

Implications for a future agrarian structure in South Africa based on conservation and sustainable agriculture: alignment of a multi-institutional and multi-policy landscape

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Key findings and recommendations

- The current development of a Conservation Agriculture (CA) policy for South Africa is a positive step for the country, as it moves to a sustainable agriculture regime. It should be recognised, however, that the conditions of a transition towards a more sustainable agriculture and food system are a matter of intense debate and of utmost importance to South African agricultural and food policy in the immediate future.
- A common vision for the transition to such systems is required by government and the private sector (farmers, agricultural organisations, input and service providers, markets), civil society and academia, based on the acceptance that “business-as-usual” is no longer an option. This is simply economically and socially unviable and compromises the country’s food security and ultimately national security.
- A policy mix exists in South Africa which can support the increased uptake of CA within a system-wide drive towards sustainable development, food and nutritional security, rural development, optimal resource use and the growth of the Green Economy within the context of climate change.
- Further policy alignment and solving of contradictions in the policy mix is required.
- CA policy must be responsive, adaptive and supportive of a series of transitions with issues of scale, time and feedback accounted for and the choice of policy instruments tailored to specific goals along this transition.
- CA policy must support transformation from the bottom up, providing a new basis for achieving the country’s agrarian and development policy objectives while accounting for external (environmental) costs.

Key findings and recommendations (cont.)

- A farmer-led practical approach is recommended with support for local research and CA system development, innovation, training and extension, appropriate financial instruments for different scales of farming, and special attention to smallholder farmers, women and youth.
- Smallholder farmers, in particular, require targeted and contextualised support on both the input and output sides of the value chain to increase their adoption of CA.
- Agri-food value chain actors and institutions in South Africa, including consumers, must be made aware of and linked to CA to ensure increased uptake and a system-wide transition to CA.
- CA uptake must be accelerated through the development of partnerships between government, farmers and agri-business, researchers and civil society, and a government-led discourse between actors to develop a consensus and clear vision of sustainable agriculture and the pathway to its achievement.
- As such it is recommended that the Department of Agriculture, Forestry and Fisheries launches a wider set of engagements with other national departments at the highest level as well as key actors and institutions across the agri-food value chain – and those “outside of it” as critics of the system. This is in order to gain system-wide political and institutional buy-in for the urgent transition towards sustainable and regenerative agricultural production systems.

Introduction

South Africa is not well-endowed in terms of agricultural production potential. Only approximately 11% of total agricultural land area can be accounted for as arable land and permanent pastures, with a general scarcity of fresh water of which 63% is used for agriculture (FAOSTAT 2013). Agriculture is faced with the enormous task of producing food to feed a nation of 55 million inhabitants (mid-2015, Statistics South Africa, <http://www.statssa.gov.za/>), increasing by almost 2% annually and expected to reach 82 million by the year 2035 (WWF 2010). Food production supported by importation must more than double to feed the expanding population and this needs to be done using the same or less natural resources. One in four inhabitants currently experience food insecurity (Labadarios et al. 2011) and many more struggle with non-communicable diseases relating to malnutrition, reducing their wellbeing and quality of life (Schönfeldt 2013, Shisana et al. 2014). Growth of industries such as mining, and the expansion of human settlements compete with agriculture for resources such as land, water and energy, and add to the challenges of waste, pollution and environmental degradation (von Bormann & Gulati 2014). Nevertheless, the government of South Africa has identified agriculture as a sector which will have to support economic development and create approximately 1 million jobs by 2030 (NPC 2011).

In order to produce more food without further degradation of the natural resource base, a transition to a more sustainable way of farming is necessary (Pretty et al. 2003, IAASTD 2009). Conventional farming practices are based on an industrial model characterised by high levels of fossil fuel use, emissions of greenhouse gases, heavy external agro-chemical inputs such as synthetic fertilisers, disturbance of the soil by ploughing, and monoculture. In contrast, the main emphasis in sustainable agriculture is on fostering synergies between agricultural production, conservation and rural livelihoods. The conditions under which a transition towards a more sustainable agriculture and food system is possible, are a matter of intense debate and of utmost importance to South African agricultural and food policy in the immediate future. The central idea is to enhance agricultural productivity by managing the natural resource base in a more sustainable way, for example by diversifying crop rotations, using organic soil nutrients, reducing soil erosion, improving water-use efficiencies and making increased use of biological regulation functions. It is increasingly necessary for South Africa to embark upon a transition from conventional ways of farming to alternatives and through this to develop a better understanding of the plurality of alternatives. Conservation Agriculture (CA) is one example of these alternatives.

In CA, which is a globally established form of sustainable agriculture (Derpsch et al. 2010), three principles are applied simultaneously (see **Box 1**): continuous minimum mechanical soil disturbance, year-round organic soil cover, and sound crop rotations and/or associations using diverse species (including legumes), supported by Good Agricultural Practices (GAP) such as integrated management of weeds, nutrients, pests and livestock (FAO 2004, 2013a). The uptake of CA can be conceptualised as a stepwise and gradual process including production stages like No-Till (NT) or CA with high external inputs (HEI) and CA with low external inputs (LEI) (Blignaut et al. 2014). The most sustainable form of an agriculture production system is portrayed in **Box 1** as Organic Conservation Agriculture (OCA).


The main differentiating factors in defining and comparing alternative sustainable farming systems over its various stages are the quantity of external inputs used, the type of tillage technology used, the amount of soil cover left and diversity in the crops used. CA was developed for the sustainable production of grain and other field crops, but the underlying principles of sound integrated management of natural resources for long-term sustainability of production apply equally to farming in the livestock and horticultural sub-sectors, with context specific adjustments.

Experience shows that CA is more than a production technology. Socio-economic improvements could include the creation of green jobs, achieving synergies between poverty alleviation and the green economy, the possibility of the green economy being an engine for

development, and growing export markets for green, sustainable and safe food (UNEP 2011, 2013, UNEP/ILO 2008, Musvoto et al. 2014). CA approaches should be underpinned by the full participation of farmers and rural people in all processes of problem analysis and technology development, adaptation and extension. This participation can contribute to more equitable access to productive resources and opportunities, and progress towards more socially and environmentally-just forms of agriculture. CA has the potential to support agrarian re-structuring, increase food production and improve food and nutritional security – if seen as part of a continuum on which agriculture and the food system moves towards a sustainable future and a greener economy (Kotze & Rose 2015).

Box 1 What is conservation and sustainable agriculture?

CA is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. In the typology of farming systems shown above, stages 1-4 refer to conventional agriculture since they rely on the high use of external agro-chemical inputs, although with increasingly less mechanical disturbance of the soil. In South Africa, most commercial grain farmers are in stage 2, where tillage is reduced to some degree but all other practices remain conventional. The progression to CA (stages 5-7) involves the avoidance of tillage (No-Till or Zero Till) together with the optimal use of external inputs of mineral or organic origin that enhance natural biological processes above and below the ground surface, as well as permanent organic soil cover and the use of crop rotations. Ultimately, the most sustainable and preferred system is organic CA (OCA) where no external synthetic inputs are used in favour of organic nutrients and enhanced integrated management systems. Ultimately, CA/OCA must gain acceptance across the value chain and be demanded by informed South African value chain actors and consumers if it is to succeed and scale up as a dominant paradigm. The principles of CA/OCA also lend themselves to application in integrated crop-livestock, agroforestry and extensive livestock production systems. Experience has shown that smallholder farmers on less than half a hectare can step up into stages 6-7 relatively easily, whereas farmers on 1-2 hectares can aim for stage 5 to start with. Larger commercial farmers generally start with stage 3-4 in the short-term but a quicker step up to stage 5 and above should be encouraged.

Stage	1	2	3	4	5	6	7
Type of farming system	Conv. tillage	Min. or reduced tillage	Conv. no tillage (NT)	Conv. zero tillage (ZT)	CA _{HEI}	CA _{LEI}	Organic CA
			(Direct seeding equipment using tines). Production system lacks adequate soil cover and sound crop rotations. High use of external inputs	(Direct seeding equipment using discs). Production system lacks adequate soil cover and sound crop rotations. High use of external inputs	(NT or ZT using <u>high</u> quantities of external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.	(NT or ZT using <u>low</u> quantities of external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.	(ZT using <u>no</u> external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.
 Sustainability gradient							

Source: Adapted from Blignaut et al. (2014)

Current uptake levels of CA in South Africa are generally low (Sybrand Engelbrecht, Maize Trust, personal communication 2015), with a few exceptions (ARC 2014, Smith et al. 2010). The role of policy and institutions in enabling a stronger uptake and impact needs to be carefully considered. This includes having a clear vision of the future agrarian system and how to get there. What could this future vision be? As stated in the draft National Strategy for Agro-ecology, “[t]he contemporary challenges of agriculture have evolved from the merely technical to also include social, cultural, economic and particularly environmental concerns. Agricultural production issues cannot be considered separately from environmental issues. In this light, a new technological and development approach is needed to provide for the agricultural needs of present and future generations without depleting our natural resource base”.

The most recent policy directive emerging from the Department of Agriculture, Forestry and Fisheries (DAFF) is the Agricultural Policy Action Plan (APAP) of 2013, which seeks to provide a long-term vision of the agricultural sector. Despite a coherent analysis of the issues facing agriculture, a common vision based on sustainability principles, incorporating nutritional and social outcomes, is not emerging strongly. This is partly because conventional agricultural practices are powerfully entrenched in the existing agrarian system. This system is characterised by decreasing the number of producers, and operating on larger production units in cooperation with agri-business and with high influence in value chains. Disparate attempts to develop policies pertaining to CA, agro-ecology and organic agriculture must be aligned and coordinated within a larger frame. There must also be clear incentives and disincentives for multiple stakeholders and actors across the agrarian system to work towards a vision for sustainable agricultural systems.

This booklet explores the current policy framework and institutions along the agricultural value chain and how they encourage or hinder the shift to conservation and sustainable agriculture. The potential for conservation agriculture is analysed in terms of its potential contribution to the achievement of key national policy goals, such as economic growth, food and nutritional security, rural development, and climate change mitigation and adaptation, while exercising stewardship of natural resources.



Policy context

In order to identify the policy interventions most appropriate to supporting conservation agriculture, it is conducive to consider the emerging policy debates and to be aware of the complex inter-sectoral response and coordination required. The current reality is that there is some discord among policies. A key question is whether existing and emerging agriculture and food policies are guided by a clear vision and whether a cogent set of measures are defined to achieve this vision.

The National Development Plan (NDP) has become the overarching development agenda for government (NPC 2011). The NDP identifies agriculture as a primary economic activity in rural areas with the potential to create one million new jobs by 2030. The plan proposes a number of approaches to land reform and its financing. However, Chapter 6 of the NDP, although not explicit, is geared

towards large-scale irrigation farming, fuel-based mechanisation, mono-cropping, and export-oriented and agro-chemical-driven conventional agriculture. Also, the NDP does not respond clearly to the realisation that the conventional model of agriculture is exacting a heavy environmental toll. Widespread land degradation in South Africa places a question mark over the ability to achieve the goals of increased production and job creation based on the conventional model – both on currently farmed and underutilised land as highlighted in the NDP.

The various policies around agriculture have, since 1994, had three main focus areas in common, namely improving competitiveness of commercial agriculture in a free market dispensation, improving participation by disadvantaged communities, and protecting the natural resource base. A land reform programme was initiated in 1995 (including restitution, redistribution and tenure reform) and this remains a work in progress. The Integrated Growth and Development Plan (IGDP) of 2012 and the Agricultural Policy Action Plan (APAP) of 2013 for DAFF seek to facilitate equitable growth and employment in the sector, in line with the NDP. These plans also speak to the sustainable use of agricultural natural resources, enhanced food security, and improved governance. In spite of continued increases in production and value generated in the sector, agricultural policy has thus far failed to stem and reverse the job-shedding which has become a major characteristic of the current agrarian system (DAFF 2010).

Agricultural policy has also been unable to deal with the widespread land degradation, in various degrees, associated with the dominant conventional cultivation approach at large scale (Le Roux et al. 2007, Mills & Fey 2003, Du Preez et al. 2011). The APAP argues for the need to find a better balance between large-scale and small-scale subsectors in order to broaden market participation and thereby increase labour absorption. A number of sub-strategies are put forward including the promotion of local food economies as a means of creating marketing efficiencies, lowering food prices and stimulating local production as well as investment into agricultural value chains and logistics. The APAP also calls for the pursuance of climate smart practices and conservation agriculture.

Although there is real promise within the APAP to shift the existing food system to one that is more equitable and efficient, with the potential for more sustainable technologies within the drive to support smallholder farmers, it does have a number of assumptions that are echoed within the NDP. The plan stops short of prescribing a transformative system-wide and sector-wide transition away from conventional and towards sustainable agriculture. It thus runs the risk of ‘tinkering on the margins’ in the search for sustainability. There is also a risk that confusion will be generated by the apparent uncoordinated development of several policies pertaining to sustainable agriculture:

- An organic agriculture policy has been under discussion and in various draft versions (currently Version 8) for a number of years. Its focus is primarily on resolving issues pertaining to certification and market access.
- An agro-ecology policy exists as a strategy document – it promotes ecological theory to design, manage and evaluate agricultural systems that are productive but also conserve natural resources.
- The policy on agriculture in sustainable development is available as a discussion document (8th draft) (DAFF, not dated). “The purpose of this policy is to facilitate a co-ordinated approach towards achieving an ecologically, socially and economically sustainable agricultural sector in South Africa that supports the government’s commitment towards poverty alleviation, food security and economic development. This emphasizes the creation of a prosperous agricultural sector while protecting the national biological and physical resource base, as well as enhancing human health and well-being.”
- Currently, a national conservation agriculture policy is under development.

While each has a specific focus, it is not clear how they fit into an overall policy framework. There exists further complexity in the strong intersections with policies and plans in other sectors, for example water resource management, environmental management, land reform and rural

development, food and nutritional security, the green economy, trade, and climate change. All of these have the potential to positively or negatively influence the uptake of sustainable practices by farmers (Mudavanhu et al. 2015). The promotion of sustainable agriculture will only succeed with greater alignment in this multi-policy, multi-institutional and system-wide frame. Similarly, a CA policy has the potential to strengthen the implementation and impact of these policies. This is illustrated in **Figure 1**, which shows a selection of policies that have a direct bearing on CA policy.

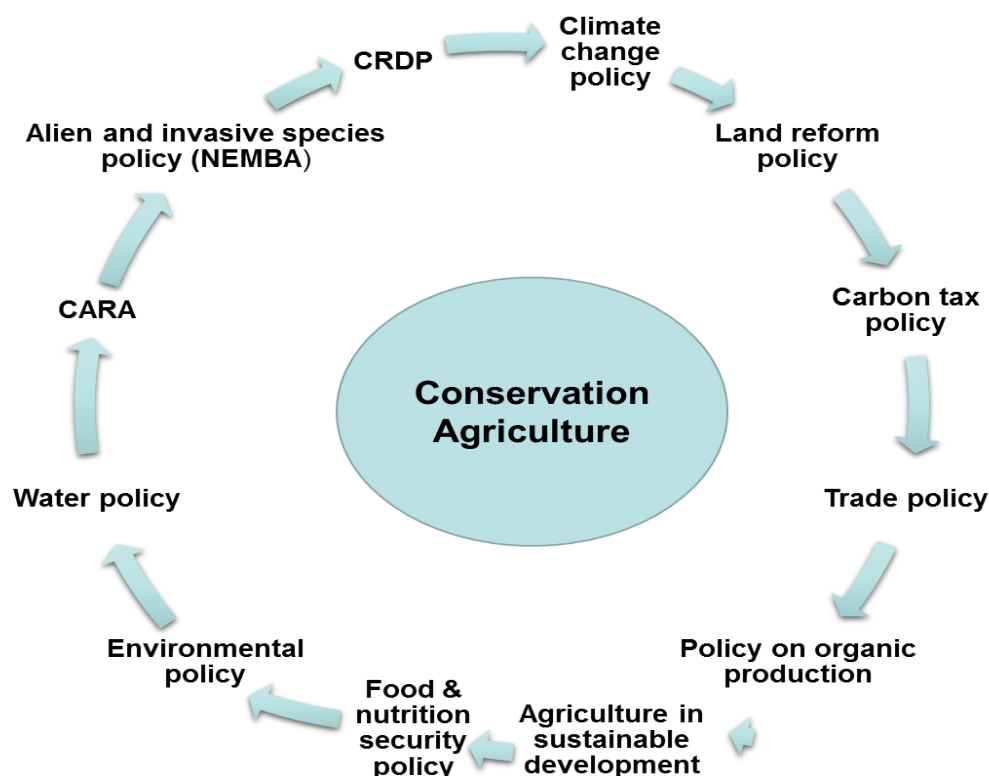


Figure 1 Conceptual diagram showing some of the South African policies, strategies, plans and Acts which have the potential to influence the uptake of Conservation Agriculture.

Source: Mudavanhu et al. (2015)

The assumption, however, that careful alignment of policy underpin the support and ultimately the implementation of CA is misplaced. The reality is that a “policy hierarchy” exists, as depicted in Box 2, which requires careful analysis and understanding. The existence of the “policy hierarchy” implies that some policies enjoy greater attention and resourcing at the highest level.

Institutional (value chain) context

Uptake of CA requires coordination from multiple institutions within the public sector (FAO 2009), but also from institutions within the private sector across the agricultural value chain (see Figure 2). One of the South African studies informing this brief found, through a series of interviews, that CA is not well understood or seen as providing potential benefits in the banking, trade (silos, mills) and local retail sectors (von Loeper et al. 2015). There are no political, social or financial imperatives to move away from the existing system based strongly on conventional agriculture, and the policy environment

does not provide any drivers for the support of conservation or sustainable agriculture in the value chain. As a result, producers and agribusinesses continue to pursue short-term financial goals within a concentrated value chain built around this system.

In South Africa, value chain actors are not willing to engage with CA under the status quo (von Loeper et al. 2015). The retail sector is already responding to limited local consumer demand for organic produce (Barrow 2006, INR 2008, Engel 2008), and claims that it is unable to establish another “brand” of sustainability, with both retailers and consumers failing to perceive the differences between CA and organic farming systems. This situation can be strategically remedied by encouraging and rewarding stepwise evolution of all agricultural systems towards organic conservation agriculture (OCA).

In contrast to an unwillingness to engage with CA, value chain actors are willing to engage with smallholder farmers, who are a stated priority of government. Indeed, existing policy drivers and instruments have given rise to political momentum and business opportunities to support smallholders. These actors agreed that CA uptake could be accelerated through smallholder farmer development, supported by ‘bottom-up’ training and extension and a drive to cooperatively aggregate and market CA produce (see **Box 3**).

The value chain can be encouraged to respond to the imperative for sustainable agriculture by policies and initiatives which serve to increase the consciousness among all kinds of consumers for the economic, health and environmental benefits of sustainable agriculture. This raises the urgent need to build this consciousness – and to challenge the dominant economic argument of conventional agriculture to include externalities (environmental and social costs).

Box 2 The ‘policy hierarchy’

A number of key national goals, such as economic growth, employment creation, food and nutritional security, rural development, and climate change mitigation and adaptation, are articulated within a broad range of policies at national level. These goals can, however, work against each other if not carefully aligned to a coherent vision. Even within the National Development Plan contradictions exist: the reduction of carbon emissions espoused in one chapter is offset by another that invites infrastructure development in support of the coal industry. The broad range of agriculture- and food-related policies also do not align coherently. This is partly because a clear vision of a future agrarian system and how to get there, is missing. A recent policy review found that South African agricultural policies do not actively promote food security and the lack of an enforceable food security policy makes it difficult to coordinate existing policies (Hendriks & Olivier 2015). This incoherence is largely derived from an ideological heterodoxy in government and the Cabinet (Calland 2015). In essence, policy coherence requires a more coordinated approach that has both political will and resourcing.

Depending on the emphasis placed on particular national goals, different policies can be situated within a “policy hierarchy”. For instance, an agriculture policy that focuses on creating 1 million new jobs will “trump” a policy that places environmental sustainability before employment creation. Similarly, in debates about land reform, goals of social justice and sustaining food security (national food production) are often juxtaposed. This hierarchy therefore shifts according to the particular issue or goal, as well as who is promoting it. This has serious implications for future policies that promote sustainable agriculture.

By understanding the array of key national goals, policies can be aligned and potential conflicts reduced. In that context, where does the CA policy fit? How and where does it align to other policy objectives? If it emphasises one issue at the expense of another it will attract a particular response. As such the “policy hierarchy” allows clear strategic analysis.

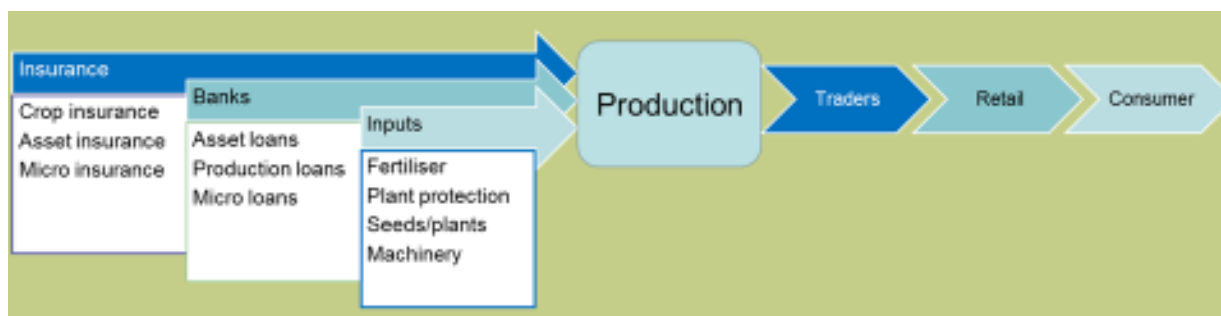


Figure 2 Simplified diagrammatic representation of a typical agri-food value chain.

Source: Von Loeper et al. (2015)

Box 3 The role of smallholder and emerging farmers in the value chain for sustainable production systems

The South African agricultural sector is strongly characterised by a dualist production system, made up of approximately 40 000 commercial farming units and 1.3 million smallholder farmers in former homelands (DAFF 2012), with 2.9 million households in the country engaging in agriculture primarily at a subsistence level (Statistics South Africa 2011). CA/OCA is ideally suited to smallholder farmers. It reduces the need for expensive agro-chemical inputs, requires lower financial investment and greater profits, supports the local production of diverse, safe and nutritious food, provides higher resilience to climatic stress, and secures a healthy environment for the rural population.

A specific issue that deserves further attention in value chains is to link emerging and smallholder farmers to agri-food supply chains for sustainable production systems (Blignaut et al. 2014, Kelly & Metelerkamp 2015). Smallholder and emerging farmers require linkages with the input and output markets in the same manner as commercial farmers – this is an essential requirement for their development and the growth of the food system (Shange 2014). The outcomes to date have not been encouraging owing to a multitude of barriers (Jordaan et al. 2014), despite substantial government investments. While vertical integration and its economic benefits have become entrenched in the commercial sector, emerging and smallholder farmers rarely have the resources to achieve this even when combined into a group of small producers (Ortmann & King 2010).

Greater integration of these farmers into the agri-food value chain could be achieved through the development of sustainable production systems tailored to their circumstances and supported through the focused development of linked sustainable value chain components and associated incentives. If emerging and smallholder CA/OCA farmers are to succeed so that this system can be scaled up across the country, technologies for CA/OCA suited to their particular conditions and budgets will have to find greater support from research, extension and input suppliers, together with access to financial resources, access to informal and formal markets and some policy adjustments (Von Loeper et al. 2015, Kelly & Metelerkamp 2015).

Why is the current agrarian system based on conventional agriculture not sustainable?

The historical legacy of South Africa has led to the current dual agricultural economy, with the dominant commercial sector pursuing the objective of ever greater yield on a large scale, made possible by the high rate of external inputs (the HEI model). This system is increasingly favouring a diminishing number of farmers and entities in the value chain (van der Heijden & Vink 2013), with high levels of concentration in some parts of the value chain and the food system, and recent investigations into anti-competitiveness. The government's vision of an inclusive and equitable rural economy and a growing production base and value added, creating large employment and livelihood opportunities, is not materialising. There has been a stubborn lack of progress on achieving broader participation at all scales and in all areas of the value chain (Ortmann & King 2010, Jordaan et al. 2014). Targets for the quicker reduction of food insecurity are also proving difficult to achieve. To some extent this can be attributed to the fragmented nature and implementation of policy. However, we argue that the agrarian system based on conventional HEI agriculture is fundamentally unsustainable and requires transformation from the bottom up. This would provide a new basis for achieving the country's agrarian and developmental policy objectives.



Conventional agriculture is suffering from rapidly escalating input costs, particularly for agro-chemicals and diesel. Market prices are, however, not keeping pace, thus placing enormous pressure on margins. The business model then drives farmers and agri-business towards greater economies of scale. Smaller farmers are particularly hard hit. The model is also heavily reliant on practices such as regular tillage which cause soil degradation. Soil erosion coupled with carbon and nutrient

depletion have led to the stagnation of advances in productivity in many areas, counteracted by the increasing use of inputs to maintain current yields (IAASTD 2009). This system will reach ecological and economic thresholds in the future (Kotze & Rose 2015) where the land will be unable to produce more and more food to meet the needs of the growing population, and production costs will regularly exceed product prices. Without systemic transformation, this will lead to a greater reliance on imports, with job losses and other social ramifications. Evidence shows that the economic, ecological and social 'hidden costs' of continuing with the current system (Blignaut et al. 2015) outweigh the costs of transitioning to a more sustainable system such as CA.

A system-wide approach is needed

The drive towards better social, economic and environmental integration needs a holistic view of the optimal use of natural resources, as well as the choices and trade-offs which this requires over various time scales. These choices and trade-offs go well beyond farm-level decision-making, technical frames and economic calculations, and speak to the long-term future of the entire food production system and the rural economy (Ikerd 1993, Kotze & Rose 2015). A system-wide approach is needed which can address inter-connected problems within the broader agrarian structure and along the whole agricultural and food system value chain.

CA provides a systemic pathway towards a better future

A companion booklet (Blignaut et al. 2015) provides new empirical evidence, using system dynamics modelling, for the system-wide benefits provided by a transition to more sustainable farming systems (beef production) and CA (maize production). Under all scenarios for conventional agriculture, the net present values (NPV) for maize production were negative, indicating that the environmental demand exceeds the value of the maize. For beef production, the dynamic analysis shows that under certain conditions (best practice) the values can become positive, but that they are currently dominantly tending negative. The evidence leads to a clear deduction: managers have to change their prevailing management practises to reduce the current net environmental loss. When the dynamic models are run for CA/sustainable practices, the externalities are offset to a large degree. **Figure 3** depicts how CA (maize) can potentially lift NPV into a positive trajectory. In some production regions a transition period of a few years can be experienced where farms changing to CA can show reduced yields, although not necessarily reduced profits owing to the significant reduction in input costs. This transition period may require targeted support in the form of short-term policy instruments to encourage all farmers to make the transition without carrying all the risk. As a new soil and ecological equilibrium and health is achieved in the longer-term and the economic benefits become clear, with CA having become the dominant farming system, these instruments can be phased out or replaced with instruments which reward further improvements in soil health, water resource management and the provision of safe and nutritious food.

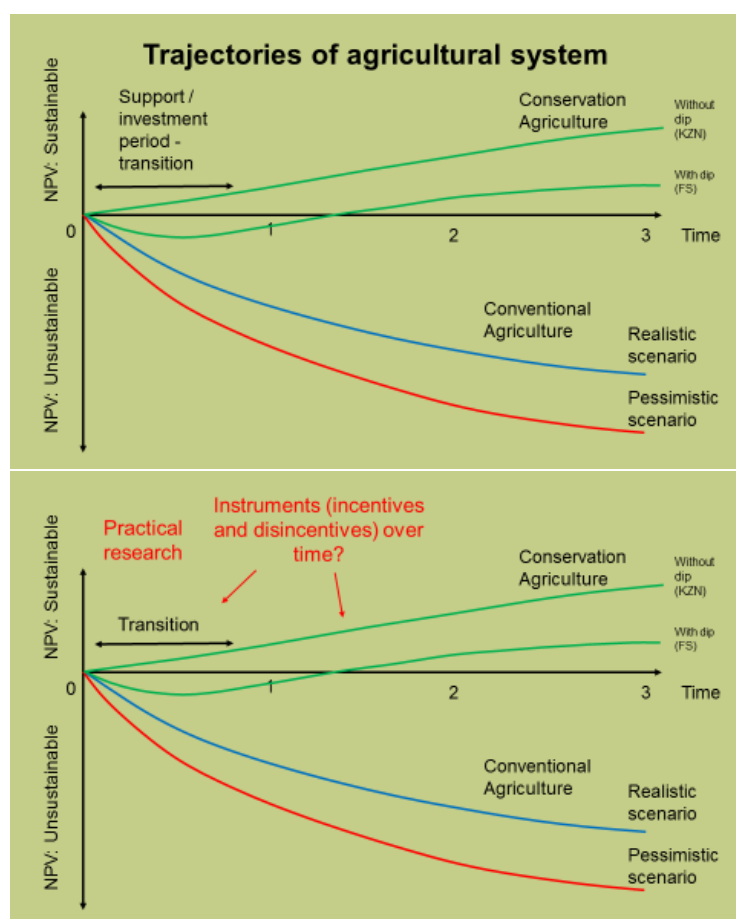


Figure 3 Simplified diagrammatic representation of Net Present Value (NPV) over time for conventional and CA maize production systems in South Africa.

Source: Adapted from Blignaut et al. (2015)

Pathways to sustainability offered by CA/OCA

There are four compelling motivations for policy-makers in South Africa to take CA/OCA seriously. A brief summary of each is presented here.

1. CA/OCA offsets external costs of conventional agriculture

The costs of environmental damage (externalities) caused by high input agricultural practices are currently borne by the environment itself, by farmers having to maintain and sometimes increase external inputs to compensate for the loss of free ecosystem services and productive potential, and by the National Treasury (i.e. the tax payer) which funds the implementation of critical restoration/rehabilitation projects at great cost (e.g. siltation of dams, climate disaster impacts). Clearly, gradual long-term declines in farm soils, grazing and biodiversity must be halted and reversed first and foremost by farmers. This will give nature the chance to recover to a stable productive state, thus avoiding critical thresholds so that future rehabilitation costs can be limited and input costs reduced.

Sustainable farming systems have a positive impact on a range of environmental factors (Mondelaers et al. 2009). Key benefits of CA and/or organic agriculture include increases in soil organic matter (SOM) and soil organic carbon (SOC) (Derpsch et al. 2010), improvements in nutrient cycling, increases in biodiversity (Bengtsson et al. 2005, Tuck et al. 2014), reductions in concentrations of toxins in water sources and soils, and improved resource use including water use. One of the key environmental benefits is the increase in rainfall infiltration into the soil and the retention of soil moisture over longer periods than in conventionally farmed soils (Derpsch et al. 2010). The economic benefits to farmers emerge through long-term increases in profitability, and to the state through systemic strengthening of national food production, reduced environmental damages and improved water resources management.

2. CA contributes towards carbon sequestration and increases resilience to climate change

In an analysis of field cropping systems in the Eastern Free State, Knot (2014) concluded that CA effectively mitigates greenhouse gas (GHG) emissions through the sequestration of organic carbon in the soil. This echoes global findings (Lal 2010, Govaerts et al. 2009). In addition, GHG emissions are reduced through the lower use of fossil fuels (especially diesel) and synthetic N-based fertilisers (Knot 2014). A modelling study over 20 years for four maize production regions of South Africa shows a significant potential for total net CO₂e-emission reductions of between 1.3 and 13.6 tons CO₂e/ha/year under a CA-friendly production system (Blignaut et al. 2015).

The beneficial effects of CA production practices on improved soil moisture retention and reductions in runoff (Derpsch et al. 2010) are especially striking during years of lower than average rainfall and drought. The combination of benefits (GHG emission reductions, reduction in soil erosion, increased soil water retention and reduced soil surface temperature resulting from soil organic cover) makes the CA system more resilient to variability of rainfall, heat stress and extreme climatic events. These conditions are expected to become more prevalent under climate change in South Africa. For this reason CA is widely acknowledged as a “climate-smart” solution (Gattinger et al. 2011, FAO 2013b).

3. CA can increase long-term sustainable food production and improved nutrition

For all scales of farming, from large-scale commercial to smallholder and subsistence farming, CA provides a pathway towards long-term growth of food production capacity in South Africa. It has a proven ability to restore depleted soils with a history of over-use, and potential to revive sensitive soils which are currently not productively used (e.g. in communal areas). Large-scale uptake of CA would boost long-term food production and food security, and contribute to the alleviation of current health challenges associated with malnourishment. The sustainability of an agricultural and food system is defined not only by the sustainability of production and consumption but also by the quality of the food delivered (see **Box 4**).

4. CA can support rural livelihoods and local food economies

Through its potential impact on smallholder farmers, CA can have a positive influence on rural livelihoods and through these local food economies. In this way it will also have a positive interaction in terms of social justice outcomes and a contribution to an evolving agrarian system. However, the expectation that smallholder farmers will succeed after a couple of years of support and funding is completely unrealistic. This has implications for sustained and comprehensive focus and support for these benefits to be made.

Policy recommendations: CA as a catalyst for agrarian reform

South Africa is grappling with the seemingly intractable challenge of transitioning towards a productive, sustainable and equitable agrarian system. There is a heightened need for a better understanding for, and vision of this future system and how to get there over time, by moving across the continuum of different types of agriculture. This would have to be done while maintaining the political imperatives around food security, economic growth, employment creation and careful use of natural resources. A CA policy needs to carefully align and intersect with broader socio-economic policies and instruments pertaining to the future agrarian system. What are the important considerations?

- **Policy alignment:** The contradictions and challenges among the range of developmental and agricultural policies and strategies must be identified and acknowledged. How, for example, does the continued support of conventional farm mechanisation (massification programme) reconcile with the need to reduce the use of fossil fuels and protect the soil? A CA policy should provide clear guidance on the pathway from entrenched and sometimes harmful technologies and practices towards the agreed vision of sustainability.
- **Linking into the existing policy mix:** Although a CA policy could exist and be implemented in its own right, a number of current highly prioritised system-wide policies and programmes are able to further support the accelerated uptake of CA. For example, the current policy focus on smallholder development, food and nutrition security, water resource management, and rural development and land reform is well-suited to raising awareness of, and accelerating, the transition from conventional to conservation agriculture. Implementation programmes, such as LandCare, should integrate CA wherever possible. In turn, CA has the potential to contribute to the success of other policies and encourage approaches that will result in comprehensive benefits and optimisation of trade-offs. Other examples where CA can help to achieve some of the policy goals include the policies and programmes on climate change, the Green Economy, trade, the environment and biodiversity.

- **A responsive and adaptive policy:** A transition which takes into account issues of scale, time and feedbacks is made possible through the progression from conventional to sustainable agriculture. This demands responsive and adaptive management and an understanding of the potentially disruptive nature of systemic changes and unintended consequences for certain elements of the system within the broader set of benefits. These can then be sensitively and strategically managed. An important consideration in the beef industry, for example, is the need for an approach to sustainable production that is culturally sensitive and strikes an acceptable balance between livelihoods, culture and environment, with attention to social goods.
- **A chance of success:** A CA policy needs to be politically acceptable and administratively feasible within the context of available capacity and finances, in order to ensure swift implementation. It must also be seen to contribute to the achievement of social justice and equity.

Box 4 Contribution of sustainable farming systems to food safety and nutrition

Quality of food can be assessed variously as the overall quality of the diet (nutrition), the safety of the food consumed (in terms of risk to cause illness or even death), and the quality of a specific food type grown under different production systems.

South Africa is undergoing a 'nutrition transition' where stunting, wasting and undernutrition in young children is occurring alongside increasing levels of obesity and overweight in older children and adults (Schönfeldt 2013). These public health problems are largely concerned with the consumption patterns of South Africans who often do not have access to a healthy and nutritionally diverse diet. In particular, many South Africans consume too much staple carbohydrate (maize and bread) in proportion to other grains and mixed vegetables, with a recent shift towards a higher consumption of protein (chicken), vegetable fats and sugar. The intake of essential micronutrients is generally insufficient. CA promotes the use of a wider diversity of crops as cover crops and in rotations, including N-fixing legumes. This can form the basis for a more diverse and nutritious diet.

Food safety is a primary concern for the agro-food industry. Food safety risks appear to be increasing in South Africa through contamination of irrigation water (Britz & Sigge 2012), and soils, where harmful organisms and toxins such as pesticides make their way into the food system.

Results of meta-analyses studies are divided on the differences in nutritional quality of organically or conventionally produced food, with some pointing out that differences are few, or that there is a lack of strong evidence (Dangour et al. 2009, Jensen et al. 2013, Smith-Spangler et al. 2012). However, there is evidence that consumption of organic foods may reduce exposure to pesticide residues, antibiotic-resistant bacteria and toxic heavy metals, and increase the intake of health-promoting antioxidants and other secondary metabolites (Barański et al. 2014, Brandt et al. 2011). These differences are linked to specific agronomic practices prescribed in organic farming, specifically fertility management and the elimination of pesticides.

Interestingly, South African consumers are trending towards a growing interest in "alternative quality" and healthier options, with retailers responding accordingly (Bienabe et al. 2011). Thus, free-range eggs and meat, "certified natural" or "Karoo lamb", organic ranges, and other sustainability labels (ecological-ethical) are in demand from consumers who perceive them to have better taste, aroma and texture. However, this (still small) market is dominated by the formal retail sector, and is poorly developed among consumers in the informal market.

Policy recommendations: supporting the technical transition from CV to OCA

The previous section argues that CA is not just a separate technical tool within agricultural policy but that the implementation context and benefits go well beyond this frame. Nevertheless, the technical considerations are not straightforward and must also be addressed by a CA policy to ensure greater uptake by both large commercial and smallholder farmers. The following recommendations should be considered:

- **A time-bound approach to transitioning:** As shown graphically in **Figure 1**, the initial transition period from conventional agriculture to CA is characterised by the rehabilitation and re-equilibration of soil structure, nutrient balance, weed and pest dynamics, which can result in transient reductions in yield, especially in areas with lower agricultural potential. This period also demands some capital investment, for example in CA planters or other CA-suited tools and machinery. In the case of beef farmers, the transition to a more sustainable production system demands measures to correct rangeland stocking rates and establish integrated livestock management approaches, which can also take a few years to return longer-term benefits. A CA policy should provide time-bound support in the form of incentives and other policy instruments aimed at this period, in order to speed up the successful transition, support the shift to a higher category of sustainability (stages 5-7 in **Figure 1**), and absorb a proportion of the risk that is taken by the farmer. Thereafter, other instruments and programmes can be brought in to support long-term continuation of the system, including the proposed carbon tax, water pricing, punitive measures (e.g. for continued soil erosion, alien invasive encroachment, eutrophication) and rewards (e.g. for improvements in soil health, water resources management, the provision of diverse, safe and nutritious food, and job creation).
- **Practical on-farm support:** Successful shifts towards more sustainable farming practices have been achieved from the bottom up, by individuals and individual institutions, without a higher level coherent strategy or action. Thus, a practical, on-farm, bottom-up policy approach is recommended to increase the uptake of CA through farmer-led innovation and local solutions. The recommendations include on-farm financial support, increased knowledge (through CA-focused training, extension and mentorship), and dissemination of the effects of bad agriculture practices. The LandCare programme would be well-suited to carrying the message through awareness and capacity building, as would existing farmer study groups. A core programme should be to mainstream CA into all education and extension programmes and to influence the inclusion of a CA focus within the new participatory extension model currently in draft version. The development of human resources could include the use of exchange programmes, and a particular focus on youth and women farmers.
- **Investment in applied CA research:** A great deal of investment and effort is still needed to continue to build locally-adapted CA systems over the short-, medium- and long-term and to scale out effectively. This should include the establishment of farmer-led research for various scales of farming, accompanied by financial models which go beyond the mere recording of yield by capturing the reduction in costs and the offsetting of environmental costs (externalities). Research into the nutritional and food safety benefits of CA should be stepped up, and certain on-farm policies (e.g. Payment for Ecosystem Services (PES)) backed up. Case studies of successes in different agro-ecological areas and different farming systems would complement these approaches and encourage farmers to make the shift. Aligned to research is the need to invest in long-term monitoring systems of the benefits to agricultural resources in South Africa – especially a carefully selected set of soil health indicators.

- Developing and nurturing partnerships: CA uptake can be accelerated through the development of partnerships. These could include government–private partnerships or government–farmer–business coalitions, as well as partnerships between commercial and smallholder farmers, between commercial farmers and farm workers, and between farmers and scientists. Successful examples exist, such as the applied research partnerships of GrainSA, ARC and others. Regional partnerships between farmers, government and scientists from South Africa and those from countries across southern Africa should be encouraged, especially from countries where CA is already practiced such as Zambia and Zimbabwe.
- Sustainable agricultural value chains: A CA policy should encompass the whole value chain and encourage all actors across the chain to support the transition to sustainable agriculture (CA and OCA). Given the current barriers, policy should identify and target “entry points” in the value chain, initially through the provision of integrated CA-friendly support and services to smallholder farmers. This should leverage the existing policy thrust in support of smallholder development and broaden participation in the value chain. It can also link with the government’s programme to develop and strengthen cooperatives for smallholder farmers. Further uptake of CA in the value chain will depend on the building of a sound business case and incentives for institutions within finance and insurance, manufacture and sales of inputs, processing and trade, and retail. Finally, a comprehensive consumer information and awareness campaign is necessary to scale up the demand for sustainable produce through an understanding of the environmental and health benefits and the reduction in long-term costs to the taxpayer.
- A united coherent understanding and vision of sustainable agriculture: Core actors in the sector do not agree on, or do not sufficiently understand, CA/OCA and sustainable agriculture. As part of policy development and effective implementation, government needs to lead the discourse between actors in order to develop a consensus understanding and vision. This is a prerequisite for the creation of an enabling environment. A greater understanding should emphasise not only the various system components but also the range of complex interactions within a larger system, thus acknowledging the wider benefits. The process of participatory exploration and knowledge exchange should be sustained over the long-term.

Possible policy instruments

A wide range of policy instruments are at government’s disposal in order to achieve the above objectives. They include but are not limited to:

- carbon and water pricing and other incentives to reduce their use and footprint within agriculture
- a CA/OCA-friendly carbon tax regime for agriculture
- a land valuation system which rewards good land use and farming practices
- shifting agricultural subsidies (e.g. synthetic fertilisers for smallholder farmers) towards more sustainable practices
- incentives for the removal of alien invasive plants on land with high potential and using the cleared land for CA/OCA farming, thus providing jobs, rehabilitating the soil and its water holding capacity, and producing more food
- offset systems whereby carbon offsets are used to rehabilitate conventionally-farmed degraded land by shifting to CA/OCA
- brokerage systems for PES on farmland, where groups of farmers collaborate to access the financial benefits of PES in return for landscape-level sustainable farming
- incentives for beef cattle farmers to improve production efficiencies and lower the environmental footprint of meat production
- assistance schemes for farmers who want to purchase specialised CA implements (such as CA planters) by

- reducing or lifting import duties
- supporting the local development and manufacturing capability (in the Western Cape, locally-developed machinery was better able to deal with local soil-specific challenges than imported versions; this also has job creation potential)
- providing low or no interest asset finance
- bank guarantees for CA/OCA farmers
- Incentives aimed at speeding up the transition from HEI (stages 1-5) to LEI (stages 6-7)
- rewards for proven social benefits brought about by conversion to CA/OCA (jobs, food security)
- using the social responsibility programmes of big corporates to encourage them to support the transition to sustainable agriculture

Way forward

The current development of a CA policy for South Africa is a positive step for the country, as it moves to a sustainable agriculture regime. It is recognised that CA is part of this trajectory. It should be reiterated, however, that the conditions of a transition towards a more sustainable agriculture and food system are a matter of intense debate and of utmost importance to South African agricultural and food policy in the immediate future. The research and justification presented in this brief and its companion paper are intended to contribute towards this process and as an important step, as an input into a CA policy. In addition and complementary to the CA policy we propose that DAFF launches a wider set of engagements with other national departments at the highest level as well as key actors and institutions across the agri-food value chain – and those “outside of it” as critics of the system. This is in order to gain system-wide political and institutional buy-in for the urgent transition towards sustainable and regenerative agricultural production systems. A common vision for the transition to such systems is required by government and the private sector (farmers, agricultural organisations, input and service providers, markets), civil society and academia, based on the acceptance that “business-as-usual” is no longer an option. This is simply economically and socially unviable, compromising the country’s food security and, ultimately, national security. Future challenges such as population growth, water and energy security, and climate change demand strong leadership and courage to do what is necessary to build a more resilient South Africa that continues to feed itself while providing greater economic opportunities for its rural population.

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