opportunities associated with changing climatic and other global conditions are understood and addressed in the context of agriculture in a green economy. UNEP's fifth Global Environment Outlook (GEO-5) report⁶³ highlights that, in terms of the current state and trends of the global environment, population growth, economic development, urbanisation and globalisation are driving degradation, which can be measured across numerous environmental indicators. According to UNEP²⁷, environmental pressures will increase for the foreseeable future, causing major changes not only in physical landscapes, but in social, political and business landscapes as well. These changes have to be understood and planned for in the context of a green economy. In addition, flexible and responsive policies are required to encourage and support sustainable agricultural and economic practices. Similarly, climate impacts, resource scarcity and resulting changes in population migration may have broader systems-level effects, destabilising regions or entire countries and thus the political and socio-economic contexts in which the green economy operates.

Imperatives for an agricultural green economy

Alongside the concept of an agriculture-based green economy is the concept of 'green agriculture'. A UNEP report⁴⁰ defines agriculture based on sustainable farming practices and technologies as 'green'. The report lists five main principles of green agriculture:

- use of naturally and sustainably produced nutrient inputs;
- diversified crop rotations;
- livestock-crop integration;
- environmentally friendly pest and weed management practices; and
- waste reduction through use of post-harvest storage and processing facilities.

The concept of a green economy based on agriculture is, however, broader than simply green agriculture. Whereas green agriculture focuses exclusively on agricultural production techniques, a green economy based on agriculture has to incorporate the principles of green agriculture and the principles of a green economy. The World Farmers' Organisation⁶⁴ has put forth four primary goals for agriculture in the context of the green economy:

- produce more with less;
- use a knowledge-based approach of best practices;
- reward farmers for adopting sustainable practices; and
- break the poverty cycle.

Given the environmental challenges facing the world, agriculture must be multifunctional if it is to support a green economy, as it not only has to meet demand for food and other non-commodity goods and services, but must do so while minimising its environmental footprint, creating sustainable livelihoods for farmers and others along the supply chain,⁶⁵ and providing other ecosystem goods and services in addition to food. It must also not disrupt social and cultural systems and must contribute to economic growth. Food insecurity and large poor rural populations persist in many developing countries. Basing green economy initiatives on agriculture in these contexts would be beneficial, given its potential to achieve the triple goals of a secure food supply, poverty reduction through improved rural livelihoods, and environmental sustainability through a reduced production footprint.⁶⁵

The Farming First Coalition, for example, highlights that⁶⁵:

[A]griculture in a green economy has to adopt a broad-based, knowledge-centred approach. Such an approach would be achieved through:

- Addressing implementation gaps through support for knowledge sharing and advisory and training services;
- Ensuring agricultural policies are based on science; and
- Supporting productivity through innovation and best practices.

In addition, making agriculture a dynamic sector which can underpin green economic initiatives will require some of the following⁶⁵:

- The adoption of supportive frameworks and investment in infrastructure and markets.
- Access to markets at the local, regional and global level in order for farmers to sustain a livelihood from their activities – in some areas, this means improving access to transport, storage and market facilities.
- Maintaining and increasing farm productivity and profitability.
- Producing food and agricultural goods and services on a sustainable basis.

- *Reducing negative externalities and gradually creating positive ones.*
- *Rebuilding ecological resources such as soil, water, air and biodiversity.*
- *Reducing pollution and using resources more efficiently.*
- *Maintaining ecosystem services on a sustained basis.*

Conclusions

For agriculture to support green economic growth, the sector has to operate in a way that integrates the principles of a green economy with those of sustainable and green agriculture. This synthesis of principles has to bring about a distinct set of principles for South Africa's agricultural sector in the context of a green economy. Such a fusion of principles has to be informed by South African realities and should not only be based on international theories and principles. This fusion will necessitate adjustments to the way in which agriculture is conceptualised and practised. The adjustments need to occur at all levels, from policy to practice, and should involve all stakeholders, including farmers, government, the private sector and civil society working together to create the right conditions for facilitating change. These conditions include enabling policies and institutions, relevant information and skills, innovations to support sustainable agricultural production, and social and economic systems. Appropriate incentives to encourage change from business as usual to practices which support a green economy and its ideals of environmental protection and social inclusion are also required. It is also critical to put in place mechanisms for managing risks and opportunities associated with changing climatic and other global conditions, so as to minimise negative impacts on (and generate benefits for) a green economy.

The process of change needs to be carefully planned. At the centre of the process are agricultural stakeholders who need to embrace the idea of changing their thinking and practices. Effecting the change requires a multi-pronged approach of educating, informing, training and capacity building. Much thought needs to go into processes for achieving the requisite change. As such, it would not be sufficient simply to list the required changes; the actual processes that need to be followed should be elucidated in detail. It will be necessary to move beyond the obvious to interrogating and developing practical processes for addressing different issues, for example social inclusivity and equity, which are critical in South Africa and in a green economy, but are not necessarily central in the agricultural sector. In addition to technical agricultural production issues, innovative ways of addressing the core issues of governance, decision-making and networking which underpin the functioning of social systems need to be addressed. The processes would have to be informed by both theoretical principles and the practical experience which the agricultural and other sectors in South Africa have accumulated. An agricultural sector that supports a green economy would need to be backed by appropriate agricultural and economic innovations which would be relevant to South Africa and also enable the country's green economy to be globally competitive.

A green economy does not operate in isolation. The green economy is fundamentally about managing the interaction of humans with the biophysical environment, in a complex social ecological system. Human and biophysical factors must therefore be considered in an integrated manner, with particular attention given to the relationships between them. The agricultural sector in a green economy therefore has to be appropriately situated and be in tune with social, economic and biophysical conditions in order to be sustainable and deliver planned benefits in the face of changes in these variables. The Africa-wide commitment to agriculture and to the green economy provides opportunities for countries to share experiences in transitioning to a green economy supported by agriculture.

Acknowledgements

We thank Dr Douglas Trotter and Dr Willem De Lange for their inputs into a report which formed the basis of this paper. This study was funded by a CSIR parliamentary grant.

Authors' contributions

C.M. was the project leader; she conceptualised and drew up the framework of the paper and wrote the sections on the technical aspects of agriculture. K.N. contributed the social review. B.K.M. and A.N. provided the economic review and analysis while B.d.W. was responsible for the environmental review and synthesis.

References

1. United Nations Environment Programme (UNEP). Principles for a green, fair and inclusive economy. Version 3 [document on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www.unep.org/greeneconomy/Portals/88/documents/GEI%20Highlights/Principles%20of%20a%20green%20economy.pdf>
2. United Nations Environment Programme (UNEP). Towards a green economy: Pathways to sustainable development and poverty eradication [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: http://www.unep.org/greeneconomy/Portals/88/documents/ger/ger_final_dec_2011/Green%20EconomyReport_Final_Dec2011.pdf
3. Messerli P, Ludi E, Breu T. 'Green economy': Development opportunity or buzzword? Evidence for Policy Series, Global Edition No 6. Bern: NCCR North-South; 2012.
4. Borel-Saladin JM, Turok IN. The impact of the green economy on jobs in South Africa. *S Afr J Sci.* 2013;109(9/10), Art. #a0033, 4 pages. <http://dx.doi.org/10.1590/sajs.2013/a0033>
5. Food and Agriculture Organization. Greening the economy with agriculture [document on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www.fao.org/docrep/015/i2745e/i2745e00.pdf>
6. Jensen ES, Peoples MB, Boddey RM, Gresshoff PM, Henrik H-N, Alves BJR, et al. Legumes for mitigation of climate change and the provision of feedstock for biofuels and biorefineries. *A review. Agron Sustain Dev.* 2012;32:329–364. <http://dx.doi.org/10.1007/s13593-011-0056-7>
7. World Bank. Fact sheet: The World Bank and agriculture in Africa. c2013 [cited 2014 Jan 21]. Available from: <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,,contentMDK:21935583--pagePK:146736--piPK:146830--theSitePK:258644,00.html>
8. Beddington J, Asaduzzaman M, Clark M, Fernández A, Guillou M, Jahn M, et al. Achieving food security in the face of climate change. Copenhagen: Commission on Sustainable Agriculture and Climate Change; 2012.
9. Department of Communications (DoC). Pocket guide to South Africa 2012/2013: Agriculture, Forestry and Fisheries. c2013 [cited 2014 Jan 21]. Available from: http://www.gcis.gov.za/sites/default/files/docs/resourcecentre/pocketguide/013_agriculture.pdf
10. Frontier Market Intelligence Ltd. Investing in Limpopo. c2013 [cited 2014 Dec 12]. Available from: http://www.southafrica.info/business/investing/opportunities/limpopo.htm#_Vlrv-jGUceg.
11. Diao X, Hazell P, Thurlow J. The role of agriculture in African development. *World Dev.* 2010;38:1375–1383. <http://dx.doi.org/10.1016/j.worlddev.2009.06.011>
12. Statistics South Africa. Quarterly labour force survey: Quarter 1, 2014 [homepage on the Internet]. c2014 [cited 2014 Jan 21]. Available from: <http://beta2.statssa.gov.za/?p=2652>
13. SouthAfrica.info. South African agriculture [homepage on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www.southafrica.info/business/economy/sectors/agricultural-sector.htm>
14. Department of Agriculture, Forestry and Fisheries (DAFF), South Africa. Estimate of the contribution of the agriculture sector to employment in the South African economy [document on the Internet]. c2010 [cited 2014 Jan 21]. Available from: http://www.nda.agric.za/docs/economic_analysis/contribution_agriculture_sectorsaeconomy.pdf
15. National Planning Commission. National Development Plan: Vision for 2030 [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: <http://www.npconline.co.za/medialib/downloads/home/NPC%20National%20Development%20Plan%20Vision%202030%20-lo-res.pdf>
16. Department of Trade and Industry (DTI). Industrial Policy Action Plan (IPAP) 2012/13–2014/15 [homepage on the Internet]. c2010 [cited 2014 Jan 21]. Available from: http://www.gov.za/sites/www.gov.za/files/dti_ipap2012-15_0.pdf

17. Department of Agriculture, Forestry and Fisheries (DAFF), South Africa. Agro-processing annual brief: Looking at 2012 [document on the Internet]. c2012 [cited 2014 Jan 21]. Available from: http://www.nda.agric.za/daoDev/sideMenu/AgroProcessingSupport/docs/Agro-processing%20annual%20%20BRIEF_final.pdf
18. Department of Environmental Affairs (DEA), South Africa. About green economy [homepage on the Internet]. No date [cited 2014 Jan 21]. Available from: http://www.environment.gov.za/?q=content/projects_programmes/greeneconomy/about
19. United Nations Economic Commission for Africa (UNECA). A green economy in the context of sustainable development and poverty eradication: What are the implications for Africa? [document on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www1.uneca.org/Portals/rio20/documents/cfssd7/1AfricaGE-BackgroundReportEN.pdf>
20. United Nations Environment Programme (UNEP). Enabling conditions supporting the transition to a global green economy [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_14_EnablingConditions.pdf
21. Hezri AA, Ghazali R. A fair green economy? Studies of agriculture, energy and waste initiatives in Malaysia. Geneva: United Nations Research Institute for Social Development, 2012.
22. United Nations Environment Programme (UNEP), editor. Bamako declaration on the environment for sustainable development [document on the Internet]. c2010 [cited 2013 Oct 17]. Available from: http://www.unep.org/roa/amcen/amcen_events/13th_Session/Docs/AMCEN-13-CRP-2_ENG.pdf
23. United Nations Economic Commission for Africa (UNECA), editor. Acting on climate change for sustainable development in Africa [document on the Internet]. c2010 [cited 2014 Jan 21]. Available from: <http://www1.uneca.org/Portals/adfvij/documents/ADF-VII-Consensus-Statement.pdf>
24. African Union, editor. Assembly of the Union: Seventeenth Ordinary Session: Decisions, declarations and resolution; 30 June - 1 July 2011; Malabo, Equatorial Guinea [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: [http://www.au.int/en/sites/default/files/Assembly_AU_Dec_363-390_\(XVII\)_E.pdf](http://www.au.int/en/sites/default/files/Assembly_AU_Dec_363-390_(XVII)_E.pdf)
25. United Nations Environment Programme (UNEP), editor. African Ministerial Conference on the Environment (AMCEN): Fourth special session: Report of the ministerial segment held on 15 and 16 September 2011 [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: http://www.unep.org/roa/Amcen/Amcen_Events/4th_ss/Docs/MinisterialSegmentReport.pdf
26. Economic Development Department (EDD), South Africa. New Growth Path: Accord 4: Green Economy Accord [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: <http://www.economic.gov.za/communications/publications/green-economy-accord>
27. United Nations Environment Programme (UNEP). Green economy scoping study: South African green economy modelling report (SAGEM) – Focus on natural resource management, agriculture, transport and energy sectors. Nairobi: UNEP; 2013.
28. Green Economy Coalition. The principles of a green economy: Initial results of a global consultation [homepage on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www.greeneconomycoalition.org/updates/sign-9-principles-green-economy>
29. Stakeholder Forum, Bioregional Earth Charter. Principles for the green economy: A collection of principles for the green economy in the context of sustainable development and poverty eradication [document on the Internet]. c2012 [cited 2014 Jan 21]. Available from: <http://www.stakeholderforum.org/fileadmin/files/Principles%20FINAL%20LAYOUT.pdf>
30. International Chamber of Commerce. Ten conditions for a transition toward a "Green Economy". Document No. 213-18/7. Paris: International Chamber of Commerce; 2011.
31. United Nations Department for Economics and Social Affairs (UNDESA). A guidebook to the green economy. Issue 2: Exploring green economy principles. New York: UNDESA; 2012.
32. Sayer A. Moral economy. Lancaster: Department of Sociology, Lancaster University; 2004. Available from: <http://www.comp.lancs.ac.uk/sociology/papers/sayer-moral-economy.pdf>
33. Psarikidou K, Szerszynski B. Growing the social: Alternative agrofood networks and social sustainability in the urban ethical foodscape. *Sustain Sci Pract Policy*. 2012;8(1):30–39.
34. Orlikowski WJ. Sociomaterial practices: Exploring technology at work. *Organ Stud*. 2007;28(9):1435–1448. <http://dx.doi.org/10.1177/0170840607081138>
35. Moodley S. By declaring 2014 the 'year of agriculture', the African Union hopes to spur a green revolution [homepage on the Internet]. c2013 [cited 2014 Jan 21]. Available from: <http://www.engineeringnews.co.za/article/by-declaring-2014-the-year-of-agriculture-the-african-union-hopes-to-spur-green-revolution-2013-09-27>
36. International Fund for Agricultural Development (IFAD). Rural poverty report 2011. Rome: IFAD; 2010. Available from: <http://www.ifad.org/rpr2011/report/e/rpr2011.pdf>
37. Statistics South Africa. Poverty profile of South Africa: Application of the poverty lines on the LCS 2008/2009. Report no. 03-10-03 (2008/2009). Pretoria: Statistics South Africa; 2012. Available from: <http://www.statssa.gov.za/publications/report-03-10-03/report-03-10-032009.pdf>
38. World Bank. World development report 2008: Agriculture for development. Washington DC: World Bank; 2007.
39. Farming First. Agriculture for a green economy: Improved rural livelihood, reduced footprint, secure food supply. Farming First policy paper on agriculture and the green economy. Farming First; 2013. Available from: http://www.farmingfirst.org/wordpress/wp-content/uploads/2011/10/Farming-First-Policy-Paper_Green-Economy.pdf
40. United Nations Environment Programme (UNEP). Green economy. Agriculture: Investing in natural capital [document on the Internet]. c2011 [cited 2014 Jan 21]. Available from: http://www.unep.org/greeneconomy/Portals/88/documents/ger/2.0_Agriculture.pdf
41. Statistics South Africa. Census 2011: Agricultural households. Report no. 03-11-01 (2011). Pretoria: Statistics South Africa; 2013. Available from: http://www.statssa.gov.za/Census2011/Products/Agricultural_Households.pdf
42. United Nations Environment Programme (UNEP). Green economy: Developing countries success stories [document on the Internet]. c2010 [cited 2014 Jan 21]. Available from: http://www.unep.org/pdf/greeneconomy_successstories.pdf
43. Frayne B, Battersby-Lennard J, Fincham R, Haysom G. Urban food security in South Africa: Case study of Cape Town, Msunduzi and Johannesburg. Johannesburg: DBSA; 2009.
44. Ravallion M. Urban poverty. *Finance and Development* [online]. 2007;44(3). Available from: <http://www.imf.org/EXTERNAL/PUBS/FT/FANDD/2007/09/ravalli.htm>
45. UN General Assembly. Report submitted by the Special Rapporteur on the right to Food; Olivier De Schutter Report A/HRC/16/49. Geneva: United Nations; 2010. Available from: <http://www2.ohchr.org/english/issues/food/docs/A-HRC-16-49.pdf>
46. DEA, EDD, DST, DTI, National Treasury, DoE, et al. Towards a resource efficient, low carbon and pro-employment growth path. Green Economy Summit Discussion Document. Pretoria: Green Economy Core Group; 2010.
47. WWF-SA. Agriculture: Facts and trends: South Africa [document on the Internet]. No date [cited 2014 Jan 21]. Available from: http://awsassets.wwf.org.za/downloads/facts_brochure_mockup_04_b.pdf
48. NEPAD. Comprehensive Africa Agriculture Development Programme. Rome: New Partnership for Africa's Development; 2002.
49. Millennium Ecosystem Assessment. Ecosystems and human well-being: Synthesis. Washington: World Resources Institute; 2006.
50. Scotcher JSB. The Green Choice Living Farms Reference 2009/2010 version [document on the Internet]. c2009 [cited 2014 Jan 21]. Available from: http://awsassets.wwf.org.za/downloads/greenchoice_living_farms_reference_2009_2010.pdf
51. FAO. Land and environmental degradation and desertification in Africa [document on the Internet]. c1995 [cited 2014 Jan 21]. Available from: <http://www.fao.org/docrep/X5318E/x5318e00.htm>
52. Meadows ME, Hoffman MT. The nature, extent and causes of land degradation in South Africa: Legacy of the past, lessons for the future. *Area*. 2002;34(4):428–437.
53. Giliomee JH. Agriculture. In: Fuggle RF, Rabie MA, editors. Environmental management in South Africa. Cape Town: Juta & Co Ltd.; 1992. p. 739–747.

54. Yeld J. Caring for the Earth-South Africa: A strategy for sustainable living. Stellenbosch: South African Nature Foundation; 1993.
55. Scotney DM, editor. Natural resources in South Africa. In: The interrelationship between soil erosion, sediment transport and the living environment. Pretoria: Water Research Commission; 1995.
56. Mather C. Towards sustainable agriculture in post-apartheid South Africa. *GeoJournal*. 1996;39:41–49. <http://dx.doi.org/10.1007/BF00174927>
57. Lumsden TG, Schulze RE, Hewitson BC. Evaluation of potential changes in hydrologically relevant statistics of rainfall in southern Africa under conditions of climate change. *Water SA*. 2009;35(5):649–656. <http://dx.doi.org/10.4314/wsa.v35i5.49190>
58. Du Toit AS, Prinsloo MA, Durand W, Kiker G. Vulnerability of maize production to climate change and adaptation in South Africa. Combined Congress: South African Society of Crop Protection and South African Society of Horticultural Science; 2002 Jan 15–17; Pietermaritzburg, South Africa.
59. Midgley G, Chapman R, Mukheibir P, Tadross M, Hewitson B, Wand S, et al. Impacts, vulnerability and adaptation in key South African sectors. An input into the long term mitigation scenarios process. Cape Town: Energy Research Centre, University of Cape Town; 2007.
60. Walker NJ, Schulze RE. Climate change impacts on agro-ecosystem sustainability across three climate regions in the maize belt of South Africa. *Agr Ecosyst Environ*. 2008;124:114–124.
61. Smith PD, Martino Z, Cai D, Gwary H, Janzen P, Kumar B, et al. Agriculture. In: Metz B, Davidson OR, Bosch PR, Dave R, Meyer LA, editors. *Climate change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge/New York: Cambridge University Press; 2007. p. 514–519. Available from: <https://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter8.pdf>
62. Gbetibouo GA, Ringler C, Hassan R. Vulnerability of the South African farming sector to climate change and variability: An indicator approach. *Nat Resour Forum*. 2010;34:175–187. <http://dx.doi.org/10.1111/j.1477-8947.2010.01302.x>
63. UNEP. *Global environment outlook 5 (GEO-5): Environment for the future we want*. Nairobi: UNEP; 2012. p. 36. Available from: http://www.unep.org/geo/pdfs/geo5/GEO5_report_full_en.pdf.
64. World Farmers' Organisation. *Agriculture's contribution to the green economy: Proposed outcomes from the Rio +20 summit*. Rome: World Farmers' Organisation; 2012.
65. Farming First Coalition [homepage on the Internet]. c2013 [cited 2014 Jan 21]. Available from: <http://www.farmingfirst.org/>

