



WWF

REPORT

ZA

2019



FOOD

Agri-food Systems: Facts and Futures

How South Africa can produce 50% more by 2050



Author: Tatjana von Bormann

Editorial team: Mkhululi Silandela (WWF-SA), Scott Drimie (Southern Africa Food Lab), Sylvia Tramberend (IIASA), Günther Fischer (IIASA), Sue Northam-Ras (WWF-SA), Inge Kotze (WWF-SA), Jon Hanks (Incite), Treve Jenkin (Incite), Jacqui Dixon (Incite), Wendy Engel (WWF-SA), Bridget Carle (Tufts)

Reviewers: Scott Drimie (Southern Africa Food Lab), Theresa Frantz (WWF-SA)

Text editor: Marlene Rose

Infographics and layout: GAPdesign

Executive summary infographic design (on page 6–7): TIGHTSHIP

Printer: Hansa Digital and Litho Printing (Pty) Ltd

Printed on: Galerie Art Natural

© Text 2019 WWF-SA

All rights reserved

Published in 2019 by WWF – World Wide Fund for Nature (formerly World Wildlife Fund), Cape Town, South Africa. Any reproduction in full or in part must mention the title and credit the above-mentioned publisher as the copyright owner.

Citation: Von Bormann, T (2019) Agri-food Systems: Facts and Futures: How South Africa can produce 50% more by 2050. WWF South Africa, Cape Town

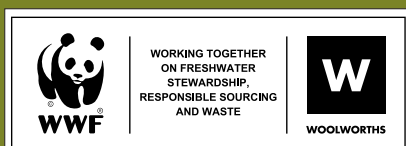
If you would like to share copies of this paper, please do so in this printed or electronic PDF format.

Available online at www.wwf.org.za/report/agrifood_systems

WWF is one of the world's largest and most experienced independent conservation organisations with over 6 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

www.wwf.org.za





CONTENTS

IN SUMMARY	4
WWF'S WORK IN AGRI-FOOD SYSTEMS	5
Section I: What are the impacts on our food system?	
CONTEXT: A GROWING NEED FOR GOOD FOOD	9
THE FOOD SYSTEM IN SOUTH AFRICA	11
SOUTH AFRICA: FOOD AND PEOPLE	12
SOUTH AFRICA: FOOD AND NATURE	16
Section II: What behaviour is influencing our food system?	
ACTORS IN THE FOOD SYSTEM	24
Section III: What is the future we want?	
FUTURE OF FOOD: RESILIENT AND REGENERATIVE	37
WWF'S APPROACH: TRANSFORMATIVE CHANGE IN FOOD SYSTEMS	43
GOING FORWARD	50
GLOSSARY	51
REFERENCES	53

IN SUMMARY

Current methods of food production threaten the environment and human health. Change is urgently required.

THE CURRENT STATE

The food system, while highly productive, has done more **damage to our natural environment** than any other human enterprise. Of all activities on Earth, the production of food is the largest contributor to biodiversity loss, deforestation, desertification and soil degradation. It escalates water scarcity, leads to declining water quality and causes widespread damage to marine ecosystems.

Climate change is accelerated by greenhouse gas emissions associated with large-scale production and consumption practices. Increases in the frequency of climate-related shocks will also significantly reduce nature's resilience and exert more intensive demands on food, energy and water supply.

Access to food and adequate nutrition are rights enshrined in the Constitution of South Africa, but while there is sufficient food to meet calorie requirements, **hunger is rife** – 22% of households have inadequate access to food. Despite the evident need, **33% of all food produced goes to waste**.

Signs that the food system is failing include increasing trends in food poverty, hunger and **malnutrition**, a lack of dietary diversity, child **stunting**, greater vulnerability to disease and an **obesity epidemic** brought on by people eating high-calorie processed foods with little nutritional value. The situation poses a major **threat to public health** and especially affects the poor, who are the most food insecure.

The food industry is characterised by **market concentration**. This means a few production, processing and retail companies determine choice, control supply and influence policy.

The **dualistic agrarian structure**, where commercial farms co-exist with a very large number of smallholder farms, reflects the historic patterns of racial and gender oppression, land dispossession and economic exclusion.

THE 2050 SCENARIO

Worldwide, a projected **50% production increase** will be required to feed the global population of almost 10 billion people by 2050. Similarly in South Africa, a population of as many as **73 million** people will **double the demand** for most commodities, with meat and milk demand expected to rise by more than 200%. Models suggest that significant increases in productivity rates twinned with limited imports can meet local demand.

But future food security is not only about increasing production. Trends in nutrition shifts, poverty, ecological impacts and climate change all demand a decidedly different approach: one based on food systems.

THE NECESSARY SOLUTIONS

To transform the food system, progress must happen across all sectors and be made on all levels more or less simultaneously. Efforts must be guided by the interconnected delivery priorities of the **Sustainable Development Goals**. All the evidence indicates that focusing on system-wide change can bring about rapid, far-reaching and positive change at scale. To achieve this, social, environmental and economic factors must be considered and supported by appropriate technology.

WWF focuses on five practical areas for transformative change in the food system, namely: **inclusive regenerative farming, optimal water use, responsible sourcing, reducing food waste and dietary shift**. This transition must alleviate poverty and reduce inequalities by focusing on those most affected by the nutritional deficit, namely women and children in low-income communities.



WWF'S WORK IN AGRI-FOOD SYSTEMS

WWF recognises the fundamental truth that healthy ecosystems form the foundation of a secure food supply, and that resilience at a production level is essential if the entire food system is to be regenerative.

Until a few years ago, WWF focused on the impacts of agricultural production, which are by far the most significant environmental impacts. However, focusing on farms only will not bring about the necessary structural transformation that is needed for a resilient and secure food system. If we want to achieve this shift within a complex adaptive system, we need to follow a socio-ecological approach where the social, economic and political dimensions (the actors) are embedded within the ecological component (nature). This approach hinges on understanding all the possible interconnections and feedback loops so that, in intending to fix one thing, we do not create another unintended consequence.

As these challenges cannot be solved by one actor alone, collaborative solutions are fundamental – urgent action is required across sectors and at multiple scales. While it is recognised that a systemic approach of this nature also includes marine impacts, wild-caught fish and aquaculture, these elements are not covered explicitly in this report (see WWF's 2016 Oceans facts and futures report).

In this context, four interlinked strategic objectives form the core of WWF's work. The organisation is working in partnership with key stakeholders to:

- secure the ecological foundation of food security and rural livelihoods through regenerative agriculture at all farm scales, from commercial to smallholder farmers
- promote responsible procurement practices
- reduce food loss and waste by supporting evidence-based action
- establish consumption patterns with positive environmental and health outcomes.

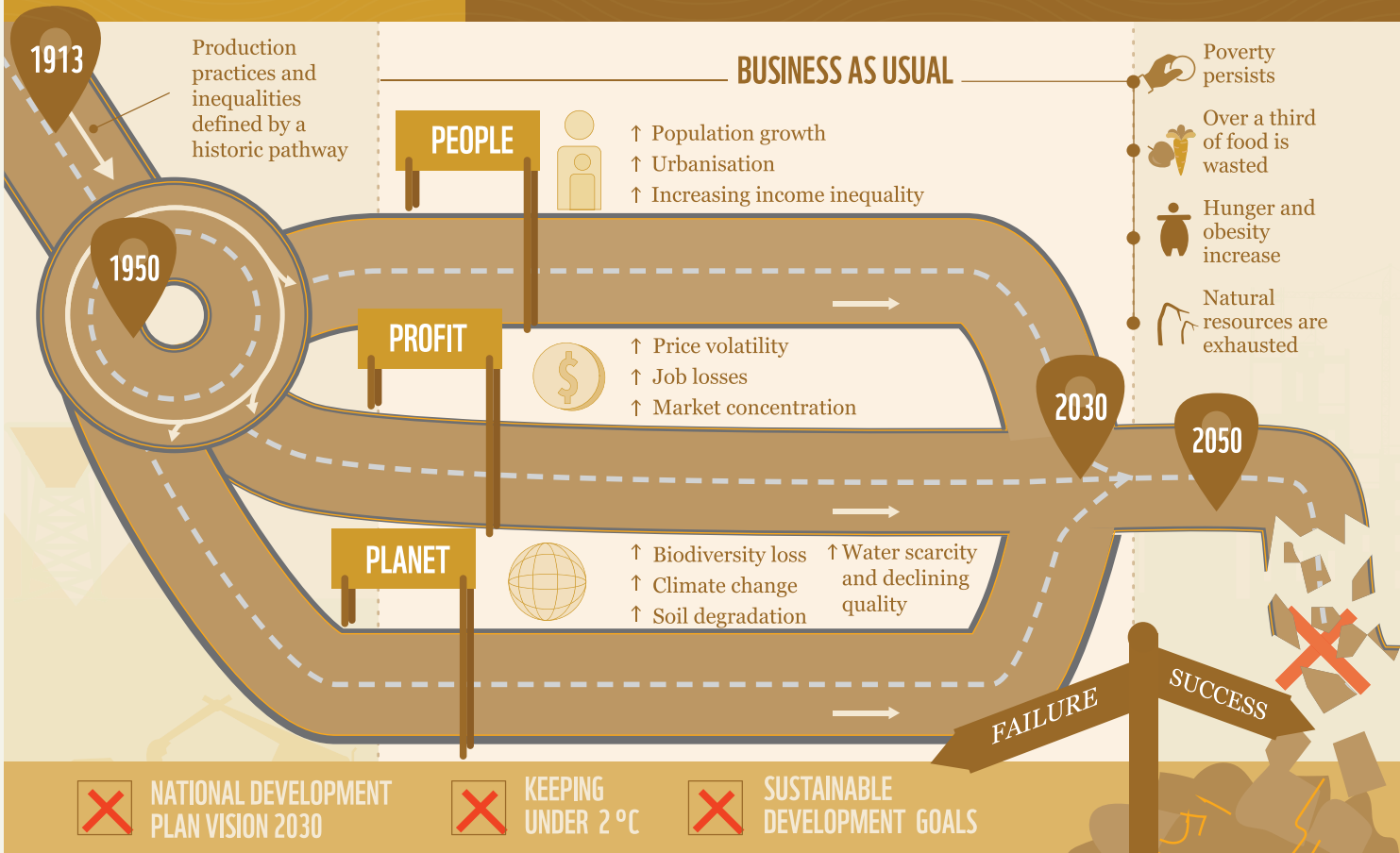


CAN WE SUSTAINABLY FEED EVERYONE IN 2050?

It can be done, but only if we act now – informed by the best available science and technology. We need holistic, people-centred solutions across all sectors and at all scales.

The current state

The current food system has *serious negative* environmental and health outcomes, most of which have arisen in the past 50 years.



But

It is not easy to fix the current system . . .



SMALLHOLDER FARMERS

A growing force (+ 2 million) but lacking access to resources



COMMERCIAL FARMERS

Sophisticated but facing an uncertain future



FOOD INDUSTRY

Market dominance and increasing industrialisation squeezing out smaller players



GOVERNMENT

Focusing on national food security, jobs and livelihoods but policies have had mixed results



CONSUMERS

More than half of South Africa's population cannot afford a healthy diet



RESEARCH INSTITUTIONS

Academic excellence but information sharing and skills development for smallholders is a gap

. . . it is a complex socio-ecological system defined by the behaviour of many ACTORS

HOW CAN SOUTH AFRICA PRODUCE 50% MORE BY 2050?



Feeling the full impacts of climate change



73 million people



Income increases of up to 200%



Food demand is expected to double

THIS COULD POSSIBLY BE MET THROUGH



Greater cropping intensity



Greater yields per hectare



A small increase in irrigated cropland

But

IT'S NOT JUST ABOUT PRODUCING ENOUGH FOOD

HOW DO WE RESPOND APPROPRIATELY WHEN SO MUCH IS STILL UNKNOWN?



Following the interconnected delivery priorities of the SDGs, we can take immediate collective action for the future we want:



WWF'S APPROACH TO TRANSFORMATIVE CHANGE IN FOOD SYSTEMS

Collective action with differentiated responsibilities

SMALLHOLDER FARMERS: Improve yields, diversify crops and reinvigorate indigenous knowledge systems

COMMERCIAL FARMERS: Use regenerative farming practices and collaborate with new farmers

FOOD INDUSTRY: Acknowledge greater accountability and adopt scientific targets for positive, lasting change

GOVERNMENT: Link agricultural, nutrition, development and conservation policies

CONSUMERS: Engage in activism by being more informed on food choices and calling for change

RESEARCH INSTITUTIONS: Inform the science-based approach while building extension capacity



WATER MANAGEMENT AND IRRIGATION EFFICIENCY: Optimising and using appropriate technology



REGENERATIVE AGRICULTURE: Merging ecological practices and conventional methods to be regenerative and decarbonising



RESPONSIBLE SOURCING: Informed by context and science-based targets



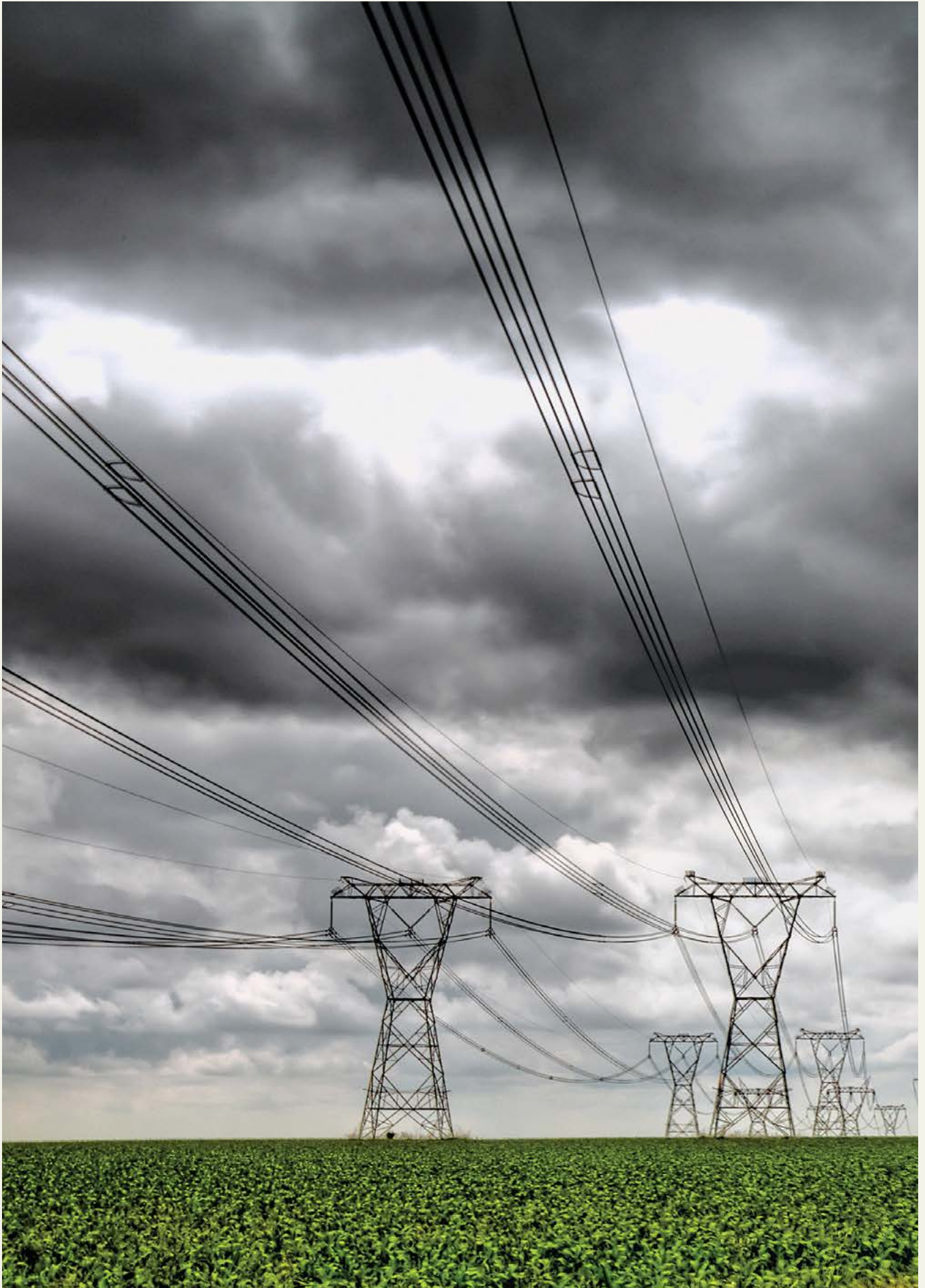
REDUCING FOOD LOSS AND WASTE: Meeting the SDG target of halving current levels by 2030



DIETARY SHIFT: More plants, less meat and dairy will improve health and the environment

HOPE FOR THE PLANET AND ITS PEOPLE

A resilient and regenerative future for food systems, a healthy environment and access – for all – to nutritious food



Food security cannot be understood in isolation; it has economic, social and environmental implications and must be viewed within the framework of the intersecting resources of land, biodiversity, water and energy.

[CONTEXT] A GROWING NEED FOR GOOD FOOD

The food system is defined by complex relationships and activities. Of all human endeavours, it has the biggest impact on biodiversity.

The food system has significant climate change impacts and vulnerabilities as well as serious humanitarian failings. It is fundamental to any conversation about the future.

In recent years, an effort to understand the boundaries and complexity of wide-reaching food systems has replaced the conventional thinking of food production that results from a simple, linear process supply chain. In this expanded understanding, all the components involved in the production, processing, distribution, consumption and waste of food need to be considered. It is a complex network, consisting of feedbacks and non-linear relationships that are defined by concentrations of power and resources of various scales and across different levels. According to a report by the Southern Africa Food Lab,¹ these components include:

- value-chain inputs, mechanisms and structures for the production (land, water, crops, marine stocks), processing, distribution, access, preparation, consumption, metabolism and waste of food
- participants in the food system, including farmers, fishers, industries (input companies, agro-processing and packaging), labour, governments, purchasers (retailers and buyers, brands, manufacturers, traders), communities and consumers
- social issues in food equity, food justice and food sovereignty, and political and spatial considerations on local, regional, national and global levels.

These components are all associated with direct and indirect humanitarian and environmental impacts. As a result, the food system is also at the core of intersecting global challenges: poverty and inequality, poor nutrition and food insecurity, and resource depletion and environmental degradation. A resilient food system would need to take into consideration the mutually reinforcing environmental, social and economic pillars of sustainable development, while providing nutritious food for all. This would require a complete transformation in approach.



¹SA Food Lab, 2015



GLOBAL POPULATION GROWTH AND DEMOGRAPHIC CHANGES

GROWING GLOBAL POPULATION, INCREASING URBANISATION AND RISING INCOME RESULT IN SHIFTING DIETS

In the past few decades, millions of people across the world have been lifted out of poverty. This has led to a rapid growth in the middle class, particularly in developing economies, with resultant lifestyle changes.

These macro-trends are expected to continue to 2050, when a projected global population of more than 9 billion will need to be fed through a food system that right now is fraught with challenges. These include accelerating climate change, rising input costs, ecosystem and resource degradation, shifting dietary preferences, social inequality and resource constraints and conflicts. Population and income growth, which are inevitably linked to a more resource-intensive diet and greater waste, intersect with environmental challenges to add further stressors within the fixed limits of planetary boundaries. Given these multiple drivers, food security cannot be understood in isolation; it has economic, social and environmental implications and must be viewed within the framework of the intersecting resources of land, biodiversity, water and energy.



Box 1: Sustainable Development Goals

The United Nations Sustainable Development Goals (SDGs) include Zero Hunger as Goal 2.² Right now the triple burden of malnutrition – over- and undernutrition and micronutrient deficiencies – affects all countries in Africa. Goal 2 aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

FOOD AND ECONOMIC GROWTH IN AFRICA

The complex food-system landscape is particularly evident in developing economies within the southern African region. The ability of the already fragmented and under-developed food systems in southern Africa to meet the needs of a growing population with rising income levels will be further compromised as the effects of climate change become more pronounced.

The challenges across southern Africa are quite similar, including increasingly degraded ecosystems and natural resources as well as resource constraints, poverty and conflict. In addition, malnutrition in all its forms is evident not only in the region but across the continent. Urbanisation is also on the increase. Estimates suggest that almost 50% of southern Africa's people will reside in urban areas by 2025, with Angola, Botswana and South Africa at 70%.

Yet there is reason to be optimistic as there is potential for improved yields from African agriculture, especially in sub-Saharan Africa, which has close to half of the world's potentially available uncultivated land and underutilised water resources. These land and water resources suggest that Africa can become self-sufficient and play a bigger role in global food security. However, there is considerable work to be done to ensure that production increases are sustainable and supported by responsible land- and water-use and farm planning at smallholder and commercial scales. Given the risks of significant climate change on the continent, the rapid adoption of climate-smart farming practices is also critical.

²For more information, visit undp.org/content/undp/en/home/sustainable-development-goals.html



ALMOST 50% OF SOUTHERN AFRICA'S PEOPLE WILL RESIDE IN URBAN AREAS BY 2025

THE FOOD SYSTEM IN SOUTH AFRICA

Given that food systems – from growing to disposing – account for up to a third of greenhouse gas (GHG) emissions, food alone has the potential to eat up the Earth’s carbon budget.

Of particular concern are cattle for beef and dairy products that are responsible for a significant portion of the methane gas produced in the world. And as diets change and more meat is required, so greater land conversion for animal feed offsets the benefits in livestock-rearing efficiencies.

In 2018, the Intergovernmental Panel on Climate Change (IPCC) report on the possibility of meeting the Paris Agreement pledge to keep climate change below 2 °C found that this would only be possible if there was an immediate and global commitment to making changes at unprecedented speed and scale.

In South Africa, where 80% of the land is suitable for livestock farming, overgrazing on erosion-prone soils has led to widespread land degradation, dramatically reducing carbon storage in soils. Farming and processing are also energy intensive – drawing energy from the country’s coal-fired sources – which dramatically increases the carbon footprint of the system.

The reality of climate change may be the push needed to transform our food system. The IPCC’s report found that the steps required to address poverty and inequality – a South African government priority – are compatible with, and even aiding decarbonisation.

In this section, we look at the current social and biophysical impacts of the food system, setting the context for the transformative actions presented in the last section on the future of food (see page 37).

[SOUTH AFRICA] FOOD AND PEOPLE

The current global food system has a significant impact on health and well-being. It also has direct long-term implications for the country's economic productivity.

South Africa has kept the prevalence of undernourishment below 5% since 1990 and is close to reaching the World Food Summit goal of decreasing the undernourished population to 50% of the 1996 value. However, in a country where half the population lives below the poverty line, South Africa still faces significant challenges. Paramount among these are diet-related health problems, such as the growing prevalence of obesity and non-communicable diseases (NCDs), and the persistence of hunger, nutrient deficiencies and stunting.

Risks are most pronounced for women, children and those with low income, reflecting and reinforcing historic socio-economic disparities. The already overburdened public healthcare system is being stressed even further by the growing health impacts of a 'nutrient transition' – from traditional diets high in cereals and fibre to a diet high in sugars, fats and animal-source protein. This is compounded by associated environmental challenges across the food value chain that further reduce population health and well-being and pose a material risk for business and the economy.



R27 BILLION
LOSSES TO SA'S GDP
FROM 2006-2015
DUE TO DIABETES,
STROKE AND
CORONARY HEART
DISEASE

South Africa's increasingly industrialised and concentrated food system makes it even more difficult to address these food-related health risks. Highly processed, nutritionally poor, energy-dense foods that are high in saturated fats, sodium, added sugars, synthetic additives and preservatives are not only readily available but also affordable and socially acceptable. The dominance of these foods in the market is having a negative impact on small food producers and the informal market, undermining healthier, more diverse rural and local food networks and their associated shorter value chains.

This has already resulted in real costs and increased social and health impacts. The accumulated losses to South Africa's gross domestic product (GDP) from 2006–2015 from diabetes, stroke and coronary heart disease alone are estimated at R27 billion. According to Genesis, an economics-based consulting firm, NCDs already account for nearly 40% of healthcare spend in Gauteng. They estimate that by 2030 this spend will reach R19,2 billion per year.³

ECONOMY AND POVERTY

Agriculture is an important economic sector and should provide decent jobs and support livelihoods for smallholder farmers and others. As a result, the agriculture sector has been identified by the South African government as both a job creator and crucial to addressing pervasive resource-access inequities. However, South Africa's history of social exclusion and economic inequality on the basis of race still defines the agriculture sector today. For decades, 'black' population groups were denied ownership of land, provided with limited or no electricity sources and were last in the queue for safe, clean water-provisioning systems.⁴ This legacy has compounded poverty and today, small farms and farmers, most of whom are land-dispossessed 'black' South Africans, are generally excluded and marginalised, unable to gain access to finance or markets.

³See genesis-analytics.com, ⁴Von Bormann & Gulati, 2016




SOUTH AFRICA'S FOOD SYSTEM AND HEALTH & WELL-BEING

FOOD SECURITY, SAFETY AND NUTRITION

 **> 26%** of South Africans are considered **FOOD INSECURE**


 **>50% increase** in consumption of processed and packaged food since 1994^b

27%  children <5 experience stunting


 **71%** of women are overweight or obese

45,8% INCREASE IN  consumption of processed meat since 1994^c

 **43%** of deaths caused by diet-related NCDs^d

2017  the year of the world's largest Listeriosis outbreak

ECONOMY AND POVERTY

 **67%** OF THE POPULATION LIVE IN URBAN AREAS

 **70%** OF HOUSEHOLDS SOURCE FOOD FROM INFORMAL MARKETS

 **35%** of income in lower LSM (1-3) households is spent on FOOD^a

↓55% fewer job opportunities in AGRICULTURE SINCE 2000 

EQUITY AND FAIRNESS

A healthy basket of food can cost up to **65%**  MORE THAN JUNK FOOD 



Land ownership is still deeply skewed along racial lines

20% OF FARMS IN SOUTH AFRICA provide **80%** OF THE FOOD IN FORMAL RETAIL OUTLETS^e 

^aMcLachlan & Landman, 2013
^bRonquest-Ross et al, 2015

^cRonquest-Ross et al, 2015
^dWHO, 2014

^eCousins, 2011

The resulting inequalities are evident in the productivity of a well-developed group of large-scale commercial farmers (approximately 37 000 and predominately white) as compared to that of the broad base of more than 2 million smallholder and emerging farmers. This presents challenges for South Africa, where many people live in extreme poverty. Efforts to mainstream smallholder farmers while at the same time ensuring safe, high-quality food at affordable prices have proven particularly challenging.

Agriculture is a significant provider of employment, especially in the rural areas, and a major earner of foreign exchange.⁵ Nevertheless, in the past two decades, direct employment in agriculture has decreased from almost 2 million in 2000 to an estimated 748 113 people in 2017.⁶

The last six years have been difficult economic times for South Africa, largely owing to low economic growth, high consumer prices, low commodity prices, low investment levels, policy uncertainty and high unemployment. The poor economic climate has placed increased pressure on South African households and, as a result, pulled more people into poverty since 2011.⁷ This has been further exacerbated by recent drought conditions that are driving significant seasonal job losses across the agriculture sector. In the Western Cape, the provincial government estimated that the drought resulted in an average production decline of about 20% and 30 000 jobs lost.



**THE ONGOING
DROUGHT RESULTED
IN 30 000 JOBS
BEING LOST IN THE
WESTERN CAPE**

The uncertainty of the changing climate presents further risks. The IPCC's 2018 report identifies the increasing risks for southern hemisphere countries: a higher degree of warming, increasing heatwaves, prolonged drought and flash floods. These changes in the climate will make farmers and fishers more vulnerable, putting at risk not only their livelihoods but also the fate of their families and dependants.

The National Development Plan 2030 states that 'with the right approach, it is possible to reverse the decline in the agriculture sector, promote food production, and raise rural income and employment' but recognises that 'if the expansion of agricultural production ... takes place within the current structure of farming by merely expanding large-scale commercial farming', the potential to create additional jobs is limited.⁸

Given the critical role of agriculture in job creation and food security and the fact that well-targeted investment is critical to increase sustainability and productivity, it is a concern that overall investment in agriculture has been declining in real terms. Investment in agriculture in South Africa has fluctuated and investment in research and development (R&D) is below the government's own target.

MARKET DYNAMICS

At a macro-level, food security is inextricably linked to the global market dynamics of production, demand and supply. These financial and international forces within the global system make changes hard to anticipate. A clear illustration is the dependence of agriculture on oil, the price of which is highly volatile. This leads to higher costs and fluctuations in the cost of energy, transportation and fertilisers. Crude oil is also linked to agricultural commodities in the financial markets, so the oil price drives the movement of traded agricultural commodities. Demand for biofuels also affects some world food commodity prices and is creating increasing competition for high-quality agricultural land.

At a household level, the rising cost of energy also affects the cost of cooking and preparing food. For example, just the final step of cooking maize – a staple food for poor households – adds an estimated 20% to its total cost at the maximum permitted retail price of paraffin.⁹

Globalisation and global trade are also driving greater availability of processed foods and international competition in local markets. This has implications for the development of local food systems, pricing and the types of foods that South Africans eat.

⁵DAFF, 2017 ⁶ILOSTAT, 2017 ⁷StatsSA, 2017 ⁸NDP, 2012: 220 ⁹Mason-Jones et al, 2014

EQUITY AND FAIRNESS

The current state of the food system has been defined by a historical pathway, which has resulted in deep imbalances both in environmental systems and in society itself. Issues of equity and fairness pertain to people's access to and ownership of resources, the nature of work and power imbalances in the spatial, gender and racial dimensions of the system.



**THE INEQUITABLE
STATE OF SA'S
FOOD SYSTEM
IS THE RESULT
OF HISTORICAL
IMBALANCES**

Given the breadth of these issues, the points below should be viewed as some of the most pertinent of the many considerations that play a role in the transition to an equitable system.


- The land reform programme has yet to realise the objective of inclusive rural development.
- Rural women and particularly women on farms are profoundly marginalised, lacking equal access to resources and basic services.
- High levels of poverty, increasing urbanisation and the reliance of many poor households on social grants have increased dependence on store-bought food, making consumers more vulnerable to price shocks.
- The powerful role of the private sector in shaping the food system has resulted in a nutrition transition towards processed energy-dense and high-protein diets. This is having a negative impact on the health of the nation.
- Barriers to entry into the formal, commercial food system continue to increase.

The entrenched power disparities in the food system require multi-stakeholder engagement to bring various points of view together in order to define a roadmap towards a food system that is both sustainable and equitable.

ANIMAL WELFARE AND FOOD SAFETY

Animal welfare is generally considered as one of the health and well-being impacts of the food system.

Over the past 20 years, South Africa has increasingly moved away from free-ranging livestock. The South African feedlot industry now collectively markets close to 80% of total beef production in the country.


45,8% ↑
**IN CONSUMPTION OF
PROCESSED MEAT
SINCE 1994**

Water consumption, pollution and direct chemical and health impacts on humans are of major concern in concentrated animal-feeding operations. In these systems, animal densities are high, conditions can be poor and welfare low, encouraging conflict, disease and infections in the animals. Consequently, there are high quantities of stress hormones, artificial hormones and antibiotics present in the meat produced. The high volumes of concentrated animal waste, if poorly managed, can have a negative effect on downstream water quality. All this has implications for human health.

The concentration of pathogens, viruses and bacteria through concentrated animal-feeding operations is an escalating risk, along with increasing resistance to antibiotics. In 2017, South Africa experienced the worst Listeriosis outbreak in recorded history, predominantly from processed meat products through a large food manufacturer. These health risks relate directly to the high consumption of industrial meats (there has been a 45,8% increase in the consumption of processed meat since 1994¹⁰) and indirectly to the nature of concentrated animal-feeding operations.

¹⁰Ronquest-Ross et al, 2015

[SOUTH AFRICA] FOOD AND NATURE

A continuation of the trends of industrialisation, expansion and intensification of food production – including crops, livestock and aquaculture – could undermine the very resource base on which the food system depends.

The negative impacts of the food system on ecosystems and the natural resource base of the world are increasing in intensity and cost. This can be described as the opportunity cost of unsustainable food production.

AGRICULTURE AND NATURAL RESOURCES

Global food production uses almost 40% of the Earth's land surface and 70% of freshwater resources. Meat production alone is associated with 18% of emissions – these arise from methane linked to animal digestion, deforestation and fertilisers required for growing animal feed.¹¹ As a result, associated environmental systems are pushed out of what would be considered as a safe operating space.

In South Africa, agriculture is the largest land-use type. It includes tribal land, communal areas and private commercial farms and has – significant – consequences for biodiversity and ecosystem functioning. It is the sector with the greatest impact on land transformation and biodiversity loss, both globally and in South Africa. Soil degradation results in a net loss of arable land every year.

Commercial agricultural practices amplify the negative environmental impacts associated with food production. These practices are typically intensively output-oriented, practise extensive tilling and mono-cropping or concentrated animal feeding, and require heavy machinery, large-scale irrigation and external inputs of fuels, chemicals, seed and feed. The scale of the larger farms, together with direct marketing from chemical companies, incentivise greater use of chemicals, pharmaceuticals and fertilisers in production. This is accompanied by expanding requirements for machines, infrastructure, technical assistance and administration, which often prompt increasing disconnection from the land. Natural areas – often considered marginal areas – and sensitive environments on farmland are being converted for production; seed-saving is abandoned and capital expenditure, debt and stress are increasing. Farmers are often locked into industrial-scale production to cover recurring debt and have less time to address social and environmental concerns. Although concentrated animal feeding and production drive cost efficiencies, these practices also amplify health, environmental and social impacts and risks.

It must also be noted that there is increasing competition for land, not only for urban development or competing land uses such as mining but also for the cultivation of crops that can be used for fuel rather than food. This is driven by mandates, subsidies and higher oil prices. It is expected that this trend – the competition for high-quality agricultural land – will intensify in coming years.



**AGRICULTURE IS THE
LARGEST LAND-USE
TYPE IN SA**

¹¹FAO, 2006



SOUTH AFRICA'S FOOD SYSTEM AND THE ENVIRONMENT

CLIMATE CHANGE causes increasing erratic weather patterns and a shift in production areas

The agri-food value chain accounts for more GHG emissions than any other sector



80% of biodiversity on farms is at risk



3% of the country has the right climate and soil combinations for rain-fed crops



50% of all SA's wetlands have already been lost



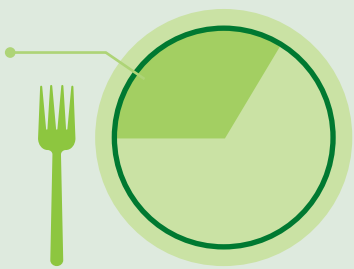
80% of SA's rivers are compromised in quality and quantity

80% OF SA'S LAND IS FARMLAND

10% OF SA'S LAND GENERATES 50% OF ALL AVAILABLE SURFACE WATER

NATURE IS THE FOUNDATION OF OUR FOOD SYSTEMS

1/3 OF ALL FOOD IS WASTED

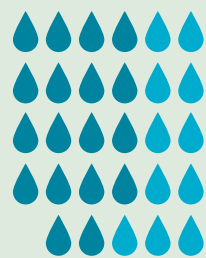


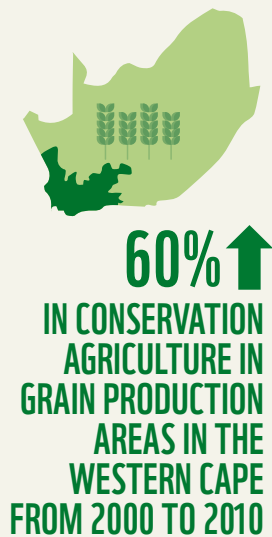
44% OF WASTED FOOD IS FRUIT & VEGETABLES



The embedded energy, water, nutrients and human labour are lost with this food too

62% OF WATER IN SA IS USED FOR IRRIGATION





Box 2: Conservation agriculture and sustainable intensification – the foundation of WWF’s regenerative agriculture approach

Conservation agriculture (CA) is strongly supported in the latest IPCC report as a critical adaptation. It is a farming approach that is based on agro-ecological principles directed at improving crop management in a sustainable manner, and is increasingly recognised as a way to minimise environmental risk. The key objective of CA is to maintain healthy soils through minimum mechanical soil disturbance, permanent organic soil cover and diversification of crops. It also has other beneficial effects: it improves the retention of soil moisture and reduces erosion. Reductions in run-off are especially striking in years of lower-than-average rainfall and drought.

Over the past 15 years, CA has been adopted by sugar and grain farmers in KwaZulu-Natal, winter grain farmers in the Western Cape and summer grain farmers in the Free State and North West provinces.

The KwaZulu-Natal No-Till Club has been conducting research since 1997 and ascribes the success of CA to favourable rainfall and high clay-content soils. Grain SA has a dedicated programme on CA for smallholder grain farmers. In the Western Cape grain production areas, the adoption of CA has increased from 5% in 2000 to 60% in 2010.¹²

However, it must be noted that CA is not always recognised as based on agro-ecological principles and is sometimes seen as a Trojan Horse for agri-businesses to continue to push products such as ‘improved’ seeds, pesticides, and so on.

Another important farming adaptation is that of sustainable intensification. This means growing more on the land currently under production. Sustainable intensification was identified in the IPCC’s 2018 report as a critical means of increasing the efficiency of inputs and enhancing health and food security. This requires sophisticated farm management and the use of precision farming tools, such as GPS fertiliser dispersion, advanced irrigation systems and environmentally optimised crop rotations. These methods can increase yield and reduce the over-stressing of resources. Sustainable intensification can prevent the depletion of groundwater and the destruction of fertile lands through the over-use of fertiliser.¹³

Both these positive outcomes are critical for the future of farming in South Africa.

¹²ARC, 2014 ¹³Elferink & Schierhorn, 2016

FRESHWATER IMPACTS



**AGRICULTURE
IS THE SINGLE
BIGGEST WATER
USER IN SA**

Water is the key environmental constraint to food production. South Africa is ranked as the 29th driest out of 193 countries¹⁴ and demand is already outstripping supply in many catchments. Agriculture, as the single largest water user in South Africa, faces a future where the share of total water withdrawals allocated to agriculture will decrease as urban and industry requirements grow. Current water users will need to reduce consumption so that water allocation in agriculture can be reformed to include more emerging farmers.

Water efficiency is vital considering the following:

- South Africa is 91% arid or semi-arid, with only 10% of the land generating half the annual run-off.¹⁵
- At present, 69% of South Africa's soils suit low-intensity grazing and livestock practices, with 13% of these soils being suitably arable, and only 3% of these deemed to be high-potential soils and capable of supporting crops without irrigation.¹⁶
- More than 70% of South Africa is affected by soil erosion, with water being the dominant agent causing erosion.¹⁷ The estimated soil loss rate of 12,6 tonnes per year, the equivalent of 2,5 tonnes per hectare per year of sediment yield, is approximately three times the soil loss rate for Australia arising from extensive cultivation and overgrazing.¹⁸
- Water constraints are exacerbated by rampant invasive alien vegetation and high rates of top-soil loss, resulting in an increase in farming on marginal land. This is in turn associated with increasing environmental impacts and land degradation, including soil erosion and the loss of soil fertility.
- Irrigation is essential, but poorly managed large-scale irrigation leads to over-irrigation, water wastage and impacts on soil through acidification and salinisation. In South Africa, 260 000 ha of irrigated land – the size of the Kruger National Park – is affected by salinisation.
- Altogether 90% of vegetable, fruit and wine production and 12% of the total area under wheat is irrigated. There is a total of 1,5 million ha under irrigation. Although this is only 1,5% of the country's land surface, it accounts for 30% of the country's crops.¹⁹
- The quality of freshwater resources in South Africa has been on a steady decline as a result of increased pollution. Freshwater ecosystems associated with South Africa's large rivers are in a critical state, with 84% considered endangered or vulnerable.²⁰
- Agriculture is responsible for two-thirds of all wetland destruction in South Africa. This is of concern for a number of reasons. Wetlands are immensely productive ecosystems, cradles of biodiversity and essential for filtering and storing water. Their role in flood mitigation is also critical as intense rainfall events increase.



**90%
OF VEGETABLE,
FRUIT AND WINE
PRODUCTION IS
IRRIGATED**

Rain-fed agriculture is already marginal across much of South Africa and the anticipated lengthening of dry periods as a result of climate change may well make current agricultural practices unviable at 1,5 °C and above.

¹⁴UNESCO-WWAP, 2006 ¹⁵Le Maitre, 2018 ¹⁶Kotze & Rose, 2015 ¹⁷Le Roux et al, 2007
¹⁸Le Roux, 2014 ¹⁹GCIS, 2009 ²⁰CSIR, 2011



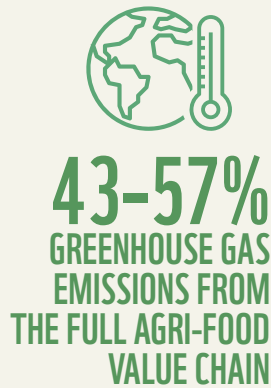
Box 3: Food packaging

Packaging plays a critical role in food preservation and safety and, as a result, plastic packaging is the largest market for plastic. It is also the primary driver of plastic waste. At least 40% of annual global plastic production is for packaging and other single-use applications (cigarette filters, bottles, earbuds, sweet wrappers, coffee-cup lids, etc.), almost all of which become worthless rubbish more or less instantly upon use. The rapid rise in single-use plastic consumption has left many countries, South Africa included, unable to cope with their solid-waste disposal.

Much of that rubbish finds its way into wetlands and waterways and ultimately into the sea, where it causes catastrophic damage. So, while there is no disputing that protecting what is in the packaging is critical, it is increasingly evident that plastic food-packaging of all forms requires a massive rethink to reduce volumes and improve reuse and recyclability as part of a systemic approach to food.

THE IMPACT OF A CHANGING CLIMATE

The food system has an impact on climate change and is in turn affected by the changes it and other sectors cause. Greenhouse gas emissions from the full agri-food 'value chain', which includes agriculture-related deforestation, farming, processing, packaging, transportation and waste, are estimated to account for 43–57% of all human GHG emissions.²¹ Apart from affecting the weather, climate change also influences soils and plant nutrition and can have a negative impact at every stage of the supply chain.



Climate change will have a pronounced effect on agricultural systems on and around the African continent. It will result in erratic weather patterns, more intense natural disasters and a shift in production areas. It will also drive a greater incidence of pests and diseases and their transboundary spreading. Indications are that even if global warming can be contained at 1,5 °C – which seems increasingly unlikely – there are still associated drops in crop yields and increased livestock losses. In Botswana, at global warming of 1,5 °C, maize yields could drop by over 20%. At 2 °C warming, yields could drop by as much as 35%.²²

Box 4: Links between climate change and nutrition

There is a growing body of scientific work that shows that, while the accumulated impact of climate change on food security is not fully understood, it is evident that there will be long-term implications for agricultural production, in terms of both quantity and the quality of food produced. Recent research on the links between climate change and nutrition has found concerning evidence of reduced overall nutrients. In part this is due to plant breeding for favourable traits combined with declining soil quality. A 2017 study found that, as carbon dioxide concentrations rise, the mineral and protein content of wheat, rice and other staple crops could shrink.²³ Given the already concerning nutritional status of South Africans, this needs further consideration.

FOOD WASTE

In 2013, food waste in South Africa amounted to about 10 million tonnes from an estimated 31 million tonnes of food available.^{24a} Together, fruits, vegetables and cereals account for 70% of the wastage and loss, which primarily occur early in the food supply chain.



**MOST FOOD
LOSS AND
WASTE IS FRUIT,
VEGETABLES AND
CEREALS**

The financial burden of food loss and waste in South Africa has been quantified at R61,5 billion or 2,1% of the national GDP.^{24b} A ballpark figure for the cost of embedded energy wasted as a consequence of food waste is R1 billion – sufficient to power the City of Johannesburg for roughly 16 weeks. The wasted embedded water would fill over 600 000 Olympic-size swimming pools. About 90% of non-farm waste in SA is disposed of to landfills, where the food-waste component leads to the production of methane gas and carbon dioxide.

Reducing food loss and waste presents a clear opportunity to improve the food system. In a hungry country, the potential also exists to divert surplus food from becoming food waste. But this should not distract businesses or the government from addressing the systemic drivers of ongoing poverty and the prevalent patterns of unsustainable food production and consumption. More collaboration is required among firms, and between the government and firms across the value chain, surplus-food organisations and other parties interested in nutrition and addressing hunger.

²¹TEEB, 2018 ²²See theconversation.com/what-latest-assessment-on-global-warming-means-for-southern-africa-104644 ²³Myers et al, 2017 ^{24a}Oelofse & Nahman, 2013 ^{24b}Nahman & De Lange, 2013

CONSUMPTION AND NATURAL RESOURCES

Changing demand is a consistent feature of increased urbanisation and per capita income growth, and both trends are strongly evident in the South African economy. Improved economic conditions twinned with rapid urbanisation have driven a shift in dietary preferences towards refined-grain staples and unhealthy packaged, ready-made and fast-food options. Accelerated food demand and urbanisation have also contributed to increasing waste.



**FOOD IS BEING
GROWN AS ANIMAL
FEED AND FUEL FOR
CARS AND PLANES**

There are numerous feedback loops between what we eat and how we grow that food. Given that the production of food is fundamentally linked to natural resources, any changes in consumption demand are inextricably linked to agricultural production. This results in a concurrent change in the embedded water and energy in the final food product.

Traditionally, maize is crucial to the South African economy and food security, and is the most important form of carbohydrate for human and animal consumption. Since the 1970s, there has been a steady decrease in the consumption of maize and bread and an increase in the consumption of chicken, beef, lamb and pork. Animal protein requires significantly more land and water resources to produce and is also associated with higher GHG emissions.

Processed foods require more energy and water than wholegrains, fruits and vegetables and provide far less calorific value. It is also worth noting that processed foods have the highest freight carbon footprint across road corridors in the country.²⁵

Increasingly, we are growing food for animals or as base ingredients for highly processed foods, and even for fuel for cars and planes.

DIETS LINK HUMAN HEALTH AND ENVIRONMENTAL SUSTAINABILITY

The 2019 report *Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems*²⁶ represents the most comprehensive effort to date to make explicit the links between diets and human health and environmental sustainability. After a three-year process of expert evidence-gathering and scientific research, the Commission presented recommendations for a diet that could feed 10 billion in 2050 within a safe planetary operating space, meeting the SDGs and the Paris Agreement ambitions.



**FEEDING 10 BILLION
BY 2050 WILL
REQUIRE A HEALTHY
DIET WITHIN
SAFE PLANETARY
BOUNDARIES**

The production parameters include no increase in land area for production, a safeguarding of biodiversity and freshwater sources, reduced nitrogen and phosphorous pollution and zero carbon emissions. The diet itself requires no increase in cereal production but allows for a drastic increase – 100% – of fruit, vegetable, legume and nut consumption. The major dietary change is a 65% reduction in global red-meat consumption. The report states that even small increases in meat and dairy consumption make the goal of sustainably feeding 10 billion people by 2050 unachievable.

Fundamental to addressing the environmental sustainability of food production and the health consequences of low-quality diets is the Commission's call for the adoption of scientific targets that set ranges of intake of food groups that are linked to sustainable production. Achieving what the Commission terms the 'Great Food Transformation' will take strong commitment to partnerships in all sectors and at all levels. It will also require application of the full gambit of regulatory governance mechanisms and corporate measures to promote scientific target setting and delivery.

²⁵WWF-SA, 2013 ²⁶Loken et al, 2018



SUMMARY: TEN TRENDS DEFINING THE SOUTH AFRICAN FOOD SYSTEM

All the impacts discussed above can be summarised in ten interrelated social and environmental trends:

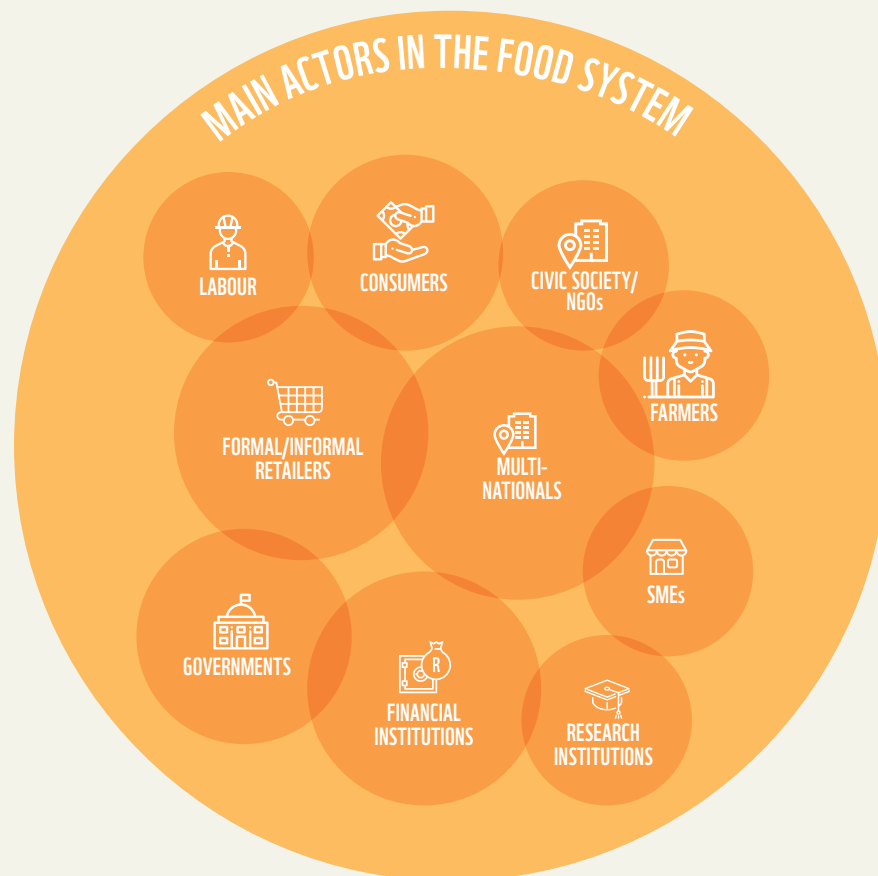
1. The triple challenge of high unemployment, crippling poverty and deep-rooted inequality continues to have implications for access to land, water, energy, food and nutritional balance in diets.
2. Rapid urbanisation and a shift towards buying food in a supermarket rather than growing it at home.
3. The duality of the current agriculture system, where large commercial farms use increasingly sophisticated practices to produce food for the formal value chain while smallholders are marginalised.
4. Uncertainty in land and agricultural policy and the resulting decline in agricultural investments.
5. The concentration of power in the hands of a few retail and food and beverage companies and the impact of this on consumer choices. Allied to this is the opportunity to adopt scientific targets to reduce impacts.
6. The ongoing nutrition transition in favour of high-calorie convenience foods and associated lifestyle changes and the impact of these on the health of the nation and the development of chronic non-communicable diseases.
7. The severe rate of stunting and the long-term impact of nutritional deficiencies on South Africa's children.
8. The impact of the scarcity of resources – particularly arable land and water – and the further risk posed by the decline in water quality.
9. The increased variability related to the impact of changes in the weather and rainfall owing to expected climate change (this may prompt the adoption of conservation agriculture).
10. High volumes of food waste that further strain the production system, while many opportunities for donating surplus food are missed.

Source: Adapted from SA Food Lab, 2015

ACTORS IN THE FOOD SYSTEM

Of all the human-designed systems based on natural resources, the food system is probably the most complex. It also has many different actors.

The vital provision of food through the food system is not a linear process but rather the result of a complex socio-ecological system arising from and defined by the behaviour of a large number of actors. As such, the food system is shaped by the terms under which farmers, companies large and small, governments and consumers operate. The following diagram illustrates the main actors in the food system.



South Africa is considered to be one of the five largest economies in sub-Saharan Africa and the region's most food-secure country. The agri-food system is characterised by vast differences between the concentrated, industrialised commercial sector and the large number of small-scale role players, from farmers through to distribution and sales. This duality of formal and informal dynamics defines the system and influences the behaviour of all the actors.

In the interest of space, an overarching summary is provided for each primary group. This means that certain other important but secondary actors, such as finance, investment, trade and civil society, are not discussed in this report, despite the fact that they play a fundamental role in the food system.



748 113
PEOPLE ARE
EMPLOYED IN
AGRICULTURE IN
SOUTH AFRICA



37 000
LARGE-SCALE
COMMERCIAL
FARMERS PRODUCE
THE BULK OF SA'S
FOOD THAT REACHES
FORMAL RETAIL
OUTLETS

PRODUCTION: COMMERCIAL FARMERS

Although agriculture's contribution to South Africa's GDP has waned significantly from 17% a hundred years ago to less than 3% today, it still has a critical role to play. The agriculture sector is highly diversified and includes the production of all major grains (except rice), oilseed, fruits, sugar, citrus, wine and most vegetables. Livestock production includes cattle, hogs and sheep, and a well-developed dairy, poultry and egg industry. The South African agriculture industry is an important contributor to national food security, providing employment for 748 113 people.

In 2016, the agriculture sector contributed about 12% to South Africa's total export earnings. More than a fifth of total agriculture export value generated in sub-Saharan Africa comes from exports from South Africa alone.²⁹ In fact, the sector has outperformed the rest of the economy in terms of earning foreign exchange.

A relatively small number of large-scale commercial growers produce the bulk of food that reaches the formal retail outlets in the country.³⁰ Although these commercial farmers currently make a critical contribution to food security, their role in South Africa's future may be threatened by new land-reform policies. The need for greater sustainability alongside other ecological, social and political factors means that farmers will have to adapt appropriately if they expect to be around in the future: they need to become polymaths, capable of understanding not just agronomy and farm management but also trading and commodity markets, socio-political developments, human psychology and new technology, among other things.

The trends influencing commercial farmer behaviour are:

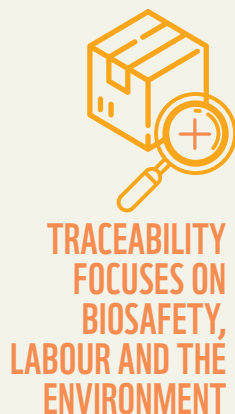
- **Doing more with less**

South Africa's agriculture has historically been allowed to develop off the back of cheap water, energy and labour, but these 'cheap' production factors have become less certain over the past few years. Changing temperature profiles, water constraints and labour-market uncertainty have forced farmers to do more with less. Soil degradation and water loss have promoted an increase in the practice of conservation agriculture (see page 18), but increasingly technology and mechanisation are also seen as ways of controlling these risks. This requires a sophisticated understanding of precision agriculture, biotechnology, water-efficient technologies including hydroponics, shade nets and tunnels, artificial intelligence and automation. For many farmers, these investments have paid off – their productivity has increased significantly through higher yields and improved production practices for dryland production.³¹

- **Protecting and conserving**

Livestock farmers, particularly within the grassland and fynbos biomes, have also committed to biodiversity stewardship agreements. This means they are becoming custodians of natural vegetation to prevent habitat fragmentation and so conserve rare and endangered species.

²⁹FAOSTAT, 2017 ³⁰Kotze & Rose, 2015 ³¹BFAP, 2017



- **Adopting traceability systems**

Increased scrutiny by export markets has forced farmers to comply with product traceability systems. This has been the case in the fruit and wine markets for some time, but now beef producers have identified export markets for higher-value beef cuts and need traceability systems to demonstrate South Africa's animal health status.

Traceability systems focus on biosafety, labour and the environment, adding further demands to a farmer's skill set. These demands will intensify if blockchain becomes a required mechanism through which an immutable record of the source of the food is captured in order to satisfy customer demands for trust and transparency. All this comes at a cost and requires market support, given that farmers are price takers in the food system, at the mercy of the markets in terms of the prices they set.

- **Consolidation, intensification and diversification**

Over the past five years, policy uncertainty, particularly about land reform, has further muted growth prospects in agriculture. To achieve economic security, many farmers have had to diversify and bring in investors. Innovative diversification strategies have seen farmers investing in other businesses both earlier or later in the value chain to diversify and control the point of sale. Mouton Boerdery, a family-owned farming business with interests in a number of provinces, has invested in the fertiliser business, and a consortium of fruit and vegetable producers and growers' associations have become shareholders in the Cape Town fresh-produce market.³² Partnerships with Independent Power Producers (IPPs) have also meant that wind and solar farms offer a viable alternative revenue model for marginal land (this is in addition to farmers increasingly adopting small-scale renewables as an on-farm energy source). Livestock farmers, supported by government policy for the wildlife economy, are also looking at game as a form of income diversification. As a result, farming with game has seen a dramatic increase in recent years.

- **Inclusive growth and transformation**

A final and possibly most critical adaptation currently being required of commercial farmers is to improve the relationship with smallholder farmers to support regenerative farming practices. At present, the misalignment between government departments is hampering growth and better collaboration between large and smallholder farmers. There is a renewed effort within government to address this but the necessary incentives for greater collaboration, namely security of tenure, water rights and stability in the sector, are not yet evident.

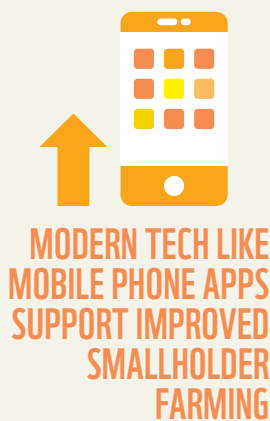
³²IOL, 2006



PRODUCTION: SMALLHOLDER FARMERS

There are about 2 million smallholder farmers in South Africa. Under the new land-reform approach, these smallholder farmers have the potential to become important landowners. This is reflected in the Department of Agriculture, Forestry and Fisheries' 2016 strategic plan that aims to develop 400 000 small-scale farmers to become commercial farmers by 2020. Owing to an increase in corporate investment in enterprise and supplier development, the majority (31%) of the small businesses developed in 2017 were in the food and agriculture sector, followed by the Information and Communication Technologies (ICT) sector at 25%.³³

The trends influencing smallholder behaviour include:



- **Increased use of technology**

The surge in the use of mobile-phone applications to support farming activities as well as some pilot projects in the use of artificial intelligence (AI) devices and the Internet of Things (IoT) (digital ecosystems) demonstrates that the smallholder farming subsector has embraced modern technology. These smart devices gather enormous amounts of data. In this way, ordinary farmers are able to construct future scenarios and are empowered to manage crop disease and water use, monitor soil quality and exchange critical information in real time. This has positive implications for improved productivity and food security.

- **Local knowledge and new sectors**

New sectors and associated government-supported opportunities such as those in the bioeconomy and bioprospecting, which depend on local knowledge and plants, are attracting the interest of marketing agents who are promoting imports from developing countries. Some of these institutions are being supported by the South African government to help create jobs and business opportunities, particularly in the small, medium-sized and micro-enterprise (SMME) sector. The involvement of the Department of Environmental Affairs in this sector is aimed at ensuring that these efforts do not further corrode the natural resource base and increase the uncertainty of future food security.

- **Improving environmental practices**

An increase in constraints resulting from climate change, such as water shortages, has created a new impetus to follow natural resource management approaches in the smallholder farming subsector. Moreover, land-reform policies are adding to the momentum in this subsector. To rise to a position of responsible smallholder farming and to be climate-smart, smallholder farmers and small businesses in the food and agriculture sector must adopt climate-smart farming and processing practices such as agroecology. Environmental NGOs (non-government organisations) are at the forefront of creating bespoke solutions to ensure that global farming standards such as GlobalG.A.P.³⁴ are locally adapted to support responsible smallholder farming and processing practices for better market access for all.

- **Constructive collaboration needs improved policy frameworks**

Small-scale agricultural and ecological farming practices, in association with more diverse and local food networks and shorter food value chains, hold the promise of meeting production challenges, improving health and addressing food-security issues. However, an optimum strategic balance of large and small food systems can only be attained through constructive collaboration between these large and small, formal and informal, players. Currently, the hegemony of large industrial players and the policy environment that supports them do not allow for a suitably conducive environment.

³³ANDE, 2017 ³⁴For more information, visit globalgap.org/uk_en

THE FOOD INDUSTRY

The total agro-industrial sector contributes 12% to GDP through strong linkages throughout the value chain. The duality that exists at a production level is reflected in the market where a formal and an informal economy exist alongside each other.



**MARKET DOMINANCE
OF LARGE PLAYERS
HAS A NEGATIVE
IMPACT ON SMALL
FOOD PRODUCERS**

As things stand, larger agricultural, processing, manufacturing and retailing companies have clear advantages. This market concentration is the predominant behaviour determinant in the food industry as it allows a few companies to dictate prices, determine choice, control information and influence policy.

The trading in agricultural commodities and in food retail environments is influenced by the increasing concentration of market players. In the last few decades there has been a radical change in governance and economic systems that underpin food provision. The top thousand companies now control the global supply chain and boast a concentration of economic activity bigger and more powerful than most nation states,³⁵ and their power is only consolidating. This has, in part, contributed to a contraction in agricultural markets so that more than half of all global food comes from three plants – rice, maize and wheat.

The process of industrialisation and the market dominance of large players in the food system have had a negative impact on small food producers and the informal market, undermining shorter food value chains and healthier, more diverse rural and local food networks. Small players are squeezed out through the associated processes of retail and agricultural expansion as increasingly concentrated and consolidated formal agro-industrial and retail food value chains are established.

Retailer expansion, coupled with shopping-oriented property developments and micro-loan and small financial service providers, incentivises participation in the formal market. This cuts out informal players and activities. Financial, legal, technical and administrative barriers associated with the rising scale, complexity and efficiency of industrial food activities further marginalise and exclude small and informal players from entering the formal system. As retailers consolidate their strategies, they undercut wholesale fresh markets and decrease business viability for small farmers, independent retailers and informal traders. Retailers squeeze their suppliers, forcing standardisation and efficiencies. They set fixed direct purchasing prices for farmers at low levels, but simultaneously seek to expand their profit margins by charging the consumer higher prices where possible. Surplus production is required from farmers to cover retailers for fluctuating demand, but this surplus is not used or compensated when not needed, adding to the food waste burden at farm level.

Although suppliers balk at the additional pressure of standardisation requirements for retailers, it must be noted that standardisation has played an important role in improving production practices. The PwC 2016 Africa Agribusiness Insights Survey³⁶ found that 76,5% of respondents conduct external audits that include sustainability. The survey also found that retailers are the most important drivers of sustainability, while the least important drivers, according to respondents, are resource scarcity and regulators.

Although the expansion of formal retail and marketing systems has facilitated the availability and acceptability of a wider range of more affordable food products in underserved urban and rural areas, these food products are predominantly healthier and offered at the expense of local food systems. Because it is challenging to distribute fresh produce through centralised distribution centres to these 'outlier' areas, fresh produce and healthier food are often unavailable, underrepresented, undermarketed, of poor quality and costlier. Retailers also run the risk of potential losses owing to uncertain sales. Foods that are supplied in these areas tend to be bulk processed grains and other non-perishable foods such as canned goods, packet soups, oil, soft drinks, sweets and crisps.

³⁵Eccles, 2012 ³⁶See citrusresouwarehouse.org.za, PwC – Africa Agribusiness Insights Survey 2016

97%

4 DOMINANT SUPERMARKET CHAINS = 97% OF FORMAL RETAIL TRADE BUT ONLY 44-54% OF THE TOTAL FOOD WHOLESALE AND RETAIL MARKET³⁷

51,8%

10 PACKAGED-FOOD COMPANIES = 51,8% OF PACKAGED-FOOD SALES

64,7%

3 SOFT-DRINK COMPANIES = 64,7% OF THE MARKET SALES

Box 5: The informal sector

The informal sector plays a critical, if often overlooked, role in the behaviour of the agri-food value chain. The ability of spaza shops to provide access to affordable food for the urban poor is an important component of future food security. Cheap food tends to be processed and VAT exempt – milk powder, rice and maize meal – and not needing refrigeration, which many of these consumers cannot afford. Policy decisions often favour the organised sector partly because the size, trading volumes and revenue of informal enterprises cannot easily be determined.³⁸ Research indicates the following:

- Market size estimates vary from R46 billion to R176 billion
- 66% of street traders sell food
- More than 350 000 street traders sell food
- Almost every day 32% of households purchase food from the informal food economy
- On average, 70% of households normally source food from informal markets or street vendors.

Source: Multiple sources as referenced in WWF, 2017



THE GOVERNMENT AND LEGISLATION

8,5 MILLION
SOUTH AFRICANS
DIRECTLY OR
INDIRECTLY DEPEND
ON AGRICULTURE
FOR INCOME

The role of the government is to ensure not only food security for the nation but also jobs and livelihoods for the estimated 8,5 million people (16% of South Africa's population) who directly or indirectly depend on agriculture for employment and income. The development challenge in South Africa revolves around how to grow the economy in a manner that creates jobs for a relatively poorly educated and unskilled workforce and improves livelihoods in marginalised rural areas. At the same time, issues of redistribution and equity must be addressed in a context of abundant coal and solar energy resources, limited water resources and limited fertile land resources.

The governance of food systems includes political and institutional considerations spanning across local, regional, national and global levels. The policy actions of the national government are both informed by and have implications for regional and local governance.

The political nature of agricultural policy, water pricing and the reliance on food imports for national food security all need to be considered to fully understand the complex nature of food security. Therefore the concept of food security is heavily embedded within, and affected by, the policies and politics of South Africa's development objectives.

Since the transition to democratic governance in 1994, the South African government has developed a range of policies that have had a direct bearing on food systems. These policies have had a mixed impact on improving food security and have done little to improve nutrition security.³⁹ Many policies have yet to achieve their intended objectives after years of implementation.⁴⁰ Most initiatives continue to focus on agriculture and productivity, neglecting the root causes of hunger, poverty and inequality.⁴¹



FOOD-POLICY
CHALLENGES
DEMAND A RANGE
OF COORDINATED
RESPONSES ACROSS
GOVERNMENT
DEPARTMENTS

On a positive note, the overarching government development agenda and long-term policy vision, the National Development Plan 2030 (NDP), 'provides an innovative framework to begin to inform action required across society to deal with pervasive hunger' which 'makes several arguments that resonate with international literature in its appraisal of what it will take to eradicate food insecurity'.⁴² The NDP embraces a systems approach that calls for collaboration, not only within government itself but also between the private sector, civil society and South African citizens in general.

This has been a challenge to put into effect. The country faces a food-policy challenge common to many governments – policy making for the food sector spans multiple policy areas and thereby demands a range of responses across government sectors.⁴³ Furthermore, government structures often create inconsistent policies owing to separate political mandates.⁴⁴ This is exacerbated by a lack of coordination to bring these sectoral mandates together to act as an enabler of more coherent food policy.

In 2002, South Africa instituted the Integrated Food Security Strategy (IFSS) which, while good on paper, faced serious institutional challenges. To be effective, the strategy required institutional reform in government departments and recognition that governance of the food system cannot happen in the public sector alone.

³⁹Pereira & Drimie, 2016; Taylor, 2015 ⁴⁰Hendriks & Olivier, 2017; Hendriks, 2014 ⁴¹Termeer et al, 2017; Pereira & Drimie, 2016
⁴²Drimie & McLachlan, 2013 ⁴³Barling et al, 2003 ⁴⁴Drimie, 2016

Put simply, the IFSS failed owing to an overemphasis on agriculture (food availability), compounded by inadequate institutional arrangements to align and coordinate related activities and programmes of state and non-state actors.

In 2013, a new National Food and Nutrition Security Policy (NFNSP) was endorsed by the Cabinet. This was translated into an implementation plan in 2015. It was in direct response to the policy failures brought about by the emphasis on food availability and the silo approach to addressing food insecurity. Reflecting a more holistic approach, the policy and plan were developed by several government departments and acknowledged the need for alignment and cooperative governance.

Although the policy vision was aligned to the NDP and regarded as a key policy pillar in achieving the NDP's vision, the coordination mechanisms, in the form of various cooperative governance forums at different spheres of government, remained vague and ambiguous.



**A SYSTEMATIC
APPROACH AND
MULTI-SECTORAL
COORDINATION IS
NECESSARY TO
GENERATE LARGE-
SCALE, SUSTAINABLE
CHANGE TO ADDRESS
THE 'WICKED
PROBLEM' OF FOOD
INSECURITY AND THE
GROWING BURDEN
OF MALNUTRITION
AND ENVIRONMENTAL
SUSTAINABILITY**

A limitation to the proposed institutional arrangements is that these remain under the direct control of the government with little space for broader participation. While the NFNSP recommended inter-sectoral coordination and the integration of existing policies guided by the Presidency, there was little to indicate that it would lead to effective outcomes. Lines of accountability and coordination between government departments, while frequently referred to, have remained unclear.

The overriding characteristic of the policy development process was a lack of consultation and co-development with stakeholders from across the food system, including those most affected by hunger. This meant that there was little buy-in to policy implementation from relevant actors in the food system. It also resulted in a limited understanding by policy makers and state officials of the diverse problems that characterise a complex system. The role of non-state actors in addressing food and nutrition insecurity was neglected. Rather than embracing the failing food system as a complex societal challenge, the policy process reverted to a top-down process that emphasised the role of the state in remedying the problem.

Another important dimension was that, although South Africa has extensive environmental legislation, this has been developed in isolation from core food policy – there is little reference to food systems in this legislation.⁴⁵ The drought in the Western Cape, following the El Niño event in 2014–2016, revealed the country's vulnerability to climate-related events. Building resilience to these shocks and other environmental change processes requires aligned and coordinated policies to ensure that the environmental dimensions are addressed. There is also clearly a need for critical engagement on the relationship between climate change and food security. Although this has been a focus for many NGOs in the region,⁴⁶ it is not reflected in national policy.

⁴⁵Pereira, 2012 ⁴⁶Gulati et al, 2013



Creating jobs for a relatively unskilled workforce and improving livelihoods in marginalised rural areas are critical development challenges.

Box 6: Structured redistribution and reform process

The National Development Plan specifically identifies agriculture as having the potential to create close to a million new jobs by 2030.

It also notes that land reform is essential to unlock the potential for a dynamic, growing and employment-creating agriculture sector. Although apartheid government policies have been revoked, the legacy of predominately white land ownership remains. It is widely agreed that land reform should seek not only to redress the imbalances of the past but should be part of an economic strategy to unlock the economic potential of land and assets in the rural economy, and support food security.

Land and water are the main pillars of agriculture and the key drivers of sufficient production. Therefore, policies related to agriculture must also meet the need for a structured redistribution process that ensures equity in access to and ownership of productive land and water rights. It is of the essence to ensure that an inclusive farming sector of small, medium and large farms is supported to maximise the production potential while preserving the ecological integrity of high-potential agricultural areas. It is also crucial to provide new or emergent farmers with proper and adequate support and training, and establish partnerships between them and organised agriculture for mentorship and market access.

In addition, and despite adequate and promising levels of projected future food supply, continuing high levels of poverty can lead to parts of the population lacking sufficient access to healthy, nutritious food. To be impactful, land redistribution must address the urgent need to improve overall soil health and protect critical freshwater resources to sustain future yields. Improved smallholder production can also support better household nutrition, build local food systems and provide additional, diversified income streams.

Box 7: The role of universities and research institutions

A transition to an equitable system that recognises both the trade-offs between and synergies within resources can only be achieved if grounded in robustly supported science. Academic research plays a key role in determining a sustainable trajectory to achieve South Africa's development goals. South Africa has a demonstrated academic strength in understanding the unique conditions of the local food system. This is further strengthened by the Centre of Excellence in Food Security, jointly hosted by the University of the Western Cape and the University of Pretoria.⁴⁷ The centre focuses on food security and nutrition research. South Africa is also the only country on the continent with globally recognised expertise in managing post-harvest food waste.

What is lacking is a focus on practical skills for hands-on agricultural extension, creating skilled officers who are willing and able to interact with all types of farmers. Transformation in the agriculture sector will require on-the-ground, trained extension officers able to support farmers, particularly smallholders, to improve their soils, crops and livestock, boost productivity and manage natural resources. The National Extension and Advisory Services Policy, currently being gazetted, highlights information sharing and skills development in support of agriculture, especially for 'smallholder entrepreneurs', recognising that in its current form, the public extension service cannot 'facilitate the accelerated capacity development of a range of producers'.⁴⁸ The policy calls for the urgent, targeted and visionary reform of extension and advisory services.

⁴⁷See foodsecurity.ac.za ⁴⁸DAFF, 2014

THE CONSUMER

Despite South Africa's ability to produce and export food, the constitutionally enshrined 'right to food' is eroded by the high levels of inequality and therefore affordability for the majority of the population at the broad base of the economic pyramid.



**ONLY 45,6% OF
SA'S POPULATION
IS FOOD SECURE**

South Africa has one of the world's highest levels of income inequality, pervasive unemployment and significant household food insecurity. National health and nutrition survey data shows that overall only 45,6% of the population is food secure.⁴⁹

Hunger is a reality not only for the urban poor. The participation of rural households in small-scale and subsistence agriculture has seen a steady decline, exacerbated by inadequate support and changing aspirations, coupled with a rising reliance on social welfare grants and food purchasing. Similarly, wild-harvesting and the cultivation of more traditional or indigenous fruits and food crops have declined. These foods often have a higher nutritional value than available transported store-bought varieties and are hardier, ensuring access to healthy fresh produce through hard times.

The result is that more than half of South Africa's population is unable to afford a healthy diet. Local research suggests that replacing unhealthy options with healthier, less processed foods can increase costs by an average of 65%.⁵⁰ Peoples' food choices are not defined by affordability alone. What people eat is to a large extent defined by food environments in stores and in the neighbourhoods and areas in which they live. To some degree people are 'locked in' to their food choices. So while consumers, through sheer numbers, have some power to shift the system, it is the private sector that has disproportionate power to influence dietary choices.

At the other end of the economic scale, there is a small segment of the market with a lifestyle similar to that of well-off Europeans or Americans. These consumers have greater economic freedom and power in their choices. This percentage of the market is responsible for a large environmental footprint owing to their high consumption levels.

Consumers at both ends of the economic spectrum in South Africa are seeking value for money and convenience. While their respective concepts of 'value' are relative, the convenience factor is driving an increase in meal solutions, ranging from fast foods to meal-ingredient delivery. There is also evidence that, with improved education, trends from upper economic brackets filter through to other income levels, particularly regarding issues related to food safety and nutrition. As the Internet of Things disrupts e-commerce and the concepts of personalised nutrition and health and wellness become increasingly widely adopted, so it will change the nature of the production and marketing of food. Clearly, the ideal consumer of the future is one who understands the connection between food and personal health and feels empowered to create change and have their informed perceptions drive innovation in food.

Ultimately, women and children need to be given primary consideration in the food system, particularly in the most vulnerable communities. Given their critical role as mothers, carers and mentors of infants and school-going children, and their traditional role in household shopping, cooking and healthcare, women present a critical opportunity area for active engagement in a more equitable and sustainable food system.

⁴⁹SANHANES-1, 2013 ⁵⁰Temple & Steyn, 2011



SUMMARY:

TEN FACTORS INFLUENCING ACTORS IN THE SYSTEM

The way the food system is shaped and defined by a large number of actors can be summarised in ten interrelated trends:

1. Addressing the imbalances in the food system between those with power and those without and the required multi-level governance is critical for sustainability.
2. The multi-dimensional and rapidly changing nature of large-scale farming means that farmers need to be skilled navigators of the social, political and economic terrain.
3. Small-scale farmers are set to collectively become significant landholders but the necessary policy certainty and investments are still not in place.
4. Market concentration is still the predominant determinant of behaviour in the food industry, allowing a few companies to determine choice and influence policy.
5. Dealing with health and agricultural policy separately will continue to have implications for nutritional security.
6. A world-class academic community has failed to deliver boots-on-the-ground extension services.
7. The right behaviour and lifestyle change signals could develop the ideal consumer of the future, one who understands ecological and nutritional health and is empowered to create change through choices. However, real change still requires a change in the operational logic of food businesses.
8. There is an increasing understanding that a focus on women presents a critical opportunity area for active engagement in a more equitable and sustainable food system.
9. The need for consultation and collaboration across scales and sectors is recognised but remains a challenge to put into effect.
10. A top-down approach to remedying the problems remains in evidence across the food system and remains a hindrance to the necessary speed and scale of change required for transformation.



The grasslands biome, such as pictured here in Wakkerstroom, Mpumalanga, is well suited to livestock rearing. However, appropriate rangeland and extensive livestock management as well as a reduction in beef consumption will be critical to safeguard existing biodiversity.

[FUTURE OF FOOD] RESILIENT AND REGENERATIVE

South Africa needs to double food production of diverse, nutritious food by 2050. With urgent and appropriate action, it can be done.

To achieve this goal, government, civil society and industry leaders will have to work together to find solutions that allow progress on all dimensions simultaneously.

South Africa needs to continue to produce nutritious food to meet the growing demand and changing dietary preferences of its inhabitants. However, at present, agricultural practices are rapidly depleting and degrading the resource base, so that increased productivity results in decreased resilience. Focusing only on production is a zero sum gain. In addition to production improvements, we need to solve the food loss and waste challenge and mitigate the impact of climate change. We need a food system that delivers more than food and nutritional security. We need a system that provides water and energy security, an enhanced role for women and youth, and a reciprocal relationship with nature and ecosystems services, giving more than it takes.

The challenges we are addressing are not linear. They are complex and their growth is exponential. So in this complex situation we need to have a sense of the future we want because it is only by applying foresight that we can make the near-terms changes we need to secure future stability. First we have to plot out the scenarios – what will get us there, and what will not? In doing so we must recognise the uncertainties – particularly in terms of the impacts of an increasingly warming climate – that are affecting our future vision, as well as the threats to what we want to achieve. We need to understand the biophysical environment and issues of well-being alongside the actors – markets, governments and consumers – not as they are today, but as they will be in 10 and 20 years.

This does not just require localised change; it requires change at an unprecedented scale – multifaceted, multisectoral and multi-impact – and at unprecedented speed. The IPCC's 2018 report gives a sense of extreme urgency in acting to address the impacts of climate change and the trade-offs and synergies that will be needed regarding not just biodiversity and land degradation but also the human element. The IPCC report recommends six critical enabling conditions for change (see left sidebar).

We have used these six conditions to frame the opportunities that WWF has identified as potential levers for a transition to an equitable food system for the future (see Box 10 on page 44). In selecting these levers, WWF also observes the IPCC's guidance that a low-carbon transition has to address poverty and inequality and that evidence indicates that, if the focus is placed on the human dimension, it might just be possible to decarbonise in the process.

6 CRITICAL ENABLING CONDITIONS FOR CHANGE

1. MULTI-LEVEL GOVERNANCE
2. POLICY INSTRUMENTS
3. INSTITUTIONAL CAPACITY
4. BEHAVIOURAL CHANGE
5. TECHNOLOGY
6. FINANCE AND INVESTMENT

SCENARIOS FOR 2050

There are no clear answers to the current debate about whether it will be possible to produce the necessary food for the planet's population in 2050. What is understood is that the decades between now and 2050 are critical as population growth is expected to peak in the middle of the century before stabilising or even declining.⁵¹ The full impact of climate change is also expected to be evident by 2050. Near-term decisions must take this long view into account to steer a course towards a more resilient and sustainable environment and society.

In 2018, WWF commissioned an analysis of the key drivers of food demand, trade and agricultural productivity growth in South Africa under different socio-economic development pathways. The analysis 'South African agriculture towards 2030/50'⁵² was conducted by the International Institute for Applied Systems Analysis (IIASA) in Austria. IIASA's World Food System Model was used to simulate food demand under alternative development scenarios, to investigate impacts on production, cropland use and food-price development. These long-term projections determine what increase in agricultural produce is required to satisfy the additional demand generated by population and income growth to 2050. Although the World Food System Model focuses on agriculture, non-agricultural economic activities are represented so that the essential dynamics across sectors among capital, labour and land are captured.



2030/2050

ANALYSIS OF
DRIVERS OF SA'S
FOOD DEMAND,
TRADE AND
AGRICULTURAL
POLICY UNDER
DIFFERENT
PATHWAYS

The WWF IIASA study focuses on two primary scenarios. Variations in the results reflect the difference between the two scenarios.

The scenario 'Sustainability – Taking the green road' (SSP1) is the only possible pathway that can most likely achieve the recently agreed SDGs.⁵³ This scenario assumes that the world actively moves towards a more sustainable path. The 'Middle of the road' scenario (SSP2) largely assumes business-as-usual trends, uses a medium population growth and generates economic and food-security improvements in all regions, but cannot achieve the ambitious climate targets of the Paris Agreement.⁵⁴ SSP2 is most closely related to the assumptions for population and economic growth in the Food and Agriculture Organization (FAO) perspective study 'World Agriculture towards 2030/2050'.⁵⁵ The two scenarios are discussed in Box 8.

⁵¹Samir & Lutz, 2017, ⁵²Fischer & Tramberend, 2018 ⁵³UN, 2015, see undp.org/content/undp/en/home/sustainable-development-goals.html ⁵⁴UN, 2015, see unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement ⁵⁵Alexandratos & Bruisma, 2012

Box 8: Shared Socio-economic Pathways as possible futures

SSP1: Sustainability – Taking the green road

SSP1 is a **sustainability scenario** where the world shifts gradually, but pervasively, towards a more sustainable path, emphasising more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural and economic costs of environmental degradation and inequality drive this shift. Rapid technological progress makes it possible to reduce the intensity with which we consume natural resources and depend on fossil fuels. Consumption (economic growth) is oriented towards low material growth and lower resource and energy intensity. Low-income countries grow more rapidly, inequality between and within economies falls, and technology spreads. Educational and health investments accelerate the demographic transition, leading to a relatively low population. The world has an open-trade economy, associated with increasingly effective and persistent cooperation and collaboration of local, national and international organisations and institutions.

These general tendencies in the SSP1 storyline were interpreted as having the following specific agriculture/irrigation-related implications:

- improvement of agricultural productivity owing to advanced technology, while maintaining environmental sustainability
- progressive elimination of barriers and distortions in international agricultural product trade
- progress towards effective land-use regulation, especially to prevent deforestation caused by expanding croplands
- enforcement of legally protected conservation areas
- large improvements in irrigation water-use efficiency, where possible
- reliable water infrastructure and water supply
- substantial improvements in global food security, including low-income countries in sub-Saharan Africa.

SSP2: Middle of the road

SSP2 is a continuation of the current trends scenario, i.e. a **business-as-usual scenario**, where the world follows a path in which social, economic and technological trends do not shift significantly from historical patterns. Development and income growth proceed unevenly, with some countries making relatively good progress while others don't. Most economies are politically stable. Global markets function imperfectly. Global and national institutions make slow progress in achieving sustainable development goals. Fossil-fuel dependency decreases slowly. Global population growth is moderate and levels off in the second half of the century because the demographic transition has run its course. However, education investments are not high enough to accelerate the transition to low fertility rates in low-income countries and to significantly slow population growth.

For implementation in this study, the SSP2 narrative translates into assumptions on the continuation of past agricultural growth paths and policies, continued (albeit decreasing over time) protection of national agriculture sectors, and further environmental damages caused by agriculture. It also includes:

- progress of agricultural productivity in developing countries as per the FAO's perspective study 'World Agriculture towards 2030/2050'
- increasing per capita consumption of livestock products owing to growing per capita incomes
- slowly reducing barriers and distortions in the international agricultural product trade
- some improvement in water-use efficiency, but limited in low-income countries
- gradual reduction in food insecurity owing to the trickle-down effect of economic development
- persistent food and water insecurity problems in some areas of low-income countries
- no effective measures and protection to prevent deforestation caused by cropland expansion.



**10-17 MILLION
MORE SOUTH
AFRICANS BY
2050**

The future is uncertain, but a number of things are evident. Population will continue to grow, albeit at a slower rate in South Africa compared to the last decades. There will be another 10 to 17 million people and average per capita income will increase by 150 to 200%, resulting in an increase in food demand in the country. The current trend in dietary changes and a higher share of livestock products are also expected to escalate with rising income levels.

Consumption of the two most environmentally intense food products, meat and milk, will more than double between 2000 and 2050. Consumption of other key commodities will also double or almost double. The IIASA analysis suggests that, with appropriate management, these increases are sustainable. They can be met by increases in domestic production through a combination of greater cropping intensity and an increase in yields per hectare of 40–45%. As a result, the projected average output per hectare of cropland will increase by 80–90% from 2000 to 2050. Given that sustained growth depends on careful use and integrated planning of water for irrigation, it is also possible that the consumption increases can be met through comparatively smaller increases in areas under irrigation. Areas equipped for irrigation will increase slightly between 2000 and 2050, from 1,5 to 1,6 million ha.

Changes in physical cropland depend on the scenario. In both scenarios the 14 million ha of arable land in 2000 decreases, to 13,6 ha in the first scenario and 13,1 million ha in the second. In SPP2, which assumes higher population growth up to 73 million by 2050, it results in a cropland increase of about 300 000 ha.

Owing to growing competition for already constrained water availability in many regions, total water withdrawals allocated to agriculture are expected to decrease over time. At an aggregate country level, by 2050, average food energy supply will increase by 16% up to 3 000 kcal per person per day. The fraction of animal protein in total protein will increase from a quarter in 2000 to more than a third by 2050.

Box 9: SDG delivery

A transformed food system is critical for human well-being and a healthy planet. It sits at the centre of delivery on the Sustainable Development Goals and our ability to live within the planetary limits. The nature of the SDGs and their delivery require a systemic approach, linking the eradication of poverty with the reduction of inequalities and climate action. Food security and nutrition are central to the successful delivery of many of the SDGs, including those on poverty (SDG1), health (SDG2), education (SDG4), gender equality (SDG5), water and sanitation (SDG6), responsible consumption and production (SDG12) and climate change (SDG13). If you add livelihoods and smallholder farmers, there is an even greater correlation.



**A CHANGE IN
MANAGEMENT
PRIORITIES,
APPROPRIATE
TECHNOLOGY AND
A SHIFT IN DIETARY
CHOICES MAY
CHANGE PATTERNS
OF LAND AND
WATER-RESOURCE
USE AND ENSURE
THE SUCCESSFUL
TRANSITION TO A
LOW-CARBON FOOD
SYSTEM**

The scenario analysis in the WWF IIASA study portrays possible futures of food and agricultural development in South Africa. Assuming moderate demographic change, quite rapid economic growth and effective technological development, the agriculture sector will be able to meet the growing food demand of a larger, even more urbanised and wealthier South African society in 2050. Nevertheless, success is not guaranteed and will require comprehensive strategies for managing land and water use, as well as research and investment to sustain yield growth.

Two major challenges as we plan for future food security in South Africa include:

- strategies for the production, distribution and accessibility of adequate and high-nutrient food
- environmental concerns focused on the conservation and regeneration of the productive land in South Africa.

It is critical that we consider how to avoid a continued decline in both the health and environmental outcomes of South Africa's food system. It is of concern that while analyses suggest adequate and promising levels of future food supply in South Africa, the challenge of poverty may result in unequal access to food. At the same time, it remains likely that urban low-income populations will remain prone to becoming overweight and obese, predominantly because of unhealthy high-fat, high-sugar foods.

Securing a healthy population in 2050 presents a unique challenge in view of the overwhelming abundance of unhealthy foods and the deep cultural acceptance of and aspiration towards these foods. This risk is already very real, and changing the current trajectory will take collaborative engagement with the food industry, civil society and government.

Finally, perhaps the greatest risks to achieving positive scenario outcomes are the impacts of climate change, environmental degradation and overexploitation, as well as the possible failure to achieve inclusive growth and avoid social conflict. A change in management priorities together with investment in appropriate technology and a shift in dietary choices may result in different patterns of land and water-resource use and ensure the successful transition to a low-carbon food system.

WHAT CAN'T BE PREDICTED?

The foresight gained from running a scenario process helps to inform necessary action. The process also helps to determine certain elements of South Africa's future that are difficult to predict with complete certainty.⁵⁶ Understanding what these are is important because it increases the sense of urgency to act; an appropriate and rapid response can decrease the impact of these uncertain development trajectories.



Demographic changes

While there is relatively high certainty about the upward trajectory of both population growth and urbanisation, there is still a question around how strong these rates of growth will be. **Migration** is the most uncertain element in demographic projections.



Economic growth

Economic growth is always uncertain, especially in the long term, but in South Africa there is the added dimension of the need for inclusive growth. Furthermore, South Africa's political future is far from certain and further turbulence will influence economic growth projections.



Climate change impacts

There is **much** uncertainty related to climate change, especially about the increased variability in rainfall, heat units and even plant nutrition. Climate change will manifest in changes in water availability both in absolute terms and in terms of distribution over the year. From a management perspective, the key question is whether South Africa will succeed in the implementation of adequate socio-ecological **climate change adaptation strategies**.



Technological changes

While technology is always expected to develop over time and to help improve food security along the entire supply chain (from field to plate), the degree of improvement is uncertain. Novel crop varieties, improved management techniques (e.g. better irrigation) and more efficient food production systems can all help to improve food security. **Identifying and developing appropriate technology as well as technology transfer and investment** are key.



Land-use and agricultural management

Land-use and agricultural management cover a wide field of themes and activities including land reform and tenure, farm size, farm type, production for subsistence or markets, and access to capital. How all these aspects will evolve in the context of South Africa contributes to uncertainty. The scenario calculations using the World Food System Model capture those from an economic perspective with South Africa integrated in the world economy. **Sustainable land management** is crucial to achieving food security as it counteracts the degradation of scarce land and water resources.



Additional demand/competition

The growing demand for agricultural products beyond food, primarily from **an evolving bioeconomy in a future world without fossil fuels**, is a major uncertainty in planning for a food-secure and resilient future.

Dietary choices

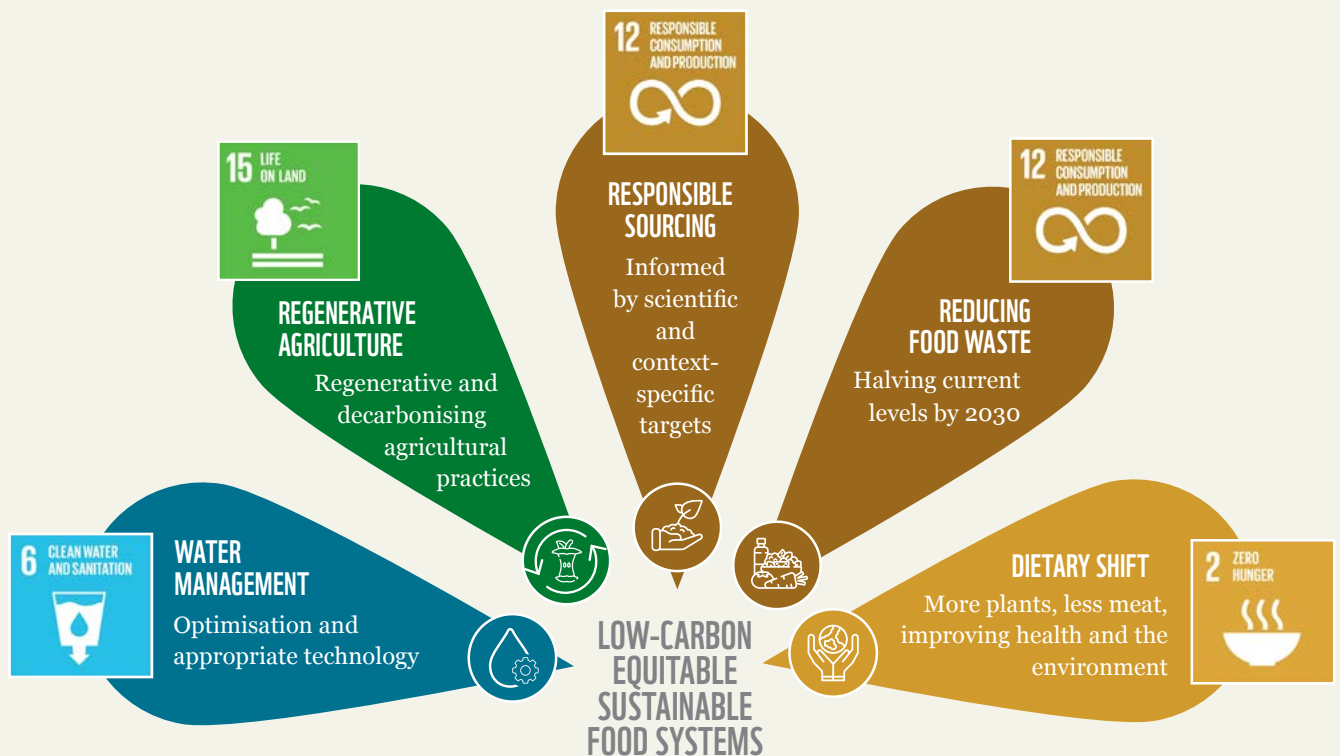
Together, demographic changes and economic growth have an impact on dietary choices, although these choices might also shift as a result of cultural changes. A shift towards a less animal-protein-intensive diet could change the demand structure. The attitude towards cheaper yellow maize, currently considered less desirable, may also change.

⁵⁶Tramberend, 2018

[WWF'S APPROACH]

TRANSFORMATIVE CHANGE IN FOOD SYSTEMS

WWF focuses on five practical areas for transformative change for a low-carbon and equitable food system in South Africa.



These five interlinked and interdependent areas are water management, good agricultural practice, responsible sourcing, reducing food waste and dietary shift. Each action directly aids in meeting the targets of one of the SDGs as well as linking to a number of others. Implicit in all these actions is the need for collective action (SDG17) as well as meeting the goals related to climate action (SDG13) and addressing poverty (SDG1) and inequality (SDG5 and 10).

In the content that follows, these areas are explained in the context of the necessary enabling conditions for each (see Box 10 on page 44), as well as practical opportunities to achieve scale. These opportunities are actions already identified by stakeholders as capable of building a system that is more resilient over time.

Box 10: The seven critical conditions for change

To achieve urgent, transformative change, specific enabling conditions must be in place. The IPCC report identifies six critical categories. The addition of scientific evidence-gathering brings this list to seven. The categories are interlinked and mutually reinforcing.



Strengthening scientific evidence

Effective action must be time bound and informed by evidence, based on scientific consensus. This requires not just a commitment to gathering evidence but also the capacity to interpret and correctly apply best-available science in developing policies and scientific target setting appropriate to local context.



Enhancing multi-level governance

The concentration of power in the agri-business sector and the resulting marginalisation of important stakeholders in the food system require mechanisms to improve engagement and the ability to cooperate across all scales and all sectors.



Strengthening policy instruments

Change requires application of the full range of evidence-based policy levers addressing issues of both soft and hard power. Policy mechanisms are also critical for de-risking investments.



Enhancing institutional capacity

The need for speed in the adoption of numerous changes requires greater capacity everywhere: in governments, companies, communities, banks and investors, among others. Government capacity is critical, but this enhanced capacity also needs to filter down to individuals and into enhanced local knowledge systems.



Enabling lifestyle and behavioural change

Substantial shifts in production and consumption will require behavioural change at institutional and individual scales. Fundamental to this approach will be awareness drives to boost public support for change.



Enabling technology innovation and transfer

Technology is required for change at scale but issues of equity and fairness are critical. The focus therefore needs to be on economic incentives for technology transfer, particularly to smallholder farmers.



Finance and investment

It is critical that economic incentives are clear, both in terms of the redirection of existing financial mechanisms into sectors, companies and technologies that promote a low-carbon, just transition and investment in new areas.



WATER MANAGEMENT AND IRRIGATION EFFICIENCY

Best practice will be achieved through knowledge transfer and appropriate technology.

Agriculture, as the single largest water user and a large energy user, is at the forefront of optimising and reducing natural resources use. This includes water efficiency – producing more with less – through the use of better technology. Technology is only part of the solution; also critical are the necessary behaviour changes and innovation to adapt to changing conditions (see page 19).

CRITICAL ENABLING CONDITIONS FOR CHANGE

- **Technology**, particularly in terms of irrigation requirements (e.g. remote sensing, soil-moisture probes) but also to improve storage and retention as well as reticulation efficiency.
- **Institutional capacity** and skills to address serious constraints on the availability of water.
- **Behavioural change**, supported by scientific evidence and an awareness drive, to shift to more efficient practices, increase legal compliance and strengthen cooperation between established and emerging farmers.
- **Policy** to incentivise good water management and determine an approach to water pricing; to reflect the true full cost of water provisioning and support reinvestment in freshwater protections in our catchments.
- **Investment** in water infrastructure, away from large-scale irrigation and towards technological innovation and on-farm adoption.

OPPORTUNITIES FOR CHANGE AT SCALE

- **Integrated resource and food-security planning:** Coordinated planning is needed across different government departments. This is an important function of the Water Research Commission, along with linking the Department of Water and Sanitation, the Department of Agriculture, Forestry and Fisheries, the Department of Health, other government departments and research institutions.
- **Supply chain scientific target setting:** Companies adopt contextual water targets – addressing shared water challenges within a river-basin context – using evidence from the WWF Water Risk Filter to inform target validity.
- **Bridging the research divide:** Upscale the efforts of the Water and Agricultural Research commissions to build public-private partnerships to bridge the divide on research and disseminate knowledge and technical expertise to a broader audience, particularly smallholders.
- **Catchment and groundwater management:** Draw up water-source area management plans and implement cooperative catchment management that includes Water User Associations.
- **Partnerships for alien plant control:** Form invasive alien plant control partnerships at the catchment or irrigation scheme scale, e.g. Water Source Partnerships and participation in the Water Stewardship Programme.
- **Circular economy principles:** In time, rainwater harvesting, waste-water recycling, desalination and other circular closed reuse systems interventions will become the norm. The required public investment in water infrastructure has yet to materialise.
- **RE for treatment and pumping:** Ensure positive linkages to the increased use of decentralised renewable energy sources for water treatment and pumping at the irrigation scheme scale.



REGENERATIVE AGRICULTURE

Rethinking current approaches is fundamental to improving yield, ecosystem functioning, livelihoods and climate resilience.

Conservation agriculture (CA), sustainable rangeland management and extensive livestock management, based on agro-ecological principles, will fast-track climate change resilience in the agriculture sector, especially in the Western Cape. Sustainable intensification is also an important form of climate adaptation. It is designed to improve yield and increase production efficiencies while limiting land degradation and improving the quality of degraded land and ecosystem function (see page 18).

CRITICAL ENABLING CONDITIONS FOR CHANGE

- **Institutional capacity** to adopt CA and sustainable intensification as a multi-pronged effort to address the ‘disconnectedness’ between climate science and African agriculture and improve extension support to facilitate agricultural decision making on the ground.
- Combine public support (**behaviour change**) for R&D with appropriate **policy** mixes that provide **investment** and incentives for the increased adoption of appropriate agro-ecology practices and to boost **technological innovations**, e.g. biotechnology and the use of data-enabled technology and artificial intelligence.
- Create **governance systems** and inclusive value-chain partnerships that enable sustainable land management to conserve ecosystem functions and services and manage the growing competition for agricultural products. Cooperating across sectors and stakeholders will also improve livelihoods and working conditions.

OPPORTUNITIES FOR CHANGE AT SCALE

- **DEA’s Green Economy Model:** Promote the South African Green Economy Model developed by the Department of Environmental Affairs. It prioritises agriculture as one of nine sectors to support the transition to resource-efficient, low-carbon and pro-employment growth.
- **CA extension services for smallholders:** The adoption of CA is well advanced in the Western Cape commercial farming sector but the next real opportunity is to support its adoption by smallholder farmers. WWF is focusing on driving sufficient well-trained extension officers and community liaison members into the system.
- **Finance for climate-smart agriculture:** Farmers can access the Land Bank’s Climate Resilience facility, financed by the European Investment Bank, to improve capacity to prepare for and adapt to the impacts of climate change.
- **Policy certainty:** The national government needs to provide policy certainty on water and land rights to encourage investment in CA. This is possible under the CA policy that is being drafted.
- **GreenAgri Portal:** The Western Cape Department of Agriculture’s GreenAgri Portal for (climate) SmartAgri is an excellent information hub that should be taken to a national scale to support knowledge transfer and as a central repository for information.
- **Knowledge transfer:** Draw on existing global expertise, e.g. the Food and Land Use Coalition (FOLU) and increase local funding for the science-based transformation of food and land-use systems.
- **Supporting smallholder initiatives:** Focus investments on promoting technological innovations adapted to smallholder needs, e.g. Solidaridad’s farming solution mobile application, a way of engaging smallholder farmers in sustainable farming in return for securing market access for high-value horticulture chains. It allows self-assessment on localg.a.p., including social and environmental criteria.



RESPONSIBLE SOURCING

Directing the purchasing power of the food industry is an effective way of driving better practice.

Well-designed and supported sustainability codes, particularly those that are based on scientifically informed target setting by food companies and retailers, play a powerful role in shifting production (see page 25 and 27).

CRITICAL ENABLING CONDITIONS FOR CHANGE

- **Technology** should be used to track efficiency and sustainability in food value chains. Artificial intelligence, blockchain, the Internet of Things and robotics have already demonstrated the potential to massively improve resource efficiency, precision agriculture and supply chain management.
- **Investment** in appropriate technology is needed for easy, credible traceability and monitoring the reduction of long-term impacts on the environment. This will also aid the **evidence-gathering** process for target setting.
- **Behaviour- and lifestyle-related measures** and demand-side management should be developed to ensure that the customer is supportive of responsible sourcing.
- **Policy instruments** and innovative financial products should be developed to incentivise circular economy approaches and support investment in on-farm changes.
- **Institutional capacity** should be expanded so that improved sourcing is a shared commitment rather than driven by sustainability departments only.

OPPORTUNITIES FOR CHANGE AT SCALE

- **Commodity-specific improvement initiatives:** Increase support for credible local initiatives linked to biodiversity-friendly farming in South Africa, including sugar (SUSFARMS® and BONSUCRO), wine (WWF Conservation Champions), fruit (SIZA initiative), red meat (Meat Naturally), wildflowers (Sustainably Harvested Wildflowers) as well as schemes such as the Woolworths Farming for the Future and the Trace & Save model used at Woodlands Dairy Association.
- **Awareness drive:** The Department of Health and the Department of Environmental Affairs should collaborate to increase public support and behaviour change through supporting consumer awareness about pesticide residues, ecosystem degradation, pollution and the declining nutritional value in food.
- **Smallholder schemes:** Centralised, local distribution chains and alternative local markets for smallholders should be supported through models such as Participatory Guarantee Systems and SPAR Rural Retail Hubs models.
- **Science-based targets and global standards:** Science-based targets and deforestation-free value chains are supported by labelling schemes such as the Roundtable on Sustainable Palm Oil, the Roundtable on Responsible Soy, the Roundtable for Responsible Beef as well as the Roundtable on Sustainable Biomaterials.
- **Blockchain technology:** Improved data collection and software, such as in blockchain platforms, allow companies to improve the traceability and transparency of commodities value chains and strengthen consumer trust. Correctly implemented, blockchain technology could drive improvements in production and consumption.



REDUCING FOOD LOSS AND WASTE

Identifying and eradicating the causes of waste will materially shift the system.

Reducing food loss and waste is also one of the few current challenges where there is immediate scope for change that does not have unwanted or unintended consequences elsewhere in the system (see page 21).

CRITICAL ENABLING CONDITIONS FOR CHANGE

- **Technology** can transform food waste into products with marketable value. It can improve processing options to develop products with a longer shelf life and address waste at other points. Integrated inventory management and collaborative logistics are important focus areas, as is food safety.
- **Policy instruments** can be developed to create disincentives for food dumping and disposal, and incentives for food donations. Allied to this is clear government department accountability.
- **National campaigns** should be run to promote behaviour change to reduce food waste from farm to kitchen.

OPPORTUNITIES FOR CHANGE AT SCALE

- **Delivery of SDG Target 12.3:** Target 12.3 of SDG12 focuses on food loss and waste. In line with the UN's Sustainable Development Goals, the South African government has committed to halving food waste by 2030. Collaborative efforts are needed to develop and establish a national food waste target, strategy and roadmap for achieving the target. This requires a clear understanding of the challenge alongside a coordinated departmental response.
- **Data and voluntary waste agreement:** The Consumer Goods Council of South Africa's voluntary agreement for waste measurement and reporting will be an important first step in understanding the causes of and solutions to waste in the value chain.
- **Donate surplus food:** Food Forward, a food-donation NGO, has established a technical platform to prevent waste. They recover and redistribute safe and nutritious food that would otherwise be wasted, to feed people. Second Harvest, a Food Forward innovation, has been established to address the logistical challenge of getting surplus fresh produce off the farm and into neighbouring food-insecure communities.
- **Adopt date label best practice:** Misunderstanding date labels, storage and usage contributes to food waste. By working together, stakeholders in the food industry can ensure labelling consistency across products and in that way support consumer understanding.
- **Actor-specific interventions:** Waste can be addressed right throughout the value chain, so not all actions can be mentioned here. However, retailers merit a special mention because of their ability to influence stakeholders up and down the value chain. Retailers need to scale current efforts to apply better technological solutions to forecast demand, improve their ability to manage inventory, adapt cosmetic specifications, motivate customers to buy only what's needed and rethink packaging to reduce food waste and the leakage of problem plastics into the environment.
- **Reducing smallholder losses:** Invest in research and pilots to help smallholder farmers reduce food losses during production and storage.



DIETARY SHIFT

Shifting towards healthy and ecological nutrition is crucial if we want to live within the limits of our planet.

There is good evidence that where meat consumption exceeds recommended levels, reducing this will make a significant contribution to reducing both emissions and land-use change.^{59a} According to the IPCC, low GHG-intensive food consumption has the most pronounced synergies – aiding delivery on multiple SDGs – and the lowest number of trade-offs with respect to achieving sustainable development (see page 22).

CRITICAL ENABLING CONDITIONS FOR CHANGE

- **Policy instruments** can create the incentives needed to nudge **behaviour change** towards responsible consumption and production, and so towards less resource-intensive diets.
- Improved **governance** is required for holistic strategies and the ability to operate across stakeholders. Multi-stakeholder action, including dialogue, should be seen as part of the broader governance of the food system that is led by government but does not prejudice other actors outside of government.

OPPORTUNITIES FOR CHANGE AT SCALE

- **Dialogue towards collective action:** The shift towards highly processed, unhealthy and environmentally intensive food choices is the result of collective failure, so it will take collective action to check the trend, rebuild trust between stakeholders and reverse negative health outcomes. A collective response is being championed by the Southern Africa Food Lab. The Food Lab, which was established in South Africa ten years ago with the support of WWF, is now one of the most mature multi-stakeholder food dialogue platforms in the world. The Food Lab team is one of unprecedented diversity in the southern African region, comprising stakeholders from the corporate, grassroots, NGO, academic and government sectors all working together to transform the food system from farm to table.
- **Healthy food incentives:** Partnering with existing initiatives such as the Consumer Goods Forum (CGF) or Food Reform for Sustainability and Health (FReSH) will help to integrate and trial healthy food incentives into food retail and canteen environments.
- **Integrated agriculture and health policy:** The Integrated Food Security Strategy (IFSS) needs to better integrate agricultural policy with health policy and create adequate institutional arrangements.
- **Target setting:** The adoption of scientific targets for healthy diets and sustainable production by all sectors is necessary to stimulate appropriate action across sectors and scales. This must be supported by public-private partnerships to increase support for production of foods that match the nutritional needs of low-income South Africans, alongside a government-supported accessibility and awareness drive.
- **Support small-scale farmers and local food systems:** Smallholder farmers and fresh-produce markets should be engaged, with a focus on agro-ecological practices, through the large-scale collaboration of multiple stakeholders. The focus initially would be on including these farmers in formal value chains, prioritising the development of alternative and (shorter) local value chains, and enhancing local food reliance and affordability.
- **Language and sufficiency:** We should change the language when talking about food. Food discourse in the public space tends to be the domain of ‘experts’, emphasising qualitative analytical dimensions over the household-level language of love and labour. Changing the language to be more about the lived experience of food growing, food choices and food preparation foregrounds a logic of sufficiency centred on people rather than profits, and elevates maternal health and child development.^{59b}

^{59a}Poore & Nemecek, 2018 ^{59b}Andrews, 2017

GOING FORWARD

It will be a monumental task to address the failings of our food system, but best we act now before our quality of life and maybe even our survival depend on untested technologies.

The challenge to double production by 2050 off a degraded base and deeply inequitable production system while achieving the ambitious climate targets of the Paris Agreement, both in South Africa and across the globe, leaves us with only two choices – to place our faith in untried or not-yet-invented technologies, or to direct our efforts into transformative systemic change guided by the interconnected delivery priorities of the SDGs. All the evidence indicates that focusing on system-wide change by considering social, environmental and economic factors, supported by appropriate technology, can bring about rapid, far-reaching and positive change at scale. Certainly, it is a complex task that will require cooperative multi-level governance to better link agricultural, nutrition, development and conservation agendas and overcome the associated political, cultural, behavioural and investment challenges.

Recognising these challenges and the exponential risks of doing business as usual, this report aims not only to consolidate the mounting evidence (facts are never enough) but also to provide some ideas for the first steps, showing where the levers are and what the quick wins might be. At a deeper level, transformation requires an adoption of a duty of care to the poor and vulnerable in our society. This complexity means that no single organisation can solve the food-system problem by itself. An inclusive process of institutions and actors is required, with a strong focus on results.

WWF stands ready to partner with those willing to make the necessary changes now, at scale and with speed. Given that a transformed food system is critical for human well-being and a healthy planet, making this our collective mission sits at the centre of SDG delivery and our ability to live within planetary limits. Our future depends on it.



GLOSSARY

Agroecology: Applying ecological concepts and principles to optimise interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system.⁶¹

Arable land: An agricultural term referring to land suitable for growing crops.

Bioeconomy: The sustainable and innovative use of renewable resources to provide food, feed and industrial products with enhanced properties. Besides economic growth, the bioeconomy aims for food security, climate protection and the conservation of scarce natural resources.

Bioprospecting: The systematic search for biochemical and genetic information in nature in order to develop commercially valuable products for pharmaceutical, agricultural, cosmetic and other applications.⁶²

Catchment stewardship: Initiatives that fall under the term ‘water stewardship’, which means that they are actions that have at their core the responsible use of water in socially equitable, environmentally sustainable and economically beneficial ways. A key to success is a stakeholder-inclusive process that involves site- and catchment-based activities.⁶³

Climate-smart agriculture: An approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. It aims to tackle three main objectives, namely sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible.

Conservation agriculture: 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. It consists of agroecology, organic farming and sustainable production practices.

Food access: Having the ability to access the available food, including the economic, legal, political and social capacity for obtaining access.⁶⁴

Food availability: The availability of sufficient quantities of food of adequate quality.

Food security: Food security refers to food availability, that is, the availability of sufficient quantities of food of adequate quality.⁶⁵

Food stability: Stability of supply and safety from risk.⁶⁶

⁶⁰fao.org ⁶¹undp.org/content/sdfinance/en/home/solutions/bioprospecting.html

⁶²Schachtschneider, 2016 ⁶³FAO, 2006 ⁶⁴FAO, 2006 ⁶⁵FAO, 2006 ⁶⁶FAO, 2006

Food utilisation: The capacity to safely and effectively utilise food, which includes having an adequate diet to maintain good nutrition, and non-food elements such as access to clean water and sanitation.⁶⁷

Food waste: Food losses and food waste, that is, it includes all food originally intended for human consumption that is ultimately never consumed.

Embedded water and energy: The sum of all the energy and water required to produce any goods or services, considered as if that energy was incorporated or 'embodied' in the product itself.

Land degradation: The many human-caused processes that drive the decline or loss in biodiversity, ecosystem functions or ecosystem services in any terrestrial and associated aquatic ecosystems.⁶⁸

Landscape approach: A multi-stakeholder process that aims to ensure the realisation of local needs and actions of those who live within the landscape, while also considering the goals and outcomes important to stakeholders outside the landscape such as national governments or the international community.

Planetary limits: A set of nine planetary boundaries within which humanity can continue to develop and thrive for generations to come.

Resilience: In a food-security context, the ability of a household to keep within a certain level of well-being (i.e. being food secure) by withstanding shocks and stresses. This depends on available livelihood options and on how well households are able to handle risks.

Scientific targets: Scientifically informed and time-bound targets are important tools for governments, businesses and other actors in the food system to effectively engage in transformative action. Science-based targets provide companies with a clearly defined pathway to future-proof growth by specifying how much and how quickly they need to reduce their greenhouse gas emissions. The scientific targets of the EAT-Lancet Commission on Food, Planet, Health provide ranges of amounts and types of food necessary for human health and reduced environmental degradation. Context-based water targets respond to the shared water challenges within a basin and using them to inform the ambition of action. These targets, which are all at different stages of development, address global issues adapted for context-specific levels of action.

Sustainable diets: Diets with low environmental impacts which contribute to food and nutrition security and to a healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy, while optimising natural and human resources.⁶⁹

The Internet of Things (IoT): A system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.⁷⁰

Transformative change: System-wide change through consideration of social and economic factors that, with technology, can bring about rapid change at scale.⁷¹

⁶⁷FAO, 2006 ⁶⁸IPBES, 2018 ⁶⁹FAO, 2012

⁷⁰internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT ⁷¹IPCC, 2018

REFERENCES

SECTION I

- ARC (2014) Agricultural Research Council: Conservation Agriculture Report, greenagri.org.za/assets/documents-/SmartAgri/Other-Resources/ARC-2014-Conservation-Agriculture-report.pdf
- BFAP (2012) Bureau for Food and Agricultural Policy, Farm Sectoral Determination: An Analysis of Agricultural Wages in South Africa
- Cousins B (2011) 'Through a glass, darkly': Towards agrarian reform in South Africa, pp. 1–25
- CSIR (2011) *Atlas of Freshwater Ecosystems Priority Areas in South Africa*, Pretoria: Council for Scientific and Industrial Research, csir.co.za/impact/docs/Final_Freshwater_Atlas_Article.pdf
- DAFF (2017) Department: Agriculture, Forestry and Fisheries, *Economic Review of the South African Agriculture 2017/18*, Pretoria: DAFF
- Elferink M & Schierhorn F (2016) Global demand for food is rising. Can we meet it? *Havard Business Review*, hbr.org/2016/04/global-demand-for-food-is-rising-can-we-meet-it
- FAO (2006) Livestock's Long Shadow, *Environmental Issues and Options*, Rome: Food and Agriculture Organization of the United Nations
- GCIS (2009) SA Yearbook 2008/09, Pretoria: Government Communication and Information System
- ILOSTAT (2017) Employment by sector, International Labour Statistics Database
- IPCC (2018) De Coninck H, Revi A, Babiker M, Bertoldi P, Buckeridge M, Cartwright A, Dong W, Ford J, Fuss S, Hourcade JC et al (2018) Strengthening and implementing the global response, in: Global warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, edited by V Masson-Delmotte, P Zhai, HO Pörtner, D Roberts, J Skea, PR Shukla, A Pirani, W Moufouma-Okia, C Péan, R Pidcock et al, in press Kotze I & Rose M (2015) Farming Facts and Futures: Reconnecting South Africa's food systems to its ecosystems, awsassets.wwf.org.za/downloads/wwf006_ffl_report_low_res.pdf
- Kotze I & Rose M (2015) Farming Facts and Futures: Reconnecting South Africa's food systems to its ecosystems, awsassets.wwf.org.za/downloads/wwf006_ffl_report_low_res.pdf
- Le Maitre DC, Seyler H, Holland M, Smith-Adao L, Nel JL, Maherry A & Witthüser K (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater, Report No. TT 743/1/18, Pretoria: Water Research Commission
- Le Roux JJ, Newby TS & Sumner PD (2007) Monitoring soil erosion in South Africa at a regional scale: Review and recommendations, *South African Journal of Science* 103 (7–8), scielo.org.za/pdf/sajs/v103n7-8/a1710308.pdf
- Le Roux JJ & Smith HJ (2014) Soil erosion in South Africa – its nature and distribution, GrainSA
- Loken B, Springmann M, Lang T, Vermeulen S, Garnett T, Fan S et al (2019) Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems, *The Lancet*, article in press, first published online on 16 January 2019, [doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
- Mason-Jones K, Notten P & Rambaran, N (2014) Energy as an input in the food value chain, *Understanding the Food Energy Water Nexus*, Cape Town: WWF-SA
- McLachlan M & Landman AP (2013) Nutrition-sensitive agriculture – a South African perspective, *Food Security*, 5(6): 857–871, link.springer.com/10.1007/s12571-013-0309-1
- Myers S, Smith MR, Guth S, Golden CD, Vaitla B, Mueller ND, Dangour AD & Huybers P (2017) Climate Change and Global Food Systems: Potential Impacts on Food Security and Undernutrition, *Annual Review of Public Health*, 38: 259–227, doi.org/10.1146/annurev-publhealth-031816-044356
- Nahman A & De Lange W (2013) Costs of food waste along the value chain: Evidence from South Africa, *Waste Management*, 33(11): 2493–2500, dx.doi.org/10.1016/j.wasman.2013.07.012
- NDP (2012) National Development Plan 20130: Our future – make it work, gov.za/sites/default/files/gcis_document/201409/ndp-2030-our-future-make-it-workr.pdf, p. 220

- Oelofse SH & Nahman A (2013) Estimating the magnitude of food waste generated in South Africa, *Waste Management & Research*, 31(1): 80–86
- Ronquest-Ross LC, Vink N & Sigge GO (2015) Food consumption changes in South Africa since 1994, *South African Journal of Science*, 111(9–10), doi: 0.17159/sajs.2015/20140354
- SA Food Lab (2015) Southern Africa Food Lab and Reos Partners South Africa, *The Future of Food in South Africa: Four scenarios examining possible futures of the food system in South Africa*, Southern Africa Food Lab
- StatsSA (2017) Poverty Trends in South Africa, An examination of absolute poverty between 2006 and 2015, Report No. 03-10-06, Pretoria: Statistics South Africa
- TEEB (2018) The Economics of Ecosystems and Biodiversity for Agriculture & Food: Scientific and Economic Foundations, Geneva: UN Environment
- UNESCO-WWAP (2006) World Water Development Report No. 2, Paris: United Nations Educational, Scientific and Cultural Organisation – World Water Assessment Programme
- Von Bormann T & Gulati M (2016) Food, Water, and Energy: Lessons from the South African Experience, *Environment: Science and Policy for Sustainable Development*, dx.doi.org/10.1080/00139157.2016.1186438
- WHO (2014) World Health Organization NCD Country Profile: South Africa, data.worldbank.org/country/south-africa#cp_gep
- WWF-SA (2013) Low Carbon Frameworks: Transport – Understanding Freight Emissions, paper commissioned from The Green House, Cape Town: WWF South Africa
- WWF-SA (2017) *Food Loss and Waste: Facts and Futures*, wwf.org.za/?21641/Food-Loss-and-Waste-Facts-and-Futures-Report
- WWF-SA (2016) Oceans facts and futures: Valuing South Africa’s ocean economy, Cape Town: WWF-SA

SECTION II

- ANDE (2017) Aspen Network of Development Entrepreneurs, 2017.andeglobal.org/report/capacity/?filter=south-africa
- Barling D, Lang T & Caraher M (2003) Joined-up food policy? The trials of governance, public policy and the food system, *Social Policy & Administration*, 36(6): 556–574
- BFAP (2017) Baseline 2017: Agriculture Outlook 2017 to 2026
- Claasen N, Van der Hoeven M & Covic N (2016) Food environments, health and nutrition in South Africa, Working Paper 34, Cape Town: PLAAS, UWC and Centre of Excellence on Food Security
- DAFF (2014) Department of Agriculture, Forestry and Fisheries: Draft National Extension and Advisory Services Policy, Pretoria: Department of Agriculture Forestry and Fisheries
- Drimie S (2016) Working paper 39: Understanding South African food and agricultural policy: Implications for agri-food value chains, regulation, and formal and informal livelihoods, Cape Town: PLAAS
- Drimie S & McLachlan M (2013) Food security in South Africa – first steps toward a transdisciplinary approach, *Food Security*, 5(2): 217–226
- Eccles RG & Serafeim G (2012) Top 1,000 Companies Wield Power Reserved for Nations, *Bloomberg.com*, 11 September
- FAOSTAT (2017) in: IIASA working paper, 2018, Rome: The Food and Agriculture Organization of the United Nations
- Gulati M, Jacobs-Mata I, Jooste A & Naidoo D (2013) The Water–energy–food Security Nexus: Challenges and Opportunities for food security in South Africa, *Aquatic Procedia*, 1: 150–164
- Hendriks S (2014) Food security in South Africa: Status quo and policy imperatives, *Agricultural Economics Research Policy and Practice in Southern Africa*, 53(October): 2
- Hendriks SL & Olivier NJJ (2017) Review of the South African Agricultural Legislative Framework: Food security implications, *Development Southern Africa*, 32(5), 555–576
- IOL (2006) Consortium buys stake in Cape produce market, *IOL Business Report*, 20 September
- Kotze I & Rose M (2015) Farming Facts and Futures: Reconnecting South Africa’s food systems to its ecosystems, awsassets.wwf.org.za/downloads/wwfo06_ffl_report_low_res.pdf
- Pereira, LM (2012) *Private Sector Adaptive Capacity to Climate Change Impacts in the Food System: Food security implications for South Africa and Brazil*, Oxford: University of Oxford
- Pereira L & Drimie S (2016) Governance Arrangements for the Future Food System: Addressing Complexity in South Africa, *Environmental Science and Policy*, 18–31

- SANHANES-1 (2013) Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, Reddy P, Parker W, Hoosain E, Naidoo P et al *South African National Health and Nutrition Examination Survey*, Cape Town: HSRC Press
- Taylor V (2015) Achieving food security through social policies: Comprehensive social protection for development, *Food Security in South Africa: Human rights and entitlement perspectives*, 145–146
- Temple NJ & Steyn NP (2011) The cost of a healthy diet: A South African perspective, *Nutrition*, 27(5): 505–508, doi: 10.1016/j.nut.2010.09.005
- Termeer CJAM, Drimie S, Ingram J, Pereira L & Whittingham MJ (2017) A diagnostic framework for food system governance arrangements: The case of South Africa, *NJAS – Wageningen Journal of Life Sciences*, 84: 85–93, doi.org/10.1016/j.njas.2017.08.001
- WWF (2017) *Food Loss and Waste: Facts and Futures*, Cape Town: WWF South Africa, wwf.org.za/?21641/Food-Loss-and-Waste-Facts-and-Futures-Report

SECTION III

- A/RES/70/1 (2016) in IPCC 2018 Ch4 UN, *Transforming our World: The 2030 Agenda for Sustainable Development*, A/RES/70/1, New York: United Nations
- Alexandratos N & Bruisma J (2012) *World Agriculture Towards 2030/2050 – The 2012 revision*, Rome: The Food and Agriculture Organization of the United Nations, fao.org/global-perspectives-studies/resources/detail/en/c/411108
- Andrews D (2017) Future of Food panel discussion, Cape Town, 5 July
- Fischer G & Tramberend S (2018) *South African Agriculture towards 2030/50*, commissioned report for WWF South Africa, Laxenburg, Austria: International Institute for Applied Systems Analysis
- IPCC (2018) De Coninck H, Revi A, Babiker M, Bertoldi P, Buckeridge M, Cartwright A, Dong W, Ford J, Fuss S, Hourcade JC et al (2018) Strengthening and implementing the global response, in: *Global warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, edited by V Masson-Delmotte, P Zhai, HO Pörtner, D Roberts, J Skea, PR Shukla, A Pirani, W Moufouma-Okia, C Péan, R Pidcock et al, in press Kotze I & Rose M (2015) *Farming Facts and Futures: Reconnecting South Africa’s food systems to its ecosystems*, awsassets.wwf.org.za/downloads/wwf006_ffl_report_low_res.pdf
- Poore J & Nemecek T (2018) Reducing food’s environmental impacts through producers and consumers, *Science*, 360(6392): 987–992, doi: 10.1126/science.aaq0216
- Samir RK & Lutz W (2017) in: IIASA working paper, 2018, The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100, *Global Environmental Change*, 42: 181–192
- Tramberend S (2018) email correspondence, ‘Key uncertainties in the scenarios’, 31 October
- UN (2015) in: IIASA working paper, 2018, *Transforming our world: The 2030 agenda for sustainable development*, New York: United Nations

GLOSSARY

- FAO (2006) Policy Brief: Food Security, Rome: Food and Agricultural Organisation of the United Nations, [ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf](http://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf)
- FAO (2010) Measuring resilience: A concept note on the Resilience Tool, Rome: Food and Agricultural Organisation of the United Nations, fao.org/docrep/013/al920e/al920e00.pdf
- FAO (2012) Sustainable diets and biodiversity: directions and solutions for policy, research and action, Rome
- FAO (2018) Family Farming Knowledge Platform, fao.org/family-farming/themes/agroecology/en
- IPBES (2018) Summary for policymakers of the assessment report on land degradation and restoration of the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services, edited by R Scholes, L Montanarella, A Brainich, N Barger, B ten Brink, M Cantele, B Erasmus, J Fisher, T Gardner, TG Holland, F Kohler, JS Kotiaho, G von Maltitz, G Nangendo, R Pandit, J Parrotta, MD Potts, S Prince, M Sankaran & L Willemen, Bonn: IPBES Secretariat
- IPCC (2018) Strengthening and implementing the global response, in: *Global warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, ipcc.ch/sr15/chapter/glossary
- Schachtschneider K (2016) Breede Catchment Water Stewardship Programme – Summary report, Cape Town: WWF South Africa, wwf.org.za/freshwater
- UNDP (n.d.) Financing Solutions for Sustainable Development, undp.org/content/sdfinance/en/home/glossary

WWF'S APPROACH TO TRANSFORMATIVE CHANGE IN FOOD SYSTEMS

REGENERATIVE AGRICULTURE

Regenerative and decarbonising agricultural practices

RESPONSIBLE SOURCING

Informed by scientific and context-specific targets



DIETARY SHIFT

More plants, less meat, improving health and the environment

WATER MANAGEMENT

Optimising and using appropriate technology

REDUCING FOOD WASTE

Halving current levels by 2030



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

wwf.org.za

WWF-SA is a registered Non-Profit Organisation, number 003-226 NPO. © 1986 panda symbol and ® "WWF" Registered Trademark of WWF – World Wide Fund for Nature (formerly World Wildlife Fund). 1st Floor Bridge House, Boundary Terraces, Mariendahl Lane, Newlands, Cape Town, PO Box 23273, Claremont 7735, t: 021 21 657 6600, e: info@wwf.org.za, wwf.org.za