

KwaZulu-Natal Environmental Outlook Report





edtea

Department :
Economic Development, Tourism and
Environmental Affairs
PROVINCE OF KWAZULU-NATAL

KwaZulu-Natal Environment Outlook Report 2017

Final

November 2017

KwaZulu-Natal Environment Outlook Report 2017

Copyright subsists in this work. No part of this document may be reproduced in whole or in part in any form or by any means without written permission from the Department of Economic Development, Tourism, Environmental Affairs. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior written permission from the Department of Economic Development, Tourism and Environmental Affairs (EDTEA).

ACKNOWLEDGEMENTS

This Report was prepared in collaboration with various stakeholders and institutions, who are thanked for their contribution. Specialists and the general public also contributed at a technical workshop in August 2017 to the second draft of the Report, particularly on issues and indicators. EDTEA is grateful to all participants who contributed through this engagement process. We would also like to thank the many organisations and individuals who provided data and information that was used in this Report.

EDTEA Core Project Management Team

Mr Scelokuhle Ziqubu and Mr Mduduzi Zondo

Project Steering Committee Members

Ms Tesslyn Aiyer (Department of Education), Mr Xolani Biyela (EDTEA), Mr Jack Govender (Department of Health), Mr Peter Kuyler (EDTEA), Mr Ntuthuko Makhubu (EDTEA), Ms Letty Mathonsi (EDTEA), Ms Zodwa Mazibuko (DAFF), Dr William Mngoma (EDTEA), Ms Seo Modise (Department of Fisheries), Mr Malcolm Moses (EDTEA), Mr Caiphus Ngubo (EDTEA), Mr Ntokozo Ngubo (EDTEA), Mr Omar Parak (EDTEA), Mr Jayasaleen Puckree (EDTEA) and Ms Heather Sheard (EDTEA)

Specialist Contributors

Dr David Glassom, Ms Kendyl Le Roux, Mr Greg Martindale, Ms Yegeshni Moodley, Ms Joanne Parker, Mr Benton Pillay, Ms Angie Sanchez Piña, Ms Olga van den Pol and Mr Mark Summerton

Specialist Reviewers

Mr Greg Martindale (Conservation Outcomes), Dr Francois Odendaal (EcoAfrica Environmental Consultants Pty Ltd), and Ms Susan van Tonder (SmartWords)

Public Workshop

Location: KZN Department of Public Works, Mayville, Durban

Date: Wednesday, 2 August 2017

Special Acknowledgements

Ms Nompumelelo 'Mpume' Madonda (Office of the Premier), Mr Nisaar Mahomed (TIKZN) and Mr Sifiso Nkontwana (EDTEA)

FOREWORD

The environment provides many benefits to people – the air that we breathe, our food and water, resources and materials that we use, as well as places of recreation where we can go to admire nature and recover spiritually. The close connection we have with the environment around us makes us vulnerable to negative impacts on the environment. For this reason, we need to make a conscious effort to monitor environmental changes, predict future trends and adapt to these changes.

In South Africa, the National Environmental Management Act (No. 107 of 1998) (NEMA) provides for all people and organs of state to have access to information related to the state of the environment and future threats to the environment. This coincides with the global trend towards sustainable development and the increasing focus on the linkages between the natural environment, economic stability, social well-being and environmental governance mechanisms.

For KwaZulu-Natal, the first State of the Environment Report was completed in 1998, with the second being the 2004 Report. Since that time several State of the Environment Reports, more recently referred to as Environment Outlook Reports, have been issued at sectoral, regional, provincial and local level in South Africa.

I am pleased to present the 2nd Environment Outlook Report for the Province of KwaZulu-Natal. This comprehensive report provides credible information about the state of the environment and contains clear findings and trends based on valuable data that are not normally easily accessible to all. It also provides a set of indicators of environmental quality for monitoring and evaluation of the environment as guided by the model provided by national government for reports of this kind. The current Report positively reflects how far the Province has come in terms of environmental monitoring and governance and contains trends, predictions and actions that can be taken to improve and safeguard the environment in which we live.

I would like to thank EcoAfrica Environmental Consultants who supported the Department in compiling the report, as well as the specialist authors, reviewers, departments, organisations, stakeholders and the general public who contributed to the Report in various ways. I urge all provincial organs of state and other stakeholders to take cognisance of the contents of the report in decision-making, planning and developing policies to achieve sustainable development.

Signature and/or picture

Member of the Executive Council

Department of Economic Development, Tourism and Environmental Affairs

Table of Contents

ACKNOWLEDGEMENTS	i
FOREWORD	ii
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
LIST OF ABBREVIATIONS AND ACRONYMS	x
GLOSSARY.....	xv
1. Introduction.....	1
1.1 What is the KwaZulu-Natal Environment Outlook Report?	1
1.2 What is the purpose of the KwaZulu-Natal Environment Outlook Report?	2
1.3 How was the KwaZulu-Natal Environment Outlook Report compiled?.....	2
1.4 Gaps and Limitations	13
2. KwaZulu-Natal Provincial Profile	14
2.1 Location	14
2.2 Municipal Structure.....	14
2.3 Geography	15
2.4 Climate.....	16
2.5 The People and Demography	17
2.6 Economy	17
2.7 References (Chapters 1 and 2)	18
3. Climate Change.....	20
3.1 Introduction.....	20
3.2 Drivers	22
3.3 Pressures	22
3.4 State	24
3.5 Impacts	27
3.6 Responses.....	32
3.7 Conclusion and Recommendations.....	35
3.8 References.....	36
4. Air Quality Management	39
4.1 Introduction.....	39
4.2 Drivers and Pressures.....	40
4.3 State	42
4.4 Impacts	46
4.5 Responses.....	48
4.6 Conclusion and Recommendations.....	50
4.7 References.....	51
5. Biodiversity and Ecosystem Health	55

5.1	Introduction.....	55
5.2	Drivers	57
5.3	Pressures	58
5.4	State	58
5.5	Impacts	64
5.6	Responses.....	66
5.7	Conclusion and Recommendations.....	69
5.8	References.....	70
6.	Land Modification.....	74
6.1	Introduction.....	74
6.2	Drivers	75
6.3	Pressures	75
6.4	State	76
6.5	Impacts	84
6.6	Responses.....	84
6.7	Conclusion and Recommendations.....	86
6.8	References.....	86
7.	Freshwater Resources	89
7.1	Introduction.....	89
7.2	Drivers	91
7.3	Pressures	92
7.4	State	92
7.5	Impacts	100
7.6	Responses.....	101
7.7	Conclusion and Recommendations.....	104
7.8	References.....	105
8.	Marine and Coastal Resources.....	108
8.1	Introduction.....	108
8.2	Drivers	110
8.3	Pressures	111
8.4	State	112
8.5	Impacts	122
8.6	Responses.....	123
8.7	Conclusion and Recommendations.....	124
8.8	References.....	125
9.	Economics.....	130
9.1	Introduction.....	130
9.2	Drivers	130

9.3	Pressures	131
9.4	State	131
9.5	Impacts and Responses	138
9.6	Responses (Cross-cutting)	140
9.7	Conclusion and Recommendations	141
9.8	References	142
10.	Human Settlements.....	145
10.1	Introduction.....	145
10.2	Drivers	145
10.3	Pressures	146
10.4	State	147
10.5	Impacts	154
10.6	Responses.....	156
10.7	References.....	157
11.	Waste.....	160
11.1	Introduction.....	160
11.2	Drivers	162
11.3	Pressures	163
11.4	State	163
11.5	Impacts	169
11.6	Responses.....	170
11.7	Conclusion and Recommendations.....	173
11.8	References.....	174
12.	Energy.....	177
12.1	Introduction.....	177
12.2	Drivers	177
12.3	Pressures	179
12.4	State	181
12.5	Impacts	187
12.6	Responses.....	189
12.7	Conclusion and Recommendations.....	191
12.8	References.....	192
13.	Governance	196
13.1	Introduction.....	196
13.2	Drivers	197
13.3	Pressures	197
13.4	State	198
13.5	Impacts	206

13.6	Responses.....	207
13.7	Conclusion and Recommendations.....	209
13.8	References.....	210
14.	Conclusion.....	211
14.1	Key Challenges.....	211
14.2	Scenarios.....	212
15.	Recommendations.....	217
15.1	Recommendations for Issues Identified.....	217

LIST OF TABLES

Table 1:	Overview of themes for KZN SoER 2004 and EOR 2017.....	5
Table 2:	Themes, issues and indicators for KZN EOR 2017.....	6
Table 3:	Indicators to measure the change in climate in KwaZulu-Natal Province.....	20
Table 4:	Legislative framework related to climate change in South Africa and KZN.....	21
Table 5:	Trends of indicators for KwaZulu-Natal (with red being negative and green positive).....	35
Table 6:	Legislative framework related to air quality in South Africa and KZN.....	39
Table 7:	Indicators to measure air quality in KwaZulu-Natal Province.....	39
Table 8:	Transport sector emissions (in tpa) for eThekweni, Ugu and King Cetshwayo municipalities.....	40
Table 9:	Emission estimates (in tpa) for industry and commerce.....	41
Table 10:	Emission estimates for biomass burning (in tpa).....	41
Table 11:	Sugarcane burning emission estimate (in tpa).....	41
Table 12:	Residential fuel burning emission estimates (in tpa).....	41
Table 13:	Impacts of poor air quality on human health.....	46
Table 14:	Ambient air quality standards for some pollutants.....	47
Table 15:	AQMP development status.....	48
Table 16:	Government-owned monitoring stations.....	49
Table 17:	Licensing progress by municipalities in 2014.....	50
Table 18:	Legislative framework for ecosystem health in South Africa and KZN.....	55
Table 19:	Indicators used in the assessment of the biodiversity in KwaZulu-Natal.....	56
Table 20:	Critical biodiversity areas in KwaZulu-Natal.....	59
Table 21:	The area of KwaZulu-Natal within the formal protected area system.....	60
Table 22:	Threat status of vegetation types between 1994 and 2017.....	62
Table 23:	Threatened ecosystems in KwaZulu-Natal.....	63
Table 24:	The number of threatened and extinct species in KwaZulu-Natal.....	64
Table 25:	Summary of biodiversity trends.....	69
Table 26:	Legislative framework related to land modification.....	74
Table 27:	Indicators used in the assessment of land modification in KZN.....	75
Table 28:	Land cover in KwaZulu-Natal.....	76
Table 29:	Summary of land-transformation trends.....	86
Table 30:	Legislation related to freshwater resources.....	90
Table 31:	Indicators used in the assessment of the freshwater resources in KZN.....	90
Table 32:	Water quality of dams and abstractions.....	97
Table 33:	KZN’s Strategic Water Source Areas.....	103

Table 34: Trends of indicators for KwaZulu-Natal.....	104
Table 35: Indicators used in the assessment of the marine and coastal resources in KZN	109
Table 36: Legislation governing protection of the coastal zone in South Africa.....	111
Table 37: Top five shore-based linefish catches (in %) between 1984-2004 and 2009/10	116
Table 38: Top five boat-based linefish catches (in %) in 1984–2004 and 2009/10.....	116
Table 39: Marine Protected Areas (MPAs) of KwaZulu-Natal	119
Table 40: Estuaries that are protected as identified by the National Biodiversity Assessment	119
Table 41: Annual coastal clean-up statistics for KZN	121
Table 42: Trends of indicators for KwaZulu-Natal.....	124
Table 43: Indicators used in the assessment of the economy in KwaZulu-Natal.....	130
Table 44: Summary of core indicator impacts and trends in KZN (with red negative and green positive).....	138
Table 45: Indicators used in the assessment of human settlements in KwaZulu-Natal	145
Table 46: Number and growth of population and households in KZN (2015)	148
Table 47: Household services	148
Table 48: Crime statistics for KZN	153
Table 49: Summary of core indicator impacts and trends in KZN.....	154
Table 50: Waste-related legislation in effect since 2004	160
Table 51: Indicators used in the assessment of the waste management in KwaZulu-Natal	161
Table 52: Summary of negative environmental impact of poor waste management	169
Table 53: Summary of waste management trends within KZN Province.....	173
Table 54: Indicators used in the assessment of the energy in KwaZulu-Natal	177
Table 55: KwaZulu-Natal’s spatial challenges for adequate energy provision.....	179
Table 56: Summary of private sector energy projects in the Province for 2015	183
Table 57: Energy outlook for KZN Province.....	191
Table 58: Legislative framework related to biodiversity and ecosystem health	196
Table 59: Indicators used in the assessment of environmental governance in KwaZulu-Natal	197
Table 60: Protected areas being established on land administered by traditional authorities.....	203
Table 61: Protected areas being established on land restitution sites	204
Table 62: Summary of governance trends	209
Table 63: Outline of scenarios without (scenario 1) and with (scenario 2) interventions.....	213
Table 64: Recommended actions in terms of priority, indicator and responsible party	218

LIST OF FIGURES

Figure 1: The DPSIR Framework used in the KZN EOR 2017 (Burkhard & Muller, 2008).....	4
Figure 2: Overview of the municipal seats (cities/towns) of the 11 district municipalities in KZN	15
Figure 3: Tugela Falls located in the Drakensberg Mountains	16
Figure 4: Predicted average mean annual temperature across South Africa	24
Figure 5: Average annual rainfall of South Africa, including KwaZulu-Natal	25
Figure 6: Contribution to emission from industries in eThekweni Municipality in 2012.....	26
Figure 7: Expected reduction in revenue in the agricultural sector as a result of climate change.....	30
Figure 8: Vulnerability to climate change per municipality	31
Figure 9: PM ₁₀ concentration trend for eThekweni Municipality	43
Figure 10: PM ₁₀ concentration trend for Richards Bay	43
Figure 11: PM ₁₀ concentration trend for other areas in KZN –red arrow is current standard.....	43

Figure 12: SO₂ concentration trend for eThekweni – the red arrow shows current standard 44

Figure 13: SO₂ concentration trend for Richards Bay – the red arrow shows current standard 44

Figure 14: SO₂ concentration trend for other areas in KZN – the red arrow shows current standard . 45

Figure 15: NO₂ concentrations for eThekweni Municipality – the red line shows current standard 46

Figure 16: Status of AQMP development..... 48

Figure 17: Government-owned station locations 50

Figure 18: The Maputaland-Pondoland-Albany Hotspot 55

Figure 19: KZN Systematic Biodiversity Plan 59

Figure 20: Protected areas in KwaZulu-Natal..... 60

Figure 21: Proportion of natural habitat remaining in KZN and associated ecological thresholds 61

Figure 22: Threat status of vegetation types in KwaZulu-Natal 62

Figure 23: Total rhino poaching mortalities in KZN between 1 January 1990 and 5 March 2017 64

Figure 24: The extent of natural land cover in KZN..... 77

Figure 25: The extent of mapped degradation and visible erosion in KZN 78

Figure 26: The extent of plantation forestry in KZN..... 79

Figure 27: The extent of cultivated land in KZN 81

Figure 28: The extent of urban and industrial development in KZN 82

Figure 29: The extent of mining development in KZN 83

Figure 30: Increasing demographics in KwaZulu-Natal 91

Figure 31: Short-term (c and d) surface water storage for Pongola CMA and South Africa 94

Figure 32: Access to piped water from 1996 to 2016 95

Figure 33: KZN Blue Drop status (%) 96

Figure 34: KZN Green Drop status..... 96

Figure 35: WWF-Mondi Wetlands Programme initiatives 99

Figure 36: South Africa’s Strategic Water Source Areas 103

Figure 37: Loggerhead and leatherback turtle nesting of the Maputaland coast (1965-2010)..... 113

Figure 38: Population growth of KZN compared to Gauteng Province..... 132

Figure 39: GVA and employment growth, KZN 133

Figure 40: Sector contribution to GVA and employment in KZN 134

Figure 41: Catalytic projects KZN 135

Figure 42: Percentage of total KZN employment in manufacturing compared to GVA contribution. 136

Figure 43: KZN Spatial Development Framework 147

Figure 44: Households according to geography in KZN..... 150

Figure 45: Modes of transport used to get to work and usually used by households..... 151

Figure 46: Number of households in KZN according to annual income brackets 152

Figure 47: Social grant recipients in 2014 153

Figure 48: KZN comparison of total waste generated versus population growth 162

Figure 49: KZN annual waste generation in tonnes per annum..... 164

Figure 50: Total waste vs waste disposed vs waste recovered/recycled (2004-2016) 165

Figure 51: Trends in KZN household refuse removal methods 166

Figure 52: Amount and types of waste disposed to licensed landfill..... 167

Figure 53: Proportion of waste disposed of, recovered and recycled between 2004 and 2016 167

Figure 54: Location of some of the general landfills in KZN..... 167

Figure 55: KZN status of district IWMPs..... 168

Figure 56: Energy carriers for the KwaZulu-Natal Province 182

Figure 57: Energy consumption by sector in eThekweni Metro Municipality	184
Figure 58: Percentage of households connected to the mains electricity supply	185
Figure 59: Percentage of households within KZN using fuels for lighting, cooking and heating	186
Figure 60: Liquid fuels sales in KwaZulu-Natal for the period 2005 to 2015	186
Figure 61: Protected areas and a 2 km buffer around them in KwaZulu-Natal	201
Figure 62: Status of management plans for state-protected areas in KwaZulu-Natal	202
Figure 63: Land administered by traditional authorities in KwaZulu-Natal	203
Figure 64: The Upper uThukela Biodiversity Stewardship Site	205
Figure 65: Agro-biodiversity zones with Ulundi Local Municipality	209

LIST OF ABBREVIATIONS AND ACRONYMS

$\mu\text{g}/\text{m}^3$	Micrograms per cubic metre
AC	Alternating Current (referring to an electric charge)
ACEP	African Coelacanth Ecosystem Project
AFOLU	Agriculture, Forestry and Land Use
AMD	Acid Mine Drainage
ASCA	Agulhas System Climate Array
AQMP	Air Quality Management Plan
CARA	Conservation of Agriculture Resources Act
CBD	Convention of Biological Diversity
CBO	Community-Based Organisation
CCA	Community Conservation Area
CDM	Clean Development Mechanism
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CKZNCCC	Central KwaZulu-Natal Climate Change Compact
CMA	Catchment Management Agency
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CPUE	Catch per Unit Effort
DAEA&RD	Department of Agriculture, Environmental Affairs and Rural Development
DAFF	Department of Agriculture, Forestry and Fisheries
DARD	Department of Agriculture and Rural Development
DCCS	Durban Climate Change Strategy
DEA	Department of Environmental Affairs
DEROS	Desired Emission Reduction Outcomes
DoE	Department of Energy
DPSIR	Driver-Pressure-State-Impact-Response
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DUCT	Durban uMngeni Conservation Trust
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation

EbA	Ecosystem-based Adaptation
ECA	Environment Conservation Act
EDTEA	Economic Development, Tourism and Environmental Affairs
EKZNW	Ezemvelo KZN Wildlife
EOR	Environment Outlook Report
EPWP	Expanded Public Works Programme
FSC	Forestry Stewardship Council
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GVA	Gross Value Added
Ha	Hectares
HDI	Human Development Indicator
HSDG	Human Settlements Development Grant
HWMP	Hazardous Waste Management Plan
IBA	Important Bird Area
ICC	International Convention Centre
ICMA	Integrated Coastal Management Act
IDP	Integrated Development Plan
IOC	Intergovernmental Oceanographic Commission
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IREAP	Integrated Renewable Energy Advancement Programme
IWM	Integrated Waste Management
IWMP	Integrated Waste Management Plan
IWRM	Integrated Water Resource Management
KSIA	King Shaka International Airport
KZN	KwaZulu-Natal
m	Metres
MAR	Mean Annual Runoff
MEC	Member of Executive Council
MIG	Municipal Infrastructure Grant

MINSET	Minimum Selection Surface
MPA	Marine Protected Area
NAAQS	National Ambient Air Quality Standards
NAP	National Adaptation Plan
NDP	National Development Plan
NEMA	National Environmental Management Act
NEMAQA	National Environmental Management: Air Quality Act
NEMBA	National Environmental Management: Biodiversity Act
NEMLA	National Environmental Management Laws Amendment (Act)
NEMPAA	National Environmental Management: Protected Areas Act
NEMWA	National Environmental Management: Waste Act
NERSA	National Energy Regulator of South Africa
NGO	Non-Governmental Organisation
NGS	National Groundwater Strategy
NMVOC	Non-Methane Volatile Organic Compound
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen
NRF	National Research Foundation
NRM	Natural Resource Management
NWCS	National Waste Collection Standards
O ₃	Ozone
OECD	Organisation for Economic Co-operation and Development
OCGT	Open Cycle Gas Turbine
ORI	Oceanographic Research Institute
PES	Present Ecological State
PGDS	Provincial Growth and Development Strategy
PV	Photovoltaic
PM	Particulate Matter
PSC	Project Steering Committee
R&D	Research and Development
R&ED	Research and Experimental Development
RBCAA	Richards Bay Clean Air Association
RDP	Reconstruction and Development Programme

RHP	River Health Programme
SAAQIS	South African Air Quality Information System
SAEON	South African Environmental Observation Network
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SARVA	South African Risk and Vulnerability Atlas
SASA	South African Sugar Association
SASRI	South African Sugarcane Research Institute
SAWIC	South African Waste Information Centre
SAWIS	South African Waste Information System
SDF	Spatial Development Framework
SEA	Sustainable Energy Africa
SIP	Strategic Infrastructure Project
SMART	Specific, Measurable, Accurate, Replicable and Time-bound
SMME	Small, Medium and Micro Enterprise
SO ₂	Sulphur Dioxide
SoER	State of Environment Report
SOPA	State of the Province Address
SPLUMA	Spatial Planning and Land Use Management Act
SST	Sea Surface Temperature
SWSA	Strategic Water Source Area
TIPS	Trade and Industrial Policy Strategies
TOC	Total Organic Compounds
TOPS	Threatened or Protected Species
TPA	Tonnes per Annum
TRS	Total Reduced Sulphur
UKZN	University of KwaZulu-Natal
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UMDM	uMgungundlovu District Municipality
uMWP	uMkhomazi Water Project

URTI	Upper Respiratory Tract Infection
VOC	Volatile Organic Compound
WARMS	Water Authorisation and Registration Management System
WHO	World Health Organization
WHS	World Heritage Site
WIOMSA	Western Indian Ocean Marine Science Association
WIS	Waste Information System
WMA	Water Management Area
WSIG	Water Services Infrastructure Grant
WTW	Water Treatment Works
WWF-MWP	World Wildlife Fund – Mondi Wetlands Programme
WWTW	Wastewater Treatment Works

GLOSSARY

Term	Definition
Alien vegetation	Plant and/or animal species that are intentionally or unintentionally introduced in an area where these would not normally occur. Through reproduction, many of these species invade areas beyond those into which they were originally introduced, thereby competing with and often eliminating native species. 'Invasive aliens' are those species that are particularly aggressive in terms of taking the space of indigenous species.
Anthropogenic	Impacts, processes or materials that are derived from human activities.
Atmosphere	The thin layer of gases surrounding the Earth that sustains life and is composed mainly of nitrogen and oxygen, with small amounts of other gases. The two main layers are the troposphere, which is from 0 to 12 km, above the Earth and the stratosphere, from 12 to 50 km above Earth.
Biodiversity hotspot	A region with a high level of endemic species.
Carbon monoxide (CO)	CO is a product of incomplete combustion of fossil fuels. It is predominantly formed in internal combustion engines of motor vehicles, but the combustion of any carbon-based material can release CO. When inhaled, CO enters the blood stream by crossing the alveolar, capillary and placental membranes. This reduces the oxygen-carrying capacity of the blood and reduces the release of oxygen from haemoglobin, which leads to tissue hypoxia.
Carbon dioxide (CO₂)	CO ₂ is a naturally occurring, colourless, odourless, incombustible gas formed during respiration, combustion, decomposition of organic substances and the reaction of acids with carbonates. It is present in the Earth's atmosphere at low concentrations and acts as a greenhouse gas. Anthropogenic sources of CO ₂ emissions include the combustion of fossil fuels and biomass to produce energy, building heating and cooling, transportation, land-use changes including deforestation, the manufacture of cement and other industrial processes.
Catch per unit effort (CPUE)	CPUE is a measure of the amount of fish caught from the population of a species of fish targeted by fishing. It is calculated by dividing the total catch by the amount of effort taken to harvest the catch.
Catchment	The area of land where water from a particular river or stream is collected to the same lowest point.
Cooperative governance	This concept refers to governance in which a number of entities participate to gain a result that they are all interested to achieve. It is referred to under the National Environment Management Act and relates to systems and procedures that include civil society in the decision-making process.
Ecosystem services	The benefits people obtain from an ecosystem, including provisioning, regulating and supporting services. Examples include fresh water, flood regulation and nutrient recycling.
Gross Domestic Product (GDP)	A measure of the overall economic output of a country. It is expressed as the total market value of all goods and services produced within the borders of a country in a year.
Habitat	The area or environment in which an organism or community occurs. It is characterised by physical properties and by other organisms that live there.
Indicator	Statistical or qualitative tool derived from environmental data that measures a property of the environment. Indicators are commonly used in environmental reporting to assist with assessing the extent to which goals and objectives are being achieved.
Landfill	A method of solid waste disposal in which waste is buried under layers of dirt usually in an excavated area that is sealed to prevent the contamination of adjacent land and water resources.

Marine Protected Area (MPA)	MPAs are declared in terms of section 43 of the Marine Living Resources Act. These are areas of the marine environment set aside to protect specific fauna or flora or their habitat. In general, no fishing is allowed in 'no take zones', construction work is prohibited unless necessary, pollution or any form of disturbance is prohibited in as far as it may be possible, and other non-desirable disturbances are allowed only unless under written permission is granted by the Minister of Environment. MPAs are declared in terms of section 43 of the Marine Living Resources Act.
Migration	The movement of people or animals from one geographical area to another.
Non-methane volatile organic compounds (NMVOCs)	Same as Volatile Organic Compound (VOCs) (see below), excluding methane as a greenhouse gas.
Nitrogen dioxide (NO₂)	NO ₂ is formed in combustion processes and other high-temperature operations such as metallurgical furnaces, blast furnaces, plasma furnaces, and kilns, industrial processes involving the generation and/or use of nitric acid, denitrification by anaerobic bacteria in soils and plants, and lightning. In humans, NO ₂ is deposited in the distal lung, where it reacts with the fluids of the respiratory tract to form nitrous and nitric acids. NO ₂ causes decrements in lung function, particularly increased airway resistance. NO ₂ also reacts with water in the atmosphere and can contribute to the formation of acid rain.
Oxides of nitrogen (NO_x)	NO _x is a symbol commonly used to refer to the combination of NO and NO ₂ .
Ozone (O₃)	Near the earth's surface, O ₃ is a secondary pollutant and a major constituent of photochemical smog. The formation of O ₃ is dependent on the availability of NO _x , VOCs and sunlight. O ₃ is a very reactive gas and a strong oxidant, and is associated with a number of health effects. These include respiratory system effects such as coughing, aggravation of asthma and reduced lung function.
Particulate matter (PM)	'Particulate matter' is a broad term used to describe the fine particles found in the atmosphere, including soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. The most distinguishing characteristic of PM is the particle size and the chemical composition.
Particulate matter of aerodynamic diameter less than 10 micron (PM₁₀)	PM ₁₀ is generally emitted from motor vehicles (primarily those using diesel engines), factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes. Coarse particles tend to have relatively short residence times as they settle out rapidly and PM ₁₀ is generally found relatively close to the source except in strong winds.
Particulate matter of aerodynamic diameter less than 2.5 micron (PM_{2.5})	PM _{2.5} particles are often called fine particles and are mostly related to combustion (motor vehicles, smelting, and incinerators). PM _{2.5} may be suspended in the atmosphere for long periods and can be transported over long distances.
Recycling	The process of collecting, sorting, cleaning and reconstituting waste material into usable products.
Renewable energy	Energy that is obtained from natural resources (such as sunlight, wind, water and geothermal heat) that cannot be depleted.
Total reduced sulphur (TRS)	TRS compounds, often associated with rotten egg or cooked cabbage odour, refer to a gaseous mixture of compounds consisting mainly of hydrogen sulphide (H ₂ S), methyl mercaptan (CH ₃ S-H), dimethyl sulphide (CH ₃ -S-CH ₃) and dimethyl disulphide (CH ₃ -S-S-CH ₃). The most commonly reported health concerns related to TRS substances are nausea and headaches.
Sulphur dioxide (SO₂)	Sources of SO ₂ include fossil fuel combustion from industry and power plants, domestic coal or kerosene burning, motor vehicles and smelting of

	<p>mined ore. SO₂ generally penetrates as far as the nose and throat, and can result in exacerbation of asthma and reduced lung function. SO₂ dissolved in precipitation can decrease the pH of rain water, altering any balance within ecosystems, and can be damaging to man-made structures.</p>
<p>Volatile organic compounds (VOCs)</p>	<p>VOC species are part of the broad group of compounds called total organic compounds (TOC). VOC species do not include organic compounds with limited or no photochemical reactivity, and are sometimes called NMVOC. VOCs are a significant contributor to ground-level ozone formation. VOC has two types of sources. The first source type is combustion sources, which include stationary fuel combustion and vehicular traffic. The second is evaporative sources, such as surface coatings and paints, petroleum product storage and distribution (e.g., at refineries, fuel stations), solvents (consumer products, industrial uses), and biomass burning and motor vehicles. VOC emissions contribute to secondary aerosol formation (haze and PM precursor), photochemical smog and ground-level ozone formation. Impacts include the health effects of respiratory problems, nose and throat infections, skin allergies and cancer from compounds such as benzene.</p>
<p>Waste</p>	<p>An item or substance that is discarded, abandoned, rejected or otherwise unwanted.</p>
<p>Waste management</p>	<p>The measures required to prevent or minimise the amount of waste produced and/or disposed of in a responsible manner, in order to reduce the risk posed by waste to human health and the environment.</p>



Photo credit: Samantha de Villiers

1. Introduction

1.1 What is the KwaZulu-Natal Environment Outlook Report?

Globally, there is an increased awareness and recognition of the importance of the environment and how the protection of ecosystems is necessary to secure our future. In 1992, the United Nations Conference on Environment and Development (UNCED) called on national governments to regularly produce 'state of environment' reports (SoERs) to ensure that environmental information and data could be made more widely available to decision-makers and the general public. The National Environmental Management Act (NEMA) (Act No. 107 of 1998) makes the compilation of State of Environment Outlook Reports (SoERs) a mandatory task for national and provincial spheres of government (Department of Environmental Affairs, 2012). As a result, South Africa produced its first National State of the Environment report in 1999. Other SoERs, more recently referred to as 'Environment Outlook Reports' or 'EORs', have also been issued within the last 18 years at various sectoral, regional, provincial and local levels in South Africa. Following the National Environmental Management Laws Amendment (NEMLA) Act (Act No. 25 of 2014), the format, content and procedure of EORs are determined by the Minister of Environment and these EORs should be produced at four-year intervals.¹

The Department of Economic Development, Tourism and Environmental Affairs (EDTEA) is responsible for environmental management in KwaZulu-Natal (KZN) Province. The EDTEA sub-programme of Environmental Planning, Governance and Information Management has the primary responsibility of implementing Chapter 3 of NEMA and its activities, which include the development of the provincial EOR.

According to the draft directive, issued in terms of the National Environmental Management Laws Second Amendment Act (Act No. 30 of 2013), the objectives of the EOR are to:

- i. provide objective, accurate and scientifically credible information about the condition and prospects of the environment;
- ii. increase stakeholder awareness and understanding of the state or condition of the environment, trends, causes and consequences;
- iii. facilitate the measurement of progress toward achieving environmental standards and targets;
- iv. provide early warnings in terms of environmental degradation;
- v. make recommendations and influence the strengthening of environmental policies and programmes, aimed at the remediation of environmental degradation; and
- vi. provide a foundation for improved decision-making at all levels.

The information presented in the EOR is based on peer-reviewed articles and extensive participation by a wide range of stakeholders. The EOR contains information relevant to policy formulation and implementation, and recommends actions that can be taken in the short- and medium term to promote sustainability in the long term. The information is presented in a way that makes it accessible and readable for decision-makers and society at large.

¹ National Environmental Management Laws Amendment Act, Act No. 25 of 2014.

1.2 What is the purpose of the KwaZulu-Natal Environment Outlook Report?

The purpose of the KZN EOR is to take stock of the current state of environment and provide recommendations for responses to improve the state of environment and the lives of people within it. More specifically, the EOR is a tool to:

- i. identify environmental issues and challenges facing the Province;
- ii. describe environmental conditions and trends;
- iii. assess the effectiveness of current programmes, plans and policies;
- iv. set priorities to address key environmental issues;
- v. provide environmental management responses and recommendations; and
- vi. present environmental indicators for monitoring.

The EOR provides a number of examples of interactions between people and the environment and demonstrates how these interactions can be negative or positive. Showing these interactions will enhance people's understanding of the interconnectedness between humans and the environment they depend on. Moreover, the information in the EOR promotes an integrated and long-term perspective and response for the sustainable use of natural resources and the improvement of the quality of life and well-being of the people of KZN into the future.

The 2004 SoER for the KZN Province, published in 2010, forms the baseline for the environmental trends presented in this EOR (where applicable). A set of indicators developed for each theme, and adapted from the 2004 SoER, provides a framework for assessing the effectiveness of existing environmental policies, strategies, plans, programmes, projects and actions. Without the necessary preparedness, the ability of the people and economy of KZN to navigate changes and irregularities within the environment will be compromised.

The EOR guides future planning and informs decision-making by all role players in their quest to ensure sustainable economic development and create a habitable urban and rural environment for the people in KZN. Together with similar provincial initiatives, the KZN EOR will ultimately inform national planning and decision-making processes to work towards a more sustainable future for people living in the Province and South Africa in general.

1.3 How was the KwaZulu-Natal Environment Outlook Report compiled?

The KZN EOR was compiled under the guidance of the Project Steering Committee (PSC) and with the support of the EDTEA, in close cooperation with stakeholders in the Province. As proposed by the DEA, an overarching methodological framework, the Driver-Pressure-State-Impact-Response (DPSIR) Framework, was used to explore the relationships between people and the environment (Figure 1). This format is applied to each chapter in this Report for consistency and integrity in the reporting process.

Through discussions at stakeholder meetings and consultations with people from the industry and academic field, the broad themes of the KZN SoER (2004) were assessed and updated to make them more relevant and representative for the Province as well as to match the reporting structure in the National Environmental Outlook Report. For example, 'Climate Change' needed a chapter on its own as a result of its growing importance. 'Air Quality', previously included in the 'Atmosphere' chapter,

was recommended as a stand-alone chapter due to its impact on the climate and on the health of the people of KZN. The 'Inland Aquatic Environment' chapter was amended to 'Freshwater' to better reflect the subject. 'Energy' was previously incorporated under socio-economic environment, but, considering its impact on the environment, it was dealt with as a stand-alone chapter. Subsequent to these discussions, 11 thematic chapters were agreed upon and are listed in Table 1 below, following the outline for the KZN EOR. Table 1 indicates the themes in the KZN SoER (2004) and the amended themes for the present EOR (2017).

Within each of the thematic chapters, priority environmental issues affecting the Province were identified. The priority issues are those areas of concern that will impact on the environmental sustainability of the Province in the long-term. These may be current issues that are providing management problems at the moment or emerging issues facing the Province. The issues identified in 2004 were assessed and amended according to a general set of criteria, which included:

- i. the level of impact these issues have on the environment;
- ii. the availability of data to monitor the issues; and
- iii. the impact on local people in the Province.

To measure and monitor these key environmental issues, a set of indicators was identified per theme or adapted from existing national and provincial indicators. Where possible, indicators were amended to be more Specific, Measurable, Accurate, Replicable and Time-bound (SMART). These indicators form part of the reporting framework. Using existing indicators developed in 2004 (see Table 2), environmental trends were assessed over a period of more than a decade to align with the data in the KZN SoER of 2004 and to allow for future projections. Although rigorous data are not always available, broad trends can often be detected through qualitative data analysis and extrapolations.

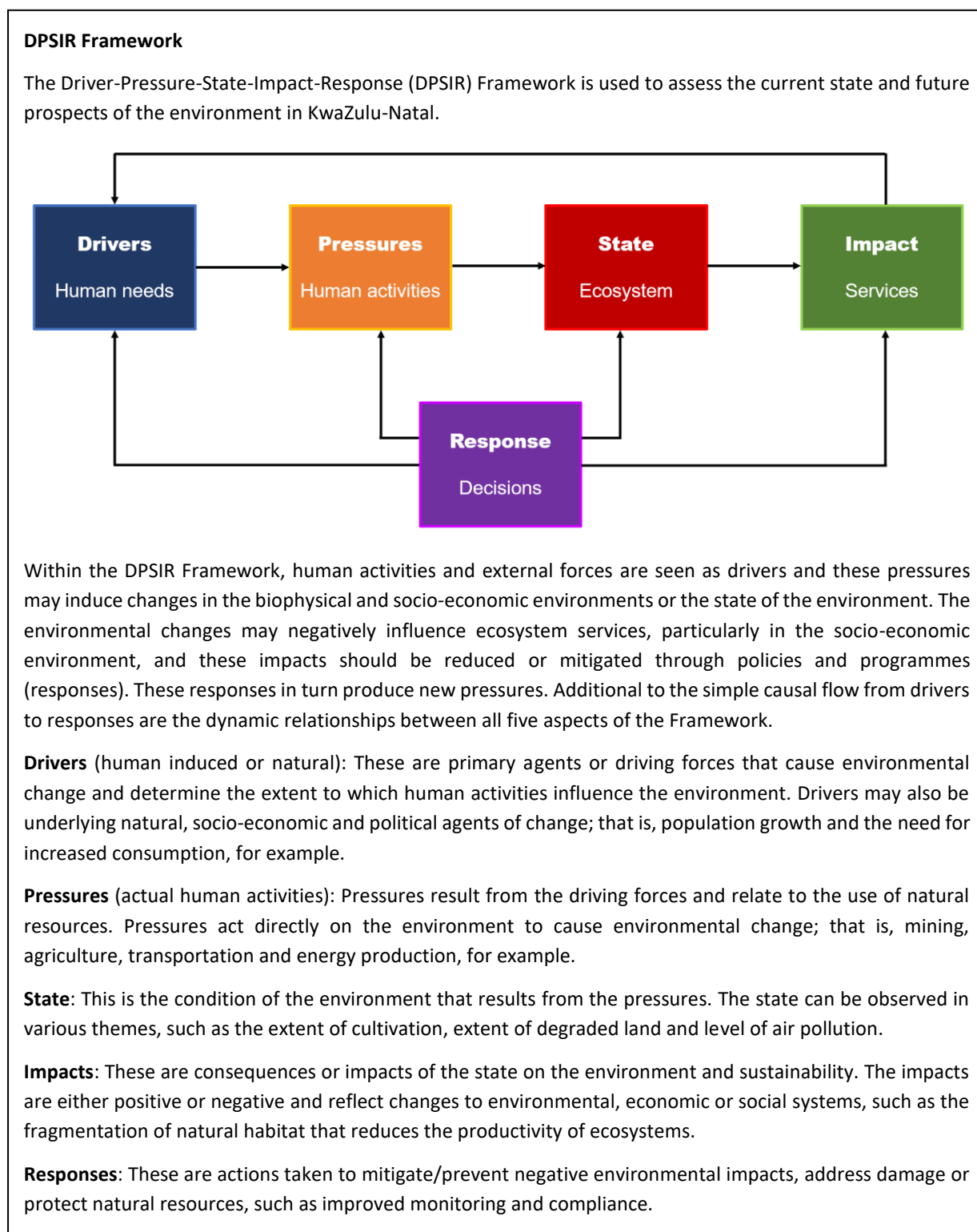


Figure 1: The DPSIR Framework used in the KZN EOR 2017 (Burkhard & Muller, 2008)

Table 1: Overview of themes for KZN SoER 2004 and EOR 2017

KZN SoER (2004)	KZN EOR (2017)
1. Human Settlements	1. Climate Change
2. Land	2. Air Quality Management
3. Biodiversity	3. Biodiversity and Ecosystem Health
4. Inland Surface Water	4. Land Modification
5. Groundwater	5. Freshwater Resources
6. Coastal Waters	6. Marine and Coastal Resources
7. Climate	7. Economics
8. Atmosphere	8. Human Settlements
9. Governing the environment	9. Waste
10. Social vulnerability and the environment	10. Energy
	11. Governance

Specialists provided relevant input into the Report, which was subsequently reviewed by experts and relevant government officials in their respective fields as the EOR developed. Components of the Report and drafts were discussed at stakeholder meetings in working groups to provide input. Additionally, an advert was published in two newspapers² inviting the broader public to attend the stakeholder workshop held in August 2017. Through these meetings, the drivers of environmental trends, specific environmental pressures or human activities, ecosystem state, impacts of the pressures on the state and responses to these were discussed and adjusted as new information became available to include in or remove from the Report. Finally, the whole Report was reviewed internally by the Project Management Team and externally by an independent reviewer.

² These newspapers were the Sunday Tribune and Ilanga Newspaper.

Table 2: Themes, issues and indicators for KZN EOR 2017

Issue (s)	Indicator (s)	Comments
Climate Change		
Limited integration of climate change into sectoral departments and strategies of the Ingonyama Trust	<ul style="list-style-type: none"> ○ The number of sectoral plans that have incorporated climate change. ○ The number of plans from traditional authorities that have incorporated climate change 	Eight sectors prioritised: Water, Agriculture, Human Settlements, Biodiversity, Disaster Management, Human Health, Transport Infrastructure and Climate Change
Increased climate variability	<ul style="list-style-type: none"> ○ Precipitation (in mm). ○ Temperature (degrees Celsius). ○ Sea level rise (mm/year). 	<p>Amount of rainfall measured at different stations across KZN Province.</p> <p>Average minimum and maximum land and sea surface temperatures measured across KZN Province.</p> <p>Rate of sea-level rise.</p>
Environmental degradation	<ul style="list-style-type: none"> ○ The cost of damage (in million Rand) and loss of lives caused by extreme weather events. 	Extreme weather events, including drought, flood and fire.
Greenhouse gas (GHG) emissions	<ul style="list-style-type: none"> ○ Levels of GHG emission (particularly atmospheric carbon dioxide (CO₂)). 	Quantification of GHG emissions from sources located within the provincial boundaries.
Limited awareness of adaptation to climate change	<ul style="list-style-type: none"> ○ Proportion of farmers using climate-smart agriculture and ecosystem-based adaptation. 	This indicator relates to effectiveness of awareness raising and capacity building of local communities for adapting to the effects of climate change.
Air Quality and Atmosphere		
Limited Air Quality Management Plan (AQMP) development and implementation	<ul style="list-style-type: none"> ○ Ambient particulate matter (PM₁₀) concentrations. 	Ambient PM ₁₀ measurements from monitoring data.
Burning of sugarcane and domestic wood fuel		
Limited ambient air quality monitoring		
PM₁₀ from all sources³	<ul style="list-style-type: none"> ○ Ambient sulphur dioxide (SO₂) concentrations. 	Ambient SO ₂ measurements from monitoring data.
Emissions from transport	<ul style="list-style-type: none"> ○ Ambient nitrogen dioxide (NO₂) concentrations. 	Ambient NO ₂ measurements from monitoring data.
Biodiversity and Ecosystem Health		
Habitat loss and degradation	<ul style="list-style-type: none"> ○ Extent of protected areas (ha). ○ Extent of natural areas remaining (ha). ○ Vegetation types, threat and protection status of vegetation types. ○ Habitat fragmentation (% of remaining habitat). 	Protected areas are areas formally protected through declaration in terms of legislation and that fall under the definition of a protected area as described in terms of section 9 of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003).

³ PM₁₀ includes inhalable particles that are small enough to penetrate the thoracic region of the respiratory system.

KwaZulu-Natal Environment Outlook Report 2017

Issue (s)	Indicator (s)	Comments
Limited biodiversity and conservation planning	<ul style="list-style-type: none"> ○ The number biodiversity/conservation planning maps and plans. 	<p>Systematic conservation (biodiversity) planning is a means of efficiently and effectively identifying the highest priority biodiversity values in a landscape in an effort to inform spatial planning and the design of protected areas.</p> <p>Such plans should be incorporated into the spatial development plans for local and regional areas.</p>
Reduction in key and endangered species	<ul style="list-style-type: none"> ○ Status of terrestrial ecosystems (ha). ○ Status of river/aquatic ecosystems (present ecological state). ○ Status of conserved areas (including Important Bird Areas) (ha). ○ Population trends of selected species. 	
Increase in invasive alien species	<ul style="list-style-type: none"> ○ The extent and types of invasive alien species. ○ Status of areas of high endemism. 	
Land Modification		
Land conversion for development	<ul style="list-style-type: none"> ○ Extent of natural land cover (in ha). ○ Change in land use (in ha). ○ Identification and conservation of geographical hotspots that provide above average ecosystem services. ○ The number of land use plans developed and implemented. 	<p>The implementation of initiatives that focus on the protection of ecological infrastructure.</p>
Limited awareness	<ul style="list-style-type: none"> ○ Budget allocated to environmental awareness programmes at schools and to the general public. 	<p>TV spots and newspaper advertisements promoting the protection of local species. Expand environmental education at schools.</p>
Unsustainable land use practices	<ul style="list-style-type: none"> ○ Extent of degraded land (in ha). ○ Extent of agricultural areas (in ha). ○ Number of initiatives to promote sustainable land use and farming practices. 	
Increase in invasive species	<ul style="list-style-type: none"> ○ The area and types of invasive species eradicated. 	<p>Spatial analysis of afforestation of native species.</p>
Competition for land use	<ul style="list-style-type: none"> ○ Extent of mining (in ha). ○ Extent of urban areas (in ha). 	

Issue (s)	Indicator (s)	Comments
Freshwater Resources		
Declined availability of water resources	<ul style="list-style-type: none"> ○ Water use (in m³) per sector. ○ Water use (in m³) per capita. ○ Comparison of historical/natural versus current river flows. ○ Amount of rainfall (in mm). ○ Number of desalination plants. 	
Declined water quality	<ul style="list-style-type: none"> ○ Measurement of water quality against standards (in mg/l). ○ Number of pollution disaster events. ○ Change in biological indicators for water quality. 	Research has shown that the number of wastewater treatment works (WWTWs) is not sufficient for the increases in service areas. Furthermore, many WWTWs are underperforming, if performing at all.
Declined (loss) of natural habitats/ecosystems	<ul style="list-style-type: none"> ○ Area of riverine vegetation. ○ Percentage of vegetation in important water catchment areas. 	
Increased land degradation/soil erosion	<ul style="list-style-type: none"> ○ Level of soil erosion caused by floods. ○ Siltation in dams affecting water availability and quality. 	
Increased trophic status of dams	<ul style="list-style-type: none"> ○ Measurement of water quality against standard (in mg/l). 	
Marine and Coastal Resources		
Change in state of marine and coastal resources	<ul style="list-style-type: none"> ○ Number of birds at selected estuaries in KZN. ○ Abundance of key focal species (in catch per unit effort or CPUE). ○ Abundance of threatened species and habitats (in CPUE). 	
Reduced ecological functioning	<ul style="list-style-type: none"> ○ Estuarine health (Present Ecological State or PES). ○ Coral bleaching ('bleaching response' index combines the frequency of bleaching with severity). 	
Reduced sustainability of coastal resources	<ul style="list-style-type: none"> ○ State of important linefish (in CPUE). ○ State of crustaceans targeted by trawlers (in CPUE). ○ Subsistence harvesting of mussels (in CPUE). ○ Sand mining (in ha). 	

KwaZulu-Natal Environment Outlook Report 2017

Issue (s)	Indicator (s)	Comments
Reduced protection of the coastal environment	<ul style="list-style-type: none"> ○ Number and extent (in km²) of protected areas. ○ Enforcement of and compliance with fisheries regulations (the number of marine and estuarine patrols). 	
Pollution	<ul style="list-style-type: none"> ○ Volume of effluent (in m³) discharged into the marine environment. ○ Condition of invertebrate communities near effluent pipelines (in CPUE). ○ Amount of litter in the coastal zone (the number of items collected). 	
Economics		
Lost revenue opportunities due to environmental degradation	<ul style="list-style-type: none"> ○ Tourism revenue. ○ Sporting event revenue for specific environmental events. 	As an example, the Duzi canoe marathon participation has declined due to poor water quality.
High population growth rate	<ul style="list-style-type: none"> ○ Population growth rate. 	
High unemployment	<ul style="list-style-type: none"> ○ Employment growth and contribution. 	
Growth of unsustainable economic sectors	<ul style="list-style-type: none"> ○ Economic sector growth and contribution to KZN. 	
Sustained low economic growth	<ul style="list-style-type: none"> ○ Economic growth and contribution to KZN. 	
Human Settlements		
Population size growth	<ul style="list-style-type: none"> ○ Population size, growth and density. ○ Extent of urban sprawl. ○ Percentage of municipalities with approved spatial plans. ○ Percentage of traditional authorities with approved spatial plans. 	
Limited access to basic and public services	<ul style="list-style-type: none"> ○ Access to basic household services (water, sanitation, waste removal and electricity). ○ Access to public transport. 	Whether the household is formal, informal, on its own stand etc.
Limited funding for social housing	<ul style="list-style-type: none"> ○ Number, type and density of households and household growth. ○ Housing backlog. ○ 	
Education	<ul style="list-style-type: none"> ○ Human Development Index (education levels, life expectancy and per capita income). ○ Income and income inequality. 	The number of people living below R3 750 per month. The number of people over the age of 20 with matric or higher. The number of reported crimes.

KwaZulu-Natal Environment Outlook Report 2017

Issue (s)	Indicator (s)	Comments
	<ul style="list-style-type: none"> ○ Incidence of crime. ○ Percentage of people with HIV. 	The number of people living with HIV.
Waste		
Limited waste management and services outside the cities	<ul style="list-style-type: none"> ○ Provincial operating revenue for waste management. ○ Provincial customer units (households) receiving a waste-collection service. 	<ul style="list-style-type: none"> ○ Data available on operating revenue for solid waste function by category municipality from 2006 to 2013 (i.e. by metros, Local Municipalities, secondary cities, large towns, small towns, mostly rural, districts) ○ Refuse removal is a local municipality function; however, consolidated provincial information is available along with numbers of those who receive free basic refuse.
Monitoring of received and recycled waste	<ul style="list-style-type: none"> ○ Amount of general waste recycled per annum (tonnes). ○ General and hazardous waste produced per capita per year (tonnes per annum). ○ Number of municipality-driven recycling initiatives (e.g. transfer stations, drop-off zones, 2 bag systems). 	<ul style="list-style-type: none"> ○ Number of waste sites not licensed unknown – only licensed sites known. ○ Should be able to show trend of municipal landfills being licensed. ○ Have amount of general waste disposed and recycled waste in KZN per annum so can show trend. ○ No consolidated data; data sourced from licensed landfill audit data.
Limited development, adoption and implementation of IWMPs	<ul style="list-style-type: none"> ○ Adoption and implementation of IWMPs. 	Provincial IWMP not adopted, hence not implemented. Many old IWMPs on record for municipalities but may not have been adopted or implemented. If not adopted, no budget is allocated to the IWMP.
Waste management disposal sites (hazardous and general)	<ul style="list-style-type: none"> ○ Percentage of increase in licensed waste facilities and landfill sites. ○ Number of licensed hazardous waste disposal sites and facilities. ○ Amount of general and hazardous waste to landfill per annum (tonnes). 	Info available on number of hazardous waste sites and other licensed facilities, amount of hazardous waste produced in the Province per year available (for licensed facilities).
Development encroachment (planned and unplanned) onto landfill sites brings about health and nuisance impacts	<ul style="list-style-type: none"> ○ Percentage of landfill airspace remaining (m³). 	
Energy		
Limited access to energy	<ul style="list-style-type: none"> ○ Electrification levels. 	It gives an overview of access to electricity within the Province.

Issue (s)	Indicator (s)	Comments
	<ul style="list-style-type: none"> ○ Household energy source. 	<p>It provides information on the real sources of energy used by households. Some households rely on other fuels, even when there is electricity available (related to affordability).</p>
Availability of primary energy and energy security	<ul style="list-style-type: none"> ○ Provincial energy balance. ○ Renewable energy generation as percentage of total electricity consumption. ○ Energy per gross domestic product (GDP). 	<p>Although no energy balance has been developed at provincial level, it would be useful for KZN to implement a system for the collection of such information.</p> <p>It gives an indication of the growth in the implementation of renewable energies.</p> <p>It provides an estimate of the energy requirements of the Province.</p>
Energy affordability	<ul style="list-style-type: none"> ○ Household energy source. ○ Portion of household expenditure on energy. 	<p>It provides information about the sources of energy used by households. The choice of energy source is determined by its availability, access and affordability.</p> <p>Although no current information is available to measure this indicator at provincial level, it would be useful for KZN to implement a system for the periodic collection of such information.</p>
Poor maintenance of the existing energy infrastructure	<ul style="list-style-type: none"> ○ Municipal expenditure on infrastructure maintenance. 	<p>This indicator provides information about municipal investments in the delivery infrastructure, and is useful for identifying electricity distribution undertaken by municipalities against Eskom distribution.</p> <p>Although there is no readily available system for the capture of such information, it would be useful for KZN to implement such a process. A potential source could be the municipal expenditure audits.</p>
Limited access to reliable and efficient transport	<ul style="list-style-type: none"> ○ Liquid fuel sales. ○ Mode of transport. 	<p>The efficiency of the transport system would be linked to the fuel consumption.</p> <p>This indicator would provide information about the type of transport used, which ultimately relates to energy efficiency.</p>

Issue (s)	Indicator (s)	Comments
	<ul style="list-style-type: none"> ○ Average travel time, average distance commuted. 	Although Statistics South Africa provides unrefined data at provincial level, it is published almost every five years.
Governance		
Substantial reductions in annual budgets for key government authorities and environmental NGOs	<ul style="list-style-type: none"> ○ Budgetary allocation for environmental management. ○ Ability of environmental NGOs to respond to applications regarding 	
Inadequate cooperative governance has resulted in conflicting priorities within government	<ul style="list-style-type: none"> ○ The number of initiatives undertaken through cooperation of two or more departments. 	
Limited integrated land-use planning between land administered by traditional authorities and municipalities	<ul style="list-style-type: none"> ○ The number of land-use plans developed. ○ The number of cross-referenced government reports with other sectors. 	
Poor strategic planning and limited understanding of ecological and environmental processes within local government	<ul style="list-style-type: none"> ○ The application of environmental programmes by local government. ○ The number of provincial (marine) protected areas with approved management plans. ○ Number of proposed or existing protected areas on land hold by the Ingonyama Trust. 	
Prolonged land claim and land reform processes in KZN create uncertainty around land tenure	<ul style="list-style-type: none"> ○ The number of projects or programmes for developing and implementing appropriate land-use practices in promoting rural development and land reform. 	

1.4 Gaps and Limitations

In compiling the KZN EOR, the following gaps and limitations were identified:

- i. Data were sourced from all available and accessible sources. However, some data were not available because of their confidential nature while other data had not been updated for some time. Furthermore, it has to be accepted that variability in the quality and accuracy of available data exists.
- ii. Taking into account the vast scope of factors that affect the environment, an adequately in-depth investigation of all aspects is ideally needed. However, the limited resources and timescale available to produce the precluded this possibility.
- iii. The information available was not always reliable, consistent or comparable. Discrepancies were found in the statistics and projections provided by Statistics South Africa compared with other sources, including national, provincial and local government departments as well as other external sources. Some issues have not been adequately addressed due to the lack of sufficient data, which must be highlighted for future environment outlook reporting.

Nonetheless, while the above-mentioned constraints may affect minor details in the Report, the conclusions drawn from the major threats to the environment, pressures, environmental trends and the future prospects are clear. The magnitude of trends and the relatively short timescales in which they are manifested point to an indisputable need to respond in a timely manner.

2. KwaZulu-Natal Provincial Profile

2.1 Location

The Province of KwaZulu-Natal (KZN) is situated along the east coast of South Africa along the Indian Ocean and stretches inland to border with three provinces (the Eastern Cape, the Free State and Mpumalanga) and two countries (Lesotho and Swaziland). In the far northeast, KZN borders Maputo Province of Mozambique (see Figure 2).

2.2 Municipal Structure

Within KZN, there are 11 district municipalities (Figure 2). These are shown below, with their municipal seats in brackets:

- i. Amajuba (Newcastle);
- ii. Zululand (Ulundi);
- iii. uMkhanyakude (Mkuze);
- iv. King Cetshwayo, formerly known as uThungulu (Richards Bay);
- v. Umzinyathi (Dundee);
- vi. uThukela (Ladysmith);
- vii. uMgungundlovu (Pietermaritzburg);
- viii. iLembe, formerly known as King Shaka (KwaDukuza, formerly known as Stanger);
- ix. eThekwini (Durban);
- x. Ugu (Port Shepstone); and
- xi. Harry Gwala, formerly known as Sisonke (Ixopo).⁴

The provincial capital is Pietermaritzburg while Durban is the largest city in KZN and the municipal seat for eThekwini Metropolitan Municipality. The eThekwini Metropolitan Municipality is one of the fastest-growing urban areas in the country and ranks third among the most populous urban areas in South Africa at about 3 442 361 people, following the metropolitan municipalities of Johannesburg (4 434 827 people) and Cape Town (3 740 026 people) (StatsSA, 2011).

In 1994, the Ingonyama Trust was established in terms of the KwaZulu Ingonyama Trust Act (Act No. 3KZ of 1994). The Trust holds various pieces of land in KZN that have historically been part of the Zulu Kingdom dating back to various Zulu kings.⁵ The Ingonyama Trust holds 32% of the land in KZN, including the major townships of uMlazi, KwaMashu and Inanda, totalling an area of about 3 million ha and hosting over 4 million people. The Zulu King, currently Goodwill Zwelithini, is the chairman of the Trust.

⁴ South Africa – KwaZulu-Natal Website. Fast Facts about KwaZulu-Natal. Retrieved from: <http://www.zulu.org.za/about/key-facts/welcome>. Accessed on 20 February 2017.

⁵ Ingonyama Trust Board Website. Information retrieved from: <http://www.ingonyamatrust.org.za/>. Accessed on 20 April 2017.

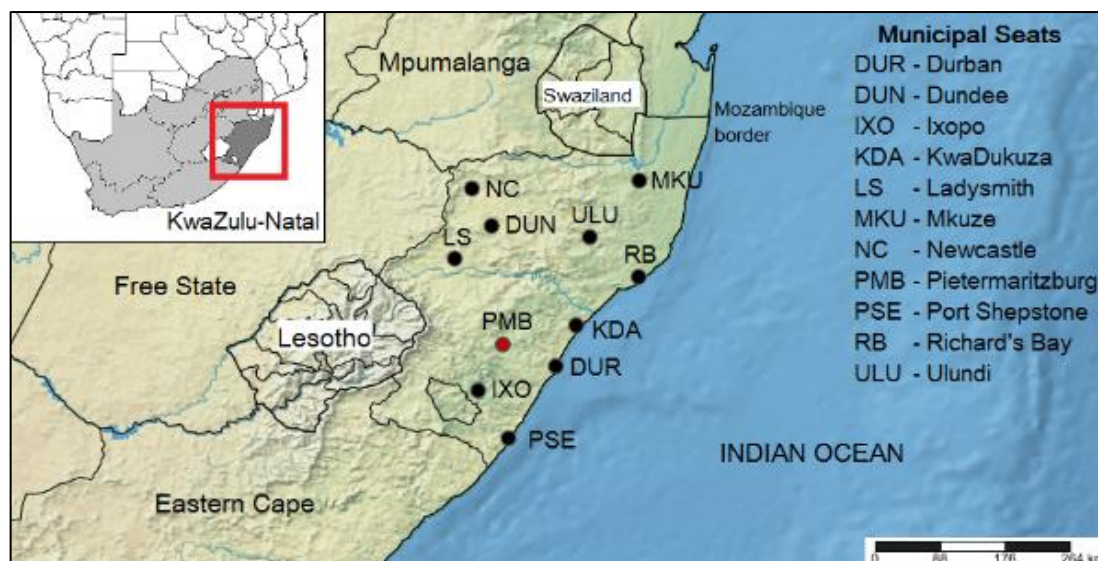


Figure 2: Overview of the municipal seats (cities/towns) of the 11 district municipalities in KZN

2.3 Geography

The total surface area of KZN is 94 361 km² (equal to 7.7% of the national land area), which ranks it the 7th largest province (out of nine provinces) in South Africa, with the Northern Cape as the largest province at 372 889 km². The Province is known as the ‘garden province’ or the ‘banana province’ and has beautiful beaches, mountains and areas of indigenous forests along the coast. KZN is divided into the eight distinct geographical regions of Durban, the South Coast, the North Coast, Pietermaritzburg and the Midlands, the Drakensberg, the Battlefields, Zululand and the Elephant Coast.

The three coastal regions border the Indian Ocean and are characterised by the thin lowland strip of the South Coast, which is dotted with resort towns. The coastal regions stretch towards the Eastern Cape, the North Coast – also known as the Dolphin Coast – which lies between the Umdloti and Tugela Rivers (or ‘Thukela’ as it is spelt in Zulu), and the more remote Elephant Coast with its internationally important wetland parks. Inland, the Drakensberg Mountain Range, which reaches 3 482 m, forms the border with Lesotho, while the Midlands region around Pietermaritzburg comprises hills and grasslands. The Battlefields region in the north is the location of some of the most famous battles in South African history, including Rorke’s Drift, Isandlwana and the Battle of Blood River. Lastly, the Zululand region is at the heart of the historic Zulu Nation, founded by King Shaka, where its vibrant cultural traditions continue to flourish.⁶

The largest river in KZN is the Tugela River, which originates from the Drakensberg Mountains and plunges 948 metres down Tugela Falls (Figure 3). According to new data from 2016, the Tugela Falls are 983 m tall, which puts them amongst the highest waterfalls in the world.⁷ The Tugela River is one of the most important rivers in the country and, along with the Pongola, Mhlatuze, iMfolozi, Mkuze, Thukela, Mvoti, UMngeni, Umkomazi, Umzimkulu and Mtamvuna

⁶ Responsible Travel Website. Retrieved from: <http://www.responsibletravel.com/holidays/kwazulu-natal/travel-guide/kwazulu-natal-history-geography>. Accessed on 18 May 2017.

⁷ Prague Daily Monitor Website. Retrieved from: <http://www.praguemonitor.com/2016/12/13/czech-surveyors-tugela-not-angel-worlds-tallest-waterfall>. Accessed on 20 April 2017.

Rivers, forms part of the Pongola-Mtamvuna Water Management Area (WMA), one of nine WMAs in South Africa.⁸



Figure 3: Tugela Falls located in the Drakensberg Mountains⁹

KZN has a network of 96 protected areas that cover about 8% of KZN, roughly 736 480 ha in extent. The larger protected areas include Hluhluwe-iMfolozi Park, iSimangaliso Wetland Park and the Maloti-Drakensberg Park, of which the latter two are World Heritage Sites (WHSs).

The Maloti-Drakensberg Park Transboundary WHS comprises the uKhahlamba Drakensberg National Park in KZN, South Africa and the Sehlabathebe National Park in Lesotho. The WHS covers an area of 249 313 ha, which makes it the largest protected area complex along the Great Escarpment of southern Africa. The Park is one of only 35 WHSs internationally that have qualified as both a natural and a cultural WHS. More than 250 endemic plant species and their associated fauna can be found in the Park. The Park has also been identified as an Important Bird Area, forming a critical part of the Lesotho Highlands Endemic Bird Area. With its outstanding natural beauty and landscapes, the Maloti-Drakensberg Park Transboundary WHS has the largest and most concentrated series of rock art in Africa south of the Sahara from the San people that lived in the Maloti-Drakensberg Mountains for four millennia.¹⁰

2.4 Climate

KZN Province has a subtropical to temperate climate, with inland temperatures falling steadily with an increase in altitude (KwaZulu-Natal State of Environment Report, 2004). From January to March, Durban has a maximum of about 28 degrees Celsius (°C) and a minimum of 21°C. From June to August, this maximum temperature drops to 23°C, and the minimum to 11°C. Moving inland, Pietermaritzburg has similar summer temperatures, but is much cooler in

⁸ Department of Water and Sanitation. Retrieved from: <https://www.dwa.gov.za/Hydrology/Weekly/wma.aspx>. Accessed on 18 May 2017.

⁹ Image retrieved from: <http://antbear.co.za/wp-content/uploads/2014/02/tugelafalls02-Drakensberg-accommodation-hotel-resort-rooms-guesthouse-lodge.jpg>. Accessed on 20 April 2017.

¹⁰ UNESCO Website. Retrieved from: <http://whc.unesco.org/en/list/985>. Accessed on 18 May 2017.

winter. Similarly, Ladysmith, in the Tugela River Valley, reaches around 30°C in the summer, but in winter temperatures may drop to below freezing point.

Rain is experienced mainly from October to April, with peaks in the summer months from December to February. The major winds that influence the climate in KZN vary according to season. In summer, northerly winds bring regular rain from the moist tropical regions, whilst in spring and early autumn southerly winds from the Arctic bring cold fronts and infrequent rain.¹¹ The inland areas of KZN are generally drier than the coastal areas and can be very cold in winter. The Drakensberg can experience heavy snow in winter, with light snow occasionally being experienced on the highest peaks in summer. The warmest climate and highest humidity are experienced in the Zululand north coast, which supports many sugarcane farms around Pongola.

2.5 The People and Demography

After the end of Apartheid in 1994, the Zulu Bantustan¹² of KwaZulu, which means "Place of the Zulu", and the Natal Province were merged and renamed as KwaZulu-Natal Province. The Province is home to the Zulu monarchy and is the only province in South Africa that has the name of its dominant ethnic group, the Zulu, as part of its name.

Despite KZN's small size in comparison to some other provinces, it has the second-largest population in South Africa with an estimated population of 11.1 million, which represents 20% of the national population (StatsSA, 2016). Approximately 23% (about 4 million) of the estimated population in KZN is between 15-34 years of age (StatsSA, 2016).

According to the 2011 census, the majority of the population is made up of Black Africans (86.8%), followed by Indians (7.4%), Whites (4.2%) and Coloureds (1.4%). The predominantly spoken language in the Province is IsiZulu (77.8%), followed by English (13.2%), IsiXhosa (3.4%) and Afrikaans (1.6%).

2.6 Economy

At a national level, KZN contributed 22% to the manufacturing industry, 25% to the agricultural industry, 19% to the construction industry and 3% to the mining industry. According to the Trade and Industrial Policy Strategies (TIPS) Provincial Review (2016), the KZN population accounted for 20% of the country's population in 2014/15, yet the Province contributed only 16% to South Africa's Gross Domestic Product (GDP). This is a decline from 2013/14, when the provincial economy contributed 25% to South Africa's GDP, with the largest of these sectors being manufacturing at 16%, followed by construction at 4%, agriculture at 3% and mining at 2%. The data indicate that KZN Province plays an important role in South Africa's manufacturing and agricultural industries.

Of the main economy sectors in KZN, construction was the fastest growing from 2011 to 2014 (TIPS Provincial Review, 2016). This as the Province benefited under the National Infrastructure Plan from major rail, road and port projects. In contrast, during the same

¹¹ South Africa – KwaZulu-Natal. Retrieved from: <http://www.zulu.org.za/about/key-facts/welcome>. Accessed on 20 February 2017.

¹² A Bantustan, also known as a Bantu homeland or simply a homeland, was a territory set aside for black inhabitants of South Africa and South West Africa (now Namibia), as part of the policy of the Apartheid Era.

period, manufacturing had a particularly slow growth at just over 1% a year, but still remained the largest sector overall (TIPS Provincial Review, 2016).

KZN has the country's largest port (Port of Durban, also commonly known as Durban Harbour) and the main North-South freight corridor (TIPS Provincial Review, 2016). In Durban, sugar refining is the main industry, while in Newcastle, rubber and chrome chemicals are produced as its main industrial products. Other industries (located mainly in and around Durban) include textile, clothing, fertiliser, paper (including paperboard and tissue), vehicle assembly and food-processing plants, tanneries, oil refineries and coal mining.

2.7 References (Chapters 1 and 2)

Burkhard, B. & Müller, F. 2008. Drivers-Pressure-State-Impact-Response. *Encyclopedia of Ecology*. 967-970. 10.10

Department of Environmental Affairs. 2012. 2nd South Africa Environment Outlook. A report on the state of the environment. Executive Summary. Department of Environmental Affairs, Pretoria. 60 pp.

KwaZulu Natal Province. 2004. State of Environment Report (SoER). Durban, South Africa.

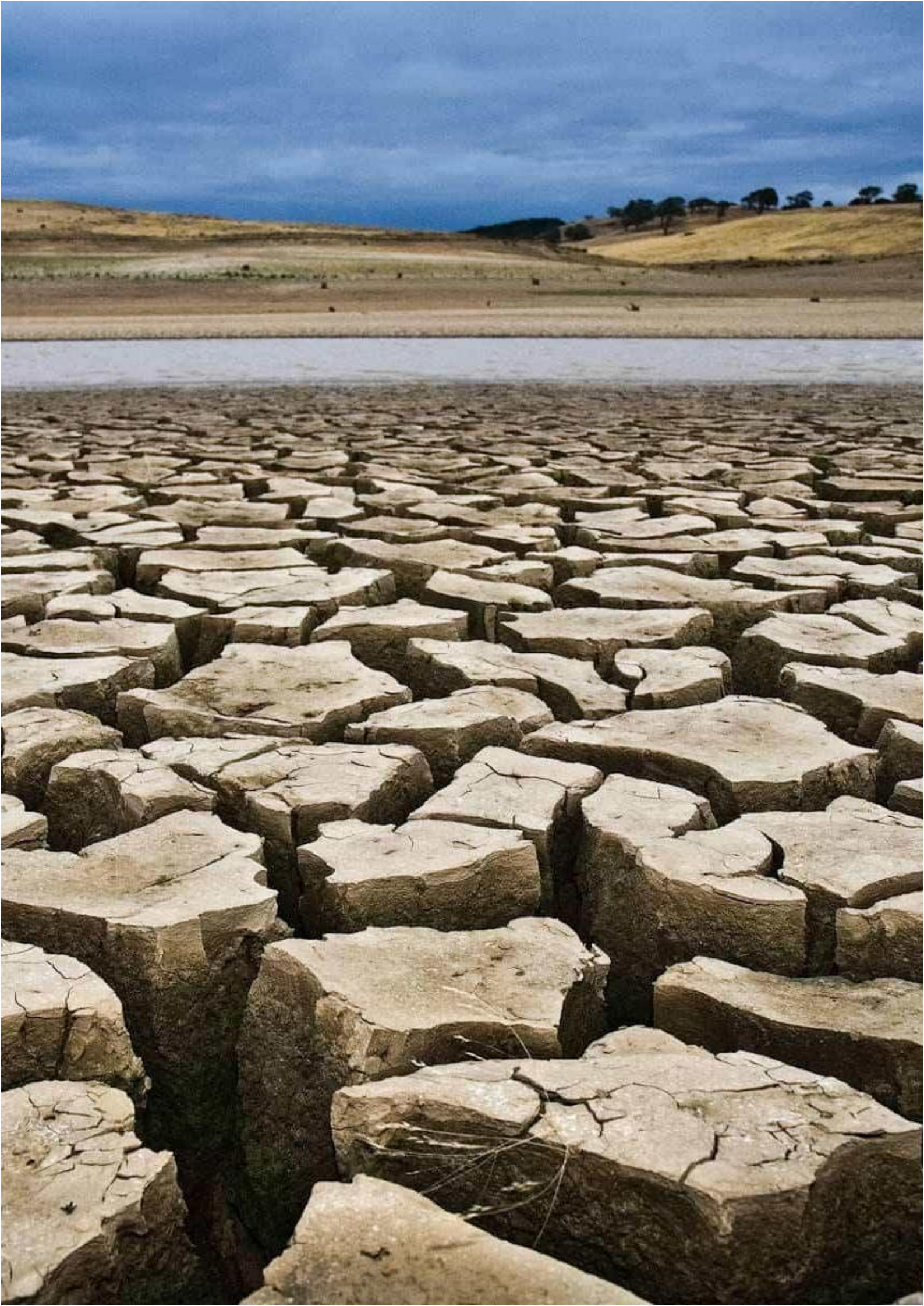
Statistics South Africa. 2016. Community Survey Results: Provinces at a glance. Retrieved from: <http://cs2016.statssa.gov.za/wp-content/uploads/2016/06/CS-2016-Provinces-at-a-glance.pdf>

Statistics South Africa. 2014. Census 2011. Provincial profile: KwaZulu-Natal

TIPS Provincial Review. 2016. The Real Economy Bulletin: Trends, developments and data. Retrieved from:

https://www.tips.org.za/images/The_REB_Provincial_Review_2016_KwaZulu-Natal.pdf.

Accessed on 20 February 2017.



3. Climate Change

3.1 Introduction

Climate change is a natural phenomenon and part of a cycle where the earth goes through warm and cold periods. Under normal circumstances, the planet's natural systems are resilient enough to adapt to these changes in temperature and rainfall, providing these changes take place over centuries. In the last five decades, however, changes in climate have accelerated and the natural cycle has been altered, with an increase in extreme peaks. This accelerated change in climate shows a strong correlation with anthropogenic activities, including *inter alia* Greenhouse gas (GHG) emissions, deforestation and unsustainable land use. Fast alterations to the natural cycle mean that the planet's natural systems are less resilient to adapt timeously to changes in climate. Consequently, the effects of human-induced climate change are increasingly noticeable and include higher land and sea surface temperatures, rising sea levels, extreme events and erratic rainfall. The effects of climate change are cross-cutting and experienced across the planet, with many interlinked effects that we are only beginning to understand.

Africa is one of the most vulnerable continents to climate change, because of multiple stresses (such as water and fertile land) and limited adaptive capacity of its people to climate change. Limited infrastructure and financial support, as well as non-diverse livelihoods within communities, lowers the adaptive capacity. Climate models predict that during the 21st century temperatures in Africa will rise faster than the global average (James, Washington and Powell, 2014). Over the last 50 years, maximum and minimum temperatures have increased across South Africa by more than 1.5 times those of the observed global averages. In addition, rainfall has shown high inter-annual variability. Despite KZN being located along the coast and currently receiving the most rainfall in the country, the Province is particularly vulnerable to climate change along the coast, where erosion is taking place as a result of sea-level rise and an increase in frequency and intensity of heavy storms.¹³ The main climate-related concerns in KZN are floods, rainfall variability, increased temperatures and sea-level rise. To measure the effects of climate change in the Province, several indicators have been developed (Table 3) that are linked to achieving Sustainable Development Goal 13 to take action against the impacts of climate change.¹⁴

Table 3: Indicators to measure the change in climate in KwaZulu-Natal Province

Indicators	Description and comments
Number of sectoral and Traditional Authority plans that have incorporated climate change¹⁵	
Precipitation (in mm)	Amount of rainfall measured at different stations across KZN.

¹³ Derived from the speech by MEC Mrs Lydia Johnson at the Pre-COP17 Summit on 26 September 2011 at the ICC in Durban.

¹⁴ <https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf>. Accessed on 7 April 2017.

¹⁵ Eight sectors are prioritised: Water, Agriculture, Human Settlements, Biodiversity, Disaster Management, Human Health, Transport infrastructure and Climate Change.

Indicators	Description and comments
Temperature (degrees Celsius)	Average minimum and maximum land and sea surface temperatures measured across KZN Province.
Sea-level rise (mm/year)	Rate of sea-level rise.
Cost of damage (in million Rand) and loss of lives caused by extreme weather events	Extreme weather events, including drought, flood and fire.
Levels of GHG emission (particularly atmospheric carbon dioxide (CO ₂))	Quantification of GHG emissions from sources located within the provincial boundaries.
Proportion of farmers using climate-smart agriculture and ecosystem-based adaptation	This indicator relates to the effectiveness of awareness raising and capacity building of local communities for adapting to the effects of climate change.

The last KZN State of Environment Report (SoER) of 2004 adopted a general approach to climate change in KZN Province, with a particular focus on the contribution of GHG emissions to climate change and the ozone layer depletion. The 2004 SoER cited figures from the Intergovernmental Panel on Climate Change (IPCC) of 2001, which indicated that temperatures across South Africa had increased by 1°C in the last 100 years. By 2050, sea levels were expected to rise by 50 cm, with a sudden rise of 5 m also being possible. For the same period, precipitation levels were expected to increase, with summer rains starting earlier and lasting longer. Additionally, an increase in frequency of extreme weather events was anticipated. As a response to climate change, the report recommended that: i) capacity building of staff for monitoring and policing of GHG emissions take place; ii) more funds be allocated to addressing climate change issues in the Province; and iii) indicators for measuring the impact of climate change be developed at provincial level and the management of climate change initiatives carried out at national level.

In recent years, climate change has been given much more attention and, since 2004, KZN has made a considerable effort to develop strategies, plans and policies as well as initiatives to adapt to and mitigate the effects of climate change (Table 4). Since the 2004 SoER, more research has been conducted and as a result more data on specific impacts of climate change for KZN are available. This EOR will therefore include climate change trends, impacts and responses since 2004.

Table 4: Legislative framework related to climate change in South Africa and KZN

Year	Legislative Framework	Type
2011	The National Climate Change Response White Paper	Policy
2004, 2011 and 2017	First, Second and Third National Communications	Regulation
2015	South Africa's intended nationally determined contribution (INDC)	Regulation
1998	National Environmental Management Act (NEMA) Act 107	Act
2016	Draft National Adaptation Strategy	Regulation
2015	Draft Carbon Tax Bill	Policy
2013	Carbon Tax Policy Paper	Policy
2014	KZN Climate Change Strategy and Action Plan	Regulation

Year	Legislative Framework	Type
2012	Climate Change Response Toolkit	Regulation

3.2 Drivers

3.2.1 Fossil fuel-based economy

Producing goods requires the use of natural resources, often oil and minerals. Fossil fuel-based industries with their emissions of GHGs are contributing to the effects of climate change. In 2013, 72% of South Africa's total primary energy consumption came from coal, followed by oil (22%), natural gas (3%), nuclear (3%), and renewables (less than 1%, primarily from hydropower), according to the British Petroleum Statistical Review of World Energy (2014). South Africa's dependence on coal has led the country to become the leading CO₂ emitter in Africa (accounting for 40% of emissions in Africa) and the 13th largest emitter in the world in 2012, according to United States Energy Information Administration (EIA) estimates.¹⁶

KZN depends heavily on coal-based energy generation but does not produce its own electricity.¹⁷ The industries using coal for energy are therefore drivers of climate change and contribute to air pollution. Coal deposits are the main mineral and/or mining commodities in KZN and are predominantly located in the north-western part of the Province. In addition, mineral extraction from dunes along the northern coast impacts on the quality of the environment and competes with conservation, tourism and other development options. More information on this is provided in the Energy chapter, Section 12.1.3.

3.2.2 Population growth

The increasing production and consumption of goods are a direct result not only of increased global wealth but also of population growth. From 2001 to 2016, the population in KZN grew from 9.5 million to 10.8 million (StatsSA, 2016). The energy required to produce the increased number of goods required to meet population demands contributes to the emission of GHGs.

3.3 Pressures

Increased human consumption of goods and food to feed the growing population puts increased pressure on the natural environment. The main pressures for KZN are described below.

3.3.1 Land modification

Native forests, grasslands and savanna play an important role in the sequestration of carbon. As a result of population growth and changes in land use in KZN, these areas are being modified, primarily for housing, development and agriculture. Additionally, KZN experiences an increased loss of natural habitat to plantation forestry and arable agriculture. Increases in

¹⁶ https://www.eia.gov/beta/international/analysis_includes/countries_long/South_Africa/south_africa.pdf
Accessed on 23 March 2017.

¹⁷ Provincial Planning Commission, Province of KwaZulu-Natal. 2011. Kwazulu-Natal Situational Overview: Kwazulu-Natal Provincial Growth and Development Strategy (PGDS).

potato, maize, soya and other forms of crop production, as well as the development of planted pastures for the dairy industry, have meant a considerable loss of natural grasslands and a concomitant loss of soil carbon.¹⁸ The loss and degradation of these grasslands consequently lead to an increase in CO₂ levels.¹⁹ However, research has shown that responsible sustainable livestock agriculture can maintain soil carbon levels in natural grasslands.

3.3.2 Greenhouse gas emissions

One of the main pressures for climate change, and the increase in temperature in particular, is the so-called greenhouse gases (GHGs), as these trap heat in the atmosphere. The main gases that contribute to global warming are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Refrigerant gases such as chlorofluorocarbons (CFCs), sulphur hexafluoride (SF₆), nitrogen trifluoride (NF₃) and hydrofluorocarbons (HFCs) are also important GHGs. These gases are currently being phased-out in an attempt by the government to reduce GHG emissions (NEMAQA, 8 May 2014).

The increase in emissions of these GHGs is driven mainly by increased consumption patterns and consequent changes in land use. The 2006 IPCC Guidelines identify the main sectors responsible for GHG emissions generally, which include Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Land Use (AFOLU); and Waste. Additionally, the continued increase in coal and wood fuel for energy use also contributes considerably to the CO₂ levels in KZN. The Province is, however, expected to quantify the levels of emissions generated as a result of different activities within its boundaries from the four sectors as prescribed by the IPCC. Once the baseline has been established, the Province can set itself long-term reduction goals in line with the country's targets committed to at the United Nations Framework Convention on Climate Change (UNFCCC). The effects of GHG emissions are not localised, but global, which consequently makes it more difficult for KZN Province to directly influence the contribution and impact of such emissions.

3.3.3 Increased consumption patterns

Related to the increased demand for food as a result of population growth is the associated demand for meat, particularly red meat. To meet the demand for red meat, more space is required for grazing livestock. The intensification of livestock production puts pressure on existing grassland as overgrazing and poor livestock management practices can lead to degradation of grasslands, which can lead to losses of soil carbon. Moreover, methane gas (CH₄) is a GHG that emanates from livestock and is 23 times more potent than CO₂.²⁰ The increased demand for red meat therefore increases the pressure on the effects of climate change.

¹⁸ Over 60% of the national terrestrial carbon stock is located in grassland and savanna ecosystems (South African Carbon Sink assessment, 2014).

¹⁹ Department of Agriculture, Forestry and Fisheries. 2015. State of the Forests Report 2010-2012.

²⁰ Retrieved from: <http://timeforchange.org/are-cows-cause-of-global-warming-meat-methane-CO2>. Accessed on 21 April 2017.

3.4 State

Climate change is becoming increasingly apparent in KZN. The effects of climate change are evident in the long-term changes in weather patterns, such as rainfall and temperature. Below follows an overview of the state of climate change in the Province.

3.4.1 Temperature

3.4.1.1 Land surface

Over the 1931 to 2015 period, KZN experienced considerable warming. Coastal weather stations have reported temperature increases of more than 2°C per century, which is more than double the global rate of temperature increase (EDTEA, 2017).

For the near term (2016–2035), all climate models predict a warming of 0.5°C to 1.0°C, with the coastal areas being closer to 0.5°C. For the long term (2080–2100), predicted temperature increases range from 2°C to 5°C, depending on emission scenarios (Figure 4). This will consequently result in an increase of heat waves and very hot days. For example, days such as on 25 December 2014 in Mandini and Richards Bay, where temperatures were 43.7°C and 42.6°C respectively, will become more frequent.²¹ Such heat waves and high temperatures will most likely have severe impacts on agriculture, water security, biodiversity and human health.

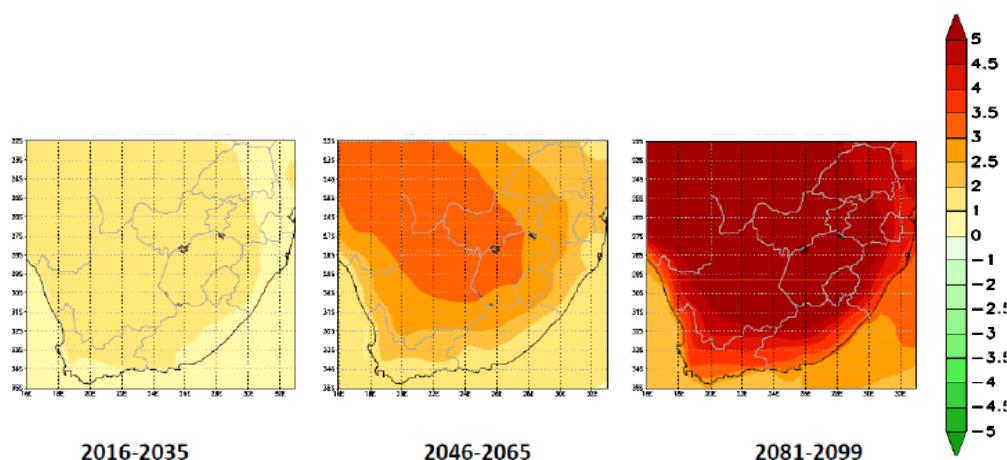


Figure 4: Predicted average mean annual temperature across South Africa

Source: DEA (2016)

3.4.1.2 Sea surface

Between 1985 and 2007, the Agulhas Current system, which runs along the KZN coast, warmed significantly by +1.5°C. In Durban, current sea-level rise has been 2.7 mm/year over the past 33 years (Mather, Garland and Stretch, 2009). This is in line with the global sea-level rise of about 3.3 mm/year, or 33 cm per century (EDTEA, 2017).

²¹ Retrieved from: <http://www.iol.co.za/dailynews/news/high-temperatures-recorded-in-kzn-1799560>. Accessed on 6 April 2017.

3.4.2 Rainfall

Over the period 1960–2015, a significant increase in annual rainfall was seen in the south of KZN and a decrease in the north of the Province. Figure 5 shows the current average annual rainfall of South Africa. KZN receives on average the most rainfall compared to other provinces in the country, at between 800 and 1000 mm per year, with the coastal areas exceeding 1000 mm per year. Rainfall is more difficult to project than temperature as more factors affect the occurrence of rainfall at a certain location. Therefore, these projections are less accurate at local or even regional level.

In the short term (2016–2035), models show insignificant changes in rainfall. Towards the mid-term (2046–2065), these changes are more significant although not uniform, with some models indicating an increase, while other models indicate a decrease. In the long term (2080–2100), trends show a significant decrease in annual rainfall across the Province, with some models showing an increase (EDTEA, 2017).

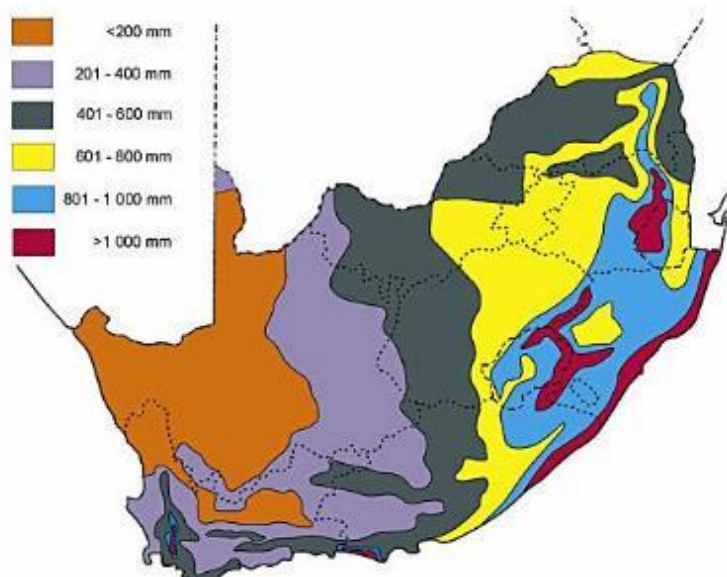


Figure 5: Average annual rainfall of South Africa, including KwaZulu-Natal²²

3.4.3 Extreme weather events

The 2009 ‘Vulnerability Study of the Impacts of Climate Change’, undertaken by the provincial Department of Agriculture, Environmental Affairs and Rural Development (DAEA&RD), indicated that the outbreak of fires had increased during the winter season as a result of prolonged droughts, whereas the incidence of floods and severe storms had increased during the summer season. Increasing temperatures and variability in precipitation will increase the likelihood of weather extremes.

The coastline of KZN is vulnerable to erosion and flooding and is also the area with the greatest urban and industrial development, as well as population density, which exacerbates the social

²² Retrieved from: <http://www.south-africa-tours-and-travel.com/south-africa-climate.html>

and economic impacts of predicted weather extremes. Because of changing weather patterns, coastal storms and cyclones are expected to increase in frequency and intensity.

3.4.4 Greenhouse gas emissions

In 2012, the total GHG emissions recorded for Durban was 29 360 395 tonnes CO₂e, a 47% increase from the 19 937 000 tCO₂e in 2002, which may be attributed to an improvement in data collection (eThekweni Municipality, 2014b).²³ In 2010, the national level emission was 518 239 000 tCO₂, of which Durban alone contributed about 5% (DEA, 2014). Figure 6 shows the sectoral contributions to the emissions in 2012, with electricity consumption being the largest contributor, followed by fuel combustion, solid waste disposal and sugarcane burning. According to the INDC (DEA, 2015), South Africa will experience a peak in GHG emissions between 2020 and 2025, followed by a plateau for about a decade, after which emissions will decline (DEA, 2015).

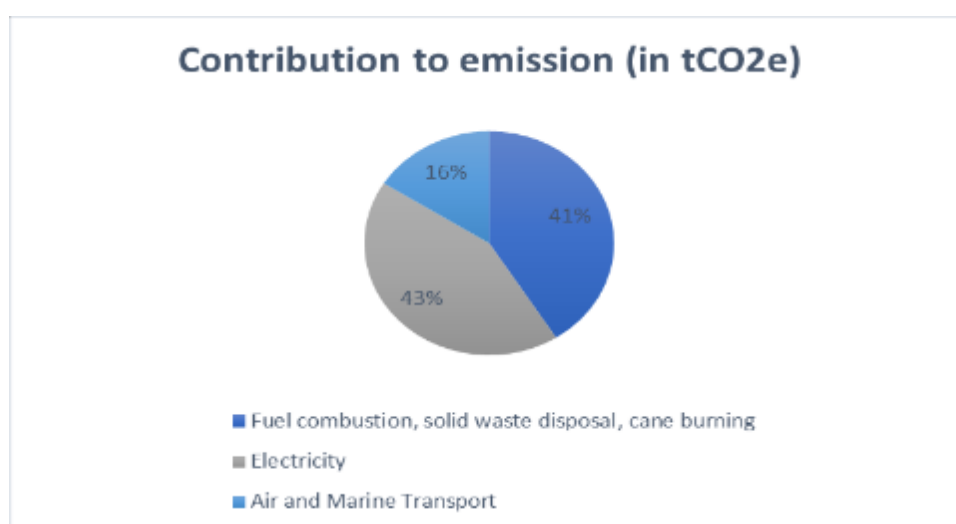


Figure 6: Contribution to emission from industries in eThekweni Municipality in 2012

3.4.5 Governance

In the Province, the EDTEA is mandated to oversee climate change issues. Coordinating efforts to mitigate the effects of climate change reside with the Air Quality and Climate Change Unit of the Department. This unit, guided by the National Climate Change Response Policy, is expected to develop Climate Change Response Strategies by working with all relevant stakeholders within the Province.

3.4.5.1 The Climate Group and States & Regions Alliance

In 2011, KZN became a member of the Climate Group. The Climate Group States & Regions Alliance provides a platform for discussion on various aspects of climate change management by various sub-nations. The objective of the group is to promote understanding of climate change issues and provide technical support and facilitate funding for projects aimed at responding to climate change among member States and Regions.

²³ Morgan, D., and O'Donoghue, S. 2014. Durban Climate Change Strategy.

3.4.5.2 KZN Council for Climate Change and Sustainable Development

The KZN Council for Climate Change and Sustainable Development was established in 2012 to coordinate climate change management activities in KZN. This multi-stakeholder council is chaired by the Premier of the Province and serves as a provincial platform for ensuring regular dialogue and consultations on climate change-related policies, plans, programmes, projects and activities. Within the Council are two working groups: i) Adaptation and Mitigation Working Group and ii) Renewable Energy Working Group.

3.5 Impacts

A study by Benhin (2006) found that 90% of respondents in KZN had noticed changes in temperature and rainfall patterns. Respondents stated that the onset of the winter rains had shifted from early April to May and overall annual rainfall had decreased, resulting in an increase in droughts. These changes were found to have had a considerable impact on the livelihoods and vulnerability of people in the Province, in particular food security, as climate variability increases the risk of crop failure and livestock loss.

Turpie and Visser (2013) have developed South Africa's most recent index of vulnerability to climate change for local municipalities, including those in KZN. This vulnerability index was calculated taking into account two sets of variables: the climate-related potential impacts (for example, flood frequency, change in temperature, water stress) and the adaptive capacity (for example, infrastructure and governance). The main sectors adversely affected by climate change are described below.

3.5.1 Ecosystems and biodiversity

The strong increase in temperatures will have considerable negative effects on the ecosystems and biodiversity in KZN. The Maputaland-Pondoland-Albany Region in KZN is a biodiversity hotspot. This region will experience droughts and increased competition with invasive alien species, which will threaten the future of the biodiverse area. The Working for Water programme is working on the clearing and management of invasive alien species in the area.

As a result of a shift in the bio-climatic zones, certain vegetation types and associated species will disappear, being unable to adapt to the fast-changing environment. It is estimated that 700 species are threatened by the effects of climate change (EDTEA, 2014).

3.5.2 Land modification

People living in the rural areas of KZN depend on natural resources and rain-fed agriculture for their livelihoods. However, increased floods and droughts in combination with "business as usual" farming practices have led to soil erosion and reduced infiltration rates of water. Consequently, the amount of arable land available for food production is reduced and food security is compromised.

This land degradation is also hindering conservation efforts as the distribution of forests under the projected climatic conditions includes a decrease in forest habitats in the north-eastern

parts of the Province and an increase in forests on the south coast of the Province (EDTEA, 2014).

To combat land degradation, sugarcane growers are increasingly promoting and implementing sustainable farm management practices. Similarly, the forestry sector has programmes and standards that promote more sustainable land practices.

3.5.2.1 Agriculture

The agricultural sector in KZN is amongst the most sensitive to the effects of climate change. This is as a result of a relatively high population density combined with a larger share of small-scale farmers, high dependence on rain-fed agriculture and severe levels of land degradation (EDTEA, 2017). Changes in temperature and rainfall patterns can therefore affect the production of crops that are currently most suitable for the area. In some areas, agricultural opportunities will be gained, while other areas will lose. According to the South African Sugar Association (SASA), sugarcane production decreased from 23 million tons in 2002/03 to about 15 million tonnes in 2015/16. Consequently, income to sugarcane farmers, of which a large part is small-scale producers, decreased considerably,²⁴ which will have a severe impact on their livelihood and food security.

Reduced crop production will result in an increased market price for that particular crop, thereby increasing the monthly expenditure of the population on food. This price increase will affect poorer households more as they already spend most of their income on food. As a result, these households may not be able to adequately feed their families, which will, in turn, affect their health status. Additionally, flooding caused by heavy rain over a short period may result in soils becoming water-logged and leached of nutrients, which will have a negative impact on crop harvests (eThekweni Municipality, 2014a).

The following main impacts on agriculture are expected in KZN as a result of the effects of climate change:

- Increased temperatures will alter the length of crop cycles, which will affect growth and productivity.
- Increased temperatures will contribute to eutrophication, thereby decreasing water quality and negatively affecting crop productivity and food security.
- Increased frequency of the drying out of top soils (particularly in the northeast of KZN) will lead to reduced crop yields and greater demand for irrigation.
- Increased frequency and intensity of extreme weather events will negatively affect the food supply chain by damaging food storage facilities and transport networks.

3.5.3 Freshwater

Rainfall variability and, in particular, reduced annual rainfall and increased heavy rains over a short period will affect water quality and quantity. In combination with rising temperatures, this would result in a greater demand for irrigation for crops, because of greater

²⁴ Retrieved from: <http://www.growinggreatness.co.za/implications-of-lingering-2015-drought-on-economy-agricultural-markets-food-processors-input-suppliers-and-consumers/>. Accessed on 3 July 2017.

evapotranspiration. However, increased rainfall variability would include short, heavy rains, thereby increasing runoff in catchments and resulting in increased risk of floods.

3.5.4 Marine

The global increase in both land and sea surface temperatures will cause glaciers and ice caps to melt and ultimately sea levels to rise. In the last 50 years, an assessment of sea-level rise in South Africa has recorded a 2.74 mm annual increase on the east coast (Mather *et al.*, 2009). In addition, the coast of KZN is already experiencing coastal erosion as a result of storm events. Climate change will exacerbate the frequency and intensity of these storms, causing further coastal erosion. As a result, there will be an increased risk of coastal flooding, particularly along the lower-lying northern coast of KZN (DEA, 2013).

Between 1989 and 2007, an increase in the diversity and quantity of reef fish species was monitored along the KZN coast from Ballito to Scottburgh. This increase in species diversity was linked to an increase in sea surface temperature (SST) along the KZN inshore region. Warmer waters resulted in the range expansion of species, consequently resulting in a higher diversity (Lloyd, Plaganyi, Weeks, Magno-Canto and Plaganyi, 2012).

Climate models predict an increase in summer rainfall along the east coast of South Africa, including in KZN. This predicted increase in rainfall will likely mean more rain days and extreme rainfall events. When coupled with sea-level rise, this may result in the loss of nursery habitat, such as mangroves. Additionally, changes in SSTs, coastal storms and CO₂ may change the salinity and the pH of the estuaries and coastal waters, in this way damaging biological structures and organisms such as fish and coral reefs (DEA, 2013). However, a large natural variability in climate and ecosystem processes exists among marine ecosystems, which also responds differently to extractive pressures. As a result, it is difficult to measure and project changes in climate variability and their effects on physical and biological ocean systems (Cheung, Pinnegar, Merino, Jones and Barange, 2012).

3.5.5 Economics

The effects of climate change, in particular storms, floods and droughts, will have a considerable impact on the economy of KZN. For example, the storms in March 2007 caused property damage that amounted to approximately R250 million (EDTEA, 2014). These costs are likely to increase as the frequency and intensity of these extreme weather events increase. In addition, Figure 7 shows that revenues for the agricultural sector in KZN will reduce considerably by the end of the century as a result of increased temperatures and reduced rainfall.

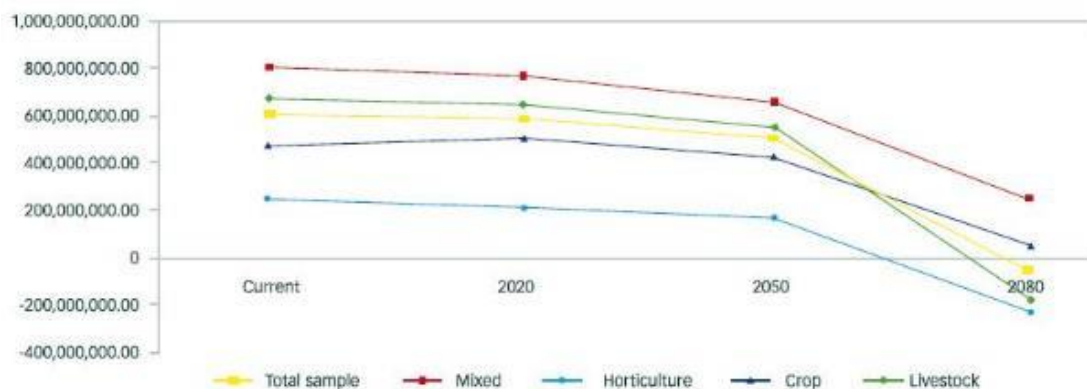


Figure 7: Expected reduction in revenue in the agricultural sector as a result of climate change

Source: Turpie and Visser (2013)

3.5.6 Human settlements

After Gauteng, KZN has the second-highest population density in South Africa. Although the highest densities can be found in the cities, the Province is relatively rural, with 48% of the population living in rural areas.²⁵ These rural areas are characterised by limited access to services such as drinking water and sanitation, which has an impact on people's health status and consequently their vulnerability to diseases. This vulnerability is exacerbated by the increased impacts of climate change, particularly rising temperatures and the increase of extreme weather events. For example, increased frequency and severity of extreme weather events such as storms and flooding will result in the destruction of shacks and consequently make a large number of people homeless. Combined with limited access to basic services, these extreme events compromise the health status of people. Figure 8 shows the relatively high vulnerability of municipalities in KZN to the effect of climate change compared to the other provinces. The Province is particularly vulnerable as most of the urban population and industrial development are located near the coast, which appears particularly vulnerable to extreme weather events and sea-level rise. On a scale from 1 to 5, with 5 indicating highly vulnerable, over half of the local municipalities in the Province scored 4, with Mandeni and Maphumulo in iLembe district and Alfred Duma in uThukela scoring 5.

²⁵ Retrieved from: www.letsrespondtoolkit.org/municipalities/kwazulu-natal. Accessed on 20 March 2017.

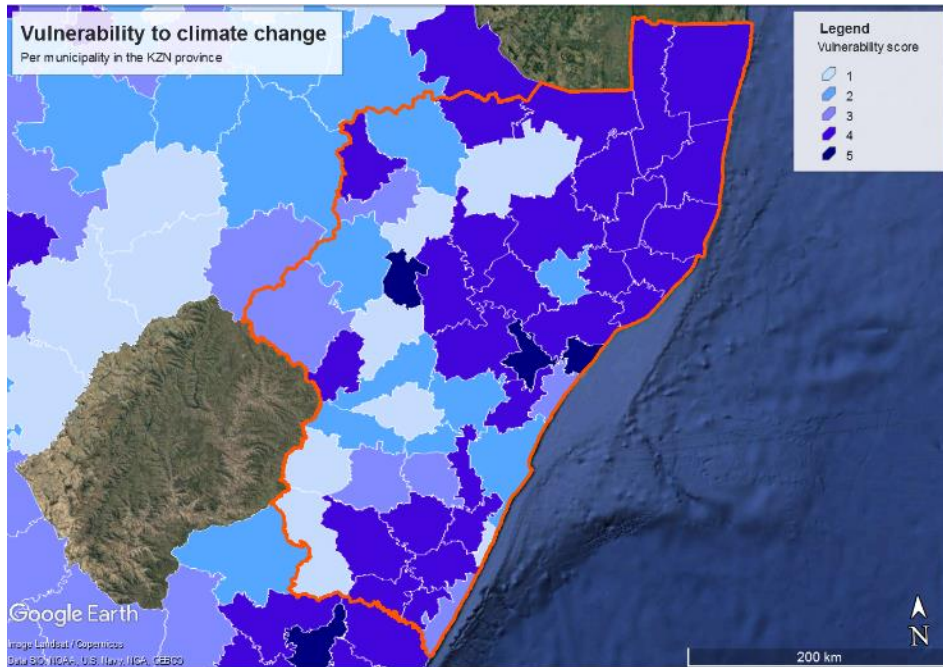


Figure 8: Vulnerability to climate change per municipality

Source: Turpie and Visser (2013)

3.5.6.1 Health

Increased temperatures and extreme events such as droughts and storms have an adverse impact on local communities in terms of injuries and death, food security and outbreak of diseases. For example, increased temperatures might expand the range of certain parasites, and mosquito-borne viruses such as dengue and malaria might become more prevalent (EDTEA, 2017). In addition, the 'Urban Heat Island' effect, where heat from the sun is trapped within the city, will make cities on average 2°C warmer than outside the cities. With the expected increases in temperature, this will hamper the respiratory ability of people and elderly people in particular will suffer from increased heat.

3.5.6.2 Waste

Adequate waste management is an ongoing challenge. Solid waste dumped in waterways will block water flow during heavy rains. Climate change will increase the risk of rainfall variability, resulting in more frequent and intense heavy rains. The blocking of water flow by solid waste during such heavy rains will lead to an increase in flooding, thereby potentially damaging livelihoods and infrastructure.

Some landfills in KZN have implemented initiatives to capture biogas (which is a GHG) for energy generation and are registered under the Clean Development Mechanism (CDM) for carbon credits. For more information see the Waste chapter (Chapter 11).

Box 1: Human vulnerability to climate change impacts

‘Vulnerability’ refers to the degree to which people or the things they value are susceptible to, or are unable to cope with, the adverse impacts of climate change. Increased temperatures will: i) expand the range of certain parasites and make mosquito-borne viruses such as dengue and malaria more prevalent; and ii) hamper the respiratory ability of people. Particularly elderly people will suffer from increased heat.

A decrease in rainfall will result in reduced food production and increased food prices, thereby jeopardising food security.

An increase in the frequency and intensity of extreme weather, particularly floods and storms, will result in the destruction of shacks and consequently make a large number of people homeless. This situation applies particularly to coastal communities, which are more vulnerable to storm surges and sea-level rise. Additionally, solid waste dumped in waterways will block water flow during heavy rains and, with limited sanitary infrastructure, this will increase the risk of flooding and the spreading of diseases.

3.6 Responses

KZN has several institutions, plans and strategies in place to respond to climate change. This can partly be attributed to the presence of a well-regarded university and the economic hubs at Durban, Pietermaritzburg and Richards Bay, which add to the capacity-building required for developing such responses.

3.6.1 University of KwaZulu-Natal

The University of KwaZulu-Natal (UKZN) offers several programmes that undertake research on climate change. For example, UKZN has entered into a strategic partnership with the Department of Trade and Industry (DTI) and the National Research Foundation (NRF) to establish the Integrated Renewable Energy Advancement Programme (IREAP) to develop a comprehensive energy solution for South Africa using biomass and waste as an energy source. UKZN also undertakes considerable research on climate change and integrated water resources research in South Africa through several projects funded by the Water Research Commission, the NRF and other international groups.

3.6.2 KZN Climate Change Strategy and Action Plan

In 2014, the EDTEA developed an Action Plan in collaboration with other spheres of government, research institutions, industry and the community of KZN and committed the Department to leading climate change response in the Province. The EDTEA will use the findings of the climate vulnerability study 2013, energy audits, carbon footprint and other information available within or outside of the Province to further develop and implement the Climate Change Strategy and Action Plan.

3.6.3 Durban Climate Change Strategy

The Durban Climate Change Strategy (DCCS) was developed as part of the Municipal Climate Protection Programme to address the challenge of adapting to climate change, while reducing the city's contributions to climate change. Through the DCCS development process, ten interrelated themes were identified and goals set to be able to address the issues.

3.6.4 Climate financing

In order to ensure an adequate and timely response to the effects of climate change, it is important to mainstream climate change responses into the fiscal budgetary process. By integrating climate change response programmes into national, provincial and local government and development finance institutions and state-owned entities, a coordinated approach can be applied. This approach should aim to prevent damage from extreme weather events and to adapt to the effects of climate change effectively.

Currently, financing for climate-related projects and events in KZN remains limited. As a result, the KZN Climate Change Strategy has not been finalised. To address this financing issue, one of the objectives of the strategy should therefore include potential avenues of climate financing and how this financing can be used for various response options.

3.6.5 Mitigation

A "Green Economy" is low in carbon use, resource efficient and socially inclusive.²⁶ To stimulate investments in the green economy, the EDTEA launched a website in 2012 to cover main developments, opportunities and resources in the green economy of KZN.²⁷ Research identified a large number of opportunities to pursue a green economy for KZN Province. Examples include: wind and biomass energy, using waste to convert into energy, recycling, solar farms, and rooftop solar for businesses and households. The potential also exists to transform the building and construction supply chain completely through the development of green building materials, retrofitting existing buildings. Other opportunities include promoting sustainable and ecologically friendly agriculture, forestry, freshwater and fisheries methods to help conserve soil fertility and water resources in KZN, with a special focus on supporting subsistence farming (Provincial Planning Commission, 2011). In 2013, the Province developed the Green Economy Strategy for KZN, which unfortunately is progressing slowly due to a lack of funding.

3.6.6 Adaptation

Adapting to climate change is a necessary component to respond to climate change. The UNFCCC established the National Adaptation Plan process to facilitate adaptation planning in least-developed countries and other developing countries. The main objectives of the NAP are to reduce vulnerability to the impacts of climate change and to facilitate the integration of climate change adaptation into existing and new policies.

²⁶ "In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services" (UNDP, 2011).

²⁷ Retrieved from: <http://www.kzngreengrowth.com/>. Accessed on 31 March 2017.

3.6.7 Ecosystem-based adaptation

The Convention of Biological Diversity (CBD) defines Ecosystem-based adaptation (EbA) as the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change. Since EbA cuts across multiple economic sectors, EbA lends itself to an integrated approach to addressing climate change challenges. In KZN, several EbA-related projects exist. For example, the uMngeni Resilience Project is working with local communities in the uMngeni District to assist them to adapt to the effects of climate change by developing and implementing EbA measures, such as early warning systems, climate-smart agriculture and climate proofing settlements. Other initiatives include the uMngeni Ecological Infrastructure Partnership, Mhlatuze Water Stewardship Partnership, EnviroChamps and Citizen Science Initiatives by WESSA and Groundtruth. Collectively such initiatives can enable sustainable natural resource utilisation that ensures the maintenance of ecological processes and continued sustainable agricultural production.

3.6.8 Climate-Smart Agriculture

The Municipality of eThekweni has designed a food security strategic plan that intends to complement its climate change policy documents. Urban agriculture is one of eThekweni's policies that support urban agricultural programmes and activities; this policy is complemented by the rural agricultural policy (under the rural area-based management). Urban agricultural programmes and activities include organic initiatives, food sovereignty, food security, economic empowerment and environmental sustainability for eThekweni residents. The Municipality's green leadership is a programme that is mainly responsible for implementing approaches to aid poor citizens to adapt to climate change. The extent and magnitude of climate change indicate that it is a multi-governance issue. Thus, eThekweni Municipality adaptation strategies are linked with national, provincial and local structures.

3.6.9 Let's Respond Toolkit

The Let's Respond Toolkit (DEA, SALGA and COGTA, 2012) was developed by the collaboration of the DEA, the South African Local Government Association (SALGA) and Cooperative Governance and traditional Affairs (COGTA) and supported by Sustainable Energy Africa (SEA). The Toolkit has been designed to assist local government to integrate disaster risk reduction and climate change adaptation into Integrated Development Plans (IDPs). It is being applied in various district and local municipalities with support from, among others, SALGA, the DEA and non-governmental organisations (NGOs). The Toolkit provides specific guidance on conducting vulnerability assessments on a local government scale.

3.6.10 100 Resilient Cities Initiatives

At the end of 2013, Durban was selected as one of the first 32 cities to participate in this initiative funded by the Rockefeller Foundation. The Foundation will assist cities around the world in building urban resilience in the face of future challenges, such as inequality, unemployment and environmental degradation, and shocks, such as floods and other disasters, which are likely to become more prevalent.

3.7 Conclusion and Recommendations

Table 5 shows the trends observed and predicted regarding the climate change indicators.

Table 5: Trends of indicators for KwaZulu-Natal (with red being negative and green positive)

Indicators	Trends
The number of sectoral plans that have incorporated climate change	Increasing
The number of plans from traditional authorities that have incorporated climate change.	Increasing
Precipitation (in mm)	Variable
Temperature (in degrees Celsius)	Increasing
Sea-level rise (in mm/year)	Increasing
The cost of damage (in million Rand) and loss of lives caused by extreme weather events	Increasing
Level of GHG emission (particularly atmospheric carbon dioxide (CO ₂))	Increasing
The percentage uptake by farmers of climate-smart agriculture and ecosystem-based adaptation	Increasing

Climate models predict that, if no action is taken, South Africa's coastal regions will warm ~1-2°C by 2050 and ~3-4°C by 2100 (DEA, 2011). Similarly, over the same period, South Africa's inland area will warm by ~3-4°C and ~6-7°C, respectively.

The Province of KZN already has several strategies and plans in place to address the effects of climate change. However, the mainstreaming of climate change into sectoral plans at provincial and municipal level needs to be improved (EDTEA, 2017). These plans include *inter alia* the Industrial Policy Action Plan, Integrated Resource Plan for Electrification Generation, Provincial Growth and Development Plans and the Integrated Development Plan. The key priorities of the IDP could be compared with proposed development, as this may be different from DEA plans. To facilitate the mainstreaming process, partnerships between government, NGOs, community-based organisations (CBOs) and the private sector must be strengthened and become part of the updated strategies and action plans.

Several opportunities exist for pursuing the green economy, but government initiatives have been limited since the start in 2012. Also, investments from the private sector have been minimal, mainly because of opposition from other stakeholders, where a proposed solar farm or waste-to-energy project was in conflict with other land uses. However, with increased population growth, in combination with increased adverse effects of climate change on the environment and the people in KZN, it is imperative to invest in initiatives that contribute to a green economy.

Although there is a basic awareness of climate change *per se*, knowledge and skills for adapting to the effects of climate change are limited. Training and ongoing capacity-building of government officials as well as community representatives would contribute to enhanced knowledge and skills needed to adapt to and mitigate the effects of climate change. This would benefit farmers particularly as, through implementing climate-smart agriculture techniques, they would be able to increase food security and reduce the vulnerability of people in the Province.

3.8 References

Benhin, J.K.A. 2006. Climate Change and South African Agriculture: Impacts and Adaptation Options. Special Series on Climate Change and Agriculture in Africa, Discussion paper.

British Petroleum Statistical Review of World Energy. 2014. Retrieved from: bp.com/statisticalreview Accessed on 2 October 2017.

Cheung, W.W.L., Pinnegar, J., Merino, G., Jones, M.C. and Barange, M. 2012. Review of climate change on marine fisheries in the UK and Ireland. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 22: 368-388.

Department of Environmental Affairs (DEA). 2016. South Africa's Third National Communication (TNC) to the UNFCCC. Chapter 3: Draft version dated 10 October 2016. Department of Environmental Affairs, Government of the Republic of South Africa, Pretoria.

Department of Environmental Affairs (DEA). 2015. Discussion Document: South Africa's Intended Nationally Determined Contribution (INDC): 1 August 2015. Government of the Republic of South Africa, Pretoria.

Department of Environmental Affairs (DEA). 2014. GHG National Inventory Report South Africa 200-2010.

Department of Environmental Affairs (DEA). 2013. Full technical report: climate change impacts on and adaptation responses for the Marine Fisheries Sector under future climate change scenarios. Government of the Republic of South Africa, Pretoria.

Department of Environmental Affairs (DEA), SALGA and COGTA. 2012. Let's Respond. An Introduction to Integrating Climate Change Risks & Opportunities into municipal planning, Department of Environmental Affairs, South African Local Government Association, Pretoria, Republic of South Africa.

Eakin, H. and Luers, A. 2006. Assessing the vulnerability of social-environmental systems. *Annual Review of Environment and Resources*, 31: 365-394.

EDTEA. 2017. Report on the update of the 2009 report "Development of a *Status Quo* Analysis on the Impacts of Climate Change in KwaZulu-Natal". Submitted by the Project Team at Climate System Analysis Group (CSAG), and African Climate Development Initiative (ACDI), University of Cape Town (UCT).

EDTEA. 2014. Draft Climate Change Action Plan.

eThekweni Municipality. 2016a. Durban Climate Change Strategy. Morgan, D., and O'Donoghue, S. 2014.

eThekweni Municipality. 2014b. eThekweni Greenhouse Gas Emissions Inventory: Technical Report, Energy Office, eThekweni Municipality.

Golder Associates. 2013. Response Strategy uMgungundlovu District Municipality Climate Change Response Strategy and Plan.

Harris, P.G. 2008. Climate Change and Global Citizenship. Law and Policy, University of Denver.

- James, R., Washington, R. and Powell, D.P. 2014. Implications of global warming for the climate of African rain forests. Published 22 July 2013. DOI: 10.1098/rstb.2012.0298.
- Kruger, A.C. and Sekele, S.S. 2012. Trends in extreme temperature indices in South Africa: 1962–2009. *International Journal Climatology*, 33(3): 661-676.
- Lloyd, P., Plaganyi, E.E., Weeks, S.J., Magno-Canto, M. and Plaganyi, G. 2012. Ocean warming alters species abundance patterns and increases species diversity in an African sub-tropical reef-fish community. *Fisheries Oceanography*, 21: 78-94.
- Lyon, B. 2009. Southern Africa summer drought and heat waves: observations and coupled model behavior. *Journal of Climate*, 22: 6033-6046.
- Mather, A. and Theron, A. 2012. Recent Extreme Events along the Coast of South Africa. Draft Report.
- Mather, A.A., Garland, G.G. and Stretch, D.D. 2009. Southern African sea levels: corrections, influences and trends. *African Journal of Marine Science*, 31(2): 145-156.
- Provincial Planning Commission. 2011. Kwazulu-Natal Situational Overview: KwaZulu-Natal Provincial Growth and Development Strategy (PGDS).
- Rouault, M., Pohl, B. and Penven, P. 2010. Coastal oceanic climate change and variability from 1982 to 2009 around South Africa. *African Journal of Marine Science*, 32(2): 237-246.
- Schulze, R.E. and Horan, M.J.C. 2010. Methods 1: Delineation of South Africa, Lesotho and Swaziland into Quinary Catchments. In: R.E. Schulze, B.C. Hewitson, K.R. Barichievy, M.A. Tadross, R.P. Kunz, M.J.C. Horan and T.G. Lumsden (eds), *Methodological Approaches to Assessing Eco-Hydrological Responses to Climate Change in South Africa*. WRC Report 1562/1/10. Water Research Commission, Pretoria.
- Trade and Industry Chamber. 2012. Hydrochlorofluorocarbons (HCFC) Phase Out Plan for South Africa. Fund for Research into Industrial Development, Growth and Equity (Fridge).
- Turpie, J. and Visser, M. 2013. The Impact of Climate Change on South Africa's Rural Areas. In: Technical Report: Submission for the 2013/14 Division of Revenue – For an Equitable Sharing of National Revenue. Midrand: Financial and Fiscal Commission, pp. 127-220.
- Wilgen, B.W. and Richardson, D.M. 2012. Three centuries of managing introduced conifers in South Africa: benefits, impacts, changing perceptions and conflict resolution. *Journal of Environmental Management*, 106(2012): 56-68.



4. Air Quality Management

4.1 Introduction

In the Air Quality Outlook of the KwaZulu-Natal (KZN) State of Environment Report (SoER) of 2004, particulate matter (PM) and sulphur dioxide (SO₂) were identified as pollutants of interest and historical records were scrutinised for ambient concentration levels. These concentration levels showed a steady decrease from 1970 and 1980 to 1990, but high levels were observed for both PM and SO₂ (DAEA&RD, 2010). A lack of ambient monitoring data was highlighted as a major concern, together with gaps in the monitoring of other major pollutants. In addition, local hotspot areas were identified, which included South Durban, Richards Bay, Pietermaritzburg, Estcourt and Newcastle. Few studies were found on air pollution impacts in the Province.

Since 2004, national developments regarding air quality have been made, which have affected provincial air quality control. A comprehensive legislative framework for controlling air pollution has been developed with the promulgation of the National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEMAQA) and other relevant Acts, policies and Regulations (Table 6).

Table 6: Legislative framework related to air quality in South Africa and KZN

Year	Legislation	Type
1965	The Atmospheric Pollution Prevention Act (repealed)	Act
1996	The Constitution of the Republic of South Africa	Act
1998	The National Environmental Management Act (NEMA)	Act
2000	The White Paper on Integrated Pollution and Waste Management for South Africa	Policy
2004/2005	The National Environmental Management: Air Quality Act	Act
2007 and 2012	The National Framework for Air Quality Management in South Africa	Policy
2010, 2012 and 2013	<i>"Minimum emission standards"</i>	Regulation
2009 and 2012	<i>"National Ambient Air Quality Standards"</i>	Regulation
2013	<i>"Dust control regulations"</i>	Regulation

Table 7 shows the main air quality indicators, in line with those in the SoER (2004).

Table 7: Indicators to measure air quality in KwaZulu-Natal Province

Indicator	Description
The number of approved AQMPs	
Ambient particulate matter (PM₁₀) concentrations.	Ambient PM ₁₀ measurements from monitoring data.
Ambient sulphur dioxide (SO₂) concentrations.	Ambient SO ₂ measurements from monitoring data.
Ambient nitrogen dioxide (NO₂) concentrations.	Ambient NO ₂ measurements from monitoring data.
The number of people with respiratory problems	Emissions from transport and burning of waste negatively affect air quality and consequently the respiration ability of people.
The number of functional monitoring stations	The monitoring stations are important sources for data collection on air quality.

4.2 Drivers and Pressures

There are various drivers and pressures on air quality in the Province. In this chapter, these are discussed together as they are closely linked. The primary air quality drivers and pressures considered are transport, industrial and commercial sectors, biomass burning, and domestic fuel burning, although additional sources and activities also affect air quality.

4.2.1 Transport

KZN has an extensive road network, with linkages to the main South African urban centres, and a well-developed metropolitan network in its major cities, including Durban and Pietermaritzburg. Two major sea-ports in Durban and Richards Bay, and the King Shaka International Airport (KSIA) in Durban, also form part of the transportation network. The eThekweni Municipality baseline assessment (Zunckel and Perumal, 2015) highlights the significant contribution of motor vehicles to nitrogen oxides (NO_x) and carbon monoxide (CO) emissions (Table 8) and the considerable contributions by the sea-ports and airport to the total emissions. In addition, significant emissions of PM₁₀ and volatile organic compounds (VOCs), including benzene, are released from vehicles, and SO₂ emissions from the sea-ports. Earlier data from the uThungulu and Ugu districts' baseline assessments also highlight significant pollutant contributions from motor vehicles (UMoya-NILU, 2012; UMoya-NILU, 2013). Other transport sector emissions were not calculated for these municipalities.

Table 8: Transport sector emissions (in tpa) for eThekweni, Ugu and King Cetshwayo municipalities

Municipalities	Sectors	SO ₂	NO _x	CO	PM ₁₀	VOC	Benzene
eThekweni	Motor vehicles	1 585	68 292	147 327	2 439	24 642	38
	Port of Durban	5 490	7 588	1 898	33	2 421	2
	KSIA	60	469	702	78 ¹	112	
Ugu	Motor vehicles	30	3 139	11 189	90	1 198	
King Cetshwayo	Motor vehicles	100	3 500	11 359	200	3 500	

¹: Total particulate matter

Sources: uMoya-NILU (2012, 2013, 2015)

4.2.2 Industrial and commercial sectors

Industrial emitters are concentrated in major centres, particularly Durban, Richards Bay, Pietermaritzburg and Port Shepstone, with fewer activities in smaller towns. Industrial pollution control is focussed on the listed activities published through NEMAQA, as this addresses the major industrial stationary sources. Commercial emitters include smaller-scale activities, such as small boilers, heaters and other fuel-burning appliances, and are regulated as controlled emitters through NEMAQA. Mining and quarrying activities are limited in scale, but widespread in the Province. These occur on a small- to medium scale and emit coarse particulate matter. In addition, these activities are generally localised sources and produce nuisance impacts. Emission estimates provided by the Air Quality Management Plan (AQMP) baseline assessment for eThekweni, Ugu and uThungulu municipalities highlight the contribution of each sector (Table 9).

Table 9: Emission estimates (in tpa) for industry and commerce

Municipalities	Sectors	SO ₂	NO _x	CO	PM ₁₀	VOC	Benzene	Lead
eThekwini	Industrial	13 197	5 090	2 482	2 036	5 307	68	
	Commerce	5 845	895	425	1 055	2		
Ugu	Industrial	268	763	934	659	1	0.2	0.04
UThungulu	Industrial	9 740	5 186	530	7 656	38		

Sources: uMoya-NILU (2012, 2013, 2015)

4.2.3 Biomass burning

Biomass burning, including the burning of agricultural residues and from wildfires, occurs on different scales across the Province. The burning of biomass primarily emits PM and is associated with secondary particulate formation (Table 10).

Table 10: Emission estimates for biomass burning (in tpa)

Municipalities	NO _x	CO	PM ₁₀	VOC
eThekwini	25	818	68 ¹	151
Ugu	47	1 521	126	281

¹: Total particulate matter

Sources: uMoya-NILU (2012, 2015)

A particular issue in the Province is the burning of sugarcane, as sugarcane cultivation is a major agricultural activity. A draft guideline document for sugarcane burning has been prepared by KZN EDTEA to assist local air quality officials to manage the impacts effectively and meet the objectives of NEMAQA (DAEA&RD, 2011b). The *status quo* report includes a limited emission estimate for sugarcane burning (Table 11).

Table 11: Sugarcane burning emission estimate (in tpa)

Localities	NO _x	CO	PM	NMVOG
Pongola, Darnall, Noodsberg and Sezela mill supply areas	365.2	44 505.2	3 799.2	6 513

Source: DAEA&RD (2011b)

4.2.4 Domestic fuel burning

Domestic fuel burning is most common in low income and informal residential areas and contributes to poor indoor and ambient air quality through emissions of SO₂, NO₂, CO, PM₁₀ and several VOCs. The combustion of fuels for cooking, heating and lighting in residential areas presents an ongoing challenge to air quality in the Province. According to emission estimates in municipal baseline assessments, residential fuel burning contributes to high levels of CO and PM₁₀ in eThekwini Municipality, with larger contributions of PM₁₀ in the Ugu and uThungulu municipalities (Table 12). For Ugu Municipality, VOC and benzene emission estimates are provided and highlight contributions to pollutant loading.

Table 12: Residential fuel burning emission estimates (in tpa)

Municipalities	SO ₂	NO _x	CO	PM ₁₀	VOC	Benzene
eThekwini	14	29	437	56		
Ugu	27	67	275	197	1 565	11
UThungulu	6	17	1 188	156		

Sources: uMoya-NILU (2012, 2013, 2015)

4.3 State

Determining the state of air quality is limited by the availability of ambient monitoring data. Areas such as eThekweni Municipality have greater monitoring coverage, but many other municipalities have limited resources to undertake such monitoring. However, the Province is currently conducting surveys in areas where no or limited air quality data exist. Results from the Province's Ambient Monitoring Network are reported to the South African Air Quality Information System (SAAQIS), which is the national repository for air quality monitoring data. Once KZN is registered with SAAQIS, provincial data will become accessible to the general public.

In this Report, the state of air quality is therefore described using available data, with an emphasis on PM₁₀, SO₂ and NO₂ data as indicators.

4.3.1 PM₁₀

PM₁₀ has several natural and anthropogenic source sectors that contribute to elevated ambient concentrations. The World Health Organization (WHO) has identified that no safe level for PM exists and that there are noticeable health effects from any exposure (World Health Organization, 2013). PM₁₀ levels in eThekweni Municipality show a trend toward higher concentrations in traffic-influenced monitoring sites, at City Hall and Ganges (Figure 9). In addition, a regional influence on PM₁₀ exists, together with natural sea spray, and long-range transport from southern Africa (eThekweni Municipality, 2009). Regional-scale transport from the industrialised interior and biomass burning increase background concentrations of PM₁₀.

Background sources of PM₁₀ contribute about 16 µg/m³ to ambient PM₁₀ concentrations in eThekweni Municipality (uMoya-NILU, 2015). PM₁₀ concentrations in Richards Bay are recorded through the Richards Bay Clean Air Association (RBCAA) network, which provides a 5-year trend from 2011 to 2015 (Figure 10). Elevated concentrations are observed in the vicinity of Richards Bay and at the CBD and Brackenham sites, with lower concentrations observed in outlying Mtunzini and St Lucia. No exceedances are recorded for this period.

Limited records are available for other areas covered by the EDTEA network. The period 2006–2008 is reflected in the trend analysis, with some sites operational in 2012 (Figure 11). Elevated concentrations are observed in Newcastle and Estcourt, with exceedances at Empangeni, Mandini and Port Shepstone. Dust-fallout monitoring identified elevated levels at Umhlali, Gledhow, Mkondeni and Cato Ridge, which may indicate elevated PM₁₀ (Zanokuhle Environmental Services, 2015). Elevated PM₁₀ concentrations are observed in most urban centres and background sites in the Province. According to the DEA (2016), "PM₁₀ is still the greatest national cause for concern in terms of air quality. Continued and increased national, provincial as well as local action is required to bring particulate matter concentrations down to acceptable levels." In Figures 9 and 10, the red arrow indicates the current standard, the blue arrow the old standard.

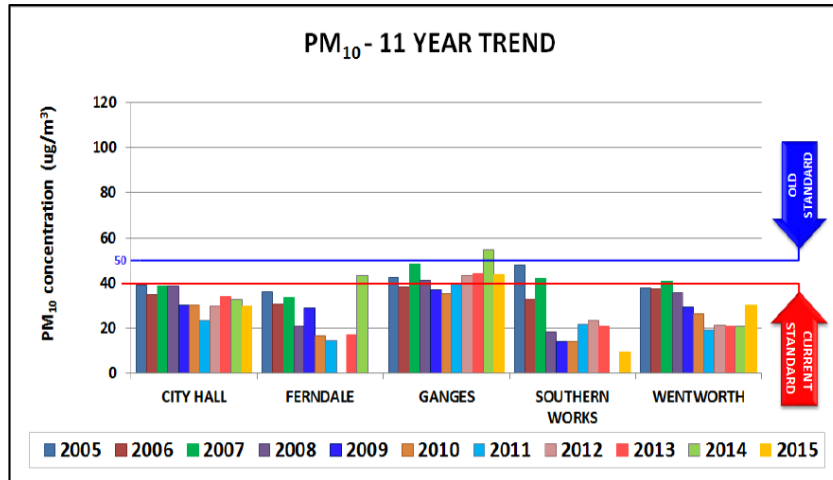


Figure 9: PM₁₀ concentration trend for eThekweni Municipality
Source: DEA (2016)

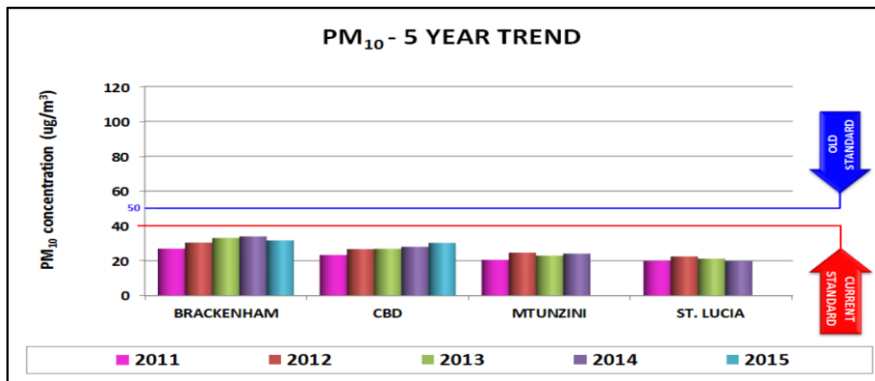


Figure 10: PM₁₀ concentration trend for Richards Bay
Source: DEA (2016)

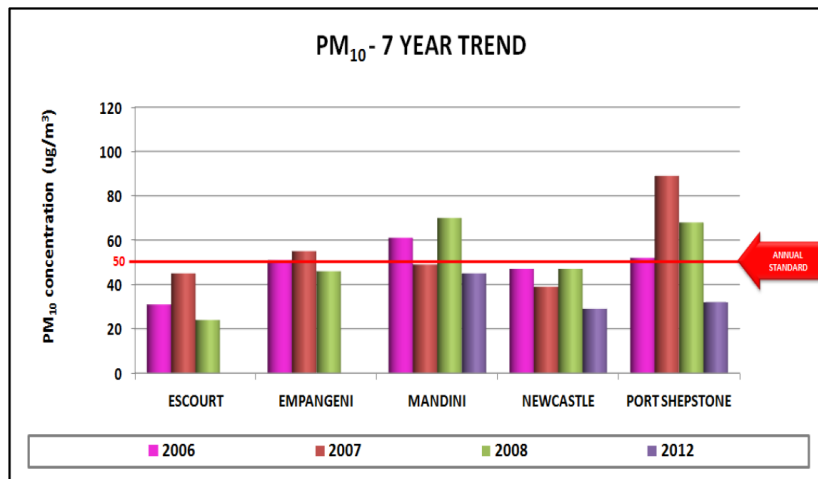


Figure 11: PM₁₀ concentration trend for other areas in KZN –red arrow is current standard
Source: DEA (2013)

4.3.2 SO₂

SO₂ is classified as an industrial pollutant, with large-scale fossil fuel combustion contributing significantly to ambient pollutant loading. Anthropogenic sources dominate the emission profile and several areas of concern are observed across the Province.

An 11-year trend is available for SO₂ concentrations in eThekweni Municipality, which highlights the major progress made in pollution management for SO₂ by the Municipality (Figure 12). Annual concentrations have decreased markedly in the South Durban area, where monitoring is focussed. The Scheduled Trade and Atmospheric Emission Licensing permitting systems are credited with assisting in management of large emitters in South Durban (DEA, 2016).

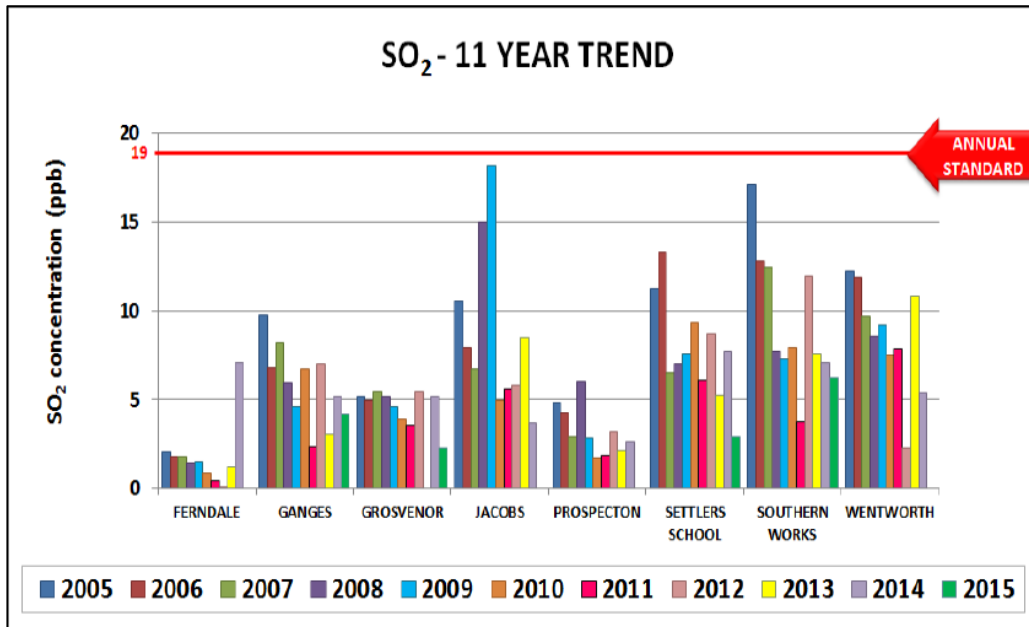


Figure 12: SO₂ concentration trend for eThekweni – the red arrow shows current standard
Source: DEA (2016)

SO₂ concentrations in Richards Bay reflect a similar trend to eThekweni Municipality, with reductions in ambient levels observed in the industrial areas of the town (Figure 13). Elevated concentrations are only observed in industrial areas, using annual average concentrations. These indicate low long-term, or chronic, exposure levels. No exceedances are recorded for the observation period.

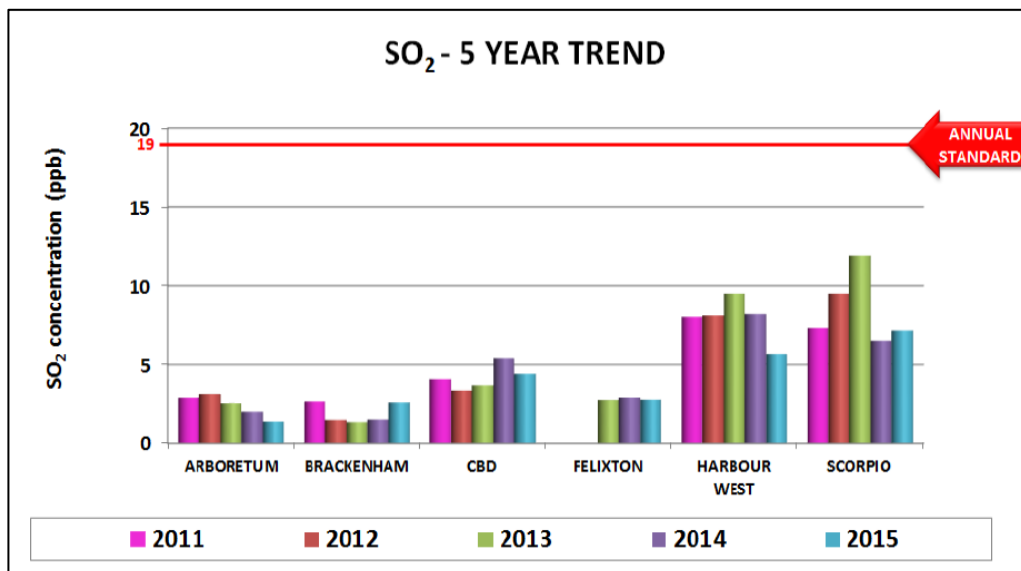


Figure 13: SO₂ concentration trend for Richards Bay – the red arrow shows current standard
Source: DEA (2016)

Limited monitoring data are available for other areas of the Province through the EDTEA network, as stations were operational for intermittent periods during this time (Figure 14). Monitoring data show that SO₂ concentrations are of concern in Estcourt, Newcastle and Pietermaritzburg, with exceedances or elevated concentrations recorded in these areas. Empangeni and Mandini recorded low concentrations.

SO₂ concentration trends show a few areas of concern across the Province. Large reductions in ambient concentrations are observed in South Durban, and limited exceedances observed in other areas across the Province. Successful management interventions, at local and national level, have contributed to overall lower ambient levels of SO₂.

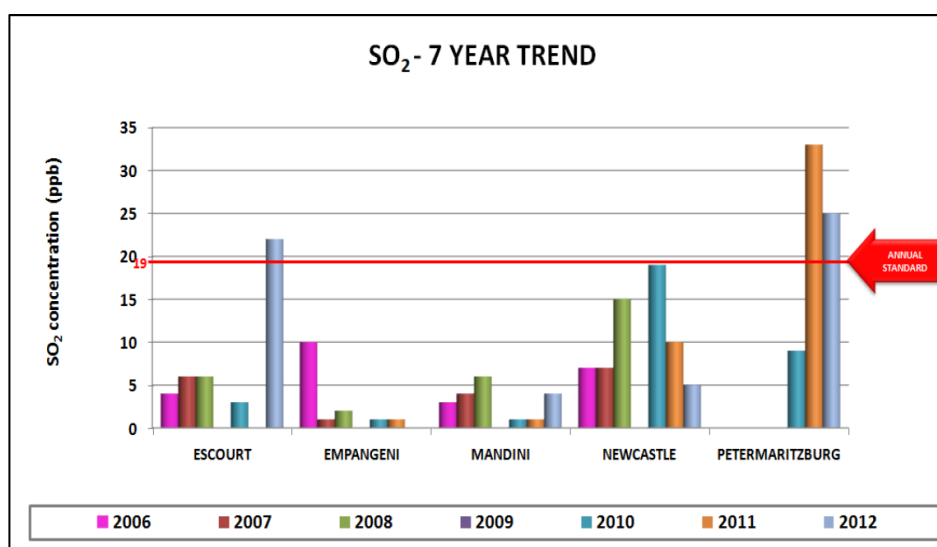


Figure 14: SO₂ concentration trend for other areas in KZN – the red arrow shows current standard
Source: DEA (2013)

4.3.3 NO₂

NO₂ concentrations are not routinely reported on by the DEA in its state of air reporting, but eThekweni Municipality has included ambient monitoring data in the baseline assessment (Figure 15). NO₂ is largely associated with traffic sources, but large-scale fossil fuel combustion also contributes to ambient pollutant levels. Traffic-influenced monitoring sites in eThekweni Municipality show elevated concentrations of NO₂, with exceedances recorded across the monitoring period. Some industrial sites also reflect high NO₂ concentrations. NO₂ is regarded as a new and emerging pollutant of interest, as traffic-related pollution increases in the Province. Data are not available for other urban centres of the Province. Management intervention is needed for assessing NO₂ concentrations in other areas.

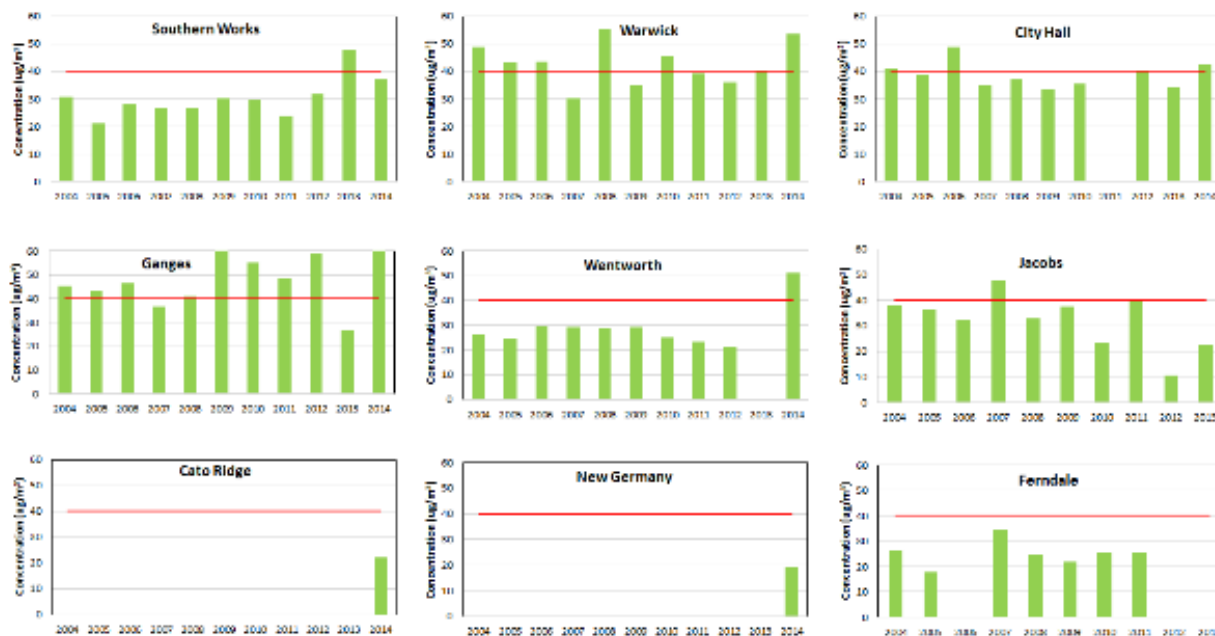


Figure 15: NO₂ concentrations for eThekweni Municipality – the red line shows current standard
Source: uMoya-NILU (2015)

4.4 Impacts

Studies related to air quality impacts are severely limited in KZN, with health studies only available for South Durban and Richards Bay (as discussed in Section 4.4.1). No province-specific ecological studies have been published to date. A general list of human health issues and the environmental factors linked to them is included to support the link between air quality and health and ecological impacts (Table 13). These health issues, caused or exacerbated by pollutants in the air, reflect the vulnerability of people that need to cope with, or are susceptible to, the adverse impacts of poor air quality.

Table 13: Impacts of poor air quality on human health

Human health	Environment
Upper and lower respiratory tract infections	Increased temperatures
Asthma and increased airway resistance	Acidification
Nausea and headaches	Eutrophication
Skin allergies	Photochemical smog
Neurological and renal impairment	Deposition on foliage
Tissue hypoxia	Soiling of buildings
Cancer	Oxidation of materials and structures
Ischemic heart disease	
Death	

4.4.1 Health

National ambient air quality standards have been published for several pollutants using health-related criteria (Table 14). Each standard consists of a limit value and a permitted frequency of exceedance or tolerance. Compliance with the ambient standard implies that ambient concentrations should be below the limit value and the frequency of exceedances (of

ambient concentrations) should not exceed the permitted tolerance. As the standards are based on health-related criteria, this implies that pollutant ambient concentrations that are lower than the ambient standard present a lower health risk.

Table 14: Ambient air quality standards for some pollutants

Pollutant	Averaging period	Limit value ($\mu\text{g}/\text{m}^3$)	Number of exceedances per annum
SO₂	1 hour	350	88
	24 hours	125	4
	1 year	50	0
NO₂	1 hour	200	88
	1 year	40	0
PM₁₀	24 hours	75	4
	1 year	40	0
PM_{2.5}	24 hours	40	4
		25 ¹	4
	1 year	20	0
		15 ¹	0
O₃	8 hours	120	11
Benzene	1 year	5	0
Lead	1 year	5	0
CO	1 hour	30	88
	8 hours	10	11

¹: Effective date is 1 January 2030. Sources: DEA (2009, 2012b)

eThekweni health study

An epidemiological study conducted in South Durban focussed on respiratory health and related chronic diseases, as well as the relationship between health and ambient air pollution. Ambient concentrations showed marked elevations, with exceedances of SO₂ and Benzene in the southern areas of Durban and with elevated particulate matter across the study areas. Persistent asthma was observed among 12% of children in the south, and was higher in the south than in the north (uMoya-NILU, 2015). Marked airway hyper-responsiveness is a marker of significant asthma and was shown to be three times higher in the south than in the north.

Richards Bay health study

The Richards Bay health study used questionnaires, medical records from local clinics, spirometer tests (lung functionality tests), ambient monitoring and dispersion modelling to collect (GES, 2013). Upper respiratory tract infection (URTI) affected 12% of patients at the Richards Bay and Mandlanzini clinics between 2009 and 2011. The trends in URTI cases indicated that coughing, chest pains, wheezing, flu, fever, headaches and asthma are the most prevalent URTI symptoms recorded from the Richards Bay communities between 2009 and 2011. The spirometer tests showed that the majority of respondents were classified as having normal respiration (60%), with obstructive respiration in 30% of respondents and the balance associated with restrictive respiration. Ambient concentrations of PM₁₀, NO₂ and SO₂ were generally low relative to the National Ambient Air Quality Standards (NAAQS). Furthermore, the dominant source of energy in Richards Bay is electricity (78%), with wood (3%) and paraffin (2%) being the next most used single fuel types. Using dispersion simulations, geospatial assessments and available air quality measurements, four priority geographical areas in which air pollution can be expected to have the greatest impact on health were identified. The

largest area was around the Richards Bay industrial area, with Felixton, around Empangeni and the area just south of Nseleni the other three areas identified.

4.5 Responses

Responses to air quality issues in the Province largely focus on regulation and, in particular, the implementation of NEMAQA. Functions are used to indicate management response include air quality management planning, monitoring of ambient air quality and the issuing of atmospheric emission licences (AELs).

4.5.1 Air quality management planning

The AQMP is a fundamental tool for air quality management in NEMAQA and the National Framework for Air Quality Management. Municipal and provincial environmental authorities have a legal responsibility to develop AQMPs to guide air quality management practices and the implementation of NEMAQA. AQMP development and implementation can be used as an indication of management response to air quality issues in the Province. The plan provides a framework within which to harmonise management activities and chart a strategic direction for air quality objectives.

SAAQIS (2016) indicates that three municipalities in the Province have progressed toward AQMP development (Figure 16). These are eThekweni, UThungulu and Ugu. In addition to the information provided by SAAQIS in Figure 16, Ugu and uMgungundlovu developed AQMPs in 2013, which is not shown in the figure (see Table 15 instead). The EDTEA is still awaiting the development of an AQMP. The detailed status of AQMP implementation is not reported publicly and therefore no further comment can be added on success of implementation.

Stronger focus is needed on the development and implementation of AQMPs to guide air quality management activities by environmental authorities. Oversight of implementation by national and provincial authorities will serve to strengthen cooperative governance and provide much-needed guidance and management input.

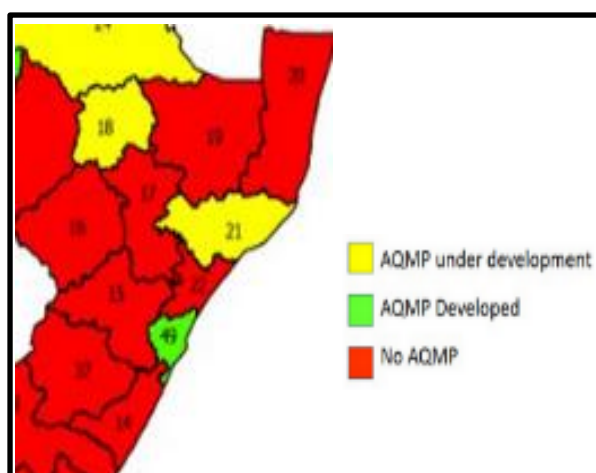


Figure 16: Status of AQMP development²⁸

Source: SAAQIS (2016)

Table 15: AQMP development status

²⁸ Ugu District Municipality (14) developed an AQMP in 2013 that is not shown on the map.

AQMP status	Municipality
No AQMP	Ilembe, uMkhanyakude, Harry Gwala, uThukela, uMzinyathi, Zululand
In process of development	Amajuba
Developed, awaiting implementation	uThungulu, Ugu, uMgungundlovu
Reviewed and awaiting Council approval	eThekwini

4.5.2 Ambient air quality monitoring

Ambient air quality monitoring is essential for describing the state of air quality and for identifying trends for predicting future air quality. Monitoring provides insight into ambient concentrations in an area and accurate measurements allow for confident policy- and decision-making. Three major continuous monitoring networks were reported during the period of study: eThekwini Municipality, the EDTEA and the Richards Bay Clean Air Association. Government-owned monitoring stations are limited in coverage for the Province (Figure 17, **Error! Reference source not found.**), with concentrated networks in Durban, Richards Bay and Pietermaritzburg and stations in smaller urban centres. Stations operated by the Msunduzi and City of uMhlatuze municipalities were not reported on in the 2015 State of Air Report. eThekwini Municipality's network is concentrated in South Durban, with recent expansion to the west and north. The EDTEA is conducting ambient monitoring surveys using dust fallout buckets and passive samplers for SO₂, NO₂, H₂S, and benzene, toluene, ethylbenzene and xylene (BTEX). It aims to acquire baseline air quality data for areas where no or few air quality data exist. Funding and technical challenges are major impediments to monitoring operations. The DEA is therefore developing an ambient monitoring strategy with norms and standards for ambient air quality monitoring.

Table 16: Government-owned monitoring stations

Station owner	Locations
EDTEA	Port Shepstone, Stanger, Empangeni, Pietermaritzburg, Newcastle, Estcourt
City of uMhlatuze	Arboretum, Brackenham, Esikhaleni
Msunduzi	Pietermaritzburg CBD, Oribi
eThekwini	Wentworth, Southern Works, Settlers, Jacobs Balfour, New Germany, Prospection, Cato Ridge, Ganges, Alverstone, City Hall, Grosvenor, Warwick Avenue, Hambanati, Amanzimtoti

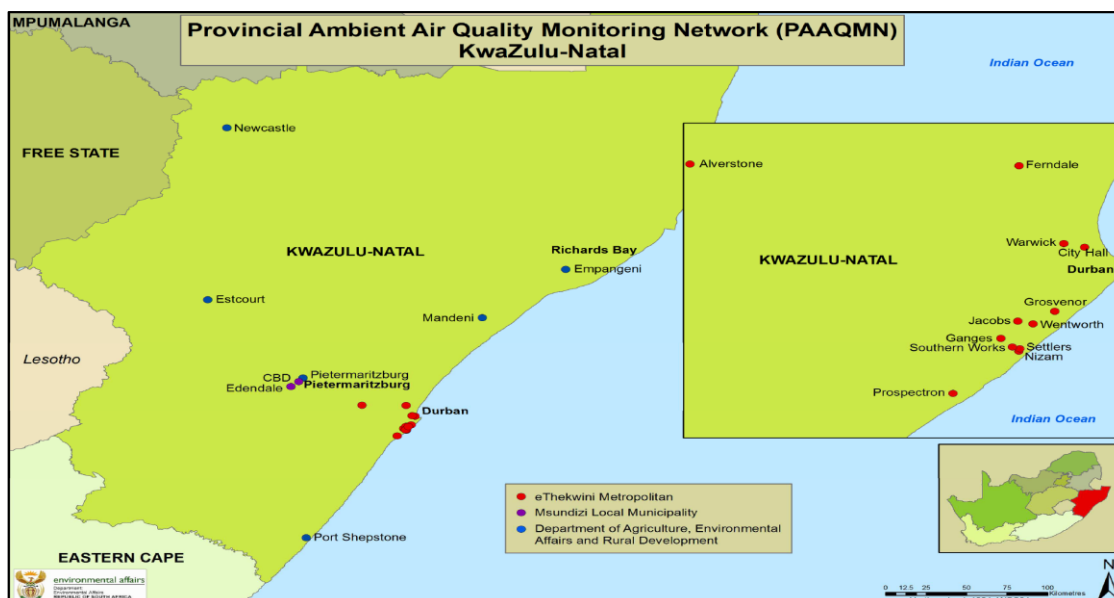


Figure 17: Government-owned station locations²⁹

Source: DEA (2011)

4.5.3 Atmospheric emission licencing

The issuing of AELs is used to control the emission profile of large industrial emitters. These include large boilers (>50MW), metallurgical and chemical processes, storage units, as well as specific waste management activities. Several AELs have been handled in the Province, concentrated in the larger more industrialised municipalities (Table 17).

Table 17: Licensing progress by municipalities in 2014

District	Number of AELs
uMgungundlovu	28
Ilembe	3
eThekwini	9
Harry Gwala	2
Amajuba	10

Source: DEA (2015)

4.6 Conclusion and Recommendations

In assessing trends regarding the issues identified in the 2004 Air Quality Outlook, it is apparent that SO₂ ambient concentrations continue to decrease in central Durban, but that concentrations in Pietermaritzburg show a marked increase in comparison with the ambient standard. The areas of local concern identified continue to require air quality management intervention. The promulgation of NEMAQA in 2004 heralded a new era, introducing international best practice, including the devolution of responsibility to local government and effects-based management. Ambient monitoring coverage and accuracy have improved significantly, allowing for stronger decision-making to take place. Industrial controls have also improved through the introduction of several legislative procedures for measuring, controlling

²⁹ eThekweni Municipality has decommissioned the Ferndale and Nizam Stations, and has commissioned stations in New Germany, Hambanati, Cato Ridge and Amanzimtoti and will shortly in Umkomaas.

and reporting emissions. The link between air quality and health in the Province has been strengthened but data paucity remains an issue across KZN.

The current Outlook reveals that the transport sector is a significant and growing polluter and that industrial and commercial emitters, biomass burning and domestic fuel burning are ongoing concerns. From the monitoring data available, elevated PM₁₀ concentrations are observed in most major urban centres. Background sites also reflect an elevated PM₁₀ baseline. SO₂ concentration trends show few areas of concern, but elevated NO₂ concentrations are observed in the high traffic areas of eThekweni Municipality. Limited data are available for other areas. NO₂ is regarded as a new and emerging pollutant of interest as traffic-related pollution increases in the Province.

For the current Air Quality Outlook, challenges include limited political will, lack of communication, the limited use of planning tools and a non-strategic approach to air quality management. The limitations result in a lack of implementation of responses, which may result in unrestricted growth of sectoral emissions. Limited monitoring makes it easier for ambient air quality standard exceedances to slip by, such as emissions of NO₂, PM₁₀ and, to a lesser extent, SO₂ and VOC. Consequently, this will put an increased health burden on communities located in proximity to large industries, open and agricultural areas, busy roadways and low-income settlements. The expected publication of the National Framework for Air Quality Management can provide guidance to all levels of government on improving implementation.

The following recommendations are provided for strengthening the Air Quality Outlook and for meeting future air quality goals:

- i. AQMPs should be developed for all district municipalities and for the EDTEA;
- ii. Oversight of AQMP implementation should be undertaken by national and provincial environmental authorities;
- iii. Data coverage and reporting for ambient air quality concentrations across the Province should be improved; and
- iv. Technical training on and financial assistance for ambient air quality monitoring should be provided.

4.7 References

Department of Agriculture, Environmental Affairs and Rural Development (DAEA&RD). 2010. KwaZulu-Natal State of Environment Report 2004, KwaZulu-Natal Provincial Government, Pietermaritzburg.

Department of Agriculture, Environmental Affairs and Rural Development in KwaZulu-Natal (DAEA&RD). 2011a. Guideline for the burning of sugarcane in KwaZulu-Natal, Final Report – September 2011.

Department of Agriculture, Environmental Affairs and Rural Development in KwaZulu-Natal (DAEA&RD). 2011b. Development of norms, standards and guidelines including a regulatory framework for the burning of sugar cane in KwaZulu-Natal, Phase 1 – status quo. Final Report – March 2011.

- Department of Environmental Affairs (DEA). 2016. State of Air Report and National Air Quality Indicator. Session 1.3, Monday, 03 October 2016, 11th Air Quality Governance Lekgotla, Mbombela.
- Department of Environmental Affairs (DEA). 2015. 2014 National Air Quality Officer's Annual Report on Air Quality Management. March 2015.
- Department of Environmental Affairs (DEA). 2014. DEA Table 24 Ground Truthing Report.
- Department of Environmental Affairs (DEA). 2013. State of Air Report and National Air Quality Indicator. Session 1.3, 8th Annual Air Quality Governance Lekgotla, 30 September 2013. Cape Town International Convention Centre.
- Department of Environmental Affairs (DEA). 2012b. National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micrometres. Notice 486, 29 June 2012, Government Gazette, 35463.
- Department of Environmental Affairs (DEA). 2012a. Integrated Strategy for the Control of Motor Vehicle Emissions, Draft.
- Department of Environmental Affairs (DEA). 2011. Baseline Survey on Government-Owned Air Quality Monitoring Networks (AQMN). Final Report, August 2011.
- Department of Environmental Affairs (DEA). 2009. National Ambient Air Quality Standards, Vol. Notice 1210, 24 December 2009, Government Gazette, 32861.
- Department of Transport. 2011. Strategic Transportation Projects, 13-14 June 2011, Investor's Conference.
- eThekwini Municipality. 2014. Report to Community and Emergency Services Committee, Air Quality Management within the eThekwini Municipal Area, Quarter 1 January 2014 to 31 March 2014.
- eThekwini Municipality. 2009. eThekwini Air Quality Monitoring Network Annual Report.
- Gondwana Environmental Solutions (GES). 2013. Air Quality Monitoring and Health Impact Assessment Study of the Richards Bay Area, Report prepared for KZN Department of Agriculture, Environment And Rural Development, RN_130535_KZN, 12 November 2013.
- Golder Associates. 2015. Annual Ambient Air Quality Monitoring and Dispersion Modelling Report. Report Number. 12614846-13412-33.
- Josipovic, M., Annegarn, H., Kneen, M., Pienaar, J. and Piketh, S. 2009. Concentrations, distributions and critical level exceedance assessment of SO₂, NO₂ and O₃ in South Africa. *Environmental Monitoring and Assessment*, 171(1):181196. DOI: 10.1007/s10661-009-1270-5.
- National Planning Commission. 2015. National Development Plan 2030. *Our Future-make it work*.
- SAAQIS. 2016. Air quality planning. Retrieved from: <http://www.saaqis.org.za/AQPlanning01.aspx>. Accessed on 9 March 2016.

uMoya-NILU. 2015. eThekweni Municipality AQMP Review and Update: Baseline Assessment, Final Report No. uMN032-15, 14 August 2015.

uMoya-NILU. 2013. Air Quality Management Plan for the uThungulu District Municipality: Output A: *Status Quo* Assessment, Report No. uMN028-2013.

uMoya-NILU. 2012. Air Quality Management Plan for the Ugu District Municipality 2013, Report No. uMN016-2012.

World Health Organization. 2013. Health effects of particulate matter. Policy implications for countries in Eastern Europe, Caucasus and central Asia.

Zanokuhle Environmental Services. 2015. KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs (EDTEA) Ambient Monitoring Annual Report, June 2014 – June 2015.

Zunckel, M. & Perumal, S. 2015. EThekweni Municipality AQMP Review and Update: AQMP Goals and Implementation Plan.



Photo credit: Greg Martindale

5. Biodiversity and Ecosystem Health

5.1 Introduction

Biodiversity is defined in the National Environmental Management: Biodiversity Act (Act No. 10 of 2004 – NEMBA) as “the variability among living organisms ... and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems”. Biodiversity is the foundation that supports all living organisms, including human survival. Functioning ecosystems with intact biodiversity are resilient to external shocks, such as drought and floods. These ecosystems reduce people’s vulnerability and prevent damage to and loss of economic infrastructure. Most of KwaZulu-Natal (KZN) falls within the Maputaland-Pondoland-Albany Hotspot, a globally recognised biodiversity hotspot (Figure 18).



Figure 18: The Maputaland-Pondoland-Albany Hotspot

South Africa has an array of legislation that addresses various aspects of biodiversity and ecosystem health (Table 18). To measure the biodiversity trends in the Province, several indicators have been developed. These are outlined in Table 19.

Table 18: Legislative framework for ecosystem health in South Africa and KZN

Year	Legislation	Type	Relevance to biodiversity and ecosystem health
1983	Conservation of Agricultural Resources Act (CARA)	Act	Act No. 43 of 1983: Provides controls for the utilisation of agricultural resources to promote the conservation of soil, water and vegetation, and for combatting invasive alien plants.
1996	Constitution of the Republic of South Africa	Act	Act No. 108 of 1996: The supreme law of the country, which provides for specific

Year	Legislation	Type	Relevance to biodiversity and ecosystem health
			environmental rights under section 24, including: <ul style="list-style-type: none"> The right to an environment that is not harmful to health or well-being. The right to have the environment protected for present and future generations to prevent ecological degradation, and promote conservation and ecologically sustainable development.
1997	KwaZulu-Natal Nature Conservation Management Act	Act	Act No. 9 of 1997: Provides the institutional structure for conservation in KwaZulu-Natal and establishes control and monitoring bodies, including the KZN Nature Conservation Board and the KZN Nature Conservation Service (Ezemvelo KZN Wildlife).
1998	National Water Act	Act	Act No. 36 of 1998: Provides for the protection, management and use of South Africa's water resources and includes a provision for an ecological reserve which guarantees a minimum flow of water to maintain critical ecological processes.
1998	National Forests Act	Act	Act No. 84 of 1998: Provides for the protection and management of natural forests, including provisions for specially protected areas such as forest nature reserves and forest wilderness areas.
1998	National Veld and Forest Fire Act	Act	Act No. 101 of 1998: Provides for the prevention and combatting of veld, forest and mountain fires.
1998	National Environmental Management Act (NEMA)	Act	Act No. 107 of 1998: Provides the general framework for environmental management in South Africa.
2003	National Environmental Management: Protected Areas Act (NEMPAA)	Act	Act No. 57 of 2003: Provides for the protection and conservation of ecologically viable areas representative of South Africa's biodiversity and its natural landscapes and seascapes.
2004	National Environmental Management: Biodiversity Act (NEMBA)	Act	Act No. 10 of 2004: Provides for the management and conservation of South Africa's biodiversity within the framework of NEMA.

Table 19: Indicators used in the assessment of the biodiversity in KwaZulu-Natal

Indicators	Description and/or comments
Existing biodiversity/conservation planning maps and plans	Systematic conservation (biodiversity) planning is a means of efficiently and effectively identifying the highest priority biodiversity values in a landscape in an effort to inform spatial planning and the design of protected areas.

Indicators	Description and/or comments
Extent of protected areas (ha)	Areas that are formally protected through declaration in terms of legislation and that fall under the definition of a protected area as described in terms of section 9 of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003).
Extent of natural areas remaining (ha)	The area of KZN that has not been irreversibly modified through anthropogenic activity such as agriculture, the development of plantation forestry, mining and urbanisation.
Vegetation types, threat and protection status of vegetation types (ha)	Biomes and the vegetation types within them are useful indicators of different habitat types within KZN. Their threat and protection status is also an indicator of how representative the protected area system is.
Habitat fragmentation (% remaining habitat)	Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into a greater number of smaller patches of lower total area, isolated from each other by a matrix of dissimilar habitats.
Invasive alien species	Invasive alien species are plants, animals, pathogens and other organisms that are not indigenous to an ecosystem and that may cause economic or environmental harm or adversely affect human health.
Status of terrestrial ecosystems (ha)	A number of ecosystems within KZN have been classified as threatened by SANBI in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).
Status of river/aquatic ecosystems (present ecological state)	A river or aquatic ecosystem is an ecosystem that includes communities of plants, animals and micro-organisms that are linked by energy and nutrient flows and that interact with each other and with the physical environment.
Population trends of selected species	Species that are threatened or extinct and species that are being illegally over-exploited for financial gain.
Status of conserved areas (including Important Bird Areas) (ha)	

5.2 Drivers

The drivers of biodiversity loss have not changed since the 2004 KZN State of Environment Report (SoER) and are related to an increasing population, high levels of rural poverty and unemployment. These have led to an increasing demand for natural resources and for land for agricultural, urban and industrial development; mining; and plantation forestry. These drivers are exacerbated by poor land-use planning, which leads to the sprawl of settlements, and by land-use practices that contribute to land degradation, soil erosion and siltation, as well as sedimentation of rivers and wetlands. Invasive alien plant infestations also contribute to biodiversity loss through the degradation and loss of natural habitat. Climate change may further magnify the impacts of these drivers. There is also limited understanding, within government and society, of the environment and the role that it plays in sustaining human livelihoods. As a result, efforts to achieve economic development are often at odds with the protection of the environment. In certain cases, where mining and mineral exploitation are prioritised over other land uses, this may result in permanent detrimental impacts. Using land for mining may undermine alternative sustainable land uses that make considerable contributions to economic development, job creation, service provision, food security and human well-being.

5.3 Pressures

The drivers of biodiversity loss lead to a loss of ecological integrity and resilience associated with:

- i. the modification, permanent loss and fragmentation of natural habitat;
- ii. land degradation; and
- iii. pollution of the environment.

The resultant direct effects of this are:

- i. a loss of species composition, variability and connectivity;
- ii. a loss of plant cover and soil, resulting in land degradation;
- iii. compromised ecological functions within both terrestrial and aquatic systems;
- iv. impacts on water and air quality; and
- v. the extinction or local extirpation of species.

These factors compromise society's ability to gain benefits from natural resources and make it more vulnerable to episodic events such as droughts and floods. As a result, critical natural processes may no longer be able to meet society's needs, which would include:

- i. the provision of suitable quantities and quality of water;
- ii. the maintenance of air quality and its impacts on human health;
- iii. the maintenance of arable soils for crop production;
- iv. sufficient fodder to sustain livestock production; and
- v. other impacts on ecological processes such as pollination, pest control, disease resistance and disaster risk mitigation.

5.4 State

5.4.1 Biodiversity/conservation planning

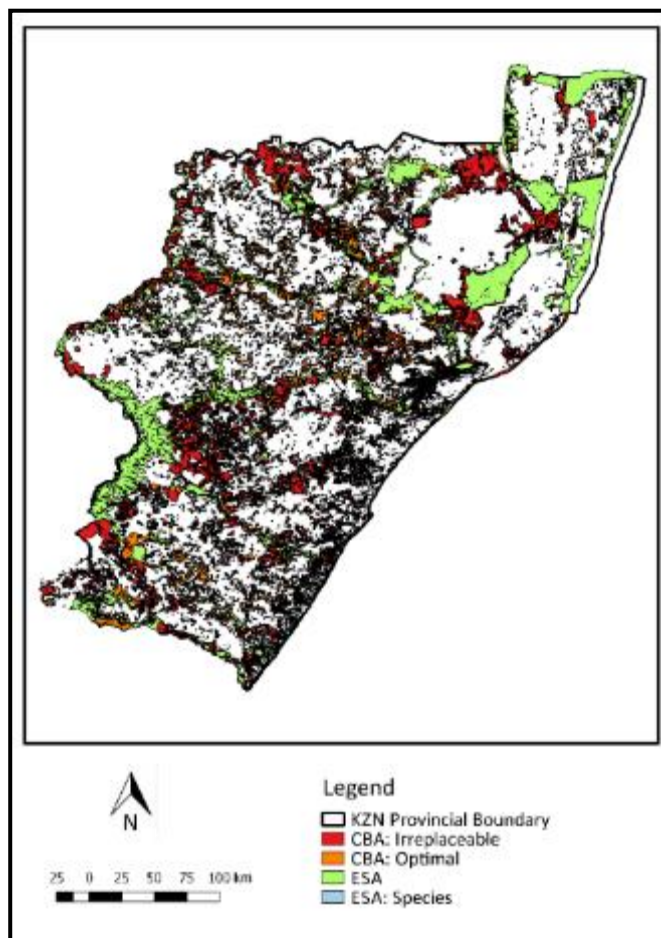
The KZN Systematic Biodiversity Plan (Ezemvelo, 2010) is the primary tool for biodiversity planning in the Province. This plan (Ezemvelo, 2010) identifies a series of area categories (Table 20, Figure 19) as follows:

- i. Critical Biodiversity Area: Irreplaceable - These are the only localities for which conservation targets for biodiversity features can be achieved;
- ii. Critical Biodiversity Area: Optimal – These are areas that represent the best localities that are optimally located to meet conservation targets;
- iii. Ecological Support Areas – These areas are required to support and sustain the ecological functioning of Critical Biodiversity Areas; and
- iv. Ecological Support Areas: Species – These are areas required for the persistence of species.

Table 20: Critical biodiversity areas in KwaZulu-Natal

Categories	Percentage of province
Critical Biodiversity Area: Irreplaceable	14.9%
Critical Biodiversity Area: Optimal	11.3%
Ecological support areas	18.5%

Source: Ezemvelo (2010)

**Figure 19: KZN Systematic Biodiversity Plan**

Source: Ezemvelo (2010)

5.4.2 Extent of protected areas

In 2007, it was estimated that approximately 53% of the biodiversity in KZN was located outside of state-protected areas on private and communal land (Wakelin, Goodman, and Porter, 2007). To address this, the KZN Protected Area Expansion Strategy identified a 20-year target to secure an additional 842 400 ha by 2028 (Carbutt and Escott, 2010). Since then, 41 new protected areas, covering an area of 111 163 ha, have been declared in terms of NEMPAA, primarily through the KZN Biodiversity Stewardship Programme. This equates to an addition to the Province's protected area system of approximately 1%, meaning that the current extent of protected areas in KZN is approximately 9% of the terrestrial surface area (Figure 20, Table 21).

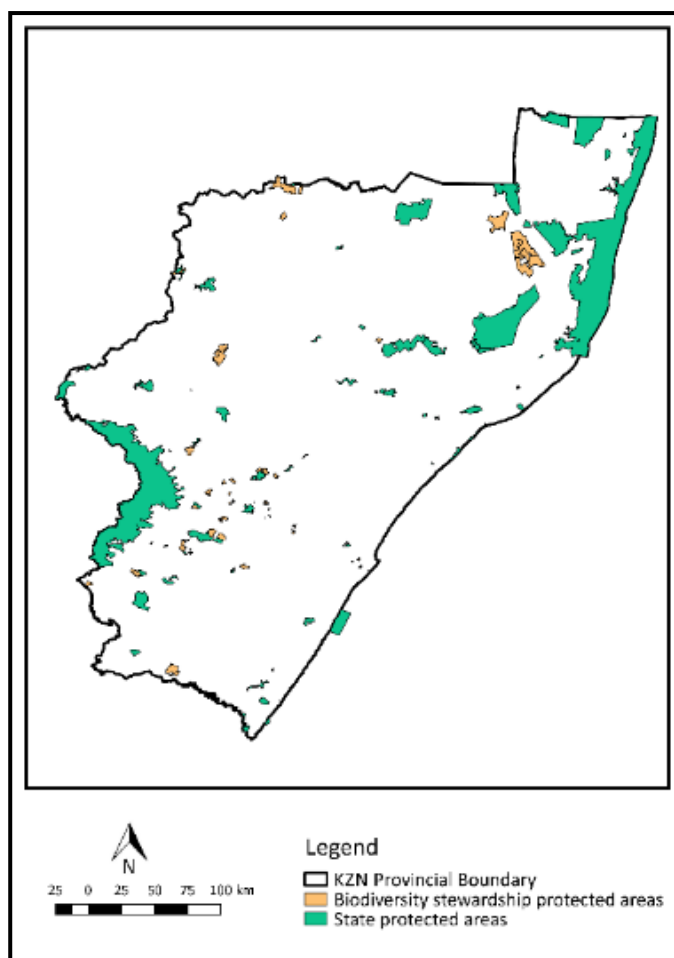


Figure 20: Protected areas in KwaZulu-Natal

Source: Ezemvelo (2010)

Table 21: The area of KwaZulu-Natal within the formal protected area system

	State managed	Private and communal	Total area declared
Area (ha)	724 984	111 163	836 147
Area (percentage)	7.68	1.18	8.86

Source: Ezemvelo (2010)

The 5-year target for protected area expansion was to secure an area of 210 600 ha by 2013. This target was not achieved but negotiations are underway to secure 20 additional areas, adding a total area in excess of 150 000 ha. The declaration of these areas will bring the total extent of the protected area system in KZN to 986 147 ha or approximately 10.4% of the Province's terrestrial surface area. This will still be short of the 20-year protected area expansion target of 17%, which will require a dedicated effort and the provision of significant resources and capacity for it to be achieved.

5.4.3 Extent of natural areas remaining

KZN has been rapidly losing natural habitat since formal monitoring began in 1994 (Figure 21). The average annual area of natural habitat lost is 109 906 ha, which equates to 1.16% of the terrestrial area of KZN (Jewitt, 2014).

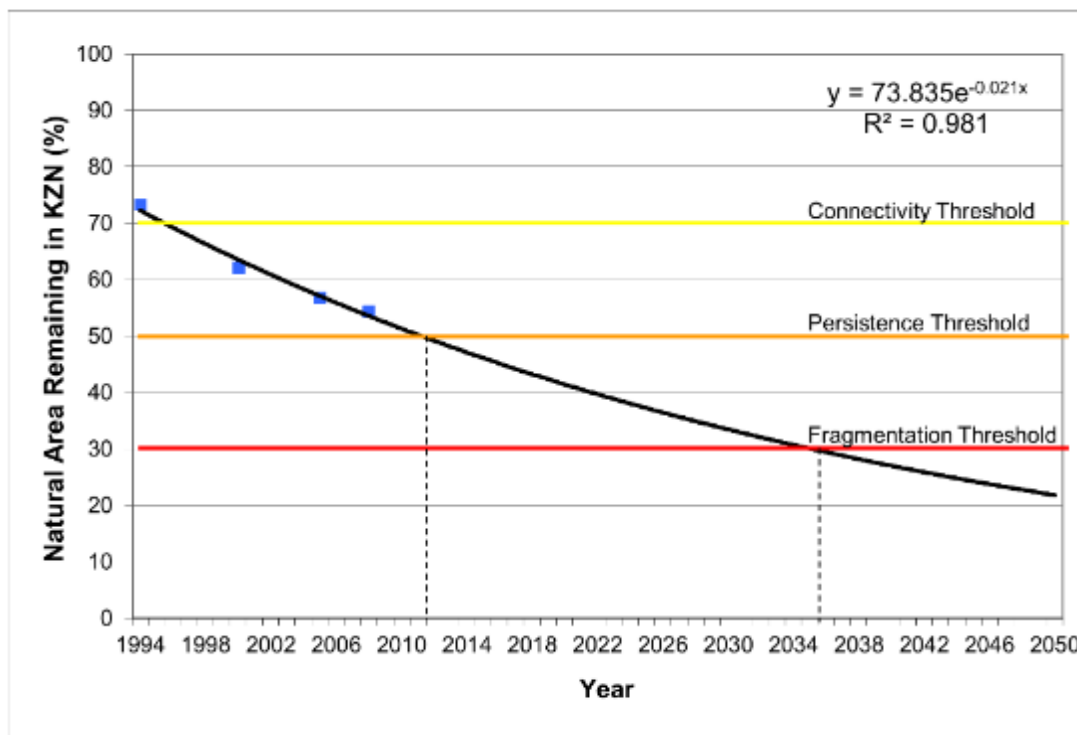


Figure 21: Proportion of natural habitat remaining in KZN and associated ecological thresholds

Source: Jewitt (2014)

The rate of loss of natural habitat, species richness and ecosystem function in KZN is one of the most alarming issues related to the Province's biodiversity. By 2011, the amount of natural habitat remaining in KZN, once modified³⁰ and with secondary habitat removed, was 53.6% of its surface area (Jewitt, 2014). This contrasts with the 2004 SoER, which indicates the remaining natural habitat as 66%. This means that over 12% of the Province's natural habitat has been lost since then. The continued loss of natural habitat means that natural areas will become too small and isolated from each other to continue to maintain viable populations of species (Jewitt, 2014). This will ultimately lead to species extinction and the complete loss of critical ecosystem functions.

5.4.4 Habitat fragmentation

Associated with high and accelerating levels of habitat loss is an increasing threat of habitat fragmentation in which remaining patches of natural habitat become increasingly smaller and isolated from each other. As the levels of habitat loss are not spread evenly across the Province, it is likely that some habitat types have become more fragmented than others, where urbanisation and development levels have led to the considerable loss of natural habitat and fragmentation. This increases the likelihood of extinction of species.

³⁰ Modified habitat is habitat that is considered to have been permanently lost through the development of built infrastructure, agricultural development or planting to commercial forestry.

5.4.5 Vegetation types, and protection status of vegetation types

The threat status of vegetation in KZN reflects high population densities and agricultural development along the coastline compared with inland areas (Figure 22). The highest proportion of critically endangered vegetation is located along the coastline, with pockets of endangered vegetation located further inland. Most of the western interior of the Province is Vulnerable or Least Threatened, as it has not been subject to the same levels of development impact as the coastal areas. The areas of endangered vegetation located inland are associated with extensive development for agriculture and plantation forestry, resulting in the loss of much of their remaining natural extent. Since 1994, there has been a marked increase in the threat status of vegetation types, even with finer-scale mapping that has resulted in an increase in the number of identified vegetation types (Table 22). Although Vulnerable and Endangered vegetation types have remained constant, the number of Critically Endangered vegetation types has increased nearly five-fold since 2004.

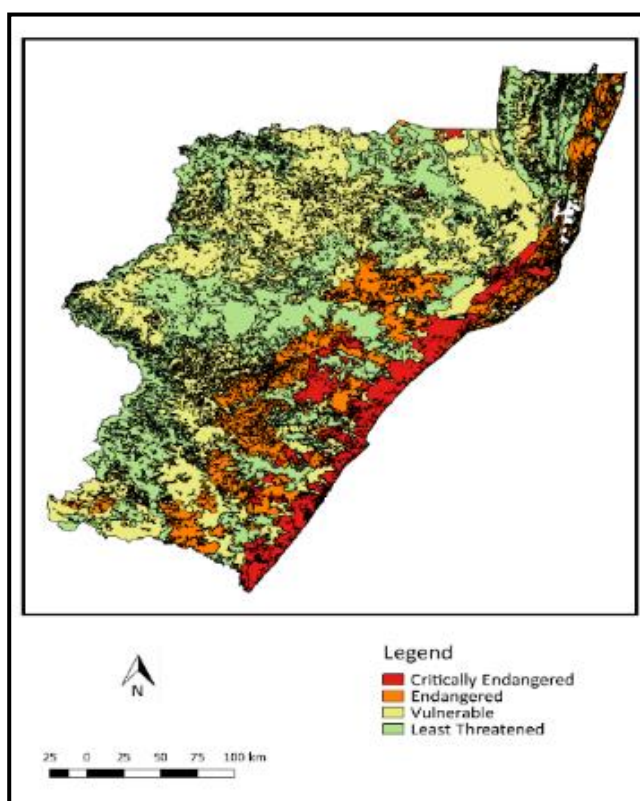


Figure 22: Threat status of vegetation types in KwaZulu-Natal

Source: Ezemvelo (2017)³¹

Table 22: Threat status of vegetation types between 1994 and 2017

Threat status	1994	2000	2017
Critically Endangered	1	4	19
Endangered	16	17	17
Vulnerable	17	18	16
Least Threatened	32	27	50

Source: Ezemvelo (2017)³²

³¹ The authors wish to acknowledge the assistance provided by Mrs Jewitt and Mrs Longmore from Ezemvelo KZN Wildlife in providing data on the threat status of species within KZN.

³² *Ibid.*

5.4.6 Status of terrestrial ecosystems

The first national list of threatened ecosystems for South Africa was gazetted in December 2011 (Table 23). Nearly 20% of KZN's surface area is listed as threatened and the Province is second only to the Western Cape in terms of the number of listed Critically Endangered ecosystems.

Table 23: Threatened ecosystems in KwaZulu-Natal

	Critically Endangered	Endangered	Vulnerable	Total
No. of ecosystems	19	24	59	145
Area (ha)*	224 000	464 000	1 164 000	1 852 000
Percentage of Province	2.4	5.0	12.5	19.9

*Area refers to the remaining natural area

Source: SANBI (2013)

5.4.7 Status of river/aquatic ecosystems

Although KZN receives relatively more rainfall than the rest of South Africa, the amount of water in catchments like the uMngeni River is insufficient to meet demand. Most rivers in KZN are considered moderately modified and some loss and change of natural habitat may have occurred. Several rivers are largely modified and have experienced a considerable loss of natural habitat, biota and basic ecosystem functions. In the case of the uMngeni River system, which is the primary source of water for eThekweni Municipality, there has also been a considerable loss of habitat and ecological function. This has serious implications as the uMngeni River is integral to the economy of the Province. These implications include significantly elevated water treatment costs as the water quality in the uMngeni River system is poor, and altered flow patterns that exacerbate flood and drought conditions.

5.4.8 Invasive alien species

Invasive alien species are introduced species, which may result in economic or environmental harm, or harm to human health. In KZN, invasive alien plants have been estimated to use approximately 5% of the Province's Mean Annual Runoff (MAR) (eThekweni Municipality, 2015). There are a number of invasive alien plant species in KZN that have significant economic implications in terms of the loss of productive land, impacts on ecosystem function and the costs to control and eradicate them (Henderson, 2007).

Invasive alien plants are controlled in terms of CARA and NEMBA. Recent regulations published in terms of the Biodiversity Act require that Category 1A and 1B listed invasive species must be controlled and eradicated. Category 2 plants may only be grown if a permit is obtained and, in terms of Regulation 29, the seller of a property must, prior to the conclusion of the sale agreement, notify the purchaser in writing of the presence of listed invasive alien species on the property.

5.4.9 Population trends of selected species

Associated with losses in habitat, there are concerning trends associated with increasing threats to species. Data on individual species are often difficult to obtain, but a number of

species extinctions have been identified along with the number of currently threatened species in KZN (Table 24).

Table 24: The number of threatened and extinct species in KwaZulu-Natal

Taxonomic group	Critically Endangered	Endangered
Plants	21	> 100
Mammals	0	9
Birds	8	-
Amphibians	4	-

Source: Ezemvelo (2017)³³

In addition to the threats to species associated with habitat loss, there have been significant increases in illegal harvesting of species and poaching. Threats to plants are associated with illegal harvesting for traditional medicinal trade and high value ornamental species like cycads. In addition, three rhinos were poached in 2004 compared to 162 in 2016 (Figure 23). Poaching poses a significant threat to the survival of black and white rhinos, to their security and to economic activities such as tourism, which may be negatively affected by poaching.

KZN TOTAL RHINO POACHING MORTALITIES 01 JANUARY 1990 TO 05 MARCH 2017

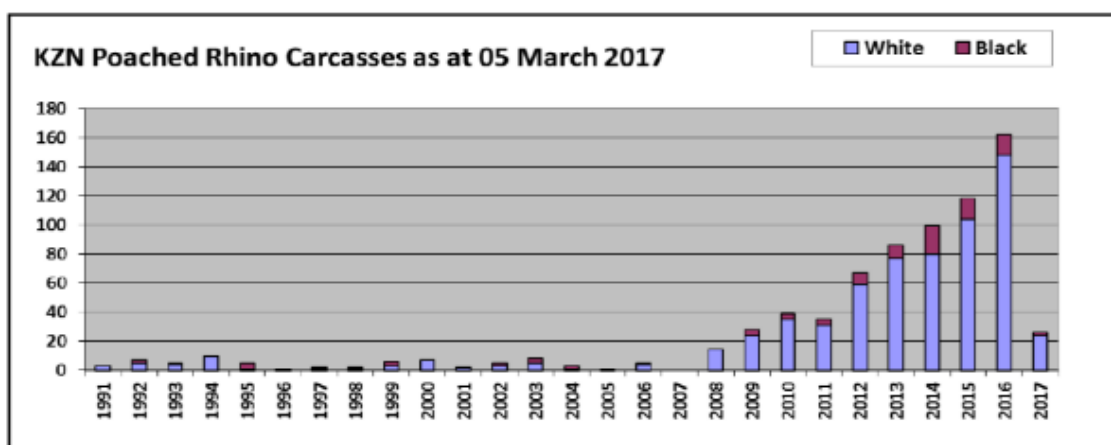


Figure 23: Total rhino poaching mortalities in KZN between 1 January 1990 and 5 March 2017

Source: Project Rhino (2017)³⁴

5.5 Impacts

Impacts that compromise KZN's ecological resilience and integrity have serious implications for society as they hinder government's ability to deliver on key commitments related to a healthy environment, socio-economic development and human well-being.

5.5.1 Loss and fragmentation of natural habitat

Much of KZN's biodiversity lies outside of protected areas. Given the rate of loss of natural habitat and that the extent of protected areas does not meet key targets for protected area coverage, there is a considerable threat of further loss and fragmentation of natural habitat. More than half of the natural habitat in the Province has been lost, excluding levels of

³³ The authors wish to acknowledge the assistance provided by Mrs Jewitt and Mrs Longmore from Ezemvelo KZN Wildlife in providing data on the threat status of species within KZN.

³⁴ Information obtained from the website and staff members of Project Rhino. <http://www.projectrhinokzn.org/>

degradation in what remains. The loss of natural habitat is not evenly spread across the Province, with the greatest losses occurring where the greatest levels of human settlement and industry exist. Further losses of natural habitat will severely compromise biodiversity in the Province and the ability to achieve important economic goals may no longer be possible. The biggest concern is the rate at which natural habitat is being lost, which has averaged over 100 000 ha or 1.1% of the Province every year since 1994 (Jewitt, 2014). This rate is unsustainable and if continued has potentially disastrous consequences for KZN and its people.

5.5.2 Loss of species composition and diversity

Land degradation and the loss of natural habitat lead to changes in species composition and diversity. In areas used for livestock grazing, a loss of species composition and diversity leads to a loss of:

- i. palatable species, which are desirable for grazing;
- ii. grassland productivity and reduced carrying capacity levels, meaning that fewer and fewer animals can be supported by the environment; and
- iii. basal cover in which more soil becomes exposed, altering functions such as water absorption and retention, which ultimately result in accelerated soil erosion.

Accelerated soil erosion results in:

- i. increased sediment and siltation in river systems;
- ii. the curtailing of the life-span of infrastructure required for water use and consumption; and
- iii. a loss of soil carbon and a diminished capacity for such environments to sequester carbon, further exacerbating the impacts of climate change.

5.5.3 Dependence on natural resources

Research on dependence on natural resources has shown how important these resources are to poor rural communities' livelihoods. For example, in Bushbuckridge in Mpumalanga, 94% of households use fuelwood, 94% use wild fruits, 92% use edible herbs and 77% use edible insects (Twine, 2013). Income from this, in the form of cash savings and provisioning, contributes an average of 22% to total household income and this may be two- or three-fold higher in poorer households (Twine, 2013). The availability of natural resources buffers poor households from uncertainty and increases their resilience to shocks (e.g. drought, loss of income or increases in food prices) and stresses (Twine, 2013). Through the degradation and loss of habitat, access to natural resources becomes limited, placing stresses on poor rural communities and the natural resources base that supports them. As a result, pressure is put on government to provide social support to compensate for the loss of natural resources.

5.5.4 Compromised ecological and ecosystem functions

A loss of species composition and diversity impacts on agricultural and urban environments, resulting in an increase in pests, higher levels of invasive alien plant invasions and reduced disease resistance. Other vital functions such as pollination, which is essential for crop production, may be compromised

Box 2: Human vulnerability to environmental changes

Compromised ecological and ecosystem functions make people and society more vulnerable, particularly in the face of increasing extreme events such as drought, flood, fires and ocean storm surges. The poorest in society are usually the most vulnerable to such events, particularly in extremely poor rural areas and on the margins of urban areas in informal settlements.

and of greatest concern is the impact on freshwater resources. The loss of functioning habitat in key watershed areas undermines the role that grasslands and wetlands play in absorbing and slowing the flow of water, reducing flood peak levels in summer and releasing water in the winter months in the form of baseflows. The inability to maintain these functions results in an increase in floods and sedimentation during high rainfall periods and a lack of flow during low rainfall periods, which has severe consequences in a water-stressed province like KZN.

5.5.5 Impacts of invasive alien species

The current level of invasive alien plant infestation in South Africa is estimated to equate to a reduction in water yield of approximately 4% of water use in the country (Marais, 2017). In terms of modelled future levels of infestation, the reduction in yield will rise to approximately 16% of water use (Marais, 2017). This highlights the adverse societal and economic impact that invasive alien species can have in KZN, which already has high levels of infestations. Invasive alien plant species have the potential to impact significantly on the availability of freshwater resources, agricultural production and food security, economic development, human health and livelihoods in KZN.

5.6 Responses

There are strong institutions and a number of innovative programmes that can contribute to halting current losses of natural habitat and habitat fragmentation, which threaten to compromise the province's ecological integrity and resilience severely. For example, the KZN systematic biodiversity plan has enabled a good understanding of the state of the Province's biodiversity and informs planning at district levels. This has, in turn, led to the development of initiatives such as the KZN Biodiversity Stewardship Programme, which has had considerable success in expanding the Province's protected area system. There are also new and emerging initiatives that hold a great deal of promise for biodiversity conservation in the Province.

5.6.1 Biodiversity stewardship

Biodiversity stewardship is a cross-cutting mechanism that addresses a range of biodiversity challenges. It provides a means to secure the investment that government, the private sector

and other role players make in the Biodiversity Economy³⁵, improved rangeland management, and ecological rehabilitation and restoration. Biodiversity stewardship is particularly effective in multiple-use landscapes, where biodiversity priorities may be embedded in a matrix of other land uses. Biodiversity stewardship sites, declared as protected areas:

- i. demonstrate a long-term commitment by landowners to biodiversity conservation and the sustainable management of their land;
- ii. provide a mechanism for securing investments in biodiversity-related projects as biodiversity stewardship includes long-term contractual agreements and oversight mechanisms; and
- iii. are conducive to collaborative approaches, drawing in partners from other areas of government and the NGO sector.

The costs to the state for securing protected areas through biodiversity stewardship are a fraction of the costs of acquiring and managing state-protected areas (SANBI, 2015). Establishing a protected area through biodiversity stewardship costs up to 400 times less per hectare than land acquisition and the cost to the state of supporting the management of a contract protected area is up to 17 times lower than the cost of managing a state-owned protected area (SANBI, 2015). Biodiversity stewardship therefore provides an efficient and cost-effective mechanism for expanding protected areas, securing critical remnant biodiversity and meeting government obligations at a provincial, national and international level.

5.6.2 The Biodiversity Economy

In 2016, a six-week long Biodiversity Economy LAB was undertaken to interrogate and develop the Biodiversity Economy. Biodiversity Economy initiatives seek to develop opportunities in the wildlife industry in an effort to provide meaningful employment and economic development opportunities, whilst enabling adaptation to climate change and the establishment of resilient rural economies.

Activities such as wildlife ranching provide opportunities for employment and business development. This is as wildlife is better adapted than European livestock species to arid savanna environments. A typical commercial wildlife ranch generates approximately 2.5 to 3 times the economic output per hectare of conventional livestock farming (Dry, 2012). Wildlife ranching is also far less dependent on unskilled labour than livestock farming, resulting in training opportunities and the development of significantly better-earning jobs. Wildlife ranching can combine a variety of activities, including tourism, hunting, live game capture and sale, and venison production, which provide the potential for resilient economic development with multiple income streams. Nature-based tourism is a good economic performer with the potential to earn foreign exchange. If properly, planned, designed and implemented, such initiatives may ensure continued access of rural communities to the natural resources on which they rely. As a result, these activities may be largely compatible

³⁵ refers to the part of the economy that is based on commercial or saleable products and services directly derived from ecosystems, habitats, species and genes. Included in this concept are also products derived from the by-product or waste streams from biodiversity management activities such as from alien clearing.

with the maintenance of vital ecosystem goods and services and the sustainable collection of plant-based natural resources, including medicinal plants, thatch, firewood and wild fruits.

Studies and employment statistics associated with wildlife ranching show that, in general, there is a considerable increase in employment levels associated with shifts from conventional livestock agriculture to wildlife ranching (Sims-Castley, 2004; Langholz and Kerley, 2006; Muir, Skowno and Kerley, 2011). Taylor *et al.* (2015) estimate that the wildlife ranching sector in South Africa employs approximately 65 000 people on a permanent basis and a large number of additional workers on a temporary basis. These estimates only include people directly employed on wildlife ranches and exclude those employed directly as a result of activities that are not based or conducted on the ranches themselves.

The South African government has acknowledged the role of the wildlife industry in the land reform and rural development process through the adoption of the Biodiversity Economy Strategy (DEA, 2016). The strategy contains ambitious targets, including:

- i. the creation of 60 000 jobs in the wildlife sector within the next 10 years;
- ii. the establishment of 2 million hectares of communal land restored and developed for conservation and commercial game ranching within 10 years; and
- iii. ownership of 300 000 head of game under black empowered and owned ranches within 10 years.

On the basis of this strategy, the South African government will invest heavily in this sector as part of the land reform and rural development process in the coming years. In KZN, there are great opportunities to undertake Biodiversity Economy initiatives that contribute to socio-economic transformation of the wildlife sector and the achievement of the key government objectives of addressing rural poverty, job creation and economic development whilst securing critical biodiversity and ecological functions.

5.6.3 Improved rangeland management

The ability to derive income from livestock is limited by the production potential of land and land degradation but there is potential for improved rangeland management practices. Examples exist in KZN and the Eastern Cape of community members pooling their herds to manage them collectively. This enables more effective rangeland-management practices, which include:

- i. more effective resting of rangeland, allowing it to recover following grazing and browsing;
- ii. reduced impacts of over-grazing and selective grazing; and
- iii. better use of fire, in conjunction with rest, which enables the control of bush encroachment and the provision of rejuvenated fodder.

5.6.4 Ecological rehabilitation and restoration

Considerable work has been undertaken in KZN through a number of projects, primarily within the DEA's Natural Resource Management Programmes, in ecological restoration and rehabilitation. The focus of this work is on invasive alien plant control, improved rangeland

management, soil conservation and ecological restoration. There is considerable potential for this work to be expanded and better integrated to achieve complementary outcomes. As an example, in areas where community members are highly reliant on firewood for heating and cooking, this has often led to over-harvesting of tree species, which, in turn, has led to habitat degradation. In contrast, in many areas subject to heavy infestations of woody invasive alien plant species, such as wattle, it would make sense to link these issues. This would allow the wattle that is being removed to be utilised for the production of charcoal, which could then be supplied to poor rural people, at a subsidised rate, to meet their cooking and heating needs. A market for the wattle being harvested would be created whilst the pressure on natural vegetation to supply firewood for heating and cooking needs would be alleviated.

5.6.5 Focus on ecological infrastructure

Through the National Development Plan (NDP), the South African government has identified 18 Strategic Infrastructure Projects (SIPs) that focus on the development of conventional infrastructure. An additional SIP has been included, which focusses on the protection of ecological infrastructure to alleviate the need for further built infrastructure and address issues such as disaster risk mitigation. The focus of this is strongly on protecting strategically important water catchments. Within KZN, SIP 19 is supported through the creation of the uMngeni Ecological Infrastructure Partnership, which brings together key role players in local, provincial and national government, as well as NGOs and private sector partners. If successfully implemented, such initiatives have great potential to unlock the resources required to protect key habitat and ecosystems that provide vital ecological goods and services particularly related to water resources.

5.6.6 Offsets

Biodiversity offsets provide a potential response to address some of the challenges associated with biodiversity loss and impacts on ecosystem health. Offsets may be used to mitigate the residual loss of biodiversity and ecosystem function associated with a development once the mitigation hierarchy of avoid, minimise and mitigate impacts has been applied. Offsets are potentially open to abuse as they may be used to enable developments within areas of highly sensitive biodiversity to proceed but, if applied appropriately, may be used to secure critical remnant habitat. A national biodiversity offsets policy is being developed by the DEA, which will guide the future use and application of offsets.

5.7 Conclusion and Recommendations

Table 25 shows the trends observed and predicted for the biodiversity and ecosystem health indicators.

Table 25: Summary of biodiversity trends

Indicators	Trends
Biodiversity/conservation planning	Increasing
Extent of protected areas	Increasing
Extent of natural areas remaining	Decreasing
Vegetation types, and protection status of vegetation types	Increasing
Habitat fragmentation	Increasing
Invasive alien species	Increasing

Status of terrestrial ecosystems	Decreasing
Status of river/aquatic ecosystems	Decreasing
Population trends of selected species	Decreasing

The drivers and pressures that lead to biodiversity loss and declining ecosystem health are largely the same in 2017 as those identified in 2004. The difference is that the drivers and pressures have become more amplified, resulting in increasing losses of natural habitat, losses of ecological integrity and greater threats to an increasing number of species. The state of most biodiversity indicators has declined; in particular, the extent of natural areas remaining has decreased, habitat fragmentation has increased, and threats to ecosystems and species have increased. In contrast, the number and extent of protected areas have increased through partnerships with private and communal landowners.

A number of encouraging initiatives are being implemented or are planned to be implemented in the short term that may address some of the challenges that biodiversity and ecosystem health face. Initiatives such as the Biodiversity Economy have great potential to enable economic development and job creation in poor rural areas in ways that are compatible with the environment and ecosystems in which they are located. Such initiatives can address government imperatives related to poverty alleviation, job creation, ownership of land, food security and climate change adaptation whilst securing critical biodiversity and threatened species. Opportunities to accelerate the Biodiversity Economy and other initiatives such as ecological rehabilitation and restoration should be pursued in an effort to move towards more sustainable and responsible rural economic development.

5.8 References

- Allsopp, N. 2013. Adaptive management for complex communal rangelands in South Africa. *African Journal of Range and Forage Science*, 30(1 & 2): 65-70.
- Carbutt, C. and Escott, B. 2010. KZN Protected Area Expansion Strategy and Action Plan (2009-2028). Ezemvelo KZN Wildlife, Pietermaritzburg.
- Centre for Rare and Endangered Wildflowers (CREW). 2015. The Pondoland Centre for Endemism (PCE). In: *The Pondoland CREW Blog*. Retrieved from: <https://www.pondolandcrew.blogspot.co.za/2015/07/the-pondoland-centre-of-endemism-pce.html>. Accessed on 10 March 2017.
- Department of Environmental Affairs. 2015. Biodiversity Economy Strategy. Government gazette No. 39268, 9 October 2015 https://www.environment.gov.za/sites/default/files/gazetted_notices/nemba10of2004_biodiversityeconomystrategy_gg39268.pdf
- Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM. Retrieved from: <https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx>. Accessed on 10 March 2017.

- Dobson, A., Lodge, D., Alder, J., Cumming, G.S., Keymer, J., McGlade, J., Mooney, H., Rusak, J.A., Sala, O., Wolters, V., Wall, D., Winfree, R. and Xenopoulos, M.A. 2006. Habitat loss, trophic collapse, and the decline of ecosystem services. *Ecology*, 87(8): 1915-1924.
- Dry, G. 2012. Wildlife Ranching in Perspective. Wildlife Ranching SA website.
- eThekweni Municipality. 2015. General Invasive Alien Plant Control – Insight into Best Practice, Removal Methods, Training and Equipment. Environmental Planning and Climate Protection Department, eThekweni Municipality, Durban.
- Ezemvelo KZN Wildlife. 2015. KwaZulu-Natal Nature Conservation Board trading as Ezemvelo KZN Wildlife Strategic Plan 2015-2020.
- Ezemvelo KZN Wildlife. 2010. Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET) 2010 Version 1.1. Unpublished GIS Coverage, Ezemvelo KZN Wildlife, Pietermaritzburg.
- Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution and Systematics*, 34: 487-515.
- Henderson, L. 2007. Invasive, naturalised and casual alien plants in South Africa: a summary based on the South African Plant Invaders Atlas (SAPIA). *Bothalia*, 37(2): 215-248.
- Jewitt, D. 2014. Landscape Level Assessments. In: Rushworth, I. (ed.) *KwaZulu-Natal State of Biodiversity Report 2013*. Unpublished Report, Ezemvelo KZN Wildlife, Pietermaritzburg.
- Jewitt, D., Goodman, P.S., Erasmus, B.F.N., O'Connor, T.G. and Witkowski, E.T.F. 2015. Systematic land-cover change in KwaZulu-Natal, South Africa: implications for biodiversity. *South African Journal of Science*, 111(9 & 10): 32-40.
- Joubert, J. 2014. Controlling the 'famine weed'. *Farmers Weekly*, January 2014.
- Langholz, J.A. and Kerley, G.I. 2006. Combining conservation and development on private lands: an assessment of ecotourism-based private game reserves in the Eastern Cape. Centre for African Conservation Ecology (formerly TERU) Report No. 56.
- MacDonald, I.A. and Lee, J. 2013. It's now or never – report on the survey of famine weed *Parthenium hysterophorus* in the Ezemvelo KZN Wildlife Reserves in Northern KwaZulu-Natal. Unpublished Report, Stellenbosch University, Stellenbosch.
- Marais, C. 2017. South African Department of Environmental Affairs Natural Resource Management Programmes as Sector Lead for Market Based Investments in the Restoration and Maintenance of Ecological Infrastructure and the Delivery of Ecosystem Services. Unpublished presentation.
- Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. *Nature*, 405: 243-253.
- Muir, A., Skowno, A. and Kerley, G. 2011. Combining conservation and socio-economic development. Unpublished report.
- SANBI. 2015. The business case for biodiversity stewardship. An unpublished report for the Department of Environmental Affairs. Developed by Cumming, T., Driver, A., Pillay, P.,

Martindale, G., Purnell, K., McCann, K. and Maree, K. South African Biodiversity Institute, Pretoria.

SANBI. 2013. Life: the state of South Africa's biodiversity 2012. South African Biodiversity Institute, Pretoria.

Sims-Castley, R. 2004. A questionnaire-based assessment of the socio-economic significance of ecotourism-based private game reserves in the Eastern Cape, p. 31. Terrestrial Ecology Research Unit, University of Port Elizabeth, Port Elizabeth, South Africa.

Taylor, W., Lindsey, P. & Davies-Mostert, H. 2016. An assessment of the economic, social and conservation value of the wildlife ranching industry and its potential to support the green economy in South Africa.

Twine, W. 2013. Multiple strategies for resilient livelihoods in communal areas of South Africa. *African Journal of Range and Forage Science*, 30(1 & 2): 39-43.

Van Wyk, A.E. 1996. Biodiversity of the Maputaland Centre. In: van der Maesen, L.J.G., van der Burgt, X.M. and van Medenbach de Rooy, J.M. (eds), *The Biodiversity of African Plants*, pp. 198-207, Springer, Netherlands.

Vetter, S. 2013. Development and sustainable management of rangeland commons – aligning policy with the realities of South Africa's rural landscape. *African Journal of Range and Forage Science*, 30(1 & 2): 1-9.

Wakelin, J., Goodman, P.S. and Porter, R. 2007. Proposed Expansion of the Formal Protected Area Network in KZN. Ezemvelo KZN Wildlife, Pietermaritzburg.



Photo credit: Greg Martindale

6. Land Modification

6.1 Introduction

The permanent, irreversible loss of natural habitat through development for agricultural production, urban development, mining and plantation forestry is referred to as 'land transformation' or, more recently, as 'land modification'. The loss of natural habitat erodes natural capital and may lead to compromised ecological integrity and resilience in KwaZulu-Natal (KZN), which may undermine the ability of the environment to support human society and economic development. Table 26 outlines the legislation that is directly relevant to land modification in KZN. These laws are cross-cutting with the biodiversity and ecosystem health (Chapter 5).

Table 27 lists the indicators identified to assess land modification in KZN.

Table 26: Legislative framework related to land modification

Year	Legislation	Type	Relevance to biodiversity and ecosystem health
1983	Conservation of Agricultural Resources Act	Act	Act No. 43 of 1983: Provides controls for the utilisation of agricultural resources to promote the conservation of soil, water and vegetation, and for combatting invasive alien plants.
1997	KwaZulu-Natal Nature Conservation Management Act	Act	Act No. 9 of 1997: Provides the institutional structure for conservation in KZN and establishes control and monitoring bodies, including the KZN Nature Conservation Board and the KZN Nature Conservation Service (Ezemvelo KZN Wildlife).
1998	National Water Act	Act	Act No. 36 of 1998: Provides for the protection, management and use of South Africa's water resources and includes a provision for an ecological reserve which guarantees a minimum flow of water to maintain critical ecological processes.
1998	National Forests Act	Act	Act No. 84 of 1998: Provides for the protection and management of natural forests, including provisions for the specially protected areas such as forest nature reserves and forest wilderness areas.
1998	National Environmental Management Act (NEMA)	Act	Act No. 107 of 1998: Provides the general framework for environmental management in South Africa.
2003	National Environmental Management: Protected Areas Act (NEMPAA)	Act	Act No. 57 of 2003: Provides for the protection and conservation of ecologically viable areas representative of South Africa's biodiversity and its natural landscapes and seascapes.
2004	National Environmental Management: Biodiversity Act (NEMBA)	Act	Act No. 10 of 2004: Provides for the management and conservation of South Africa's biodiversity within the framework of NEMA.

Table 27: Indicators used in the assessment of land modification in KZN

Indicators	Description and/or comments
Extent of natural land cover (ha)	The area remaining of natural land cover in KZN in contrast to the area of natural habitat that has been permanently lost through habitat modification.
Extent of degraded land (ha)	The area of land that is considered to be degraded in KZN.
Extent of afforestation (ha).	The area of KZN that has been lost to the development of plantation forestry.
Extent of agricultural areas (ha)	The area of land that has been converted to arable land in KZN.
Extent of urban areas (ha)	The area of land that has been converted to urban development in KZN.
Extent of mining (ha)³⁶	The area of land that has been converted for mining in KZN.
Change in land use³⁷	The area of KZN that has been permanently lost and the rate at which it is being lost.
Budget allocated to environmental awareness programmes at schools and to the general public	TV spots and newspaper advertisements promoting the protection of local species. Expand environmental education at schools.
The area and types of invasive species eradicated	Spatial analysis of afforestation of native species
Ecological carrying capacities³⁸	The ecological carrying capacity of KZN, which is related to the extent of natural land cover and the extent of degraded land in KZN.

6.2 Drivers

Increased population, urbanisation, industrialisation, demand for forestry and agricultural products, as well as mineral exploration, are the primary drivers of natural habitat loss in KZN. These drivers are compounded by a limited understanding by the government and the general public of the importance of the environment and biodiversity in maintaining ecological integrity and resilience, which underpin human survival, society's well-being and economic development. As a result, inappropriate land-use decisions continue to be made, resulting in harmful land-use practices that exacerbate already unsustainable levels and rates of natural habitat loss.

6.3 Pressures

Rates of habitat loss and land degradation in KZN have increased greatly in the last 25 years and threaten the survival of species and the maintenance of key ecological processes in the Province (Jewitt, 2014). Increasing demands for natural resources in an environment in which they are fast diminishing further exacerbate unsustainable land-use practices and activities. These, in turn, result in the further degradation and loss of natural habitat.

³⁶ This is based on the 2013–2014 National Land-cover Dataset (GeoTerra Image, 2015).

³⁷ This is based on the 2014 State of Biodiversity Assessment (Jewitt, 2014).

³⁸ This is based on a discussion of the Bioresource Units developed by the KZN Department of Agriculture and Rural Development (Camp, 1999).

6.4 State

The most current land-cover data for KZN come from the 2013–2014 national land-cover map developed for the DEA and cover the entire country. The data include a number of land-cover classes that show the area and percentage of land cover for different land-use types in KZN (Table 28).³⁹

Table 28: Land cover in KwaZulu-Natal

Land-cover type	Area (ha)	Proportion of provincial surface area
Natural vegetation	6 335 096	67.9%
Eroded areas	67 097	0.7%
Plantation forestry	709 172	7.6%
Cultivated areas	1 429 179	15.3%
Developed land (urban and industrial)	786 465	8.4%
Mining development	5 537	0.1%
TOTAL	9 332 546	100%

6.4.1 Extent of natural land cover

According to the national land-cover layer, ~68% of the surface area of KZN is natural land cover (Figure 24). This differs significantly from the land-cover assessment of Ezemvelo KZN Wildlife of 2011, which showed that only 53.6% of natural land cover remained in the Province. This difference is probably a result of the resolution used in mapping land cover at a national scale. It is important to understand that, in mapping land cover, degraded land and secondary habitat are extremely difficult to map. This is because degraded land may appear superficially the same as natural habitat while significant changes in species composition and diversity, as well as losses of soil, may have occurred that are associated with it. Similarly, secondary habitats, which are habitats that re-emerge following disturbance, usually in the form of ploughing for crop production, may superficially appear the same as natural vegetation. Such areas are, however, extremely poor in terms of species diversity and are usually dominated by a small number of pioneer-type species. As a result, secondary habitat may fulfil some function in terms of ecological processes, but it is of limited biodiversity value and usually plays no role in supporting threatened species.

³⁹ The authors wish to acknowledge the invaluable assistance provided by Mr B. Escott from Ezemvelo KZN Wildlife in processing the mapping layers and calculating the coverages for each land-class type.

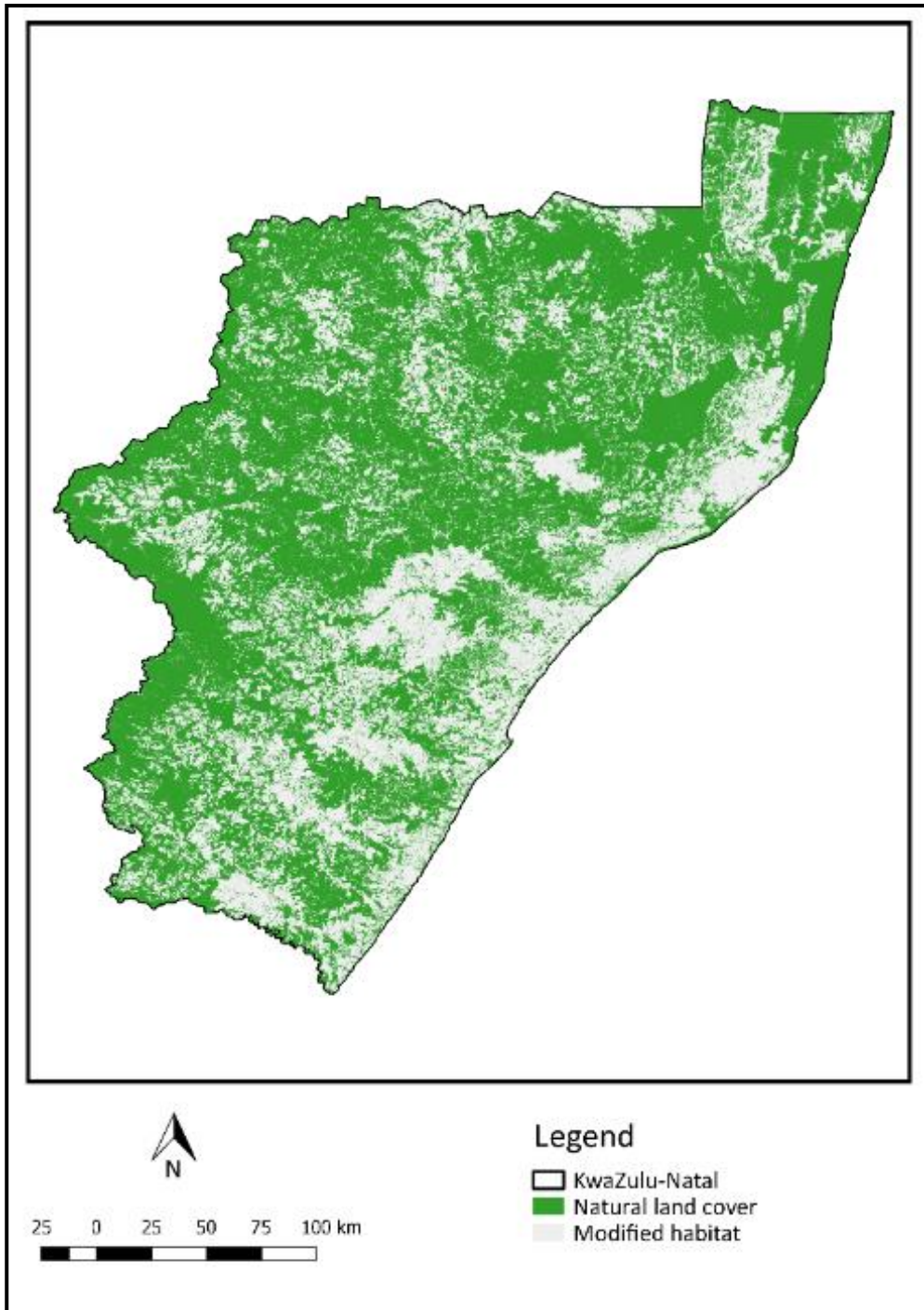


Figure 24: The extent of natural land cover in KZN

Source: DEA (2015)

6.4.2 Extent of degraded land

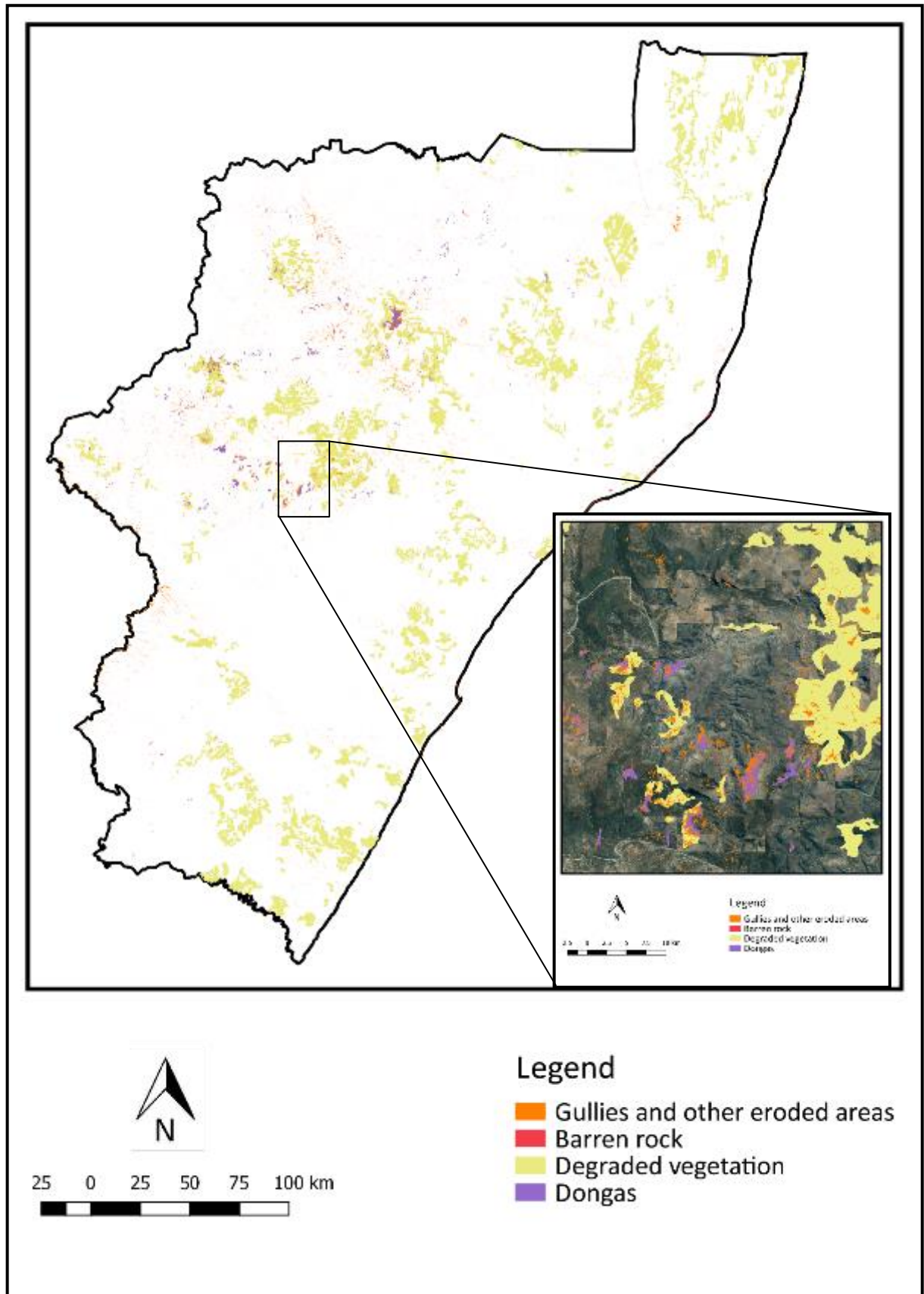


Figure 25: The extent of mapped degradation and visible erosion in KZN

Source: DEA (2015)

As described above, measuring degradation is extremely challenging. Nevertheless, there are indicators of the extent of degradation in KZN. The KZN 2008 land-cover layer includes a degradation layer. This layer depicts areas in which natural vegetation has been degraded but there are limitations to its accuracy. The national land-cover layer (DEA, 2015) also includes an erosion layer, which is based on areas of visible erosion (dongas) and other areas that are bare of vegetation (Figure 25). The areas of visible erosion are over 67 000 ha in size and make up approximately 0.7% of the Province’s land area. This percentage may seem insignificant; however, it represents only those areas that were visible for mapping purposes on a national scale and indicates that there are areas of extreme erosion in KZN in addition to areas of more superficial degradation.

6.4.3 Extent of afforestation

According to the national land-cover layer (DEA, 2015), plantation forestry covers an area in excess of 700 000 ha or 7.6% of KZN’s land area (Figure 26).

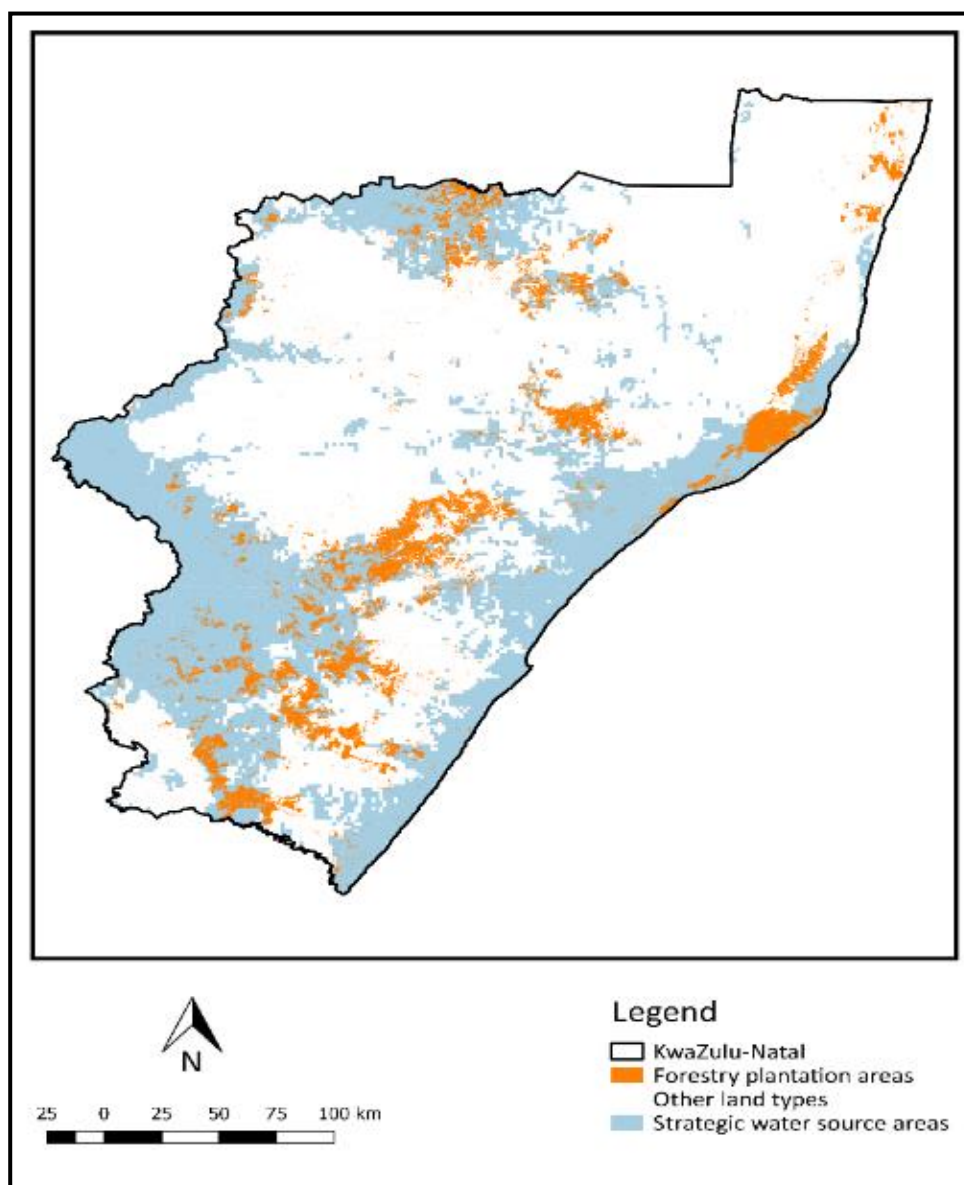


Figure 26: The extent of plantation forestry in KZN

Source: DEA (2015)

This is a vast area, particularly when one considers that it is equivalent to the extent of state-protected areas in the Province (~8%). Furthermore, in examining the impacts of plantation forestry on the Province, it is important to consider the location of plantations. Plantation forestry is often located in threatened vegetation and habitat types, and has largely been the driver of the threat status of the vegetation. For example, little remaining natural extent of particular vegetation types, such as Mistbelt Grasslands, exist because these types have been modified by plantation forestry. In terms of ecological processes, almost all plantation forestry in the Province is located within strategic water source areas. These areas constitute the 8% of South Africa's surface area that produces more than 50% of the runoff and are thus of immense importance from a water-resource perspective in the Province. Plantation forestry has been developed in these areas because of the need for high rainfall for forestry production. However, it also means that forestry is a significant user of freshwater resources that could otherwise be used for other purposes.

6.4.4 Extent of agricultural areas

With over 1.4 million ha or 15.2% of the Province's surface area, cultivated areas form the largest identified land class after natural areas in KZN (Figure 27). Ploughing and cultivation of land have been the primary drivers of land modification and of loss of natural habitat and ecosystem function in KZN.

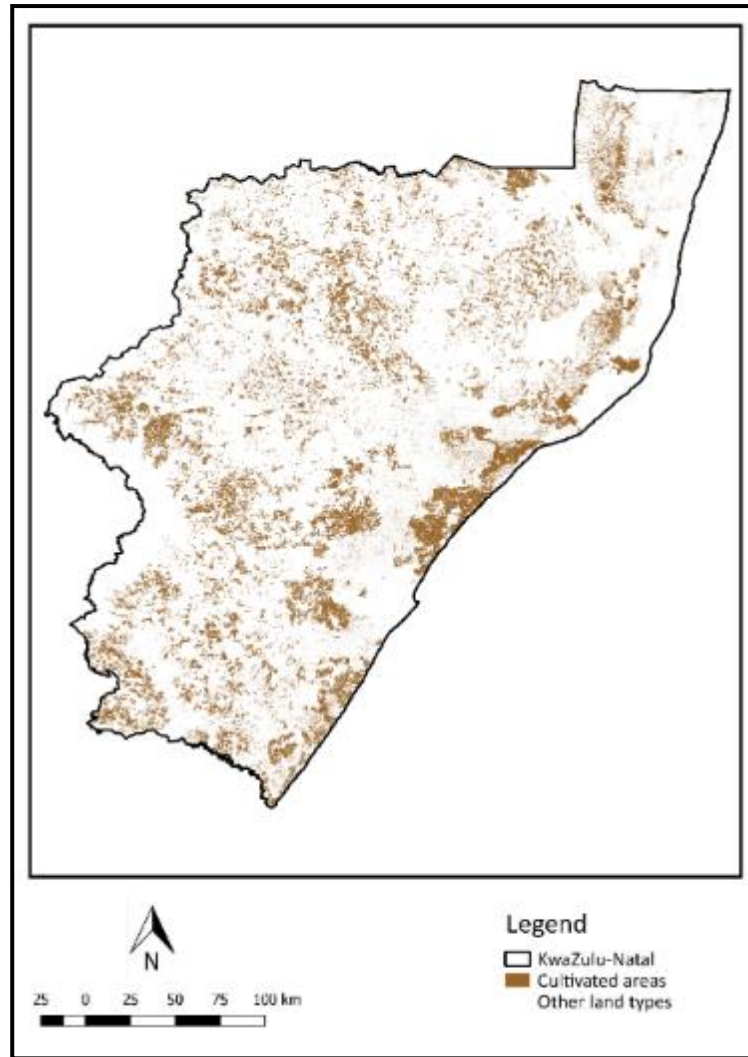


Figure 27: The extent of cultivated land in KZN

Source: DEA (2015)

6.4.5 Extent of urban areas

Over 780 000 hectares or 8.4% of the surface area of KZN has been modified for urban or industrial development (Figure 28). This is the third-largest land class in the Province and has been one of the primary drivers of land modification and loss of natural habitat. Together with agricultural development, urban and industrial development reflect extremely high levels of habitat modification in the Indian Ocean Coastal Belt Biome. Consequently, these developments are the underlying reason for the high threat status of vegetation within this biome.

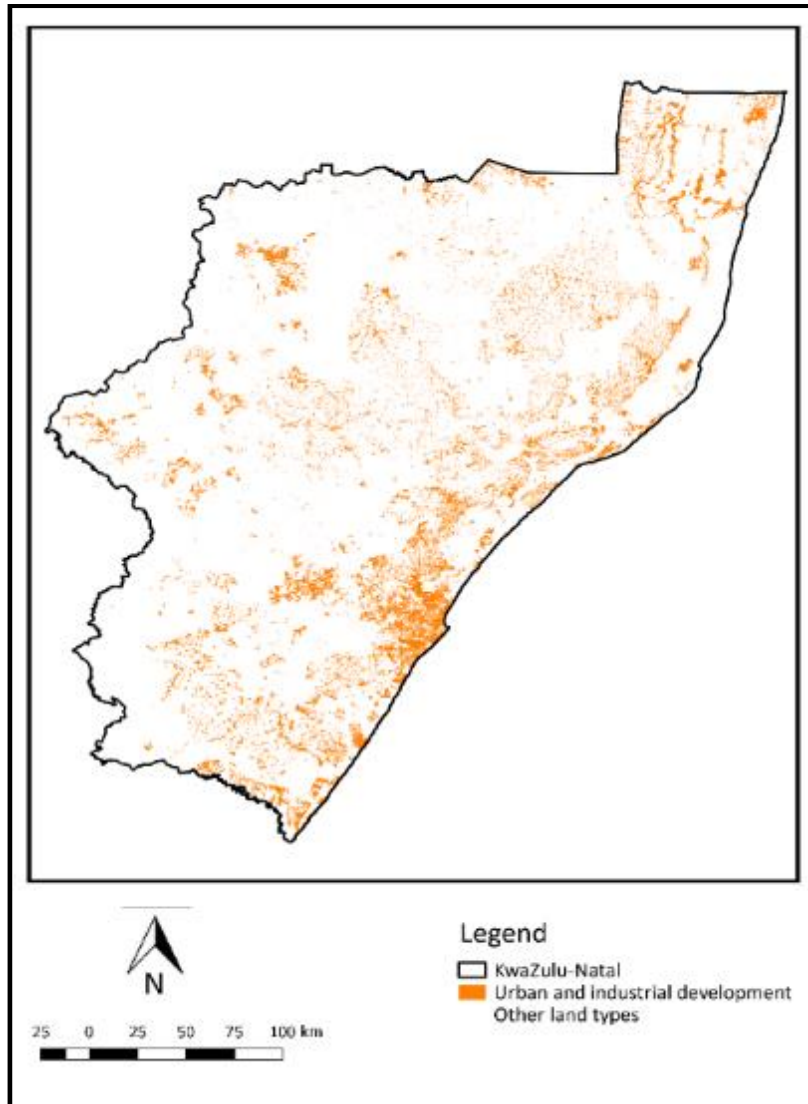


Figure 28: The extent of urban and industrial development in KZN

Source: DEA (2015)

6.4.6 Extent of mining

Mining covers an area of only about 5 500 ha or 0.06% of the surface area of KZN (Figure 29). Nevertheless, the impact of mining is disproportionate to the extent of land area that mining covers. Mining has significant impacts on water resources, primarily through acid mine drainage. It also has air quality, noise, socio-economic and visual impacts that alter the character and sense of place of a region.

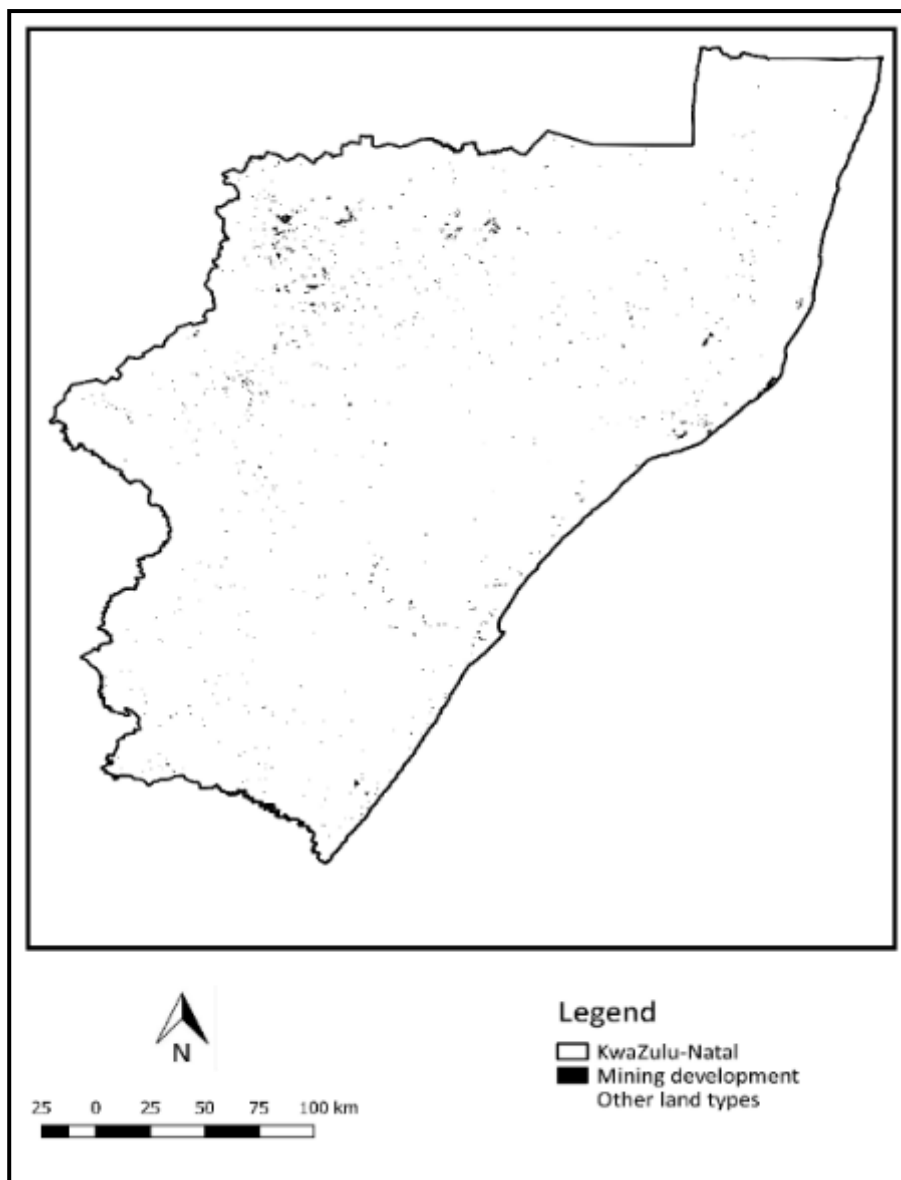


Figure 29: The extent of mining development in KZN

Source: DEA (2015)

6.4.7 Rate of change in land use

As highlighted in Section 5.4.3 of the Biodiversity Chapter, KZN has undergone a rapid loss of natural habitat since 1994 (see Figure 21 in Section 5.4.3). The average annual area of natural habitat lost each year is 109 906 ha, which equates to 1.16% of the terrestrial area of KZN. Over 12% of the Province’s natural habitat has been lost since the 2004 SoER. These rates of habitat loss are a great concern as the ecological integrity and critical ecological processes are being disrupted, which has implications for how the environment can support and sustain society and maintain human livelihoods.

6.4.8 Ecological carrying capacities

The concept of ecological carrying capacity defines how many animals may be maintained in a productive condition in an area without leading to habitat or soil degradation. The factors

that determine carrying capacity relate to topography, soils, vegetation and climate. Of these, climate is the most important as rainfall and temperature are the primary determinants of fodder production. The KZN Department of Agriculture and Rural Development (DARD) has categorised the Province into 622 defined zones called Bioresource Units, based on these factors (Camp, 1999), in an effort to assist in determining carrying capacities and associated stocking rates of livestock. The condition of the habitat (commonly known as veld or rangeland condition) within these Bioresource Units forms an important determinant of carrying capacity. Habitat and soil degradation results in a decline in fodder production, meaning that degraded land, which has been subject to changes in species composition and loss of plant cover and soil, produces proportionally less fodder for livestock consumption than does habitat in excellent or good condition. The implication is that the high rates of loss of natural habitat and levels of land degradation in KZN have led to correspondingly great losses of carrying capacity for livestock and other animals in the Province. Consequently, the Province has a considerably reduced capacity to support livestock for agricultural production, which, in turn, has severe implications for food security and human well-being. The trends in habitat loss and land degradation in the Province indicate that the ecological carrying capacity will continue to decline and with it the ability to support livestock for agricultural production.

6.5 Impacts

6.5.1 Loss of natural capital

The primary impact of land modification is a loss of natural habitat leading to diminished ecological integrity and resilience in KZN. This loss reduces the capacity of the environment to provide vital ecological services to society and to support human livelihoods and economic development. High rates of habitat loss and unsustainable land-use practices compromise important natural assets, which has implications for the provision of freshwater, maintenance of natural nutrient cycles, protection of soils, maintenance of fodder resources, and the ability to mitigate and assimilate impacts.

6.5.2 Unsustainable development

Increased land degradation and loss of natural habitat mean that many economic development activities are increasingly becoming unsustainable. Developments in agriculture, plantation forestry and mining, together with increasing levels of urban and industrial development, as well as land degradation, disrupt critical ecological functions and contribute to the loss of habitat and species. This has implications for society as the impacts of these activities undermine the natural resource base upon which society relies for its survival and well-being. Ultimately this has implications for the ability of society to respond and adapt to climate change and to maintain water and food security.

6.6 Responses

The key factors that contribute to land modification are land degradation, the further loss of habitat and ecological function, and limited awareness of the importance of the environment, which leads to unsustainable land-use practices. There is therefore a need to adopt new

approaches to stem the loss of natural habitat and ecological function thereby encouraging economic development that is sensitive to and compatible with the environment.

6.6.1 Improved planning and environmental authorisation processes

A wide variety of tools are available to assist government representatives with informed land-use planning and decision-making. These tools include systematic conservation plans, bioregional plans, strategic environmental assessments, and local planning instruments such as spatial development frameworks and land-use management schemes. These planning tools enable the identification of ecologically sensitive areas that should be kept in a natural state because of the role these play in maintaining ecological functions and the provision of ecosystem services. Planning can ensure that compatible land uses, such as extensive livestock grazing, are allowed in such areas and that the loss of natural habitat is curtailed. Together with other processes such as the environmental authorisation process, which requires the completion of a basic assessment or full environmental impact assessment, there are sufficient tools to enable informed decision-making and ensure that critically important components of habitat are protected and are not inappropriately developed. The challenges lie in ensuring that these planning instruments and environmental authorisation processes are implemented and adhered to.

6.6.2 Adoption of sustainable land-use practices

In addressing competition for land, stronger efforts must be made to factor in the importance of the environment and the impacts that particular land uses will have on land degradation, habitat loss and the loss of ecological function. This requires efforts to develop land-use practices that are appropriate to the environment and allow for sustainable utilisation whilst protecting habitats and ecological processes. Improved sustainable land-use practices such as those promoted by the SUSFARMS Initiative (Sustainable Sugarcane Farm Management System) and Forestry Stewardship Council (FSC), which aim to reduce the impact of the sugar and forestry industries on biodiversity and ecosystems, are important initiatives that can reverse some of the negative impacts associated with habitat loss in the Province. Other examples of compatible land-use practices can be found in the thinking that drives the Biodiversity Economy, which seeks to undertake the socio-economic transformation of the wildlife sector. Importantly, it seeks to drive rural economic development that is best suited to the environment in which such ventures can occur. These initiatives can create economic development, substantial levels of job creation and small business development whilst protecting biodiversity and ecological functioning of natural systems.

Other examples include initiatives such as the KZN Biodiversity Stewardship Programme, which focusses on the maintenance of sustainable agricultural production, in particular through extensive livestock grazing, whilst protecting biodiversity. Several biodiversity stewardship sites have been established in agricultural production landscapes, often with the support and assistance of the DARD, in which critical biodiversity and ecological functions are protected. These areas are vital for maintaining critically important biodiversity as they usually include threatened habitat types and species. Furthermore, these areas are important for ecosystem functioning as they protect strategic water source areas and national freshwater ecosystem priority areas, focus on macro-ecological corridors and often allow for climate

change adaptation. It should therefore be a priority for KZN to expand and accelerate programmes like the KZN Biodiversity Stewardship Programme and the Biodiversity Economy to secure critical remnant biodiversity and the ecological infrastructure that underpins the livelihoods and well-being of the people in the Province.

6.7 Conclusion and Recommendations

Trends in land modification in KZN show that competition among land uses and growing levels and rates of habitat loss are continuing (Table 29).

Table 29: Summary of land-transformation trends

Indicators	Trends
Extent of natural land cover	Decreasing
Extent of afforestation	Increasing
Extent of degraded land	Increasing
Extent of agricultural areas	Increasing
Extent of urban areas	Increasing
Extent of mining	Increasing
Rate of change in land use	Increasing
Ecological carrying capacities	Decreasing

The extent and rate of loss of habitat in KZN are severely undermining the Province's ecological integrity and resilience. Since the 2004 SoER, over 12% of the Province's natural habitat has been lost, which is alarming and completely unsustainable. Chapter 5 highlights that the Province has breached the persistence threshold and in highly developed areas, such as those along the coast, the fragmentation threshold has most likely been breached. This means that it is likely that local and more widespread extinctions are occurring and that the natural environment, upon which human survival depends, is being compromised. This has implications for the provision of critical ecological services, particularly freshwater, in the Province and for the ability to adapt to the uncertainties associated with climate change. Concerted efforts should be made to halt the levels of habitat loss and to promote more sustainable land-use practices through appropriate land use planning for urban areas, agriculture and forestry. Critical remnant habitat should be retained in a natural state and protected through appropriate biodiversity conservation mechanisms. Compatible land uses such as extensive sustainable livestock agriculture, wildlife ranching and tourism in these areas should be encouraged.

6.8 References

Camp, K.G.T. 1999. *The Bioresource Groups of KwaZulu-Natal*. Cedara Report No. N/A/99/15. KZN Department of Agriculture, Pietermaritzburg.

Department of Environmental Affairs. 2015. Biodiversity Economy Strategy. Government gazette No. 39268, 9 October 2015
https://www.environment.gov.za/sites/default/files/gazetted_notices/nemba10of2004_biodiversityeconomystrategy_gg39268.pdf

GeoTerra Image. 2015. 2013–2014 South African National Land-Cover Dataset. Department of Environmental Affairs Open Access.

Jewitt, D. 2014. Landscape Level Assessments. In: Rushworth, I. (ed.) *KwaZulu-Natal State of Biodiversity Report 2013*. Unpublished Report, Ezemvelo KZN Wildlife, Pietermaritzburg.

Jewitt, J., Goodman, P.S., Erasmus, B.F.N., O'Connor, T.G. and Witkowski, E.T.F. 2015. Systematic land-cover change in KwaZulu-Natal, South Africa: implications for biodiversity. *South African Journal of Science*, 111: 1-9.



Photo credit: Samantha de Villiers

7. Freshwater Resources

7.1 Introduction

The aim of managing water resources is to safeguard human health through providing safe and adequate water for drinking purposes, whilst maintaining important environmental aquatic and terrestrial ecosystems. Freshwater is essential not only to the life and health of humankind, and the physiological processes of organisms, but also to ensuring economic sustainability by providing a key resource to the industry. It is therefore important to quantify the current state of and impacts on water and the environment and how these are changing over time.

The province of KwaZulu-Natal (KZN) has a relatively high mean annual precipitation of 900 mm (varying from 600 mm inland to around 1 200 mm along the coast) compared to the national average of 450 mm. KZN is also a prime location for some of the largest water users, such as commercial agriculture, sugarcane plantations and afforestation. These water users contribute considerably to socio-economic development, including the eradication of poverty, and therefore play a key role in the economy of the Province and the country. However, in most parts of South Africa, including KZN, water resources are under stress and require rigorous water resource management and monitoring.

The Department of Water and Sanitation (DWS) is mandated with ensuring that the country's water resources are protected, managed, used, developed, conserved and controlled by regulating and supporting the delivery of effective water supply and sanitation. In addition to the DWS, two water utilities contribute to the water and environment management of the Province: Mhlathuze Water and uMngeni Water. These utilities play a key role in reporting on water quantity and quality.

To assess the freshwater resources of KZN, several indicators have been developed (Table 31) using the Driver-Pressure-State-Impact-Response (DPSIR) framework. This framework shows links between the Driving forces and resulting environmental Pressures on the State of the environment, the Impacts resulting from the changes in environmental quality and the societal Responses to these changes in the environment.

The previous State of Environment Report (SoER) for KZN (2004) listed as the main issues and indicators: the quantity and quality of surface and groundwater, ecological health of rivers and wetlands, and the biodiversity of rivers. For the reported period, many of the issues facing inland waters were related to dense human settlements, which affected the quality of surface water and groundwater via contamination with human waste and nutrients. Formal treatment systems were often inadequate, which resulted in contamination of water resources, particularly during rain events. Furthermore, many rivers were already over extended in terms of water use as the demand for water exceeded supply. The main demand for water was domestic and industrial, but demand also came from farm dams, agriculture and forestry. Limited availability of data and information made the management of groundwater quantity and quality difficult.

In 2004, of major concern was that, already then, the health of rivers was under pressure, particularly downstream of wastewater treatment works (WWTW), which affected the

conservation status of rivers. Of equal concern was that the regulatory framework provided by the DWS was not being used.

Table 30 outlines the main legislation for freshwater resources in KZN.

Table 30: Legislation related to freshwater resources

Year	Legislation	Type	Relevance to freshwater resources
1997	Water Services Act	Act	Act No. 108 of 1997: A framework for the provision of water supply and sanitation services to households in South Africa. It sets the standards for local and provincial agencies, and the rights and duties of the state and of water service providers in monitoring water services, and promotes effective water resource management.
1998	National Water Act	Act	Act No. 36 of 1998: Makes comprehensive provision for the protection, use, development, conservation, management and control of South Africa's water resources.
2013	National Water Resource Strategy (2013)	Regulation	Enables the implementation of water management principles, which are to ensure that national water resources are protected, used, developed, conserved, managed and controlled in an efficient and sustainable manner towards achieving South Africa's development priorities in an equitable manner over the next 5 to 10 years.

To assess the changes in freshwater resources, indicators from the 2004 SoER have been used and amended. The main indicators identified are outlined in Table 31.

Table 31: Indicators used in the assessment of the freshwater resources in KZN

Indicator	Description
Availability of water resources	The quantity of water contained in surface water bodies – rivers, dams and reservoirs – and groundwater relative to the use demanded by various sectors.
Water resources per capita	Water resources per capita are used to define a threshold on which water supply planning can be based to meet a predefined assurance of supply.
Comparison of natural versus current river flows	The historical and current (includes development and anthropogenic effects) quantity of water contained in the surface water bodies.
Water quality	The quality of water in surface water bodies – rivers, dams and reservoirs – and groundwater.
Number and locality of pollution disaster events	The number and locality of pollution incidents.
Trophic status of dams	The quality of water within the dams of KZN as indicated by dam level and eutrophication, which is an ecological process driven by excessive inputs of phosphates and nitrates into the system.
Health of river habitats	This indicator assessment framework utilises the River Health Programme (RHP) assessment method for a rapid assessment of the general aquatic integrity at a specific location or small section of a particular river or stream, which is representative of a river reach. The programme makes use of various indices, through which complex ecological data can be summarised and output provided in a simple numeric format.

In addition to highlighting the current state of water resources, this chapter will provide an indication of the main trends from 2004 to the present, and the outlook for the next 10 years.

7.2 Drivers

The primary driver for the impact of water resources in the environment is an ever-increasing consumption of a limited water resource. This increasing demand originates from several human and natural users, often competing for the same finite resource. Human demand for potable water increases with population growth and as the government provides more people with basic access to water, thereby eliminating water backlogs (from 43% of households not having access in 1994 to 21% in 2016, according to DWS, 2016) (Figure 30). In some instances, human water demand is not consistent but seasonal; for example, in coastal holiday towns, whose demand for water can double during the holiday season. This is particularly a problem on the KZN North Coast along the Dolphin Coast, which continues to grow exponentially.

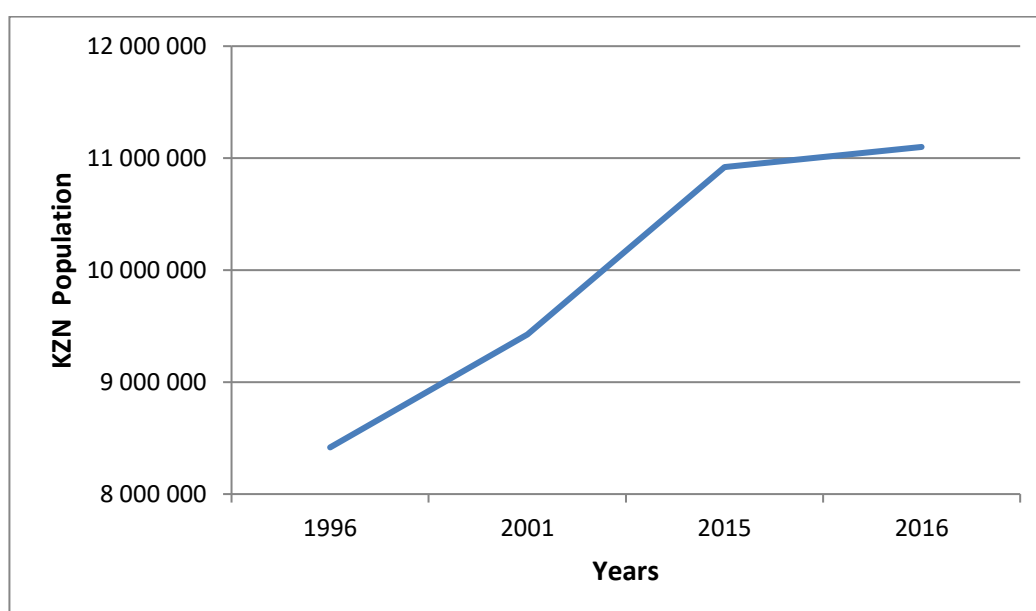


Figure 30: Increasing demographics in KwaZulu-Natal

Source: StatsSA Census and community surveys (2011, 2016)

The second driver is weather and climate related through changing temperature, rainfall and evaporation patterns. Of all the potential impacts, the impacts of climate change will be felt in the natural environment and especially in the availability of water resources. For example, as a result of an increase in temperature, evaporation rates will increase. Additionally, rainfall will become less predictable and droughts and extreme events more common. KZN is particularly vulnerable to the effects of climate change and is increasingly experiencing floods, coastal erosion and warmer days. Proposed adaptation measures often entail conventional measures such as increasing the capacity to store water. However, this solution depends on adequate rainfall and therefore becomes a less dependable water source. Chapter 3 contains further information on climate change.

Water quality-related drivers stem mainly from increasing demographics and WWTWs that are poorly maintained for adequately treating effluent or are non-functional. Water quality is a problem particularly where rivers flow through informal settlements that do not have proper

sanitation services. Storm events exacerbate this situation when higher runoff washes effluent into watercourses or inadequate storm flow drainage results in volumes that are in excess of the design capabilities of WWTWs. The use of fertilisers and pesticides for agriculture are other drivers of water quality-related problems.

7.3 Pressures

The main pressure experienced in KZN is unlawful and excessive abstraction of water. South Africa has a system where water abstraction must be authorised by the DWS, whose duty includes calculating a hydrological balance to determine whether or not the hydrological cycle and environment can accommodate additional abstractions without disadvantaging existing lawful water users. The DWS maintains all authorisations in its Water Authorisation and Registration Management System (WARMS) database. However, the process is not always adhered to in practice and is rarely controlled. Relatively new pressures, such as a changing climate, have also not been adequately accounted for in historical authorisations.

The wastage of potable drinking water through leaks remains a significant pressure in many of the municipalities in KZN. Although the main centres such as Pietermaritzburg and Durban have had some success in reducing their water losses to around 35%, until recently there have been reports of losses of up to 65%; for example, as reported by uMngeni Water (2013) for areas in the north-western region of KZN.

7.4 State

The state of water resources in KZN is increasingly characteristic of the archetypal description of water resources – too much, too little or too dirty. This has been largely influenced by reduced rainfall and deteriorating water quality, mainly as a result of the increased demands of a growing population.

7.4.1 Water quantity

Figure 31 shows long-term (a and b) and short-term (c and d) surface water storage trends for the Pongola Mtamvuna Catchment Management Agency (CMA) and South Africa respectively from 2012 to 2017. Surface water storage in KZN (as indicated by Figure 31: Pongola Mtamvuna WMA) has been declining since early 2014 mainly due to drought. It recently dropped below 50%, its lowest level since 2012. Specific areas within KZN were affected more than others, with northern KZN possibly being the worst. Farmers reported that the drought had been the worst since 1932, with three extreme drought events having occurred in the last 20 years.⁴⁰ The Richards Bay area continues to struggle with low water resources and supply. KZN water storage levels have only recently recovered to “moderately low” levels that are on average higher than at this time last year (Figure 31c). KZN is, however, in a worse situation than the national average (Figures 31b and d).

⁴⁰ Retrieved from: <http://zululandobserver.co.za/59028/goedertrouw-dam-around-50/>. Accessed on 29 August 2017.

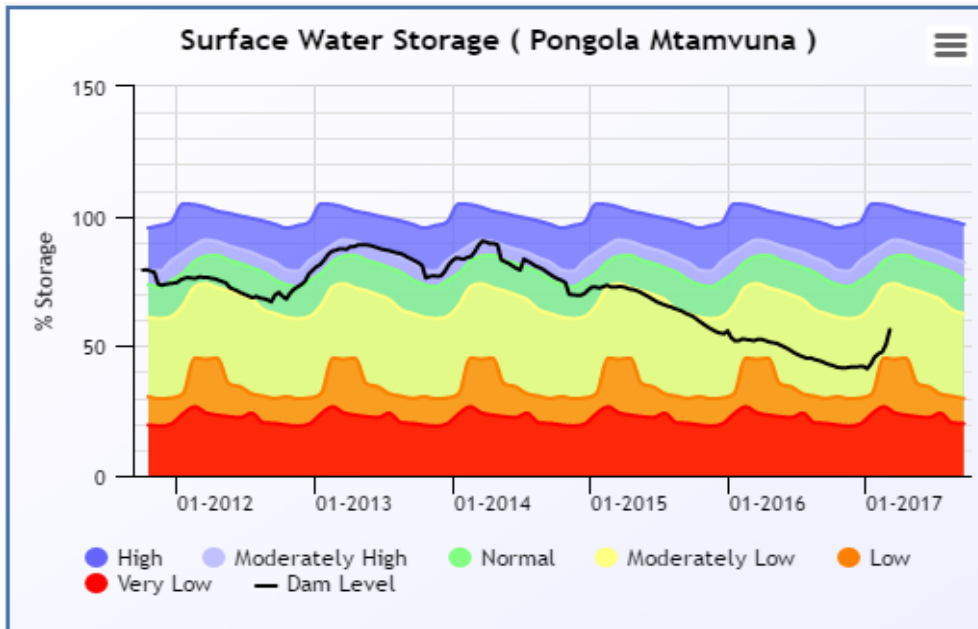


Figure 31a

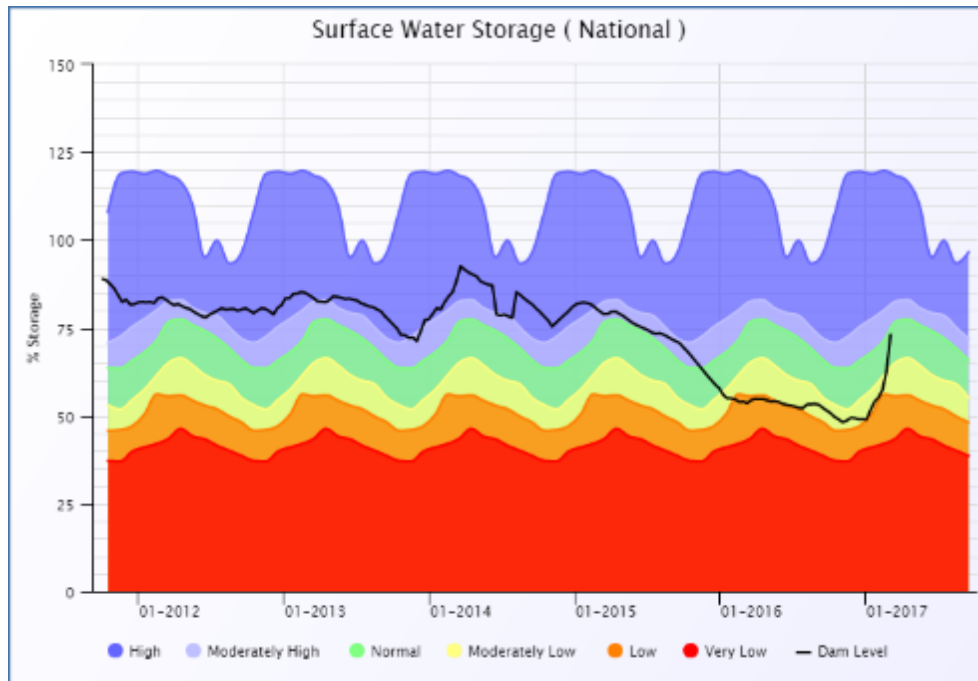


Figure 31b: Long-term (a and b) surface water storage for Pongola Mtamvuna CMA and South Africa respectively

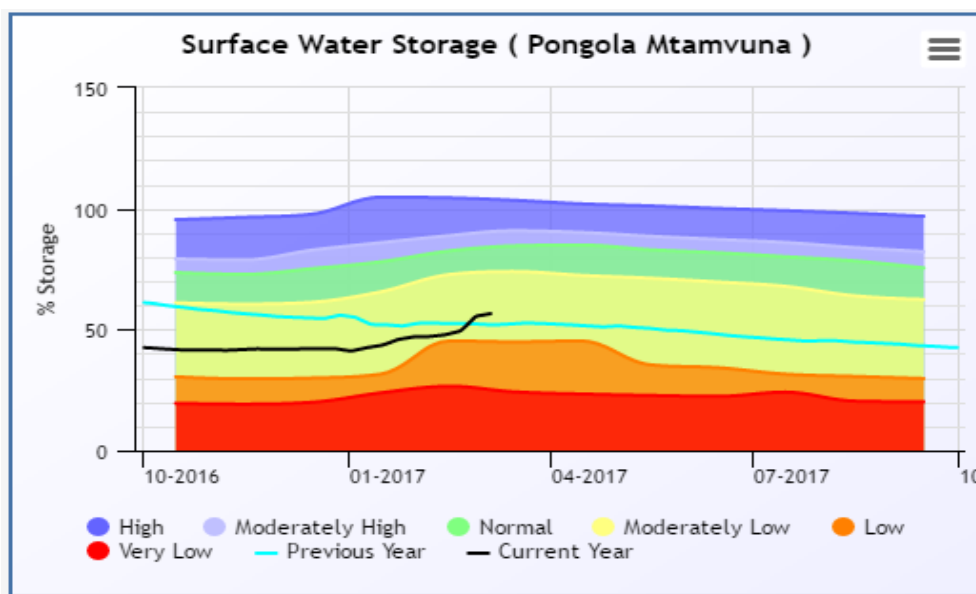


Figure 31c

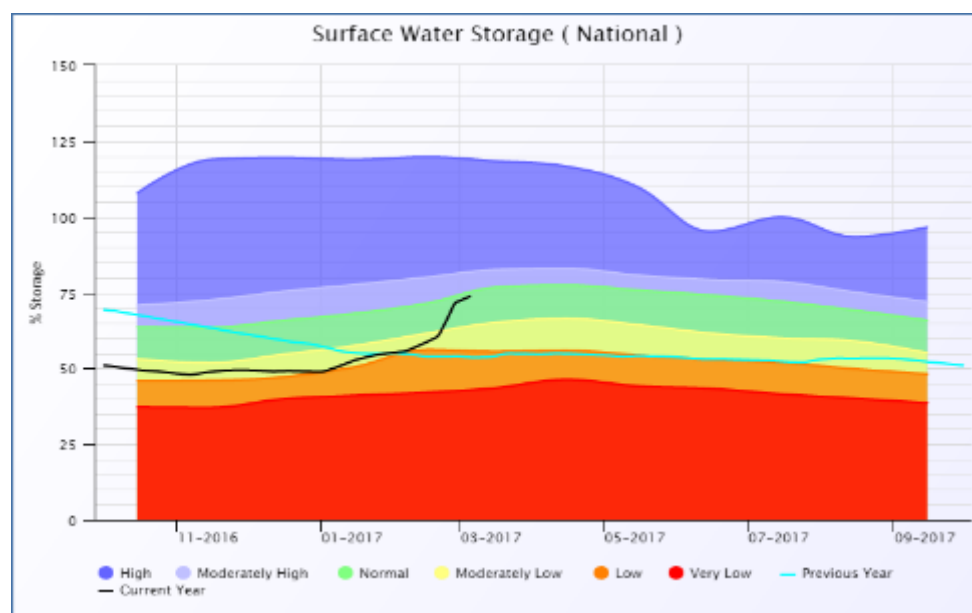


Figure 31d

Figure 31: Short-term (c and d) surface water storage for Pongola CMA and South Africa

Source: DWS (2017a)

7.4.2 Access to potable drinking water

Although access to water has improved in KZN over time, indications are that KZN is lagging behind the rest of South Africa (Figure 32). This is mostly due to challenges in developing infrastructure to reach communities that are often long distances away and that are reached by traversing rugged terrain. A further challenge is poorly maintained and ageing infrastructure.

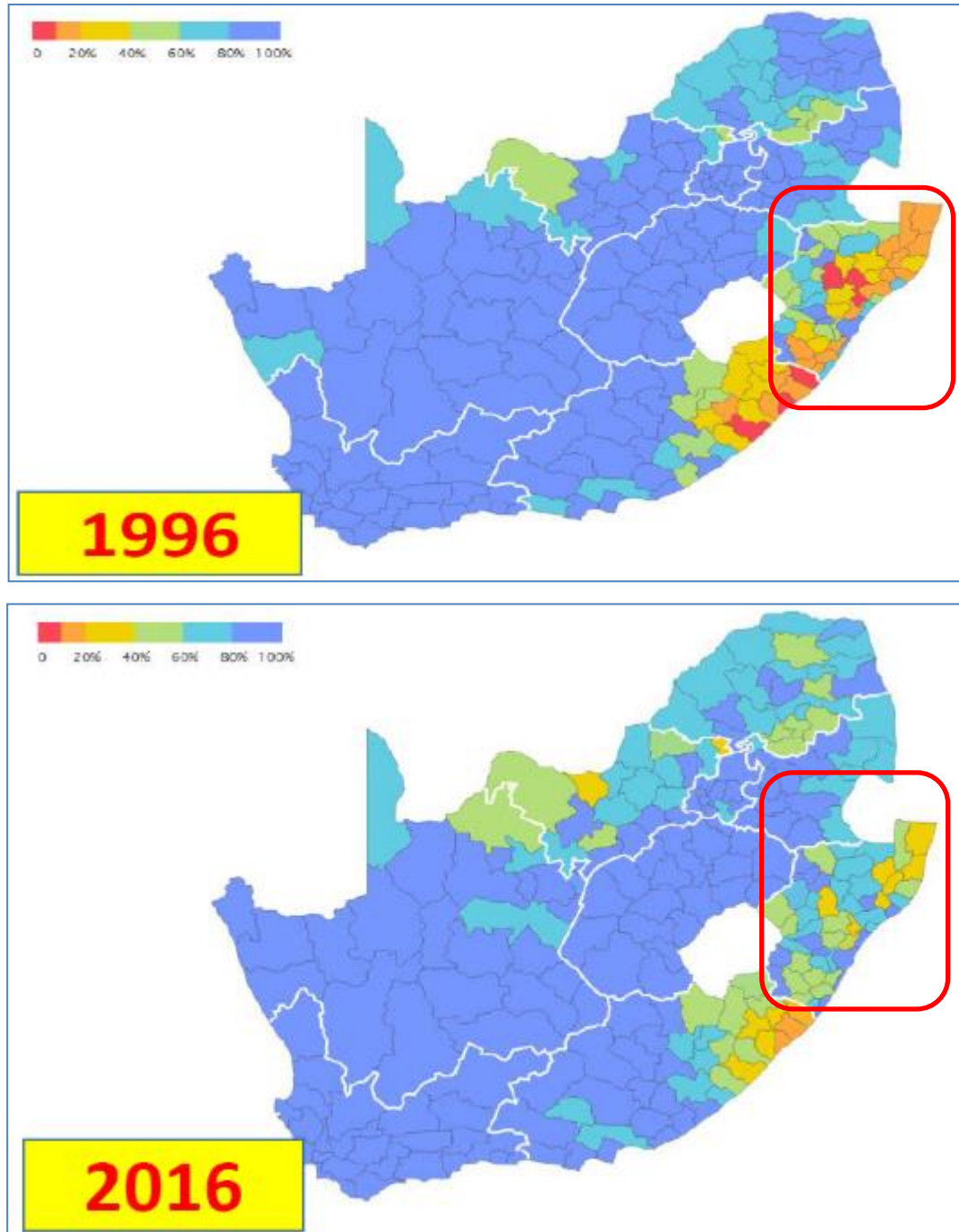


Figure 32: Access to piped water from 1996 to 2016

Source: KZNPPC (2016)

7.4.3 Water quality

The DWS Blue and Green Drop⁴¹ programme has been in operation since 2009 and has the potential to monitor water quality in a consistent, spatially representative manner. The Blue Drop trend for KZN is depicted in Figure 33. No data were available for 2013 and 2015. The Blue Drop ratings of six of the country’s nine provinces declined substantially between 2012 and 2014, with KZN decreasing from 92% in 2012 to 86% in 2014.

⁴¹ Blue drop refers to the quality of drinking water and Green drop refers to waste water.

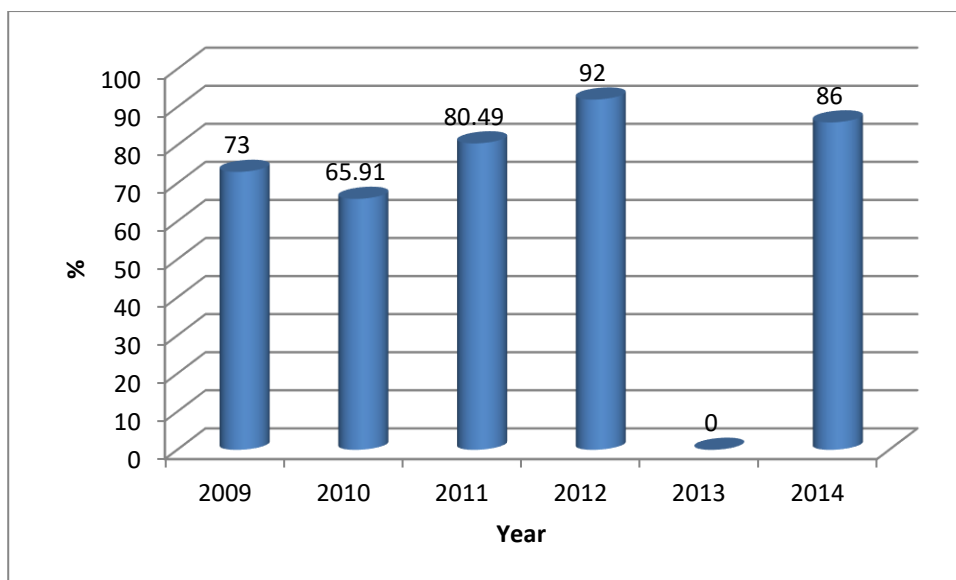


Figure 33: KZN Blue Drop status (%)

The Water Institute of South Africa (EWISA) (2017) has provided possibly the only year-by-year collation of Green Drop data, which is shown in Figure 34. Although the risk trend for some of the performance categories is improving, of concern is that most trends are digressing, including the overall trend. Unfortunately, data are not available beyond 2012 and most commentators have expressed concern that wastewater quality has continued to decline in recent years.

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	2008	2009	2011	2012	Risk Trend (2011-2012)
Highest CRR	25	31	32	28	↓
Average CRR	13.5	14.3	15.3	15.3	→
Lowest CRR	5	7	6	7	↑
Average Design Rating (A)	2.5	2.8	2.6	2.6	→
Average Capacity Exceedance Rating (B)	3.3	3.3	3.6	3.7	↑
Average Effluent Failure Rating (C)	3.2	3.5	4.4	4.2	↓
Average Technical Skills Rating (D)	1.7	1.5	1.6	1.9	↑
AVERAGE % DEVIATION FROM maximum-CRR	26.0	48.0	58.5	62.3	↑

N/A = Not applied ↓ = improvement, ↑ = digress, → = no change

Figure 34: KZN Green Drop status

Source: EWISA (2017)

uMngeni Water produces an assessment of water quality on a regular basis for its supply area (southern KZN) and provides a good case study of how water quality can be assessed. Key dams, rivers and WWTWs are sampled on a regular basis. Sampling frequency is adapted on a regular basis, depending on prevailing conditions, but generally dams are sampled weekly, rivers monthly and WWTWs daily. Many WWTWs do not comply with their authorisation conditions as a result of ageing infrastructure, illegal connections, stolen infrastructure and lack of maintenance. The authorities do not put enough pressure on holders to come into compliance and, as a result, discharged water is not of an acceptable standard.

A summary of the status of water quality per supply source/catchment is provided for uMngeni Water from 2010 to 2014 (Table 32).⁴² Current water quality risks are associated with the presence of feedlots, WWTWs upstream of some dams and reservoirs, seasonal changes (rainfall/storm events, impoundment stratification) and sewerage problems. These risks include: algal blooms and aquatic weed problems associated with eutrophication, chemical (including iron and manganese) contamination, elevated turbidity and faecal contamination (and associated pathogen risk), and erosion runoff contamination.

Table 32: Water quality of dams and abstractions

River, Dam	Gross Capacity (million m ³)	2010	2011	2012	2013	2014
uMngeni System						
Mooi River, Mearns Weir	5.1	Good	Good	Good	Good	Good
Mooi River, Spring Grove Dam	139	N/A	N/A	N/A	N/A	Good
Mgeni River, Midmar Dam	235	Excellent	Good	Good	Excellent	Excellent
Mgeni River, Albert Falls Dam	290	Good	Good	Good	Good	Excellent
Mgeni River, Nagle Dam	25	Good	Satisfactory	Satisfactory	Good	Excellent
Mgeni River, Inanda Dam	252	Good	Satisfactory	Satisfactory	Good	Good
North Coast System						
Mdloti River, Hazelmere Dam	18	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Good
Mvoti River	7.3	N/A	N/A	Satisfactory	Satisfactory	Good
Thukela River	110	N/A	N/A	N/A	Unsatisfactory	Poor
Imvutshane River	7	N/A	N/A	N/A	Satisfactory	Good
South Coast System						
Mtwalume River	4.4	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Mzumbe River, Mhlaba-tshane Dam	2.5	N/A	N/A	N/A	N/A	Good
iNungwane River,	2.2	Satisfactory	Satisfactory	Satisfactory	Good	Excellent

⁴²Umgeni Water Website. Retrieved from: http://www.umgeni.co.za/sustainable_development/e.asp. Accessed on 7 July 2017.

Nungwane Dam						
Mzimayi River, E J Smith Dam	0.9	Unsatisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory
Mzinto River, Mzinto Dam	0.4	Poor	Poor	Satisfactory	Satisfactory	Good
Ixopo System						
Xhobo River Ixopo Dam	0.6	Satisfactory	Poor	Poor	Poor	Unsatisfactory

7.4.4 Groundwater

The 2004 report highlighted several concerns related to groundwater management in KZN, including poor management as a result of the “invisible” nature of its abstraction and long delays before the impacts of over-exploitation become apparent. Groundwater management has, however, improved since the National Groundwater Strategy (NGS) was developed in the early 2000s, which took groundwater from a neglected private water status to that of a significant resource managed as part of Integrated Water Resource Management (IWRM). In South Africa, groundwater has become a source of domestic water and livelihood for more than 60% of communities in many villages as part of a national drive to meet basic water needs. In KZN, only 1% of the total water use is from groundwater, suggesting that there are still further groundwater resources remaining untapped. In KZN:

- four irrigation and domestic users are the largest abstractors (100 000 – 1 million m³/a each);
- groundwater occurrence is in the order of 0.5 to 2.0 l/s over most of the Province;
- electrical conductivity (an indicator of potability) is generally less than 70 mS/m over most of the Province;
- water level is between 10 and 35 m for most of the Province;
- utilisable groundwater exploitation potential ranges mostly from less than 2 500 to 6 000 m³/km²/a; however, there do exist small areas of up to 50 000 m³/km²/a in the Drakensberg and along the coast; and
- groundwater contributes from 4 000 to 65 000 m³/km²/a baseflow to rivers in KZN.

7.4.5 Impact of forestry on water resources

The 2004 report discussed briefly the impact of forestry on water resources. Commercial afforestation impacts water resources by reducing runoff because of increased interception loss and evapotranspiration. The magnitude of this reduction has been the subject of several studies; however, the impact of afforestation on water resources is complex. Possibly the most comprehensive research in KZN was conducted by Summerton (1995), who used commercial tree water use trials in Zululand and other research to estimate that commercial tree water use could be as high as 18 mm/d under irrigation, with a peak of 9 mm/day being plausible under rain-fed conditions. Actual water use is dependent on rainfall, soils, genera and species and site preparation. A total of 503 212 ha (or 7.5%) of KZN’s area of 9.1 million ha is planted for commercial forestry, with a significant water resource allocation.

7.4.6 Wetland rehabilitation to conserve freshwater

The 2004 report highlighted that one of the most important indicators of wetland health was the measurement of how many wetlands had been lost and that the indicator was misleading. Unfortunately, this remains the case, except for the eight wetlands with Ramsar status. The World Wildlife Fund – Mondi Wetlands Programme (WWF-MWP, 2016) is arguably the most active institution in terms of wetland preservation; their work is summarised in Figure 35.

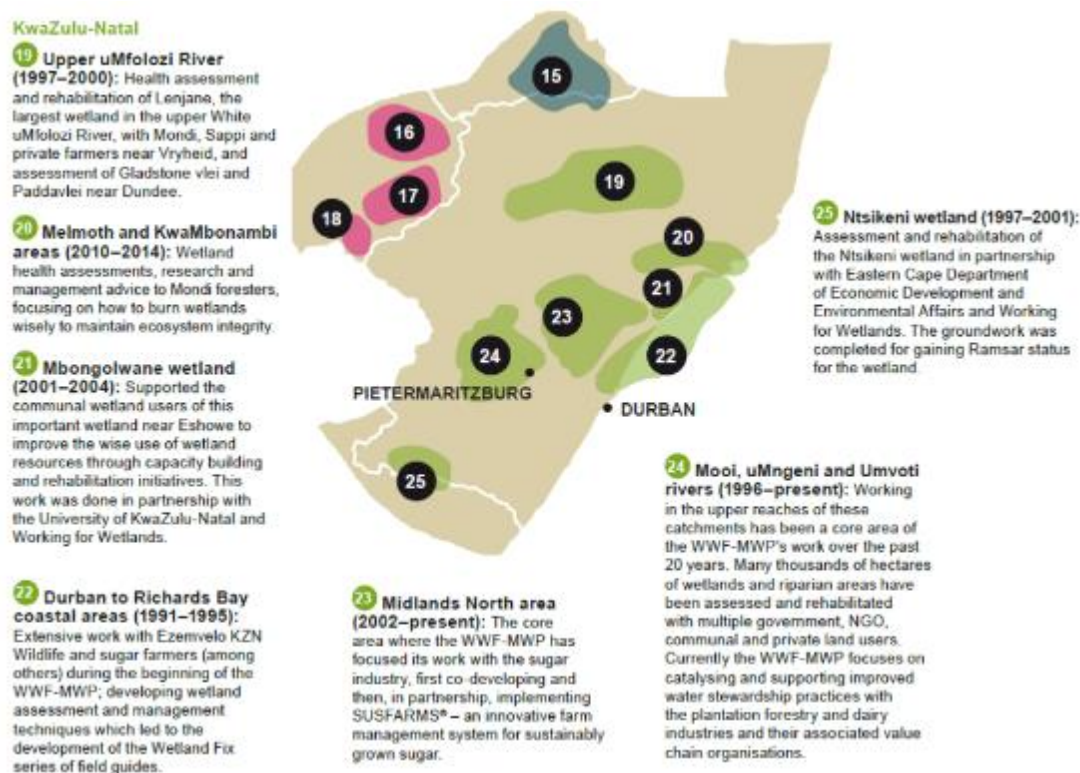


Figure 35: WWF-Mondi Wetlands Programme initiatives

Source: WWF-MWP (2016)

7.4.7 Water management by the Ingonyama Trust

The Ingonyama Trust Board derives its mandate from sections 25 and 27 of the Constitution. Specifically, section 27 (i.e. the healthcare, food, water and social security clause) confirms the framework for the provision of support to rural communities that reside on Ingonyama Trust land. The Ingonyama Trust works closely with local government to ensure that water requirements are met.

7.4.8 Hydropower

KZN has two operational hydropower schemes: the Drakensberg pumped storage scheme, completed in 1981, and the Ingula pumped storage scheme, completed in 2017. The Drakensberg scheme provides for up to 27.6 gigawatt-hours (99 TJ) of electricity storage in the form of 27 million cubic metres of water. The water is pumped to Driekloof during times of low national power consumption (generally over weekends) and released back into Kilburn through four 250 megawatts (340 000 hp) turbine generators in times of high electricity demand. Fin 24 (2017) details the Ingula scheme, where water flows at high speeds down to

the turbines at around 60 km per hour, with enough water passing through each turbine to fill an Olympic-sized swimming pool in six seconds. Rotating at 428 revolutions per minute, each unit produces 333 MW, with a total for the station of 1 332 MW.

7.4.9 Desalination

A growing number of countries are turning to desalination to increase their water supply, in this way reducing risks of drought. An increasing number of organisations in the public and private sector in KZN are considering desalination. The first desalination plant in KZN was launched in October 2016 by South32 in Richards Bay. The plant will provide up to two megalitres per day. In addition, Durban is in the process of constructing a low-energy demonstration desalination plant that will produce 6.5 megalitres per day. uMngeni Water has proposed two additional desalination plants, in Tongaat and Illovo (each of 150 megalitres per day). However, these are unlikely to be constructed in the short- to medium term.

7.4.10 Enforcement of regulations

There are fewer than 20 staff members at the DWS regional office for inspecting and enforcing regulations in forestry, dam safety, water quality, groundwater and general abstractions. Considering that the WARMS database for KZN contains nearly 35 000 records, indications are that enforcement of regulations is less than adequate.

7.4.11 Capacity of government and technical staff

There are challenges that relate to the capacity of government and technical staff in the KZN regional office of the DWS. Several senior managers will be retiring over the next few years without plans being put in place to retain their knowledge and adequately train their successors. As a result, the remaining staff will lack the required depth of experience. This means that institutional knowledge needs to be documented.

7.5 Impacts

Persistent drought conditions brought on by the worst El Niño phenomenon since the 1980s resulted in the declaration of a state of disaster in October 2014 and again in November 2015. Drought conditions have continued to persist into 2017 and water levels remain low.

The drought adds to the existing and growing problem of over abstraction from rivers, which will be exacerbated during periods of drought. The Province has several anecdotal examples of reduced surface and groundwater levels, with associated impacts on aquatic and terrestrial ecosystems such as wetlands. For example, homeowners near the country's newest Ramsar site, the uMngeni Vlei, tell stories of how animals are able to walk through areas that were previously unnavigable due to the water depth. The severity of this consequence is even more alarming when one considers that the Vlei is part of the southern Drakensberg water source area (see Section 7.6: Responses for further detail).

Although a declaration of disaster has prompted funding for specific drought-relief measures, the true cost of the drought remains unknown. As acknowledged by the Premier in his State of the Province Address (SOPA, 2017), the drought situation has had a devastating impact on the economy, commercial demand for water, human access to potable water, drinking water

for livestock and game farms, crop production and food security, as well as the environment. Examples of impacts include:

- increased pressure on urbanisation to cities, where water services are perceived to be better;
- the impact of deteriorating water quality on human and environmental health throughout the Province. For example, in its most recent Infrastructure Master Plan, uMngeni Water (2016) reports that nutrients into Midmar Dam and in the Pietermaritzburg CBD have recently exceeded the resources quality objectives on a number of occasions due to poor sewerage infrastructure. Agricultural activities have also contributed to nutrient and algal counts that are non-compliant and higher than the previous year.

Box 3: Human vulnerability to the degradation of freshwater resources

Humans are particularly vulnerable to negative impacts on water resources; for example:

- inadequate water supply for basic needs during drought;
- loss of property and sometimes life due to flooding;
- illness due to poor water quality; for example, cholera; and
- sub-optimal economic growth due to inadequate water.

7.6 Responses

Most of the recent and ongoing responses address the persistent drought conditions in the Province. In the 2015/2016 financial year, more than R503 million was spent on drought interventions, and the DWS has prioritised a further R700 million for drought interventions for the 2016/2017 financial year. Responses have ranged from emergency relief to implementing mandatory 15% restrictions, emergency water supply using tankers and implementing emergency infrastructure. The KZN Provincial Growth and Development Strategy (PGDS, 2016) provides recommendations for preventing negative impacts on freshwater resources and the environment in KZN. Using the PGDS as a point of departure, recommended responses to address freshwater challenges in KZN include:

- improved enforcement of water resources and environmental control measures at a provincial and national level;
- an intensified focus on land-use planning, management and governance to protect and conserve water and the environment;
- improved waste management infrastructure and practices and maintenance of storm water systems;
- improved coordination, planning and implementation of water infrastructure at bulk and community levels;
- greater emphasis on conserving and protecting the quality and quantity of finite surface and groundwater resources of the Province, so as to meet current demands and not to undermine projected future socio-economic development opportunities;
- provision of appropriate housing as one of the top priorities for the KZN population to improve the water quality and environmental health situation in the Province; and

- exploring innovative funding models to ensure appropriate levels of new capital investment are made to expand the infrastructure networks in the Province, as well as for the operation and maintenance of existing infrastructure.

The PGDS (2016) strategic analysis is expanded with indicators and responses for seven strategic goals. Those directly pertinent to water resources include: a) ensuring availability and sustainable management of water and sanitation for all, and b) enhancing resilience of ecosystem services.

7.6.1 Potential response indicators

The PGDS (2016) recommends several water and environment indicators that could be used to monitor the progress of responses. It is recommended that the indicators be used as a point of departure for the development of standard indicators that would assist monitoring of trends over time. Suggested indicators are as follows:

- Percentage Mean Annual Runoff (MAR) as an indicator of water stored in each district.
- Quantity of water abstracted per annum in each district.
- Water resources yield for strategic rivers and dams.
- Number of households receiving minimum standards of water and sanitation.
- Percentage households with access to safe drinking water.
- Cubic metres of water available.
- Surface water storage as a percentage of surface mean annual runoff per district.
- Non-revenue water loss – (physical and non-physical water loss).
- Number of projects not approved due to bulk water and sanitation infrastructure constraint.
- Number of Municipal Infrastructure Grant (MIG) and Water Services Infrastructure Grant (WSIG) projects that meet 75 litres of water per person per day.
- Provincial Land Degradation Index.
- Percentage compliance with Blue Drop rating.
- Percentage compliance with Green Drop status.
- Percentage of WWTWs that comply with enforcement measures to meet effluent standards.
- Number of WWTWs relevant to population served.
- Percentage of waste licence applications finalised within legislated time frames.

7.6.2 Strategic Water Source Areas

A meaningful response is to promote the importance of the protection of Strategic Water Source Areas (SWSAs). SWSAs are those areas that supply a disproportionately high amount of the country's MAR, in relation to their surface area, sometimes defined as those catchment areas that contribute more than 50% of the country's MAR. South Africa's water source areas are generally found in the highest parts of the landscape, which receive the most rainfall. Downstream users and ecosystems are dependent on the healthy functioning of these areas to sustain good quality water supplies. Figure 36 locates South Africa's SWSAs. Noticeably, many of these are in KZN, which highlights the importance of preserving the water resources of KZN. KZN's SWSAs are captured in Table 33. To conserve these areas, water recharge areas

for natural filtration should be integrated into spatial development planning. Water reuse should also be emphasised as a potential option to conserve water resources. In addition, the system where water abstraction must be authorised by the DWS requires significant improvements to determine water availability more accurately. More sophisticated water accounting practices should be adopted.



Figure 36: South Africa’s Strategic Water Source Areas

Source: WWF-SA (2013)

Table 33: KZN’s Strategic Water Source Areas

SWSA	Supply To	Main Rivers	Threats	Impacts
iMfolozi	Richards Bay, Vryheid, eSikhawini	Len Lenjane Black iMfolozi Pongola	<ul style="list-style-type: none"> • Land degradation • Large-scale plantations • Coal mining • Large-scale cultivation 	<ul style="list-style-type: none"> • Ecosystems • Erosion • Sediment • Flooding • Wetlands • Water use • Acid Mine Drainage (AMD) (water quality)
Northern Drakensberg	Gauteng and Free-State provinces, parts of the North West province (Rustenburg, Potchefstroom, Klerksdorp, Orkney, Stilfontein, Wolmaranstad, Vryburg), parts of	Senqu Caledon Thukela Orange Vaal	<ul style="list-style-type: none"> • Land degradation • Coal mining 	<ul style="list-style-type: none"> • Ecosystems • Erosion • Sediment • Flooding • AMD (water quality)

	KZN (Durban, Pietermaritzburg, and Port Shepstone)			
Southern Drakensberg	Parts of KZN (Durban, Pietermaritzburg and Port Shepstone)	uMngeni Mooi Thukela Mkomasi uMzimkulu	<ul style="list-style-type: none"> • Land degradation • Large-scale plantations 	<ul style="list-style-type: none"> • Ecosystems • Erosion • Sediment • Flooding • Wetlands • Water use
Zululand Coast	KwaDukuza, Mandeni, uMlalazi and uMhlathuze Municipalities	Mvoti Thukela Mhlathuze	<ul style="list-style-type: none"> • Land degradation • Wildfires • Invasive alien vegetation 	<ul style="list-style-type: none"> • Ecosystems • Erosion • Sediment • Flooding • Water use

7.7 Conclusion and Recommendations

Table 34 shows the trends observed and predicted for the freshwater resource indicators.

Table 34: Trends of indicators for KwaZulu-Natal

Indicator	Trends
Availability of water resources	Decreasing
Water resources per capita	Decreasing
Comparison of natural versus current river flows	Decreasing
Water quality	Decreasing
Number and locality of pollution disaster events	Increasing
Trophic status of dams	Increasing
Health of river habitats	Decreasing

The quantity and quality of freshwater resources continue to decline in the Province of KZN. This is mainly due to increasing consumption of the limited water resource by several human and natural users. A secondary driver is changing temperature, rainfall and evaporation patterns largely due to a changing climate. Water supply via rainfall is becoming less predictable and droughts and extreme events more common. This is exacerbated by unlawful and excessive abstraction of water, with the wastage of potable drinking water through leaks a significant pressure in many of the municipalities in KZN. Water quality-related drivers stem mainly from an increasing population and poorly maintained or non-functional WWTWs for adequately treating effluent. For example, waste water does not always get to these treatment facilities because of lack of infrastructure and drainage systems. This is a problem particularly where rivers flow through informal settlements that have no proper sanitation services. It is recommended that ways are sought to address this problem.

A concerted effort to focus on the recommendations of the KZN PGDS (PGDS, 2016) for preventing negative impacts on freshwater resources and the environment in KZN would go a long way to improving the freshwater status in KZN. *Inter alia*, the PGDS calls for an intensified focus on land-use planning, management and governance to protect and conserve water and the environment. A second essential focus is on identifying information gaps to conserving and protecting the quality and quantity of finite surface and groundwater resources in the Province.

7.8 References

- DWS. 2016. DWS Access to Infrastructure. Retrieved from: <https://www.dwa.gov.za/wsk/DefaultList.aspx?SubjectAreaID=2&DataTopicDetailID=63&DisplayTypeID=1&PerspectiveID=0&LvlID=10&DataTopicID=35>
- DWS. 2017a. National Integrated Water Information System. Retrieved from: <http://niwis.dws.gov.za/niwis2/>
- DWS. 2017b. Dam levels and indicators. Retrieved from: <http://www.dwaf.gov.za/Hydrology/Weekly/ProvinceWeek.aspx?region=KN>
- DWS. 2017c. KZN Reconciliation strategy.
- EWISA. 2017. KwaZulu-Natal Municipal Greendrop performance. Retrieved from: http://www.ewater.co.za/eWISAWaterworks/misc/MunicipalContacts/KZNContacts_GreenDrop.htm. Accessed on 6 July 2017.
- Fin 24. 2017. After spiralling costs, Ingula is now powering the economy. Retrieved from: <http://www.fin24.com/Economy/Eskom/after-spiralling-costs-ingula-is-now-powering-the-economy-20170309-2>
- KZN Provincial Planning Commission (KZNPPC). 2016. Moving KZN Towards Achieving Vision 2035, presentation to SAPOA 28 October 2016.
- National Groundwater Strategy (NGS). 2016. Department of Water and Sanitation, December 2016.
- Provincial Growth and Development Strategy (PGDS). 2016. 2035 Provincial Growth and Development Strategy – Building a better future together. ISBN1-920041-15-X.
- Provincial Planning Commission. 2016. KwaZulu-Natal Situational Overview.
- State of the Province Address (SOPA). 2017. State of the Province Address as delivered by Mr T.W. Mchunu, MPL, honourable member of the province of KwaZulu-Natal on 01 March 2017.
- Statistics South Africa. 2016. Community Survey Results: Provinces at a glance. Retrieved from: <http://cs2016.statssa.gov.za/wp-content/uploads/2016/06/CS-2016-Provinces-at-a-glance.pdf>
- Statistics South Africa. 2014. Census 2011. Provincial profile: KwaZulu-Natal.
- Summerton, M.J. 1995. Process and Modelling studies in Forest Hydrology. MSc thesis, Department of Agricultural Engineering, University of Natal.
- uMgeni Water. 2013. North-West Region Bulk Water Services Study, with specific reference to the Ngagane and Biggarsberg Bulk Water Systems.
- uMgeni Water. 2016. Infrastructure Master Plan 2016. Volume 1 2016/2017 – 2046/2047.
- uMgeni Water. 2017. Water Quality Index Report. January 2017.

WWF-SA. 2013. An Introduction to South Africa's water source areas. The 8% land that provides 50% of our surface water. Retrieved from: <http://www.journeyofwater.co.za/>

WWF-MWP. 2016. Celebrating 25 years.



Photo credit: Nicholas Moxham

8. Marine and Coastal Resources

8.1 Introduction

The South African National Environmental Management Integrated Coastal Management Act, 2014 (Act No. 36 of 2014, section 1), defines the coastal zone as “the area comprising coastal public property, the coastal protection zone, coastal access land, coastal protected areas and coastal waters, and includes any aspect of the environment on, in, under and above such area”. In KwaZulu-Natal (KZN) this includes a wide variety of terrestrial, marine and transitional habitats.

The KZN coast extends 580 km from the Mozambique border in the north to the Mtamvuna Estuary in the south. Bounded by the warm Agulhas Current, KZN has a humid subtropical northern region grading to a warm-temperate climate in the south. The KZN continental shelf is very narrow (3-12 km), widening off the Thukela River to a maximum of 47 km. Prominent features of the KZN coast include a series of reefs from Kosi Bay near the southern Mozambican border to Leven Point, 12 km north of Cape Vidal (Schleyer, 1999). Further south, rocky reefs dominate, including the Aliwal Shoal, which is an important shark-breeding ground and nursery area. Interspersed along the coastline are 76 estuaries, varying in size and productivity. Northern KZN has 13 coastal lakes that, together with forested coastal dunes, define the landward side of the coastal zone.

Coastal habitats are under pressure from anthropogenic activities such as coastal development, resource extraction and mining. Continued population growth and demand for development opportunities along the coast are likely to result in these pressures continuing to grow, thereby threatening the provision of important ecosystem goods and services. The 2004 KZN State of Environment Report (SoER) assessed key drivers and pressures along the KZN coastline and identified indicators to measure the impact of these pressures over time (DAEA&RD, 2010). Pressures on the marine environment were found to include: mining, overharvesting, land modification, climate change, mariculture⁴³, invasive alien species, pollution, poor catchment management and limited management and control of the Admiralty Reserve.

This report builds on the 2004 KZN SoER, allowing for the reassessment of drivers, pressures and indicators. New indicators have been added to include new and emergent issues (Table 35). This report also aligns with the upcoming Provincial State of the Coast Report, anticipated in 2018. In order to assess and monitor indicators for this KZN EOR, five primary subjects were chosen: i) the condition of marine and coastal biodiversity, ii) the functioning of marine ecosystems, iii) the state of coastal resources in the Province, iv) adequacy of protection of the coastal environment and v) pollution.

⁴³ ‘Mariculture’ is defined as the cultivation of fish or other marine life for food.

Table 35: Indicators used in the assessment of the marine and coastal resources in KZN

Indicators	Description and comments
State of marine and coastal resources	
Number of birds at selected estuaries in KZN.	Birds, particularly estuarine waders, are susceptible to habitat loss, making their population trends a good indicator of the state of estuarine health.
Abundance of key focal species.	Population trends of selected species that play a key role in the environment provide a proxy for assessing environmental change and/or health.
Abundance of threatened species and habitats.	Data on a provincial level of threatened species and habitats are limited. The IUCN red list provides a good overview of threatened species within the province, while a reduction in mangrove cover is a high-level indicator of environmental change within estuaries.
Ecological functioning	
Estuarine health.	'Estuarine health' refers to the ability of the estuary to maintain its function as an estuary, while providing goods and services to adjacent environments. Present Ecological State (PES) provides a multifaceted overview of estuarine health.
Coral bleaching.	Coral bleaching, a stress response to spikes in water temperature, is used as an indicator of the effects of climate change on ecological functioning of marine habitats.
Sustainability of coastal resources	
State of important linefish.	Changes in contribution of targeted species, give indications of changes in stocks.
State of crustaceans targeted by trawlers.	Changes in catch and species composition of crustaceans targeted by trawlers are likely to be indicative of stocks present, providing fishing effort remains constant. This indicator uses data until 2010, when effort decreased substantially.
Subsistence harvesting of mussels.	Subsistence harvesting is an important food source, especially for rural communities. Amount (kg) harvested annually provides an indication of pressures on stocks.
Sand mining.	Sand mining is common in rivers and estuaries, having both a direct impact on the receiving environment and an indirect impact on the adjacent coastal environment. Increases in both legal and illegal sand mining indicate a deterioration in the condition of coastal ecosystems.
Protection of the coastal environment	
Number and extent of protected areas.	Protection of the marine environment is vital for conserving biodiversity. Sufficient and representative Marine Protected Areas (MPAs) and reserves are required to achieve this. Progress towards conservation goals is used as an indicator.
Enforcement of and compliance with fisheries regulations.	Monitoring and compliance is required to ensure the sustainability of fish stocks. This is assessed by the number of enforcement officers and patrols undertaken, including non-compliances identified.
Pollution	
Volume of effluent discharged into the marine environment.	Discharge of effluent via pipelines has a negative impact on the marine environment. Calculation of the volumes of effluent discharge into the marine environment can be used as an indication of the magnitude of its potential impact.
Condition of invertebrate communities near effluent pipelines.	In addition to effluent volumes, the abundance and community structure of invertebrate communities can

Indicators	Description and comments
	provide insight into nutrient loading and its impact on the marine environment.
Amount of litter in the coastal zone.	Litter in the coastal zone, primarily from land-based sources, is becoming a significant problem. Assessing annual changes in the amount of litter removed from beaches at the coastal clean-up day allows us to assess whether the amount of debris is increasing, stabilising or decreasing.

8.2 Drivers

8.2.1 Urbanisation

Currently, up to 64% of South Africans are living in urban areas, with an annual urbanisation rate of 1.5%, resulting in habitat fragmentation and increased CO₂ emissions (Stats SA, 2011). KZN is the second-most populous province in South Africa, with a population of 10.8 million people in 2015, of which over 50% reside in coastal municipalities primarily around Durban and Richards Bay. Poverty levels in KZN remain high, with many people not having access to adequate sanitation and waste management services, resulting in untreated waste and rubbish being introduced to rivers and streams and ultimately to coastal environments.

8.2.2 Industrialisation

In South Africa, manufacturing and industry have historically been concentrated inland; however, this has changed in recent years as industry has seen the benefit of being close to the ocean for transportation and waste assimilation (Goble, van der Elst, and Oellermann, 2014). Although the KZN economy is largely constituted by tertiary industries such as retail, manufacturing, which includes petro-chemical and automotive industries, is one of the largest individual sectors. The manufacturing sector contributed 16.5% of provincial GDP in 2015 (KZN Treasury, 2016).

8.2.3 Climate change

Effects of climate change in the coastal zone are already becoming evident; for example, coral bleaching is occurring as a result of increased sea surface temperatures (SSTs). However, climate change will drive more drastic changes in the future. As a consequence of increased SSTs, oxygen levels in water will decline, resulting in losses of species or changes to species distribution.

8.2.4 Governance

Protection of the coastal zone is governed by a number of legislative instruments (Table 36) but their effectiveness is hampered as governance has historically been fragmented among government departments (Goble *et al.*, 2014). A major role player in the future use of KZN marine and coastal resources is Operation Phakisa, which aims to generate R20 billion and 22 000 jobs by 2019 (Operation Phakisa, 2016). However, increased focus on oil and gas exploration as well as mining of marine and coastal resources is likely to result in further pressures on the marine environment.

Table 36: Legislation governing protection of the coastal zone in South Africa

Year	Legislation	Type	Description
1998	National Environmental Management Act (NEMA)	Act	Act No. 107 of 1998: Provides the overarching framework for environmental legislation in South Africa.
1998	Marine Living Resources Act	Act	Act No. 18 of 1998: Focusses on the equitable and sustainable use of marine resources, primarily seaward of the highwater mark.
1998	National Water Act	Act	Act No. 36 of 1998: Legislates the requirement to determine the “ecological reserve”, which ensures sufficient water is provided to areas such as estuaries to maintain functioning.
2014	National Environmental Management: Integrated Coastal Management Act (ICMA)	Act	Act No. 24 of 2008, amended as Act No. 36 of 2014: Implemented to manage South Africa’s unique coastal area, including natural resources, and complex anthropogenic relationship to ensure that the benefits of the coastline can be sustainably and equitably exploited.
2014	Operation Phakisa	Policy	Unlock the economic potential of the ocean.

8.3 Pressures

Growing urbanisation and industrialisation drive increased pressures on coastal resources, with development in coastal zones resulting in habitat loss and fragmentation. Increased sewage storm water and other waste flows to the coastal environment result in volumes that cannot be adequately treated, further overburdening KZN’s already stressed sanitation network. The waste then enters the marine environment through coastal outfall⁴⁴, streams or estuaries. This waste is typically characterised by high nutrient loads, which can have a severe negative impact on water quality and ecosystem functioning.

Exploitation of living resources in the coastal zone for both recreation and subsistence can put high pressures on stocks, particularly on species such as mussels and ascidians (or sea squirts)⁴⁵. In addition to exploiting species, humans inadvertently introduce alien and invasive species that may out-compete their indigenous counterparts. This is likely to be exacerbated as climate change may alter species’ natural distribution ranges. Pressures may be further exacerbated by poor practices beyond the coastal belt, such as inadequate management of catchment areas.

⁴⁴ Generic term used for pipeline or other discharge at sea.

⁴⁵ Ascidians or sea squirts are a group of sac-like marine invertebrate filter feeders in the subphylum *Tunicata* (Class: *Ascidacea*).

8.4 State

8.4.1 State of marine and coastal resources

Biodiversity is defined as “the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and among ecosystems” (NEMBA, Act No. 10 of 2004). The 2004 SoER identified four indicators for the assessment of marine biodiversity: i) the number of birds at selected estuaries in KZN, ii) species diversity and abundance in the bycatch⁴⁶ of crustacean trawlers, iii) species richness on rocky and coral reefs and iv) abundance of keystone species (sharks).

Both bycatch of trawlers and species richness on rocky and coral reefs were assessed using data from the Oceanographic Research Institute (ORI) for the 2004 KZN SoER. Unfortunately, updated data were not available for inclusion in these indicators in the current Report. Indicators used to assess the condition of marine and coastal resources in KZN in this Report were: i) the number of birds counted at selected estuaries, ii) abundance of key focal species (sharks, turtles and alien and invasive species) and iii) abundance of threatened species and habitats.

8.4.1.1 Number of birds at Durban Bay

Birds, particularly estuarine waders, are susceptible to habitat loss, which makes them good indicators of estuarine state (DAEA&RD, 2010). Estuaries are affected by a range of anthropogenic activities such as canalisation or alteration of mouth state. These changes result in changes in both the abundance and the species composition of birds present; for example, by favouring fish-eating birds (Allan, Sinclair and Rossouw, 1999).

Durban Bay has undergone major habitat loss, with tidal flats and mangroves declining by 86% and 97% respectively. This has resulted in a decline in water birds and palaeartic waders since 1965 by 70% and 81% respectively (Allan *et al.*, 1999). Subsequent to 1999, three more species appeared to be locally extinct: the Kittlitz Plover (*Charadrius pecuarius*), White Fronted Plover (*Charadrius marginatus*) and Greater Sand Plover (*Charadrius leschenaultii*). Monthly bird counts from July 1999 to June 2013, supplementing counts from March 1999 to February 2002, showed both short- and long-term declines in water birds in the bay (Allan, 2012).

8.4.1.2 Abundance of focal species

Sharks

The removal of keystone species is likely to have a profound effect on ecosystem functioning. Declines in the populations of keystone species are important indicators of deterioration in an environment. KZN has deployed long, anchored gillnets to ensure better protection since 1952. Fourteen species are regularly caught in the nets, of which four, the blacktip, great hammerhead, scalloped hammerhead and Java shark, significantly declined between 1978 and 1999 when standardised for catch per unit effort (CPUE) (Dudley, 2002). From 2000 to 2010, a decline was observed in the catch of all large predatory shark species, with drumline

⁴⁶ 'Bycatch' is the unwanted fish and other marine animals trapped by commercial fishing nets during fishing for a different species.

data also showing a decrease in the number of sharks caught between 2007 and 2014 when standardised for CPUE.

Turtles

Turtles are an important flagship species for protecting sandy coastal habitats. Both loggerhead (*Caretta caretta*) and leatherback (*Dermodochelys coriacea*) turtles nest in northern KZN. As adults, they are exposed to numerous threats, including artisanal fishing or as bycatch in inshore trawling, shark nets and pelagic longline fisheries. Nests are threatened by predation and beach erosion. Climate change has the potential to affect sex ratios, thereby further negatively impacting on populations (Schwanz and Janzen, 2008). Conservation measures implemented under the Maputaland turtle conservation and monitoring programme have resulted in improved protection of turtles (de Wet, 2012). Loggerhead turtles have undergone many distinct phases, with an initial rapid increase in the first five to ten years in response to protection, followed by a prolonged stability (Figure 37). A rapid increase between the early 2000s and 2012 was attributed to consistent protection of hatchlings returning to the area to nest and to a collapse in the Mozambican prawn industry that resulted in fewer turtles caught in prawn nets (Ezemvelo, pers. comm.). A peak occurred in 2014, followed by three years of decline in nesting events, of which the cause is currently unknown. Leatherback populations show high inter-annual variability, although currently overall nesting populations are stable (Figure 37) (Ezemvelo, pers. comm.).

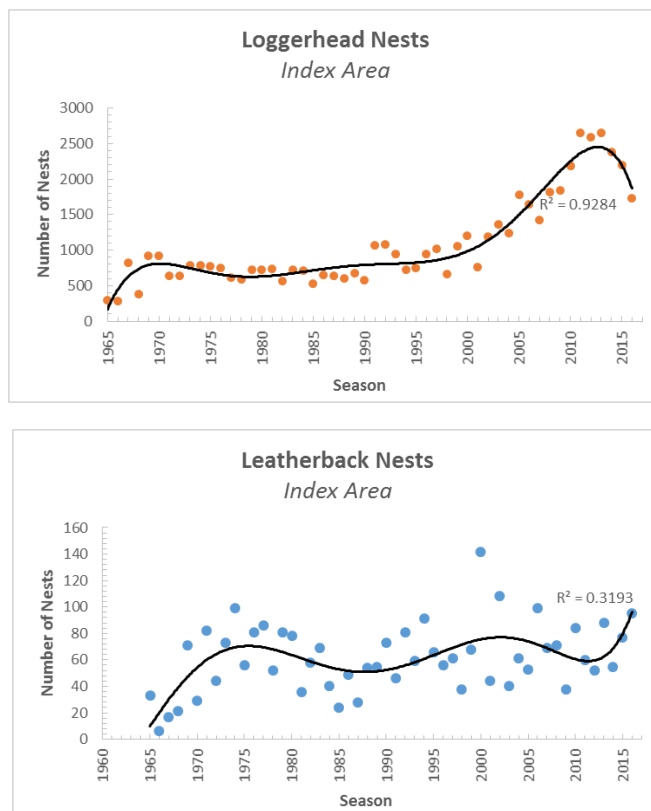


Figure 37: Loggerhead and leatherback turtle nesting of the Maputaland coast (1965-2010)

Source: Ezemvelo, pers. comm.

Alien and invasive species

Alien and invasive species have the potential to impact across the economic, social and ecological spheres. For example, mussel rafts in Saldanha Bay (in the Western Cape) become extensively infected by an invasive ascidian (*Ciona intestinalis*) that inhibits mussel growth and reduces efficiency in sorting, which results in a removal cost of R100 000 per annum (Robinson, 2015).

In 2011 and 2015, a total of respectively 85 and 87 marine and estuarine alien plants and animals were recorded in South Africa (Mead, Carlton, Griffiths and Rius, 2011; Robinson, 2015). It is likely that alien and invasive species are more prevalent in the Natal Ecoregion due to the presence of the Durban and Richards Bay harbours, which provide protected waters and high ship traffic (Brooker, 2016).

8.4.1.3 Abundance of threatened species and habitats*IUCN Red List Species*

Very few datasets are available regarding threatened species and habitats at a provincial level. Adequate assessment of these species and habitats needs to be undertaken to ensure protection and conservation. The IUCN Red List of Species indicates that the Western Indian Ocean region has 188 Vulnerable species, 34 Endangered species and 11 Critically endangered species. Certain species are adequately protected; for example, the Seventy-Four, by a fishing moratorium, and turtles, by protection of their breeding areas. However, numerous species are still at risk.

Mangroves

Habitat-level indicators are important as they can show general trends in the condition of ecosystems. Mangroves occur in estuaries along the KZN coast and are subject to numerous anthropogenic stresses. Being highly susceptible to stressors, mangroves are good indicators of change, but are currently declining in presence and coverage throughout KZN. Between 1982 and 1999, mangroves were lost from nine estuaries, and from a further two estuaries between 1999 and 2006. Aerial coverage of mangroves declined by over half during this period. This contrasts with the general perception of improvement of the ecological state noted in small KZN estuaries (van Niekerk and Turpie, 2012). Mangrove cover and condition should thus be included in future assessments of estuarine condition.

8.4.2 Ecological functioning

Functioning ecosystems provide a range of valuable goods and services, including marine resources, storm protection, waste assimilation, and filtering via estuaries and marine outfalls. Replacing ecological goods and services with manufactured substitutes is costly and is often less efficient than the natural processes.

The KZN SoER (2004) identified the following indicators of ecological functioning: i) trends in mouth state of estuaries, ii) estuarine indices and iii) bleaching and recruitment on coral reefs. While mouth state provides a good indicator of ecosystem functioning, no long-term datasets are currently available for assessing trends in mouth state since the 2004 KZN SoER.

Monitoring of mouth state of at least selected estuaries is recommended for inclusion in future reports.

For the above reason, only two key indicators have been used to assess ecosystem function in this Report: i) estuarine health indices and ii) bleaching of coral reefs.

8.4.2.1 Estuarine health

Estuaries are important nursery grounds for marine fish and crustaceans. They are, however, highly susceptible to environmental change, particularly in fresh and seawater inflow, sedimentation and decreased water quality caused by pollution. Prolonged mouth closure is thus likely to have a negative impact on stocks of estuarine-dependent species. Two key areas of concern are: i) whether the estuary is adequately managed and ii) whether there is adequate freshwater input (Turpie *et al.*, 2002).

Present Ecological State (PES)

Comparisons of data on Present Ecological State from several reports appear to show an increase in the number of estuaries rated as fair or good rather than poor. The state of two of the largest systems, St Lucia and Durban Bay, declined in the decade from 2000 to 2011 (Whitfield 2000; van Niekerk and Turpie, 2012) and many smaller estuaries, especially south of Durban experience large amounts of anthropogenic pressure. However estuarine indices cannot be accurately compared as they are formulated in a variety of ways and this apparent trend must be regarded with circumspection. For example, a recent assessment of estuaries in the Ethekeini area found 9 of 16 estuaries to be poor or highly degraded (Ethekeini Municipality, undated), while Mackay (2014) rated the condition of all KZN estuaries as ranging from fair to poor. The loss of habitat, especially mangroves (Forbes and Demetriades 2008, Rajkaran and Adams 2011), may have resulted in declining species diversity and loss of nursery and coastal protection functions in some estuaries and the invasive mollusc *Tarebia granifera* is a growing problem that is not picked up in the comparisons. The assessment of PES has now been standardised and future data should be more comparable. The Ethekeini report on Durban's estuaries recommended an approach to management based on protection, restoration and recreation of habitats and ecosystems. Progress towards these goals should serve as a future indicator of estuarine state.

8.4.2.2 Coral bleaching

Coral reefs are highly sensitive to changes in water temperature and quality. Bleaching is a general stress response in corals, but large-scale bleaching is most commonly a response to thermal stress. Coral bleaching is thus a good indicator of the effects of climate change on ecological functioning of marine habitats (Harikishun, 2013).

Minor bleaching events were noted in northern KZN in 1998, 2000 and 2002 (Celliers and Schleyer, 2002; Floros, Samways and Armstrong, 2004), with a warm water event in 2005 showing unprecedented numbers of bleached colonies, despite the low 'bleaching response'⁴⁷ index reading.

⁴⁷ The 'bleaching response' index combines the frequency of bleaching with severity.

8.4.3 Sustainability of coastal resources

Coastal resources can be divided into living (renewable) and non-living (non-renewable) resources. Renewable resources include plants and animals that are collected for food, aquaria or decoration. Non-renewable resources include the land itself, estuaries, beaches and minerals. Renewable resources in KZN are exploited by three fishery sectors: commercial, recreational and subsistence.

The 2004 KZN SoER identified three indicators for the assessment of the state of coastal resources: i) the state of stocks of important linefish, ii) the state of crustaceans targeted by trawlers and iii) subsistence harvesting of intertidal mussels. All three indicators were assessed in this Report, with the inclusion of the one additional indicator for non-renewable resources of sand mining.

8.4.3.1 State of linefish stocks

The KZN shore fisheries

Changes in contribution of the five most targeted species were evident between 2004 and 2010 (DAEA&RD, 2010; Dunlop, 2011; ORI, 2013), with a decline in catches of shad and an increase of strepie particularly notable (Table 37). Overall CPUE declined for all species; however, mean size of fish caught remained constant. Table 37 includes trends in CPUE, mean size and stock status (↑=increasing, →=stable, ↓=decreasing).

Table 37: Top five shore-based linefish catches (in %) between 1984-2004 and 2009/10

Common name	Species name	1985-2004 ¹	Shore 2009/10 ²	CPUE 2013 ³	Trend in mean size 2013	Status 2013
Strepie	<i>Sarpa salpa</i>	17%	34.8%	↓	→	underexploited
Shad	<i>Pomatomus saltatrix</i>	61%	14.7%	↓	↑	overexploited
Blacktail	<i>Diplodus capensis</i>	4%	14.5%	↓	→	not assessed
Pinky	<i>Pomadasys olivaceus</i>	4%	6.5%	↓	→	optimally exploited
Seabream	<i>Rhabdosargus holubi</i>	-	4.9%	↓	→	not assessed
Spotted Grunter	<i>Pomadasys commersonni</i>	2%	-	No clear trend	No clear trend	overexploited

Sources: ¹DAEA&RD (2010), ²Dunlop (2011), ³ORI (2013)

KZN boat fisheries

Trends in CPUE for the boat-based fishery from 1986 to 2004 and between February 2009 and April 2010 were assessed. Overall trends were difficult to ascertain for line fisheries; however, two species prevalent in 2004 catches, santer and catfaced rockcod, no longer featured in the top five in catches in 2009/10. These were replaced by yellowfin tuna and chub mackerel (Table 38). Table 38 includes trends in CPUE, mean size and stock status (↑=increasing, →=stable, ↓=decreasing).

Table 38: Top five boat-based linefish catches (in %) in 1984–2004 and 2009/10.

Common name	Species name	2004 ¹	2009/10 ²	CPUE 2013	Mean size 2013	Status 2013
Slinger	<i>Chrysoblephus puniceus</i>	25%	33.9%	↑	→	optimally exploited
Santer	<i>Cheimerus nufar</i>	9%	-	↑	↑	optimally exploited
Blue emperor	<i>Lethrinus nebulosus</i>	6%	9.0	Unknown	Unknown	not assessed
Englishman	<i>Chrysoblephus anglicus</i>	4%	4.4%	↑	↓	collapsed
Yellowfin tuna	<i>Thunnus albacares</i>	-	7.4%	→	↓	optimally exploited
Chub mackerel	<i>Scomber japonicus</i>	-	5.3%	Unknown	Unknown	overexploited
Catfaced rockcod	<i>Epinephelus andersoni</i>	7%	-	↓	Unknown	optimally exploited

Sources: ¹ORI, (2013), ²Dunlop (2011)

8.4.3.2 State of crustaceans targeted by trawlers

The KZN trawl industry can be subdivided into the shallow water fishery in <50 m of water and the offshore trawl fishery at depths of 300-600 m (Fennessy and Groenewald, 1997; Fennessy, 2001). Inshore trawling has ceased due to low catches as a result of long-term closure of the St Lucia Estuary (DAEA&RD, 2010).

The 2004 KZN SoER described stocks of knife prawn and langoustine as fluctuating, but relatively stable. Current data are difficult to interpret because of the decline in trawling activity for a number of reasons, including the landed price (ORI, 2015).

8.4.3.3 Subsistence harvesting

Subsistence mussel harvesting is an important protein source, particularly for rural communities. Previous analysis of the long-term data series available for subsistence harvesting shows an overall decline in catches. This decline may not be due to an actual decline in stocks but as a result of local communities identifying the need to reduce pressure on the stocks or the development of a cash economy (Kyle, Pearson, Fielding, Robertson and Birnie, 1997). Prior studies have found Maputaland subsistence harvesting to be within acceptable limits, with some areas over-exploited but not threatened (Tomalin and Kyle, 1998). A subsequent study undertaken by Ezemvelo has highlighted over-exploitation as a concern, but without proper survey data it is challenging to identify whether stocks are in decline (EKZNW, 2003).

8.4.3.4 Sand mining

Sand mining can have direct effects, such as the loss of biodiversity or altered stream characteristics due to physical disturbance, and indirect effects, including the interruption of coastal processes such as the provision of sand (DAEA&RD, 2010). Sand mining in the coastal zone often occurs illegally within estuaries, resulting in further degradation of already negatively impacted environments.

Sand mining is common in KZN. The illegal mining is of particular concern as miners tend to exploit areas that should not be disturbed, practise damaging abstraction methods and do not undertake rehabilitation post mining. Findings of a survey conducted from the Thukela to the Mtumvuna Rivers revealed that 18 out of 64 estuaries showed evidence of sand mining; however, no estimate of the volume of sand being removed is available (Demetriades, 2007). As this survey was only undertaken once, it is impossible to ascertain trends. However, increased illegal sand mining is likely to occur as the value of sand increases and data should be collected to make this a useful indicator.

8.4.4 Protection of the coastal environment

South Africa has numerous environmental laws that obligate the protection of the marine and coastal environment. Most biodiversity typically falls outside of protected areas, yet must still be adequately protected. This means that monitoring and enforcement of regulations outside of MPAs are required to ensure compliance.

The 2004 KZN SoER identified two indicators to assess this: i) the number and extent of protected areas, and ii) enforcement of and compliance with fisheries regulations. Both have been included as indicators in the current EOR. A third indicator, coastal stability and maintenance of littoral drift (i.e. the transport of loose sediment, mainly sand, due to the action of breaking waves), was highlighted in the 2004 SoER. However, due to limited data, this was not explored in this Report. Although coastal stability and littoral drift are still likely to be important indicators, no datasets have been identified for adequately assessing them.

8.4.4.1 Proportion of Areas Protected

Approximately 9% of South African coasts are fully protected while a further 14% occur in MPAs with varied levels of use. Offshore levels of protection are negligible, with only 0.16% of the Exclusive Economic Zone (EEZ) protected (Sink and Samaai, 2009). Currently there are four MPAs along the KZN coastline, protecting approximately 25% of it. No MPAs occur between St Lucia and Durban, leaving important areas such as the Natal Bight unprotected. South of Durban, Aliwal Shoal provides protection to an important rock reef. In the south, Trafalgar MPA provides protection primarily to coastal features, including cretaceous fossils and estuaries. It is, however, limited in its effectiveness by its size (Table 39). Associated with the assessment of under-protected habitats by the National Spatial Biodiversity Assessments, the South African National Biodiversity Institute (SANBI) identified offshore areas of high biodiversity, importance for protecting fish stocks and vulnerable marine ecosystems requiring protection (Sink and Samaai, 2009). In KZN these offshore areas include an extension offshore of the iSimangaliso Wetlands Park, Thukela Banks, an inshore extension of Aliwal Shoal to protect the coast and Protea Banks. Should promulgation of these MPAs occur, this will be a good step towards conserving KZN marine and coastal environments. However, no increase in size of MPAs has been formalised to date.

Table 39: Marine Protected Areas (MPAs) of KwaZulu-Natal

MPA	Year established	Size (in km ²)	Zoned	% no take	Type of use in extractive use zones
Trafalgar	1979	8.3	No	0	Recreational shore angling
Aliwal Shoal	2004	124.7	Yes	1.7	Shore and boat-based angling, commercial linefishing, subsistence harvesting
St Lucia	1976	442.0	Yes	30.3	Shore angling (all species), recreational linefishing (pelagic species only)
Maputaland	1987	384.5	Yes	33.8	Shore angling (all species), recreational linefishing (pelagic species only)

Source: Sink *et al.* (2012)

Estuaries

The 2004 KZN SoER identified ten estuaries in KZN that had received some degree of statutory protection. All but two of these were situated north of Durban and primarily comprised medium-large open estuaries. The 2004 SoER identified a lack of no-take estuaries, with the reef at the mouth of Kosi Bay being the only sanctuary (van Niekerk and Turpie, 2012). The St Lucia Estuary is listed as fully protected; however, fishing is still permitted, which means that St Lucia has not been adequately protected (van Niekerk and Turpie, 2012). Efforts to remediate the situation are currently under way, primarily through re-uniting the mouth of the iMfolozi with the St Lucia mouth.

The increase in no-take zones is an improvement, but is by no means adequate for the protection of estuaries in KZN. Table 40 shows the estuaries that require full protection. Adequate protection of the St Lucia and small south coast estuaries is still required to ensure representation of different estuarine types. The following eleven estuaries have been identified as requiring full protection by the National Biodiversity Assessment (2011), of which only six are already protected (van Niekerk *et al.*, 2011).

Table 40: Estuaries that are protected as identified by the National Biodiversity Assessment

Estuary	Protected area	Amount of estuary in protected area	Level of Protection
Mtamvuna*	Pondoland MPA	Part	Low
Mpenjati	Mpenjati Nature Reserve	Part	Medium
Mgeni	Beechwood Nature Reserve	Part	Medium
Mhlanga*	-	All	High
Mlalazi*	Mlalazi Nature Reserve	All	High
Mhlathuze	-	Part	Medium
St Lucia/iMfolozi*	iSimangaliso Wetland Park	90%	High/medium
Mgobezeleni*	iSimangaliso Wetland Park	All	Low
Kosi Bay*	iSimangaliso Wetland Park	All	Medium

Source: van Niekerk and Turpie (2012)

*Estuaries already protected.

8.4.4.2 Enforcement

The 2004 KZN SoER reported that between 1994 and 1996, the overall level of enforcement and monitoring in KZN was at 10.9% of shore anglers inspected, which was considerably higher than the < 2% for other provinces. After 2004, the number of marine and estuarine patrols increased, with a peak in 2008. Thereafter, a steady decline in patrols was recorded, resulting in lower distances covered and fewer checks (Maggs 2016). As of 2016, compliance monitoring has moved to the Department of Agriculture, Forestry and Fisheries (DAFF). It is still unclear how this will impact the ability to monitor and protect marine resources (Maggs *et al.*, 2016).

8.4.5 Pollution

Pollution is a primary concern in the marine and coastal environment. In this context, it refers to human-derived waste, industrial effluent, sewage and storm water. The primary source of land-derived waste to the ocean comes from effluent outfalls and pollution that flows out of rivers and estuaries. Litter, particularly single-use plastics, has been highlighted as a major concern for our oceans and coast.

Indicators outlined in the 2004 KZN SoER have been included in this Report: i) amount of effluent discharged into the marine environment, ii) condition of invertebrate communities near the effluent pipeline and iii) amount of land-based litter.

8.4.5.1 Volume of discharge of effluent into the marine environment

The coastal environment has been used to dispose of a variety of human-derived waste. Under normal levels, and providing volumes and nutrient loads are not excessive, this is unlikely to result in major impacts. However, high nutrient loading may result in eutrophic and anoxic conditions.

The 2004 SoER found that Durban outfalls' discharge levels fell within the conditions set by their permits. Current trends show a considerable decrease in discharge volumes from the Southern WWTW and a slight increase from the Central WWTW. A slight overall increase in wastewater is anticipated with population growth. However, a significant decrease from the Southern WWTW is more difficult to account for and it is questioned whether wastewater is being disposed of elsewhere.

8.4.5.2 Condition of invertebrate communities near the effluent pipeline

The impacts of pollution are often estimated through assessing the community structure of soft-sediment bottom-dwelling organisms as they are often sedentary and unable to move away from disturbances. Polluted environments typically show a decrease in the number of species present as well as a shift in community composition to "opportunistic species".

The 2004 KZN SoER was able to access data for two Durban pipelines (wastewater effluent) and the SAPPI SAICCOR (pulp effluent) pipeline. However, only the Durban pipelines (Central and Southern Works) were accessible for this EOR.

The CSIR found that the Southern Works was enriched with particulate organic material, resulting in a change in the macrofaunal community structure in close proximity to the outfall

in both 2011 and 2015 (CSIR, 2011/2015). The amount of enrichment appears to be increasing gradually and, while not of immediate concern, will require monitoring into the future. The Central Works appears to be operating within assimilation capacity; however, impacts from nutrient enrichment had also started to become evident in both 2011 and 2015.

8.4.5.3 Amount of plastic litter collected annually in the coastal zone

Coastal debris and litter are a worldwide issue and KZN is no exception. The primary source of litter in KZN is poor waste disposal, which results in litter being washed down rivers and streams before entering the marine environment. Aside from the impact on aesthetics, the economic impacts caused by having to remove it and loss of tourism potential can be significant. Litter is a threat to marine life, with effects ranging from ingestion to entanglement.

A yearly coastal clean-up has been undertaken in KZN since 1996. Ezemvelo records and collates effort data, distance covered, and amount of litter collected to allow for a comparison between subsequent years. Trends show an increase in the amount of litter collected if standardised for distance cleaned. A notable increase in the amount of litter occurred in 2013 and 2014, almost doubling the amount of litter collected in previous years (Table 41). Most litter collected comprises a variety of plastics.

Table 41: Annual coastal clean-up statistics for KZN

	2011	2012	2013	2014	2015	2016
Volunteers	7 604	2 069*	6 123	8 102	5 200	2 407*
Distance cleaned (km)	550	230	320	314	400	162
Bags collected	15 200	4 152	15 369	22 420	11 627	4 280
Estimated weight (kg)	32 310	11 330	34 180	31 267	22 871	17 460
Average weight (kg) per km cleaned	58.75	49.26	106.81	99.58	57.17	107.78

Source: EKZNW (2015)

*2012 and 2016 had low volunteer turnout due to heavy rainfall.

8.4.6 Emerging issues

While not assessed in detail in this Report, many emerging issues require consideration in the future.

Seismic surveys are currently undertaken in KZN in the search for oil and gas. A connection between seismic surveys and the impact on marine species, particularly marine mammals, is well established (Dunlop *et al.*, 2016). Although strandings of marine species cannot be directly attributed to seismic surveys, they have been seen to increase over periods that seismic surveys have occurred. In 2016, ten whales stranded (Ezemvelo KZN Wildlife, pers. comm.). The fact that seismic surveys were permitted during the period of whale migration along the KZN coast during 2016 is a real concern.

In addition to seismic surveys, future abstraction of oil and gas may result in physical damage to substrata and fauna, disturbance through smothering, pollution events and introduction of alien and invasive species. Currently only four exploration wells have been dug on the east

coast, but preliminary data justify further exploration, particularly in the Thukela Basin (Sink *et al.*, 2012).

No new effluent pipelines have been constructed in KZN recently; however, with the authorisation of the first desalination plant in Illovo, south of Durban, this will change. Brine produced as a waste product of the reverse osmosis process and cleaning products used within the facility will be pumped directly to sea via a newly constructed marine outfall. The impact of this and subsequent desalination plants needs to be monitored closely.

Aquaculture has been identified for potential economic growth as part of Operation Phakisa. In KZN the Amatikulu Estuary, the site of a historical aquaculture facility, has been identified for expansion and rejuvenation. Aquaculture, while potentially beneficial, can increase environmental impacts and risks and should be closely monitored in the future.

8.5 Impacts

Marine and coastal habitats provide a range of vital goods and services that depend on healthy and functioning ecosystems. For example, the economic benefit of preserving healthy mangroves may exceed that of clearing mangroves for aquaculture ponds (Chong, 2007). In addition, the interconnectivity of species and systems could mean that the loss of one species or habitat has the cascading effect of a loss of multiple species or habitats.

Loss of ecological function is a primary concern in the coastal zone. The important role that natural processes maintain without external input such as replenishment of beaches or assimilation of waste is often underestimated. For example, the need for replenishment of Durban's beaches due to the extension of the southern breakwater of the harbour, which cuts off natural sand migration, costs the municipality R8 million annually (Goble *et al.*, 2014). Less easily ascertained is the loss of productivity due to a decline in ecosystem function. The prolonged closure of the St Lucia mouth as a result of management strategies directed the iMfolozi River away from the estuary, reduced freshwater inflow and resulted in the collapse of the inshore trawling ground on the Natal Bight (Everett, 2014).

Pollution, including litter, has a significantly negative impact on the coastal environment. The cost of controlling, monitoring and managing pollution can be extremely high. This is exacerbated by the need to react to sporadic high-impact events such as oil spills. The ecological costs of pollution are becoming more evident, particularly with entanglement of litter or ingestion of microplastics by marine organisms. Although economic and social impacts of ecosystem degradation are difficult to quantify, these are likely to lead to the loss of livelihoods or employment opportunities. Health may also be affected in the event of declining water quality.

Box 4: Human vulnerability to the degradation of marine and coastal resources

Loss of goods and services

- Loss of vegetation results in increased vulnerability to storm surges and damage and loss of property.

Loss of ecosystem functioning

- Decreased sand replenishment can make beaches unsafe for bathing and can damage coastal properties.
- Prolonged estuarine mouth closure can result in decreased fish recruitment, resulting in lower catch per unit effort. This may result in a loss of income or subsistence.

Overexploitation of coastal resources

- This may lead to a loss of a sense of place and/or tourism opportunities.

Pollution

- Plastic, nutrient or oil pollution may result in a loss of tourism and subsistence harvesting opportunities, with subsequent effects on downstream employment opportunities.
- Health may be negatively affected by chronic or acute pollution.

8.6 Responses

A range of responses is available to prevent and mitigate the impact of environmental degradation. These may be divided into responses to improve knowledge, to conserve resources, to manage habitats and ecosystems better, and to adapt to changes. Many of these responses take place at national level, but are still relevant to KZN. Knowledge and monitoring of environmental changes are a vital part of responding to environmental degradation. An example of a large-scale programme is the African Coelacanth Ecosystem Project (ACEP), which promotes research off the coast from KZN.

A number of research programmes for enhancing knowledge of biodiversity in the Province are ongoing. Examples include the national introduction of a 'Foundational Biodiversity Information Programme' and 'Seakeys' to document species occurrence and population abundance. Sampling the deep offshore substrata, under successive iterations of the ACEP project, is adding valuable knowledge in under-reported habitats.

Physical changes in ocean and coastal processes are key drivers of biodiversity changes and thus important to measure. An example of a measurement instrument is the Agulhas System Climate Array (ASCA), which is designed to measure the influence of climate change on Agulhas, and thus on the global conveyor belt. It is imperative that long-term datasets are instituted to monitor change. The South African Environmental Observation Network (SAEON) and National Marine Linefish System have improved long-term data collection and disseminated the data to assess trends.

MPAs can act as important refuges, allowing for spill over to adjacent habitats and improving fisheries and livelihoods. The South African National Biodiversity Institute (SANBI) has identified spatial management measures, including MPAs, to protect offshore biodiversity and vulnerable marine ecosystems. In KZN, this has resulted in the proposal of a further three MPAs: the iSimangaliso Offshore, Thukela Banks and Protea Banks.

Responses to socio-economic threats from environmental change range from the South African Risk and Vulnerability Atlas (SARVA), funded by the Department of Science and

Technology (DST),⁴⁸ to specific climate adaptation strategies by various government agencies at all levels. A relevant example is eThekweni Municipality, which has developed a climate response strategy with ten themes: water; sea-level rise; biodiversity; food security; health; energy; waste and pollution; transport; economic development; and knowledge generation. Each theme has a set of goals to be achieved and a strategy in place to reach the goals.

South Africa has relatively comprehensive environmental legislation, with the ICM Act formalising the protection of the coastal zone. Improved legislation is only as effective as its implementation and the ability of the relevant authority to enforce it. In this light, the removal of KZN Ezemvelo Wildlife from compliance monitoring and the impact on the National Marine Linefish System is concerning and checks should be implemented to ensure that the level of enforcement is maintained.

8.7 Conclusion and Recommendations

Table 42 shows the trends observed and predicted for the marine and coastal indicators.

Table 42: Trends of indicators for KwaZulu-Natal

Indicators	Trends
1. State of marine and coastal resources	
Number of birds at selected estuaries in KZN	Decreasing
Abundance of key focal species	Variable
Abundance of threatened species and habitats	Increasing
2. Ecological functioning	
Estuarine health	Variable
Coral bleaching	Inconclusive
3. Sustainability of coastal resources	
State of important linefish	Decreasing
State of crustaceans targeted by trawlers	Data deficient ⁴⁹
Subsistence harvesting of mussels	Data deficient
Sand mining	Increasing
4. Protection of the coastal environment	
Number and extent of protected areas	Increasing
Enforcement of and compliance with fisheries' regulations	Decreasing
5. Pollution	
Volume of effluent discharged into the marine environment	Variable
Condition of invertebrate communities near effluent pipelines	No change
Amount of litter in the coastal zone	Increasing

Impacts of anthropogenic stress on the marine and coastal environment are already apparent. Exploration for and exploitation of marine resources thus need to be undertaken in a manner that minimises impacts and ensures sustainability. In addition, a representative network of MPAs to protect 5% of the ocean, with the aim of 10% in the future, needs to be established.

⁴⁸ Retrieved from: <http://sarva.dirisa.org/>. Accessed on 18 August 2017.

⁴⁹ This is identified as a recent indicator and not sufficient data has been collected to identify a trend. However, with the next EOR, sufficient data should be available to allow comparison.

Along with MPAs, Estuarine Management Plans and ecological reserves for estuaries need to be finalised and implemented.

In addition to protection, restoring capacity in compliance monitoring and enforcement is vital for protecting the marine environment. Along with this, enforcement of bylaws and improvement of management by local authorities are required to reduce the amount of litter that is reaching the oceans and shorelines.

In summary, the outlook for the KZN coast shows an increase in pressure on the coastal environment and it is imperative that appropriate responses to these pressures are implemented to reduce potential impacts.

8.8 References

Allan, D.G. 2012. Novitates: Special Addition. The waterbirds of Durban Bay, Durban Natural Science Museum, eThekweni Municipality, 35: 1-34.

Allan, D.G., Sinclair, J.C. and Rossouw, J. 1999. The water-birds (Aves) of Durban Bay: current status and historical trends. *Durban Museum Novitates*, 24: 1-21.

Beal, L. and Elipot, S. 2016. Broadening not strengthening of the Agulhas Current since the early 1990s. *Nature*, 540: 570-573.

Begg, G. 1978. The estuaries of Natal. Report 41. Natal Town and Regional Planning Commission, Durban.

Begg, G. 1984. The Estuaries of Natal: Part 2. The Regional Planning Commission Report, 55: 657 pp.

Brooker, B. 2016. Distribution and predictors of non-indigenous marine species with South Africa's MPA network. University of Cape Town.

Carter, R. 2003. Review of Durban outfalls effluent and environmental monitoring. Report prepared for the Coastwatch Programme and the Wildlife and Environment Society of South Africa.

Celliers, L. and Schleyer, M. 2002. Coral bleaching on high latitude reefs at Sodwana Bay, South Africa. *Marine Pollution Bulletin*, 44: 1380-1387.

Chong, V.C. 2007. Sustainable utilization and management of Mangrove ecosystems of Malaysia. *Aquatic Ecosystem Health and Management*, 9(2): 249-260.

Cliff, G. and Dudley, S. 2011. Reducing the environmental impact of shark-control programs: a case study for KwaZulu-Natal, 62: 700-709.

Cooper, J.A.G., Harrison, T.D., Ramm, A.E.L. and Singh, R.A. 1993. Refinement, enhancement and application of estuarine health index to Natal's estuaries, Tugela-Mtamvuna. Unpublished Technical Report. CSIR, Durban.

CSIR. 2011. Sea disposal of sewage: environmental surveys in the Durban outfalls region. Surveys made in 2011. CSIR report for eThekweni Municipality, Water and Sanitation, 16 pp.

CSIR. 2015. Sea disposal of sewage: environmental surveys in the Durban outfalls region. Surveys made in 2015. CSIR report for eThekweni Municipality, Water and Sanitation.

- Demetriades, N. 2007. Inventory of sandmining operations: Thukela to Mtumvuna, 31 pp. Department of Agriculture, Environmental Affairs and Rural Development (DAEA&RD). 2010. KwaZulu-Natal State of the Environment 2004: Marine and Coastal Environment Specialist Report, KwaZulu-Natal Provincial Government, Pietermaritzburg.
- Dudley, S. (2002) Shark catch trends and effort reduction in the beach protection programme. NAFO SCR Doc. 2002/124. Ser. No. N4746, KwaZulu-Natal, South Africa.
- Dunlop, S.W. 2011. An assessment of the shore-based and offshore boat based linefisheries of KwaZulu-Natal, South Africa. University of KwaZulu-Natal.
- Dunlop, R.A., Noad, M.J., McCauley, R.D., Kniest, E., Slade, R., Paton, D. and Cato, D.H. 2016. Response of the humpback whales (*Megaptera novaeangliae*) to ramp-up of a small experimental air gun array. *Marine Pollution Bulletin*, 103: 72-83.
- eThekwini Municipality. 2017. Unpublished data.
- Ezemvelo KwaZulu-Natal Wildlife (EKZNW). 2003. Management plan for subsistence harvesting of rocky shore invertebrates in KwaZulu-Natal. Ezemvelo KwaZulu-Natal Wildlife, Pietermaritzburg.
- Ezemvelo KwaZulu-Natal Wildlife (EKZNW). 2015. KZN Coastal Cleanup Results.
- Everett, B. (ed.) 2014. *Marine and estuarine fisheries along the KwaZulu-Natal Coast: an inventory and brief description*. South African Association for Marine Biological Research, South Africa, 106 pp.
- Fennessy, S. 2001. A report on the KwaZulu-Natal crustacean trawling for the economics and sectoral study of the South African fishing industry. Unpublished Report, South African Association for Marine Biological Research.
- Fennessy, S. and Groenewald, J. 1997. A review of the offshore trawl fisheries of crustaceans on the east coast of South Africa. *Fisheries Management and Ecology*, 4(2): 135-147.
- Floros, C., Samways, B. and Armstrong, B. 2004. Taxonomic patterns of bleaching within a South African coral assemblage. *Biodiversity and Conservation*, 13: 1175-1194.
- Forbes and Demetriades. 2008. Durban's estuaries. eThekwini Municipality, KwaZulu-Natal, South Africa.
- Goble, B., van der Elst, R. and Oellermann, L. 2014. *Ugu Lwethu – Our Coast: a profile of the coastal KwaZulu-Natal*, KwaZulu-Natal Department of Agriculture and Environmental Affairs and the Oceanographic Research Institute, Cedara, 202 pp.
- Harikishun, A. 2013. Coral bleaching responses in Sodwana, South Africa, University of Cape Town, 34 pp.
- Harrison, T.D., Cooper, J.A.G. and Ramm, A.E.L. 2000. State of South African estuaries: geomorphology, ichthyofauna, water quality and aesthetics. South African Department of Environmental Affairs and Tourism, Pretoria.
- Heydorn, A.E.F. (ed.) 1986. An assessment of the state of the estuaries of the Cape and Natal in 1985/86. SA National Scientific Programme Report no. 130. Foundation for Research

Development, Pretoria.

Hutchings, L., Morris, T., van der Lingen, C.D., Lamberth, S.J., Connell, A.D., Taljaard, S. and van Niekerk, L. 2010. Ecosystem considerations of the KwaZulu-Natal sardine run. *African Journal of Marine Science*, 32: 413-421.

Kyle, R., Pearson, B., Fielding, P.J., Robertson, W.D. and Birnie, S.L. 1997. Subsistence shellfish harvesting in the Maputaland marine reserve in northern KwaZulu-Natal, South Africa. *Biological Conservation*, 82(2): 183-192.

KZN Treasury. 2016. The KwaZulu-Natal Economy – A performance overview: Update 27.

Lamont, T. and Barlow, R.G. 2015. Environmental influence on phytoplankton production during summer on the KwaZulu-Natal shelf of the Agulhas ecosystem. *African Journal of Marine Science*, 37: 485-501.

MacKay, F. 2014. Estuaries. In: Goble, B.J., van der Elst, R.P. and Oellermann, L.K. (eds). Ugu Lwethu – Out Coast. A profile of coastal KwaZulu-Natal. KwaZulu-Natal Department of Agricultural and Environmental Affairs and the Oceanographic Research Institute, Cedara, 33-36.

Maggs, J., Mann, B., Else, M. and Khumalo, D. 2016. National Marine Linefish System: KZN recreational fisheries monitoring data collection by Ezemvelo KZN Wildlife: 2015 Annual Report. ORI Unpublished Report.

Mead, A., Carlton, C., Griffiths, C.L. and Rius, M. 2011. Introduced and cryptogenic marine and estuarine species of South Africa. *Journal of Natural History*, 45(39-40): 2463-2524.

van Niekerk, L. and Turpie, J. 2012. National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component.

Operation Phakisa. 2016, *Operation Phakisa*. Retrieved from: <http://www.operationphakisa.gov.za/Pages/Home.aspx>. Accessed on 24 June 2017.

Oceanographic Research Institute (ORI). 2013. Southern African Marine Linefish Species Profile, Special Publication No. 9.

Oceanographic Research Institute (ORI). 2015. Offshore fisheries of the South-west Indian Ocean: their status and impact on vulnerable species. Van der Elst, R. and Everett, B. (eds.), Oceanographic Research Institute and the Western Indian Ocean Marine Sciences Association (WIOMSA).

Rajkaran, A. 2011. A status assessment of mangrove forests in South Africa and the utilization of mangroves at Mngazana Estuary (Doctoral dissertation). Nelson Mandela Metropolitan University, 140 pp.

Robinson, T. 2015. Marine invasions in South Africa: patterns and trends. *Quest*, pp.44–45.

Sink, K. and Samaai, T. 2009. Identifying Potential Vulnerable Marine Ecosystems in the Offshore Environment of South Africa. Unpublished Report, Cape Town: South African National Biodiversity Institute.

Sink, K., Holness, S., Harris, L., Majiedt, P., Atkinson, L., Robinson, T., Kirkman, S., Hutchings, L., Leslie, R., Lamberth, S., Kerwath, S., van der Heyden, S., Lombard, A., Attwood, C., Branch,

- G., Fairweather, T., Taljaard, S., Weerts, S., Cowley, P., Awad, A., Halpern, B., Grantham, H. and Wolf, T. 2012. National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component. South African National Biodiversity Institute, Pretoria, 325 pp.
- Schleyer, M. 1999. A synthesis of KwaZulu-Natal coral research. *Special publication*, 5: 1-36.
- Statistics South Africa (Stats SA). 2011. *Statistics South Africa*. Retrieved from: <http://www.statssa.gov.za/>. Accessed on 24 June 2017.
- Steinke, T. 1999. Mangroves in South African Estuaries. In: *Estuaries of South Africa*, pp.119-140.
- Schwanz, L.E. & Janzen, F.J. 2008. Climate Change and Temperature-Dependent Sex Determination: Can Individual Plasticity in Nesting Phenology Prevent Extreme Sex Ratios? *Physiological and Biochemical Zoology*.
- Tomalin, B. and Kyle, R. 1998. Subsistence and recreational mussel (*Perna perna*) collecting in KwaZulu-Natal, South Africa: fishing mortality and precautionary management. *South African Journal of Zoology*, 33(1): 12-22.
- Turpie, J.K., Adams, J.B., Joubert, A., Harrison, T.D., Colloty, B.M., Maree, R.C., Whitfield, A.K., Wooldridge, T.H., Lamberth, S.J., Taljaard, S. & Van Niekerk, L. 2002. Assessment of the conservation priority status of South African estuaries for use in management and water allocation. *Water SA* 28 (2).
- Whitfield, A. 2000. Available scientific information on individual South African estuarine systems. Water Research Commission Report 577/ 3/ 00: 217 pp.
- de Wet, A. 2012. Factors affecting survivorship of loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles of South Africa. Masters Thesis, Nelson Mandela Metropolitan University, pp.1-184.
- WIOFish, 2016. *Western Indian Ocean Fisheries Database*. Retrieved from: <http://www.wiofish.org/> Accessed on 24 June 2017.



9. Economics

9.1 Introduction

The primary planning document of KwaZulu-Natal (KZN) is the Provincial Growth and Development Strategy (PGDS), which guides the economic development strategy and targets for KZN. Two goals from the PGDS are relevant to the economics chapter of this Environment Outlook Report (EOR) – these are Goal 1 and Goal 4. Goal 1 aims to achieve inclusive economic growth and uses the following indicators: i) percentage change in economic growth; ii) increase in GDP per capita; iii) increase in employment; and iv) increase in youth employment. Goal 4 aims to develop strategic infrastructure that has various impacts on the economy, as it includes the development of airports and the development of ICT infrastructure. Both the inclusive economic growth and the strategic infrastructure objectives aim to leverage economic growth from KZN's competitive sectors, which are logistics, tourism, manufacturing and agriculture. Moreover, KZN has strategic advantages, which include having a large labour pool, being situated along the coast (a natural asset that resulted in the establishment of the Ports of Durban and Richards Bay) and being located on the Durban-Johannesburg transport corridor.

The indicators used to assess the impact of the economy on the environment in KZN are presented in Table 43.

Table 43: Indicators used in the assessment of the economy in KwaZulu-Natal

Indicators	Description and/or comments
Tourism revenue	Tourism in KZN is often based on environmental assets, and a healthy environment is important for the conservation of biodiversity and the livelihood of people.
Population growth rate	Growth in population is measured by the number of people who reside in KZN during census survey.
Employment growth and contribution	Employment growth of KZN, contribution to South Africa's employment as compared with other provinces, and contribution to employment per sector.
Economic sector growth and contribution to KZN	Economic growth is measured by Gross Domestic Product (GDP), which is a measure of the monetary value of value added through each phase of production in the value chain. The economic growth per sector and contribution per sector to the KZN economy are measured.
Economic growth and contribution for KZN	Economic growth of KZN and contribution to South Africa's economy as compared with other provinces.

The following sub-sections unpack the drivers of economic change, the resulting pressures, the current state of the drivers, the impact these are having on the environment and the possible responses for reducing these impacts.

9.2 Drivers

There are several drivers of economic growth, which include labour productivity, innovation, investment, capital stock, institutions, cost of production and availability of natural resources. Investment, employment, innovation and the need for resources are all driven by the demand for goods and services. Increased demand is a result of population growth and increased

purchasing power (*income*). As the purchasing power of people increases, more goods and services are produced, resulting in further *employment* and further increases in purchasing power. Growth in times of under-employment and low income is often driven by the state, which can invest in strategic infrastructure and continue to invest in public services.

In KZN, the sector that contributes the most to economic growth and employment is the tertiary sector (i.e. business services and retail). However, KZN's competitive advantages are in a mixture of sectors such as tourism (tertiary), logistics and manufacturing (secondary), and agriculture (primary). The state of these drivers is discussed in Section 9.4 below.

9.3 Pressures

In KZN, there is a major focus on the most productive sectors (i.e. agriculture and manufacturing) because they present the largest opportunity for extending the value chain, resulting in economic growth and employment. However, it is these productive industries that often put the most significant pressures on the environment through air pollution, water and energy use, as well as land absorption (the scale of the pressure varies across industry/product; e.g. sugar cane farming produces its own electricity and is predominantly rain fed).

Other economic sectors include retail (e.g. bars, food outlets and gambling facilities), logistics, manufacturing and agricultural sectors. Growth in retail sectors without congruent growth in employment results in high levels of consumer indebtedness, sustaining poverty and related environmental issues. Growth in logistics and manufacturing could negatively impact air and water quality, as well as lifestyle elements. Expansion of agriculture results in reduced land quality and water availability. All of these sectors compete for land with more sustainable land uses such as conservation areas, open spaces, lifestyle elements and tourism.

As resources are directed into the growth of these sectors, the emphasis on the environment is reduced and fewer resources are directed towards environmentally friendly industries and practices. The pressure from the growth of unsustainable sectors is felt in KZN through increased health issues in the South Durban Basin; over-use of roads, agricultural land and other public assets; and the extension of 'dirty' industry that creeps into residential spaces, such as the creation of warehouses out of old residential stock.

The state of population growth, economic growth and employment is provided below, with the intention of measuring the state of the pressures on the environment.

9.4 State

9.4.1 Population

Figure 38 shows the population growth from 2005 to 2015 for both KZN and, the largest market in South Africa, Gauteng.

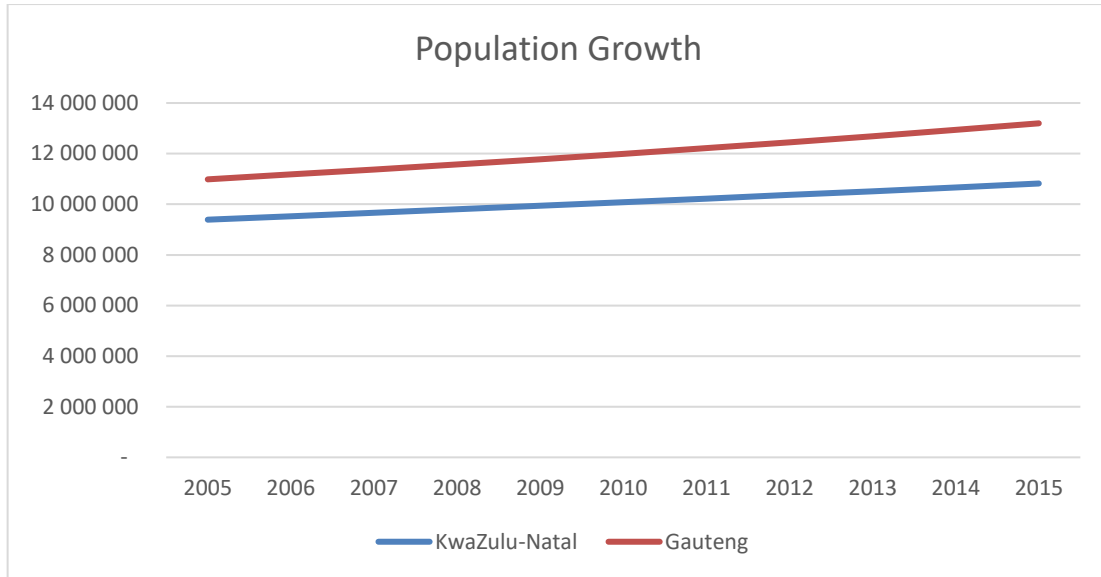


Figure 38: Population growth of KZN compared to Gauteng Province

Source: Quantec Standardised Regional Dataset (2015)

In 2015, KZN's population was 10 819 016 and had been growing consistently at an average annual growth rate of 1.4% over the previous 10 years. However, this growth rate had decreased from a very high 2.5% reported in the 2004 KZN State of Environment Report (SoER). According to the 2011 Census, KZN experiences considerable migration, with 109 000 people per year leaving the Province, which tempers the population growth rate.

Gauteng's increasing population uses natural resources from KZN to meet economic demand with resulting environmental impact. The Gauteng population in 2015 was 13 197 140, with an average annual growth rate of around 1.9%. Gauteng's population growth will therefore place increasing pressure on both the logistics and agricultural sectors of KZN to service the needs of this growing population.

Globally, the total fertility rate to replace the existing population is 2.5 children per woman, which is close to South Africa's rate of 2.4.⁵⁰ South Africa's growth rate is higher than that of all BRICS nations (the nearest is India with 1.15% growth), but lower than its sub-Saharan African peers (Kenya, Nigeria and Zambia all have growth rates of above 2%).

9.4.2 Economic production and employment

9.4.2.1 KZN gross value added (GVA) and employment

Figure 39 below shows the level of economic growth as well as formal and informal employment in KZN. StatsSA measures informal employment as all persons employed in the informal sector (such as street traders, domestic workers and taxi conductors), as well as employees in the formal sector, and persons working in private households who do not have a written contract of employment and whose employers do not contribute to a medical aid plan or a pension on their behalf (StatsSA, 2008).

⁵⁰ Retrieved from: <http://www.un.org/en/development/desa/population/publications/pdf/fertility/world-fertility-patterns-2015.pdf>. Accessed on 4 September 2017.

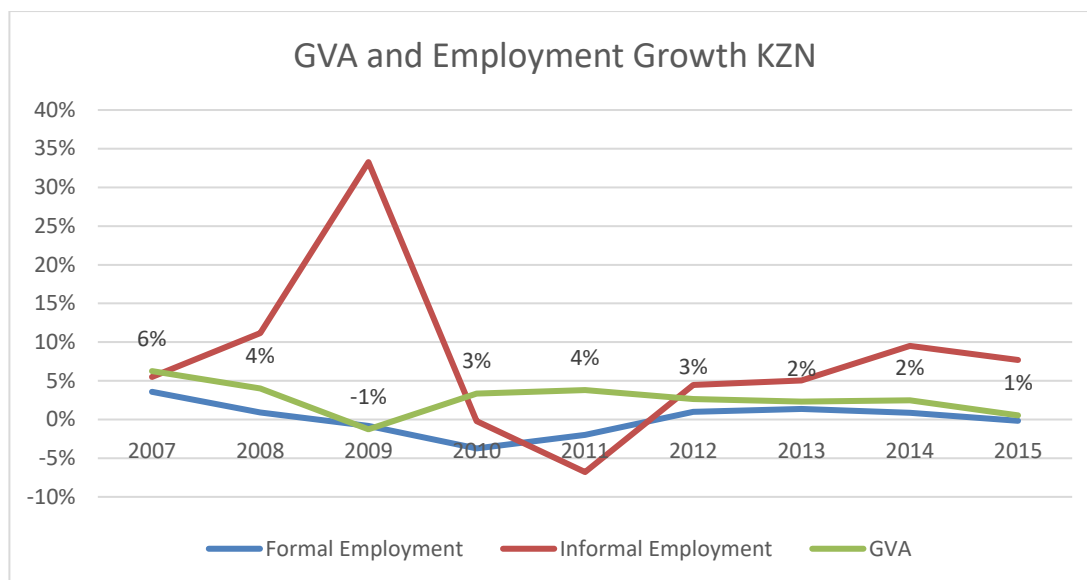


Figure 39: GVA and employment growth, KZN

Source: Quantec Standardised Regional Dataset (2015)

The economic growth rate in KZN has reduced, from 2.5% in 2004, through a recession in 2009, to a 1% growth rate in 2015. There is a lag between economic growth and employment, as businesses retrench staff in times of low economic growth, but do not employ staff immediately as growth picks up. In 2015, there was no significant increase in employment, resulting in a 0% growth rate. Figure 39 shows that the growth rate of informal employment follows the exact opposite trend to that of formal employment. Low economic growth results in increased informal activity such as piece jobs, domestic work and casual employment without formal contracts. As economic growth increases, formal employment opportunities increase and informal jobs decrease. This shows the fluidity and flexibility of low-skilled workers and informal businesses. Currently, informal employment is growing at a faster rate than formal employment.

In 2015, the total number of people employed in KZN was 2 410 204, which is 35% of the working age population. The number of people employed in the informal sector was 637 080 in 2015, which is a substantial increase from 376 026 in 2004. The number of people unemployed in KZN was 1 041 188 and the unemployment rate was 30%, which is 5% higher than the national rate. The youth unemployment rate in KZN was 33% in 2015, which is lower than the national rate of 37%.

9.4.2.2 KZN sectoral contribution to GVA and employment

Figure 40 shows the contribution of each economic sector to KZN's economy. Manufacturing (mostly fuel, chemicals, rubber, food and beverages) and business services (mostly finance and insurance) each contribute 18% to KZN's economy, followed by government services (mostly education) and retail at 16% and 15% respectively. Transport and logistics contribute 14% (mostly land and water transport). The fastest-growing sector in KZN has been the wholesale and retail trade (including catering and accommodation), while the lowest growth sector has been the mining and quarrying sector, followed by the agriculture, forestry and fishing sectors.

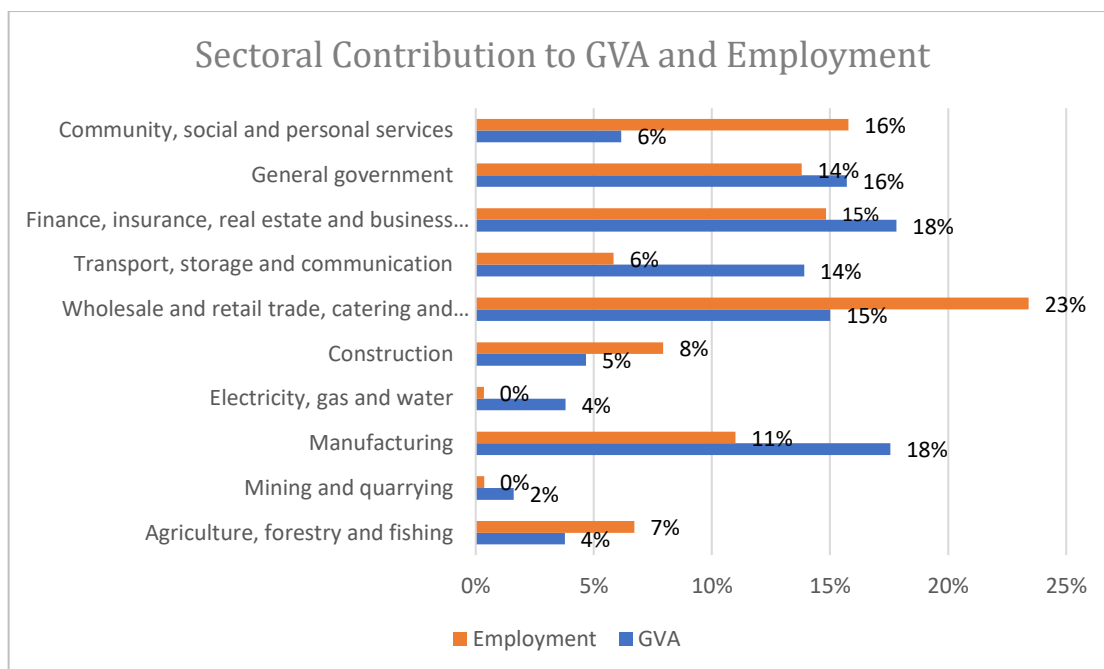


Figure 40: Sector contribution to GVA and employment in KZN
 Source: Quantec Standardised Regional Dataset (2015)

The sector that employs the most people is the retail sector (23%), followed by community services, business services and general government. While most sectors show a general increase in employment from 2005 to 2015, there has been a decrease in employment in the manufacturing and agriculture, forestry and fishing sectors. Even though manufacturing is one of the highest contributors to GVA in KZN at 18%, manufacturing is becoming less labour intensive, decreasing from 324 884 employees in 2005 to 264 884 in 2015. A similar trend is observed in agriculture, forestry and fishing. Between 2006 and 2011, this sector employed fewer people while it made a stable contribution to the economy.

The South African and KZN governments aim to increase employment by creating catalytic projects. In KZN, these are mostly linked to transport infrastructure (i.e. Ports of Durban and Richards Bay, King Shaka International Airport (KSIA), N3 and N2 national roads). While these projects are critical for employment creation, these already have an adverse impact on the environment, and this pressure will grow as these projects are expanded. The projects are shown in Figure 41 below.

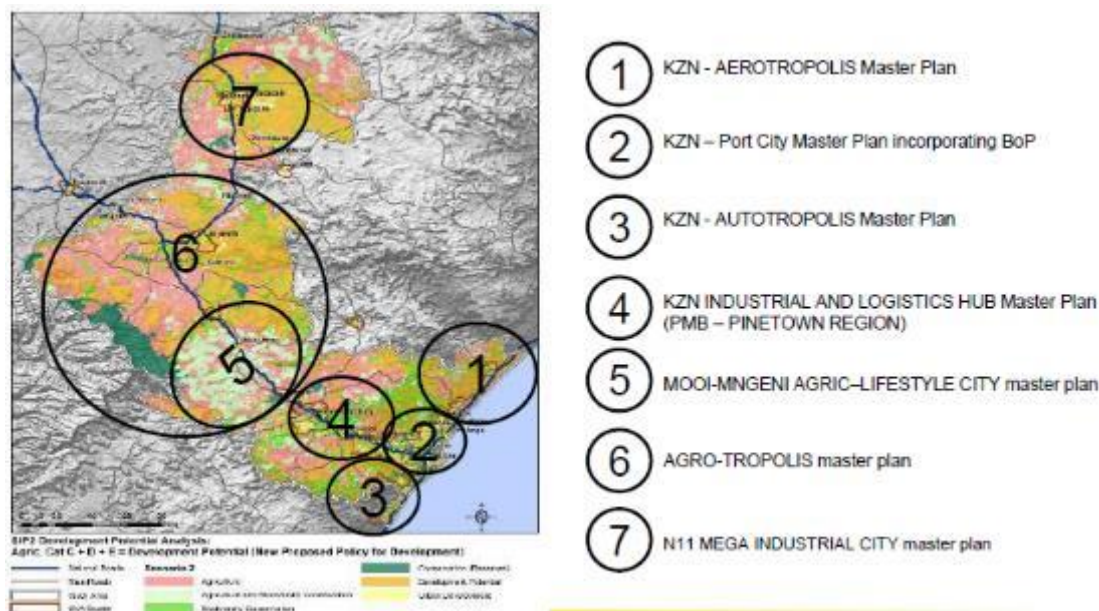


Figure 41: Catalytic projects KZN

Source: COGTA (2015)

The following sections will describe the state of key sectors within the economy.

Logistics

The logistics industry is based mostly in Durban and Richards Bay, surrounding and supporting the Port of Durban and the Port of Richards Bay, where road, rail and sea transport coincide. The Port of Durban services all surrounding provinces, but the largest market is that of Gauteng. Therefore, KZN’s economic growth and environmental pressures are closely linked to those of Gauteng. The result of this is that, on the one hand, KZN experiences the negative externalities (i.e. air and water pollution, degradation of roads and space constraints) of having the largest logistics sector in South Africa to service a growing market 500 km inland. This is especially true for the petro-chemicals industry as KZN is home to two refineries that produce petrol and diesel mostly for the Gauteng market, while causing severe health problems (asthma) for residents of the South Durban Basin. On the other hand, KZN benefits from electricity produced from coal mines in Gauteng and Mpumalanga, whose residents suffer from associated negative environmental and health impacts. The manufacturing industry, positioned near the Ports of Durban and Richards Bay, also adds to air pollution with the resultant health impacts. Both the logistics and manufacturing industries compete with residents for water, electricity and land.

Manufacturing

KZN’s manufacturing exports are driven by ores (i.e. Assmang and others), paper (i.e. Mondi and Sappi), pulp and chemical cellulose, iron and steel, aluminium, and vehicles (i.e. Toyota). Exports have grown in value by 10% on average annually since 2006. The manufacturing industry’s contribution to KZN’s total GVA has increased from R56 million in 2005 to R102 million in 2015. However, as a percentage of total GVA in KZN, the manufacturing sector has decreased from about 20% in 2006 to 17% in 2015, which is shown in Figure 42 below.

Formal employment in the manufacturing sector has followed a similar trend, decreasing from ~13.4% in 2005 to ~9.3% in 2015 of total employment in KZN.

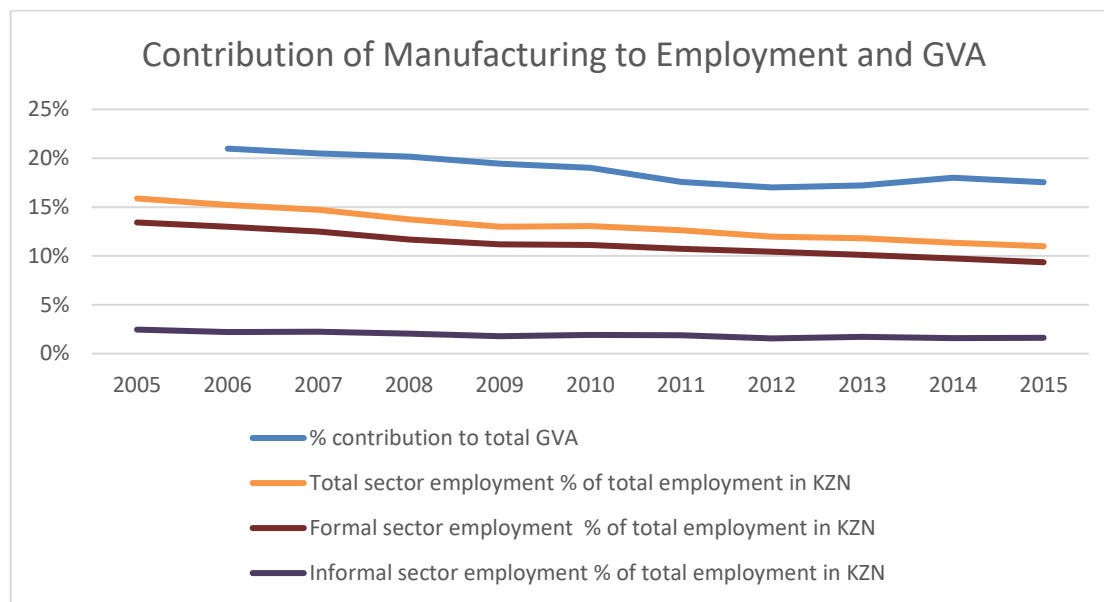


Figure 42: Percentage of total KZN employment in manufacturing compared to GVA contribution
 Source: Quantec Standardised Regional Dataset (2015)

Agriculture

The agricultural industry is based in rural KZN and assists in providing food and livestock for South Africans, which would be more expensive if they were imported.

While the pressures on air quality are lower, the pressures on water use and land use are significant. Sugarcane production is extensive in KZN, yet it is the third-most water-intensive agricultural crop, requiring between 600 and 900 mm per year (Jenkins, Baptisa and Porth, 2015). Plantation forestry reduces the amount of water that enters rivers by 2.7% per year; this can have a considerable impact on water resources in KZN since plantation forestry covers approximately 5.3% of total land area in the Province (DAFF, 2014/2015).

“Pulp and paper mills are the largest users of water (\pm 250 million m³ per annum) in the forestry industry and produce the largest volume of waste.” (van der Merwe, Steytler and Wille, 2017)

KZN only produces 5% of South Africa’s commercial maize crop, less than 3% of the country’s dry beans and 6% of its fruits and vegetables. However, KZN is a major dairy producer and in the last two decades has become a significant potato producer.

Tourism

Tourism occurs across KZN, with the beach being the major attraction, followed by world-class game reserves, natural heritage sites, internationally recognised wetlands, the Drakensberg Mountains and historical sites. The benefits of tourism are dispersed across KZN and the environmental pressures are far lower than for other sectors. Natural land uses and assets are preserved for tourism.

Electricity, gas and water

Although the total GVA contribution of this sector to the KZN economy is less than 4% of total GVA in the Province, the generation and supply of clean electricity, gas and water have an important impact on the environment. Currently almost all electricity is imported to KZN from other provinces via the national grid. Employment in this sector is stable and has not grown with the increase in production from 2% in 2006 to just less than 4% in 2015, as this sector is highly mechanised and not labour intensive.

In KZN, very few new investments in renewable energy-generation plants have been made due to the competitive advantage of resource availability in other provinces. However, biomass and waste-to-energy technologies are considered KZN's competitive advantage. KZN's water resources, on the other hand, compare favourably, and uMngeni Water is the largest supplier of bulk potable water in KZN. As South Africa is a water-scarce country and vulnerable to droughts, water is a limited resource. The Department of Water and Sanitation (DWS) is therefore mandated to ensure equitable distribution of water to all sectors: industrial, commercial and residential.

9.4.2.3 Innovation

Research and Development (R&D) is often considered a proxy for innovation. The trend over the last ten years has shown that investment in R&D is gradually replacing investment in machinery and equipment. In the USA and Finland, investment in R&D has surpassed investment in machinery and equipment (European Commission, 2014). South Africa's gross expenditure on Research and Experimental Development (R&ED) increased by 1.4% between 2012/13 and 2013/14 and equated to R25.661 billion (0.73% of Gross Domestic Product (GDP)). This is less than the global average of 2.1% of GDP. Of the total R&D expenditure, 46.7% was spent within Gauteng Province, followed by the Western Cape with 19.3% and KZN with 10.7% of total spend (DST, 2016). Given the state of the economy, the environmental impacts are assessed in the Human Settlements chapter.

9.5 Impacts and Responses

Table 44 below summarises the issues, impacts, trends and responses regarding each economy-related driver in KZN.

Table 44: Summary of core indicator impacts and trends in KZN (with red negative and green positive)

Indicators	State: 2010-2015	Current negative impact on the economy	Responses
Population growth and rate.	Increasing at 1.4% annually	Driver of economic growth and population and the environmental pressures associated with those. Impact: Medium/Increasing	Investment in innovative technologies to generate and use water, electricity and land efficiently (such as the desalination plant, which uses sewage and sea water to create drinking water, being piloted on the Bluff in Durban) is critical.
Employment growth and contribution.	30% unemployment rate. Formal employment stagnant; informal employment growing at 3% annually	Decreased tax revenue; increased government financial burden; depleted funds for provision of housing and services, resulting in informal settlements; and decreased will and funding for environmental issues. Informal employment is hard to regulate but flexible to economic climate. Impact: Critical/Stagnant	Environmentally friendly employment strategies include investment in cleaner economic sectors (see below); using fossil fuel tax to implement public expanded works programmes that focus on environmental programmes, such as working for water; implementing job sharing, which increases employment but also shortens the length of the working year for individuals; and investing in the green and biodiversity economies.
Growth of unsustainable sectors.	Agriculture, forestry & fishing: 3.6% growth of small base (contracted in 2015)	Agriculture results in depleted water and land resources; manufacturing and logistics impacts on air and water quality; retail without employment growth results in indebtedness Impact: Medium/Increasing	Adds to local food security and has expanded value chain opportunities.
	Mining: 2.7% average annual growth (0% in 2015) off low base (2% contribution to KZN)	Water and land intensive, decreasing labour intensity, land-use change, decreasing biodiversity, controlled pollution, visual impacts and undermined sense of place, incompatibility with many other land uses (e.g. tourism). Impact: Low/Increasing	Declining impact due to declining market size.

KwaZulu-Natal Environment Outlook Report 2017

	Manufacturing: 1.1% annual growth (contracted in 2015)	Water and energy intensive; generates waste and pollution contaminating water and the atmosphere; declining labour intensity Impact: High/Stagnant	Materials recycling potential, resource efficiency potential, substantial contribution to economy and exports, local production of goods.
	Electricity, gas, water: -0.3%	Low labour absorption; limited resources; heavily dependent on fossil fuels; vulnerable to climate change Impact: Medium/Stagnant	Renewable energy technologies offer new opportunities.
	Construction: 3.1%	Resource intensive (concrete production is energy intensive); creates permanent land-use change Impact: Medium/Increasing	Declining impact due to declining market size, labour intensive, opportunity to utilise greener construction methods and products.
	Retail and trade: 2.5% annual growth (1% 2015)	Waste generation is high in fast consumables; risk of increasing debt Impact: Medium/Increasing	Increasing impact due to increasing market size, tourism aligned to conservation, labour intensive.
	Logistics: 2.6% annual growth (1% 2015)	Transport and logistics are heavily dependent on fossil fuels, generating air pollution. Temperature-controlled storage is energy intensive Impact: High/Increasing	Labour intensive; potential to shift from road to rail to reduce liquid fuel consumption and CO ₂ emissions; ICT requires little energy, water or land.
	Business services: 2.6%	None	
	Government: 2.9% (1% 2015)	None	
	Community services: 2.2% (1% 2015)	None	
Economic growth in KZN (GVA)	2.3% average annual growth (1% in 2015)	Sustained low economic growth results in unemployment, with all its related environmental impacts. Impact: High/Stagnant	Opportunities to increase GDP growth rate include investment in innovation, education and sustainable industries.

9.6 Responses (Cross-cutting)

Aligning environmental goals with economic growth and employment goals to achieve sustainability is the most highly recommended response strategy. While expanding the depth of the manufacturing, agriculture and logistics industries is important, this should not detract from a focus on the green economy, especially waste beneficiation. Other non-resource-intensive industries such as tourism and business services (i.e. including business process outsourcing and ICT) should also be a focus. These sectors will sustain the economy while allowing resources to regenerate. The Department of Economic Development, Tourism and Environmental Affairs (EDTEA) has recognised the importance of a green economy and is well positioned to grow green economy initiatives due to both environmental affairs and economic development being under one department. EDTEA's current initiatives across KZN include:

- solar farms, wind farms, anaerobic digester programmes, biofuels and waste-to-energy projects;
- a GIS tool for the identification of land parcels suitable for renewable energy development;
- development of a green fund, facilitating and funding feasibility and other research studies, lobbying big business to move to renewable energy sources, and lobbying government to procure sustainable energy and products;
- a partnership with Durban University of Technology and Mangosuthu University of Technology to install rooftop solar Photovoltaic (PV) systems on five government buildings;
- manufacturing of renewable energy technologies, and export to the SADC market;
- manufacturing of sustainable products for rural areas such as wood-fired stoves and mini grids; and
- industrial symbiosis, where the value chain of any industry is extended to be circular in nature (all waste is used as an input for new production) (EDTEA, 2014).

In addition to the green economy is the Biodiversity Economy, which envisages the socio-economic transformation of the wildlife and tourism sectors, with a focus on growth in nature-based tourism, hunting, game ranching and venison production. These industries can make a major contribution to rural development and land reform and can be ecologically appropriate to the environment in which they are located. The Biodiversity Economy also envisages the development of the product chain with supporting and ancillary services to the tourism and game ranching sectors (e.g. Small, Medium and Micro Enterprises (SMMEs) providing supporting services such as transport, food supply, laundry and hunting outfitters) and secondary markets (e.g. taxidermy, tanning, meat processing and production of décor products).

Skills training is essential for growing the green economy in a way that also has a great impact on employment. Environment is a new area in South Africa's education, training and skills development landscape. Currently, there are approximately 250 000 environmental employees in South Africa and this could increase by 300 000 in the longer term. However,

these skills are not represented in school curriculums and technical training colleges. More research is required in each industry to understand the opportunities for green jobs and to create awareness amongst businesses, schools and higher-education facilities. Improving green skills would lead not only to increased employment in the job market but also to increased entrepreneurship in the environmental field. The scope for entrepreneurship in the green economy is significant, considering the number of new processes and technologies frequently coming onto the market and the rising level of demand for these processes and technologies.

International and local legislation is going to force changes that could lead to business models that demand reduced emissions. Pro-actively encouraging this transition would protect business from the shocks that will arise from this new regulation. However, persuading businesses into this change must be followed up with enforcement.

An increase in cleaner production and resource efficiency across all sectors can have multiple cost savings, as well as carbon, waste and pollution reductions. For example, in the period 2010–2013, KSIA implemented three projects with the assistance of the Industrial Energy Efficiency Programme, hosted by the National Cleaner Production Agency. Over the 3-year period, the projects resulted in a total saving of 1 932 576 kWh and monetary saving of R2.7 million for an investment of R0.4 million (payback period of 1.8 months). A reduction of 1 850 tonnes of CO₂ was also achieved. The impact of energy efficiency measures and renewable energy alternatives is discussed further in the Energy chapter (Chapter 12).

The manufacturing sector can participate in a form of green economy by implementing a “cradle to grave” approach, sourcing materials that are sustainably grown or produced and ensuring minimal by-products as well as buy-back programmes to divert waste from landfills. Environmental stewardship by manufacturing companies can be government regulated and can lead to increased job opportunities for additional in-house waste processing.

The major barrier to the implementation of these responses is the will of leadership, which is under immense pressure to grow the economy and create jobs. The ‘Resilient Cities’ programme is currently gaining traction in eThekweni Municipality and is one example of how leadership can create jobs while simultaneously planning for a time in the future when resources and climate change will alter economic growth as we understand it today. Furthermore, the programme cuts across all departments and suggests an all-encompassing solution. It is essential to work across departments to create this new avenue of thinking as employment and economic growth are themselves cross-cutting issues.

9.7 Conclusion and Recommendations

The primary drivers of economic growth are the provision of services and food to a growing population, which leads to employment and income generation, which in itself leads to increased purchasing power. The pressures that are placed on the environment come from continuous expansion of the goods and services required by and offered to residents. The state and impact of, and responses to, population growth, unemployment and the economic growth of each sector have been detailed. One of the most critical threats to the environment is unemployment as it leads to a host of environmental issues. These are further described in the Human Settlements chapter (Chapter 10). Increasing employment often outweighs the

demands of the environment in the minds of some officials (who are, understandably, looking for quick wins with regard to the unemployment crisis). However, both unemployment and negative impacts on the environment can be reduced with the right leadership and strategies. Increasing employment and meeting the demands to protect the environment should not be seen as mutually exclusive but as closely linked to each other. Degradation of the environment has severe long-term economic costs, which undermine future economic growth and the ability to alleviate the plight of the poor and drive job creation. Inappropriate developmental decisions often ignore the role that the environment has to play in supporting the livelihoods of the poor and in underpinning economic development. The unintended consequences of these decisions are greater costs to compensate for the services that have been lost, and potentially further loss of employment opportunities.

If strong leadership and a break from silo solutions are not achieved, the most critical threat will be depletion of natural resources such as freshwater, air quality and land. The impact on each element of the environment is described throughout this EOR. If unemployment continues to grow at its current rate, the social skills related to poverty will expand, many of which are described in the Human Settlements chapter (Chapter 10) as these relate to quality of life. However, if new ways of thinking about economic growth and employment, as suggested in this chapter, are adopted across departments and tiers of government, this threat could be mitigated. Focussing on green sectors and innovation is essential for the long-term environmental, economic and social health of the Province.

9.8 References

Department of Agriculture Forestry and Fisheries. 2015. Commercial Timber Resources and Primary Roundwood Processing in South Africa 2014/2015.

Department of Science and Technology (2016) 'Statistical Report 2013/14. Available: <http://www.dst.gov.za/index.php/resource-center/rad-reports/1786-rad-survey-results-2013-2014>

European Commission (2014) 'Innovation performance in the EU' Available at: http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2014/iuc_progress_report_2014.pdf

Jenkins, B., Baptista, P. and Porth, M. 2015. Collaborating for Change in Sugar Production: Building Blocks for Sustainability at Scale. Cambridge, MA: The CSR Initiative at the Harvard Kennedy School and Business Fights Poverty.

KwaZulu-Natal Provincial Planning Commission (KZNPPC). 2016. Provincial Growth and Development Strategy. Draft for Comment. Retrieved from: www.kznonline.gov.za/.../12-05-21%20PGDS%20Final%20Printed%20Version.pdf

Quantec Regional Standardised dataset. 2015. Retrieved from: www.quantec.co.za

StatsSA. 2008. Statistical release P0211.1 Quarterly Labour Force Survey. Additional aspects of the labour market in South Africa: Informal employment; Underemployment and underutilised labour; Unemployment. Published by Statistics South Africa. Pretoria. <https://www.statssa.gov.za/publications/P02111/P021112008.pdf>

van der Merwe M., Steytler, B. and Wille, P. 2017. NATSURV 12: Water and Wastewater Management in the Paper and Pulp Industry (Edition 2). South African Water Research Commission. Retrieved from:

[http://www.wrc.org.za/Pages/DisplayItem.aspx?ItemID=11957&FromURL=%2FPages%2FResearch.aspx%3Fdt%3D%26ms%3D%26d%3DNATSURV+12%3A+Water+and+Wastewater+Management+in+the+Paper+and+Pulp+Industry+\(Edition+2\)%26start%3D1](http://www.wrc.org.za/Pages/DisplayItem.aspx?ItemID=11957&FromURL=%2FPages%2FResearch.aspx%3Fdt%3D%26ms%3D%26d%3DNATSURV+12%3A+Water+and+Wastewater+Management+in+the+Paper+and+Pulp+Industry+(Edition+2)%26start%3D1)



10. Human Settlements

10.1 Introduction

An analysis of human settlements includes the physical and spatial dynamics of housing (such as location, topography, type of housing and basic services), as well as the quality of life of residents and their ability to improve their lives. This means that population density and socio-economic conditions of human settlements (i.e. employment, education, income inequality, crime and health) also have a range of direct and indirect impacts on the environment and, in turn, impact on people's quality of life. The design and functioning of human settlements are critical for enabling people to improve their lives.

The indicators used to assess the impact of the human settlements on the environment in KwaZulu-Natal (KZN) are presented in Table 45.

Table 45: Indicators used in the assessment of human settlements in KwaZulu-Natal

Indicators	Description and/or comments
Population size, growth and density	Number of people who reside in KZN, growth in population over five years, and population density.
Net migration into KZN	Number of people who have moved into KZN from other areas less those that have moved out of KZN.
Number and growth of households in KZN	The number of households in KZN and their growth in numbers over five years.
Household density	'Density' refers to the number of households per square kilometre in KZN.
Housing backlog	This refers to the number of houses that are considered 'formal'.
Settlement type	Settlement type refers to whether the households are urban, rural or farmland.
Access to housing and basic household services	Whether the household is formal, informal, on its own stand etc. Percentage of households that have access to piped water, electricity, waste removal and sanitation.
Public transport access	Access to public transport and mode of transport.
Number of vehicles and road safety	The number of vehicles on the road and the number of fatal accidents.
Human Development Index (HDI)	Human Development Index measures the education levels, life expectancy and per capita income of an area to determine the 'potential for individual development' within a society.
Poverty and food security	The number of people living below R3 750 per month
Education level	The number of people over the age of 20 with matric or higher.
HIV rate	The number of people living with HIV.
Crime rate (in numbers)	The number of reported crimes.
Human vulnerability	The summary of all human settlements' indicators, reflecting the vulnerability of residents currently to changes in human settlements.

10.2 Drivers

South Africa is in a unique situation where government, through the Group Areas Act of 1950, legislated the eviction of people from prime productive land and areas, excluding them from generating income and grouping them in dispersed areas, some rural and some on the outskirts of urban areas, for an extended period. This is the legacy of apartheid spatial planning and racial discrimination, which has resulted in human settlements that are

separated by race and income levels, with higher income areas having received services for decades, while lower income areas were neglected. This segregation is one of the primary drivers of human settlements in KZN.

Other than the historical drivers, the impacts of human settlements on the environment are driven by:

- population growth, which results in increased need for basic services such as housing, water, electricity, sewerage and waste services;
- presence of and perceived employment opportunities, which result in changes in spatial dynamics such as the rate of urbanisation;
- income, income inequality and poverty;
- legislation determining where various human settlements are and aren't allowed, and how they should be managed;
- improved transport infrastructure, which unlocks human settlements, changing their nature, and is a key driver of the location of new settlements;
- presence of natural resources favourable to human settlements, such as water sources, favourable topography, land availability, and lifestyle elements such as beaches; and
- crime.

The pressures these drivers could place on the environment if not properly controlled are discussed below.

10.3 Pressures

Population growth results in the need for housing and basic services such as water, energy, shelter and food security, thereby contributing to the depletion of natural resources. In KZN, a large number of low density, dispersed human settlements exists and service backlogs occur where there is clustering around primary, secondary and tertiary nodes. The impact of service backlogs on the environment is largely due to poor waste disposal methods, which lead to polluted water systems and soil erosion and place residents under several risks, such as fire and health risks.

The type of human settlement changes when income increases. High income areas have increased consumption, waste and energy usage, as well as high quality services. Transport infrastructure such as roads competes with environmental assets but also allows access to economic opportunities to those excluded from these. Public transport has a far lower impact on the environment than private travel. The current state of these pressures is provided below.

10.4 State

10.4.1 Spatial context

The spatial context of KZN is depicted in Figure 43 below.

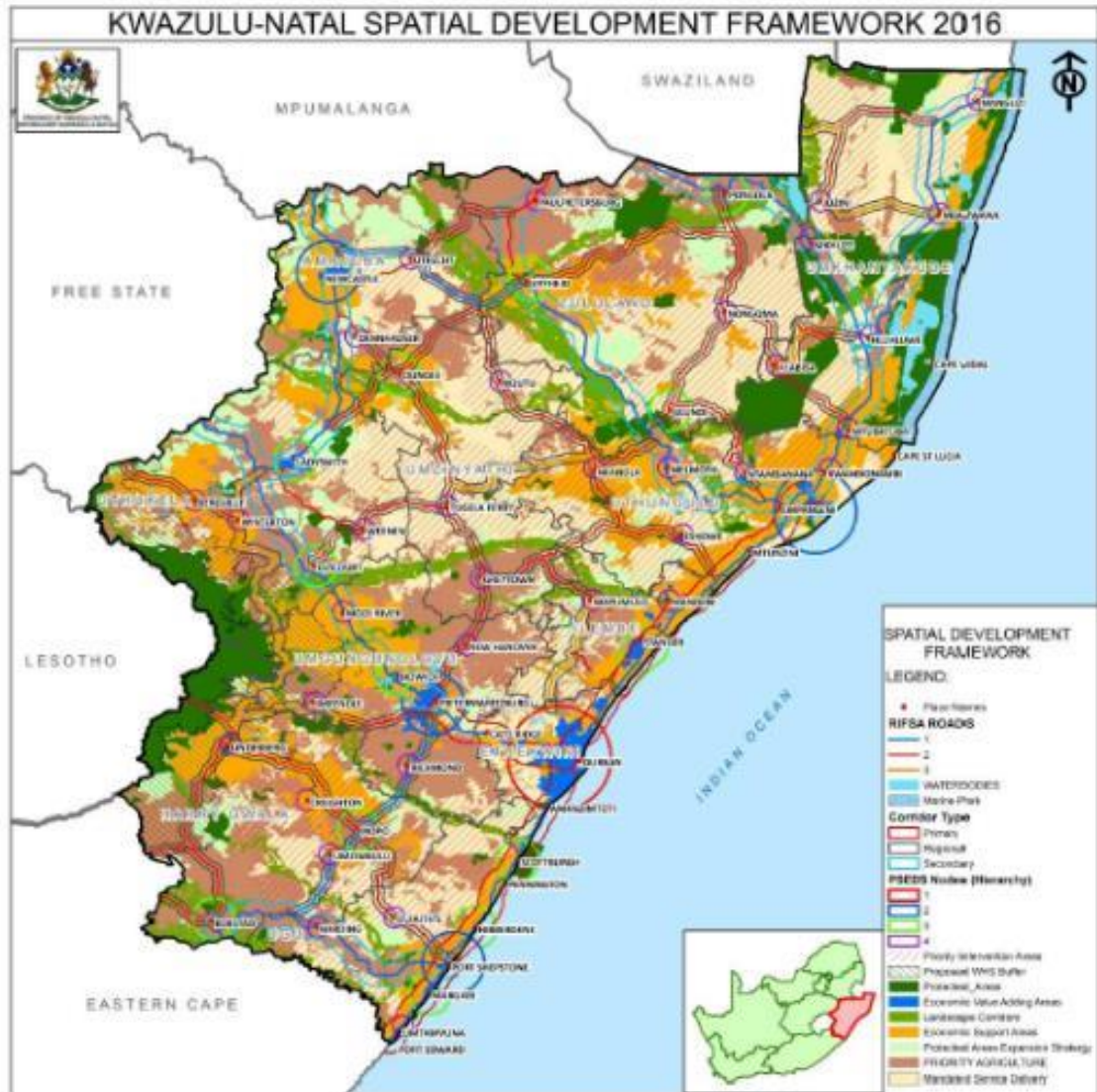


Figure 43: KZN Spatial Development Framework

Source: KZN Spatial Development Framework (2011)

Much of KZN is characterised by dispersed rural settlements where infrastructure service delivery is challenging to roll out. Fifty-one per cent of the population is characterised as rural and 32% of this population falls under Ingonyama Trust Board land. Of KZN’s land surface, 17% is arable and 7.5% has high potential, with 28% of households involved in agricultural activities (KZN PGDS, 2016). The KZN government is making a concerted effort to develop nodes and cluster human settlements in and around these nodes, which will assist with the planning and cost-effective roll out of infrastructure.

10.4.2 Population and households

KZN is the second-highest contributor to South Africa's population, which is significant when one considers that KZN contributes only 16% to South Africa's economy and 15% to employment. KZN experiences a relatively low net migration of 6 729 per annum (StatsSA, 2016). The number and growth of population and households are presented in Table 46 below.

Table 46: Number and growth of population and households in KZN (2015)

	Number of people	5-year growth
Population	10 819 016	1.4%
Households	2 689 431	1.5%

Source: Quantec Standardised Regional Dataset (2015)

The population of KZN has grown, from 9 426 017 people in 2001 to 10 819 016 people in 2015, and consequently the population density has increased, from 102 people per km² to 115 people per km² over the same period. The current growth rate is 1.4%, which is lower than the 2004 growth rate of 2.5%. The 2 689 431 households are growing at a faster rate than the population at 1.5%, which leads to a backlog of housing in KZN.

10.4.3 Household infrastructure

In 2015, the housing backlog was 742 019 houses in KZN and the Province has the second-highest backlog in the country, with a relatively high percentage of people living in traditional dwellings. Nine per cent of households in KZN were informal and 18% were traditional in 2015. The housing backlog continues to grow as more and more households qualify for social housing support.

Funding for housing in 2015/16 equated to R4 131 025 and the funding for housing in 2004/5 was R943 117, which equates to a nominal average annual growth rate of 14%. The 2017/18 budget for KZN states that housing funding will be focussed on slum clearance projects that will provide alternative permanent housing for 134 601 families currently living in slums. A further focus for the Department of Human Settlements will be on delivering 2 830 housing units within the Cornubia Development in eThekweni Municipality (Scott, 2017).

In addition to the housing backlog, there is a backlog in securing the land tenure rights of residents of South Africa, including KZN, especially in rural KZN. Tenure is important because for poor, rural families, land rights are their one major asset and should be clearly recognised. Few statistics exist in KZN on the backlog to secure tenure for communal land, peri-urban houses and RDP houses. However, monitoring of tenure is going to become a priority due to the instatement of Sustainable Development Goal 1.4.2 on land tenure.

Table 47 below, shows the current provision of household services, such as toilets, water access, electricity and refuse removal.

Table 47: Household services

	2004	%	2016	%
Electricity	1 423 949	66%	2 102 067	78%
Refuse removed by local authority at least once a week	1 068 346	49%	1 383 110	51%

Flush or chemical toilet	1 011 273	47%	1 205 904	45%
Piped water inside dwelling	690 373	32%	1 067 471	39%
Piped water inside yard	468 291	22%	643 059	24%
Piped water on community stand: distance less than 200 m from dwelling	247 453	11%	402 178	15%
Piped water on community stand: distance greater than 200 m from dwelling	256 280	12%	208 363	8%

Source: Quantec Regional Data (2015)

Since 2004, progress has been made regarding the distribution of electricity. However, 22% of households in KZN still do not have access to electricity for lighting. At 51%, the percentage of total households with weekly refuse removal remains low. Since 2004, the percentage of households that have a flush toilet has increased, to 45% in 2016. The number of households with access to piped water has increased, from 77% in 2004 to 86% in 2016. Access to basic services and infrastructure varies per municipality in KZN. The municipalities with the lowest rates of access to piped water, electricity, flush toilets and waste refuse removal are Maphumulo, Vulamehlo, Ezingoleni, Umhlabuyalingana, Misinga, Umzumbe, Imbabzane and Ntambanana.

10.4.4 Human settlements type

Changes in human settlements type reflect the status of densification and urbanisation and the reasons these occur. There are on average 29 houses per square kilometre (km²) and an average population of 115 people per km² in KZN, and the density of both houses and population is growing at a 5-year growth rate of 7.2% and 7.3% respectively (Quantec Standardised Regional Dataset, 2015).

Within KZN, population density ranges from the highest at 1 352 persons/km² in eThekweni, followed by 976 in uMsunduzi and 422 in uMhlathuze, to the lowest at 25 in Greater Kokstad, 21 in Mpofana, 14 in Big Five False Bay, 10 in eMadlangeni and 7 in KwaSani municipal area. Population density does not entirely match economic growth in KZN because people are attracted to urban areas for various reasons, including perceived economic opportunities, family and kin networks, and perceived quality of life. High levels of economic growth do not necessarily equate to increases in employment opportunities because economic activities have differing labour absorption potential. Areas of high population density will also experience greater population growth and associated pressures on resources, services and employment opportunities, which put a strain on economic growth.

Figure 44 shows the rural/urban mix of the Province. The 2004 KZN State of Environment Report (SoER), indicated that 54% of the total population lived in rural areas. This had reduced to 47% by 2015.

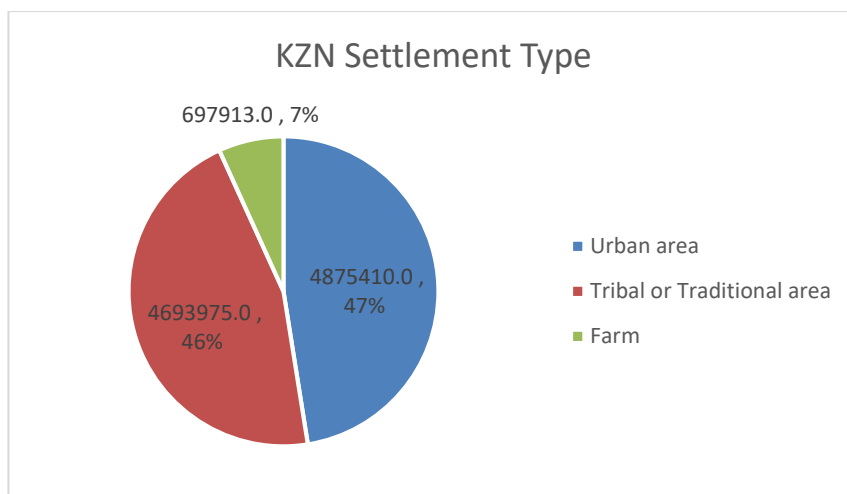


Figure 44: Households according to geography in KZN

Source: Quantec Standardised Regional Dataset (2015)

Basic services and infrastructure in urban and rural areas are paid for by local government through revenue generated from rate payers and municipal infrastructure grants (MIGs). Services to low-income households are cross-subsidised by the rates paid by middle- to high-income households.

10.4.5 Transport

Transport services are important for connecting people and for enabling access to economic opportunities, schools and health care services, which are all essential for improving quality of life. Sprawling urban development leads to higher infrastructure, maintenance and operating costs than experienced by compact cities. Inadequate investment in public and non-motorised transport with an over-emphasis on private motorised transport results in restricted mobility, which negatively affects access to people, goods, services and information (Rode *et al.*, 2014).

Figure 45 below, describes the modes of transport usually used by households and the modes of transport used by workers to get to work.

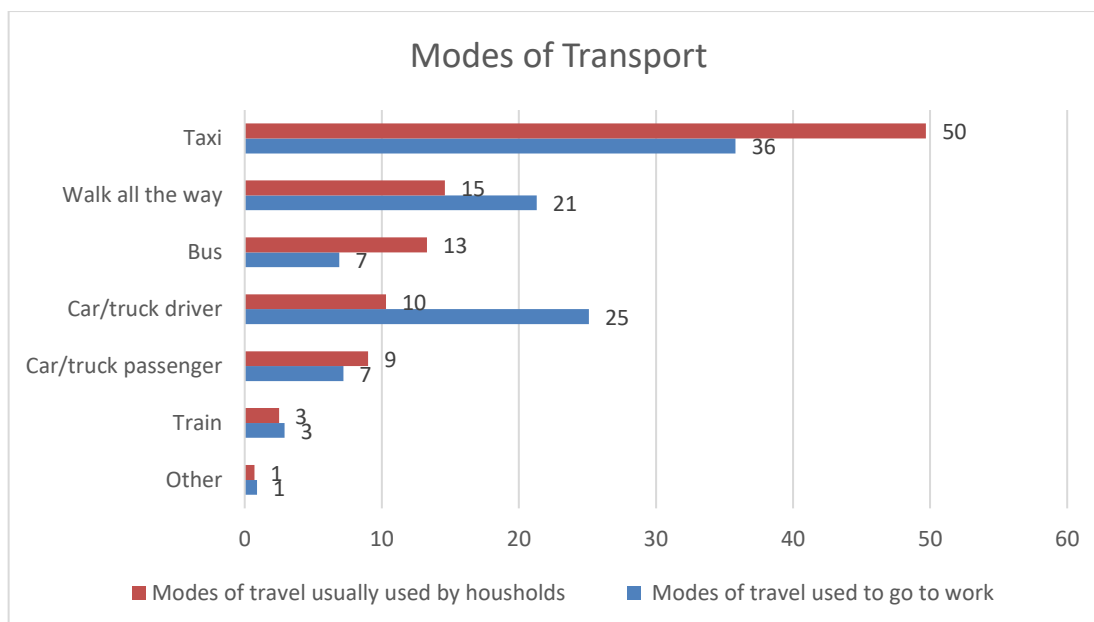


Figure 45: Modes of transport used to get to work and usually used by households

Source: StatsSA (2013)

The main modes of transport used by people to get to work in KZN are taxi (36%), car or truck (25%) and walking (21%). The main modes of transport used by households (all members of the household) to get to various places (e.g. school, work, shop) are taxi (50%), walking (15%) and bus (3%). Few people in KZN travel by train (only 3%). The penetration of taxis has increased substantially since the 2004 KZN SoER, which showed that approximately 18% of people used taxis, and the number of people walking has decreased substantially from the almost 40% reported in the 2004 KZN SoER to 21% in 2013.

Since 2004, the number of vehicles on KZN roads has increased from approximately 1 million to 1.6 million (eNaTIS, 2017). The number of heavy load trucks has increased from approximately 38 000 to 49 000, and the number of heavy load trailers has increased from approximately 20 000 to 24 000. The strong growth in the number of vehicles, especially heavy load vehicles, on KZN roads leads to an increase in energy, pollution and congestion. Without proper policing and transport planning, the increase in vehicles also leads to an increase in road accident fatalities. The number of fatal crashes on KZN roads has increased from 1 581 in 2003 to 2 367 in 2016 (20% of all fatal crashes in South Africa occur in KZN) (Road Traffic Management Corporation, 2017).

10.4.6 Income, poverty and vulnerability

Households earning less than R3 750 per month are considered poor and qualify for social housing subsidies. Using this definition, approximately 40% of households in KZN are poor – earning less than R45 000 per year or R3 750 per month.

Figure 46 below, shows that more households earn between R30 000 and R42 000 per year than any other income bracket. Many of these households rely on social grants.

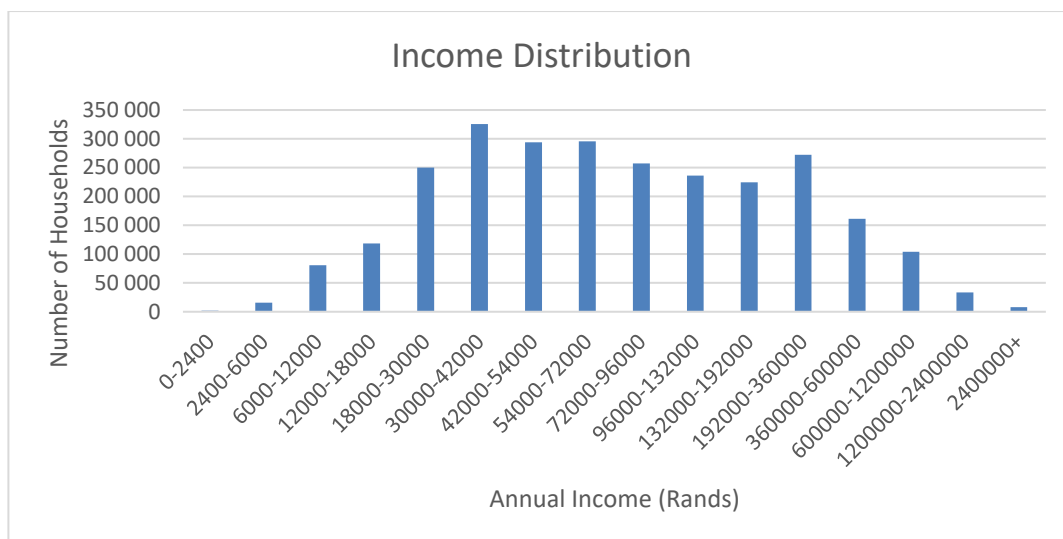


Figure 46: Number of households in KZN according to annual income brackets

Source: Quantec Standardised Regional Dataset (2015)

Income inequality is measured using the Gini Coefficient, where 0 indicates absolute equality and 1 indicates absolute inequality. South Africa's Gini Coefficient is 0.63.

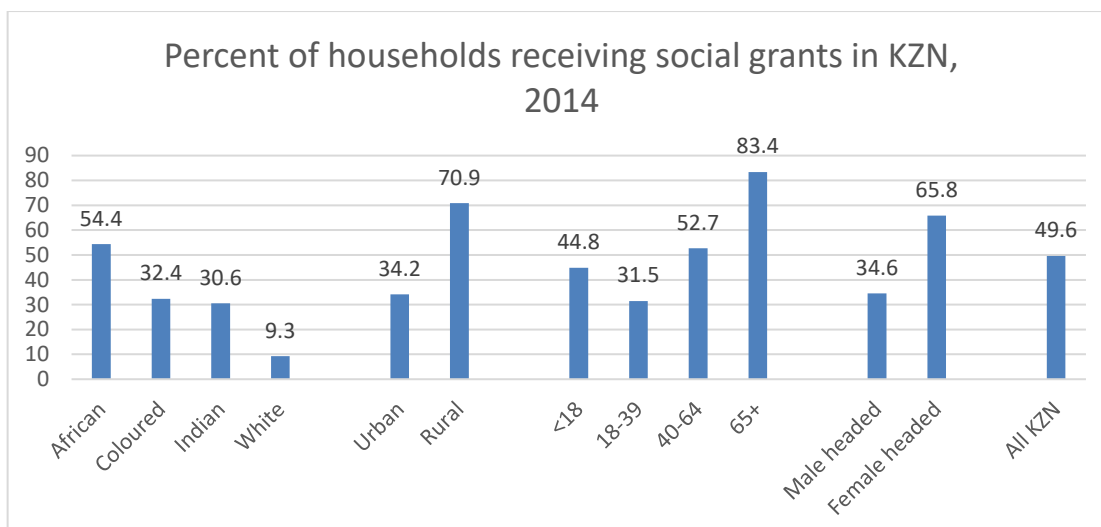
With regard to *education levels*:

- The number of learners has decreased, from 2.9 million in 2004 to 2.8 million in 2016;
- The number of educators has increased, from 71 619 in 2004 to 96 335 educators in 2016;
- The number of schools has increased, from 5 968 in 2004 to 6 196 in 2016; and
- The number of people over the age of 20 who have matric or higher has risen, from 26.7% in 2004 to ~40% in 2016.

The *Human Development Indicator (HDI)* incorporates life expectancy at birth, mean and expected years of schooling, and income per capita to measure quality of life. South Africa's national HDI is 0.67, ranking the country in the medium human development bracket. Similarly, KZN's HDI is 0.61, indicating medium human development.

In terms of *food security*, 23% of households with children reported that children seldom or sometimes experienced insufficient food, while for 6% this was a regular experience. Most of these were in rural areas (KZN PGDS, 2016).

In 2014, approximately 50% of households in KZN received *social grants* – this is a great burden on state resources (Figure 47). In 2017, KZN received 3.9 million grant receipts for care dependency, child support, disability and pension, among others. In total, KZN receives the highest number of grants in the country at 22.6% of total grants, followed by the Eastern Cape (16%) and Gauteng (14.6%).

**Figure 47: Social grant recipients in 2014**

Source: KZN PGDS (2016)

While HIV is not associated with poverty, it does represent vulnerability and provides an indication of the state of human settlements in KZN. The number of *HIV positive* people in KZN in 2015 was 1 657 989, and this has grown at an average annual rate of 2.2% over the last 10 years, reducing to 2.1% over the last 5 years. The number of deaths due to AIDS in 2015 was 44 500; however, this number is reducing annually (Quantec, 2015).

10.4.7 Crime

Since 2005, there has been a marginal decline across most categories of crime in KZN, with the number of reported crimes per 100 000 households decreasing from 3 583 in 2005 to 3 272 in 2014 (Table 48). Theft, commercial crime and shoplifting crimes have decreased the most – by -6%.

Table 48: Crime statistics for KZN

Crime Category	2015/16	% Change
Contact Crimes (murder, sexual offences, assault, robbery)	97 870	-0.9%
Contact-Related Crimes (arson, damage to property)	15 534	0.5%
Property-Related Crimes (burglary, theft of vehicle, stock theft)	86 385	-0.5%
Other Serious Crimes (theft, commercial crime, shoplifting)	68 616	-6.0%
Community-Reported Serious Crimes	268 405	-2.0%
Crime Detected as a Result of Police Action (possession of alcohol and drugs, driving under influence, sex worker)	64 875	-0.8%

Source: SAPS (2016)

10.5 Impacts

Table 49: Summary of core indicator impacts and trends in KZN

Indicators	State	Current negative impact on human settlements	Trend
Population size, growth and density	The population of KZN is the second-highest of all provinces in South Africa and is growing at a rate of 1.4% annually.	high	Increasing
Net migration into KZN	KZN experiences a relatively low net migration of 6 729 people.	low	Stable
Growth and density of households in KZN	KZN's 2 689 431 households are growing at a faster rate than the population at 1.5%. There are 29 houses per km ² on average in KZN, and the density of both households and population is growing at a rate of 7.2% and 7.3% respectively.	high	Increasing
Rate of urban sprawl	Due to increased population growth combined with limited land use planning, there is increased urban sprawl in the form of informal settlements.	high	Increasing
Housing backlog	KZN has the second-highest backlog of housing development in the country and a relatively high percentage of people living in traditional dwellings. Nine per cent of households in KZN were informal and 18% were traditional in 2015.	high	Decreasing
Settlement type	The 2004 KZN SoER reported that 54% of the total population lived in rural areas, which had reduced to 51% by 2015.	medium	Stable
Access to basic household services	Since 2004, progress has been made with regard to the distribution of electricity. However, 22% of households in KZN still do not have access to electricity for lighting. The percentage of total households with weekly refuse removal remains low at 51%. The percentage of households that have a flush toilet has decreased since 2004, to 39% in 2016. The number of households with access to piped water has increased, from 77% in 2004 to 86% in 2016.	high	Stable
Public transport access	The penetration of taxis has increased substantially from the 2004 KZN SoER, which showed that approximately 18% of people used taxis. The number of people walking has decreased substantially, from almost 40% as reported in the 2004 KZN SoER to 21% in 2013.	high	Increasing
Number of vehicles and road safety	Since 2004, the number of live vehicles on KZN roads has increased from approximately 1 million vehicles to 1.6 million vehicles. The number of fatalities as a result of car crashes on KZN roads increased from 1 581 deaths in 2003 to 2 367 deaths in 2016.	high	Increasing

KwaZulu-Natal Environment Outlook Report 2017

Indicators	State	Current negative impact on human settlements	Trend
Human Development Index (HDI)	KZN's HDI is 0.61, indicating medium human development.	medium	Decreasing
Poverty and food security	Approximately 40% of households in KZN are poor – earning less than R45 000 per year or R3 750 per month. Twenty-three per cent of households with children reported that children seldom or sometimes experienced insufficient food; for 6% this was a regular experience. Approximately 50% of households were receiving <i>social grants</i> in 2014 in KZN.	high	Stable
Education	The number of people over the age of 20 who have matric or higher has risen, from 26.7% in 2004 to ~40% in 2016.	medium	Decreasing
HIV	The number of <i>HIV-infected</i> people in KZN in 2015 was 1 657 989, and this has grown at an average annual rate of 2.2% over the last 10 years.	high	Increasing
Crime	The trend since 2005 shows that the number of reported crimes per 100 000 households has decreased, from 3 583 in 2005 to 3 272 in 2014.	high	Decreasing
Human vulnerability	Taking all of the above indicators into account.	high	Stable

10.6 Responses

Sustainability in human settlement design and function is paramount to improving quality of life, building resilience and reducing the negative impact on the environment. Governance and leadership, basic services, land tenure and community facilities are key elements in ensuring sustainable development of human settlements. The New Draft White Paper on Human Settlement (to be published in 2017/2018) recognises the importance of services and facilities (such as open public and recreational spaces as well as access to economic opportunities, schools and clinics) in both greenfields and brownfields⁵¹ developments.

The new white paper proposes the following conditions for greenfields developments:

“A fully constructed housing unit for all households qualifying for a full or partial subsidy may only be provided in circumstances where the development promotes integration, densification, in transport nodes, and found cost effective to provide for everyone in the programme.”

The new white paper promotes public sector partnerships with private sector developers and land owners to develop integrated housing such as the Cornubia and new Durban City developments, which balance subsidised housing with middle-income housing. It also recognises the value of affordable rental housing options and promotes the development of these.

Brownfields developments involve improving services and connectivity of existing settlements such as informal settlements and rural settlements. *In situ* upgrades are necessary to prevent unsustainable human settlements from impacting the environment. Interim services for informal settlements are also a necessary response to be prioritised with *in situ* upgrades.

Restricting further urban sprawl and investing in brownfields development for mixed-use residential and commercial use will bring people closer to economic opportunities and services. Increasing population density *without* increased waste removal, water, transport and energy services, as well as facilities such as suitable public spaces, will have adverse effects on quality of life, human health and the environment.

Opportunities exist for waste services, water and sanitation services to be rolled out more efficiently. In addition, there are opportunities to minimise waste generation through raising awareness about means to reduce wasteful consumption, re-use resources and recycle.

Access to communal gardens and opportunities for urban agriculture is necessary to increase food security among the urban and rural poor. KZN has identified agri-villages, communal estates and river valley models to combat dispersion of human settlements, eradicate poverty, increase food security, improve safety and enhance social cohesion (KZN DARD, 2015/16). This also goes with improvements in land tenure to provide ownership of land to people and consequently promoting sustainable land use practices.

To reduce vehicle kilometres travelled by passengers (and freight) requires a well-functioning reliable public transport system and facilities for non-motorised transport.

Investment in green jobs is another top priority for alleviating poverty and income inequality and for reducing the negative impact on the environment. Green jobs are typically in new and established low

⁵¹ Brownfields developments involve improving services and connectivity of existing settlements.

carbon economic sectors such as tourism, renewable energy and green buildings. New jobs can also be created in the public transport sector while also promoting a shift from private to public transport. Finally, family planning strategies could be prioritised in government, including creating awareness and improving access to family planning clinics and contraceptives. While population growth is not necessarily bad for the environment, when accompanied by insufficient housing, limited land tenure, services and employment, it can have an increasingly negative impact on the environment.

10.7 References

- ASSAf. 2011. *Towards a Low Carbon City: Focus on Durban*. Published by Academy of Science of South Africa (ASSAf).
- Dlungwana, M. 2017. KwaZulu-Natal Education Budget Vote 2017/18. Department of Education. Retrieved from: <http://www.gov.za/SPEECHES/mec-dlungwana-20172018-education-budget-4-may-2017-0000>. Accessed on 9 July 2017.
- Department of Human Settlements KwaZulu-Natal. 2016. Annual Performance Plan 2017/18-2019/20. Retrieved from: http://www.kzndhs.gov.za/Uploads/documents/Resource_Centre/Strategic_documents/Annual_Performance_Plans/APP_2017-18-2019-20_CD.pdf
- eNaTIS. 2017. Live vehicle population as per the National Traffic Information System. 30 March 2017. Retrieved from: <http://www.enatis.com/index.php/statistics/13-live-vehicle-population>. Accessed on 6 July 2017.
- Goebel, A. 2007. Sustainable urban development? Low-cost housing challenges in South Africa. *Habitat International*, 31(3–4): 291-302. doi: 10.1016/j.habitatint.2007.03.001.
- KZN Provincial Planning Commission. 2011. Provincial Spatial Development Framework. Draft 2.
- KZN DARD. 2015/16. Strategy for Agrarian Transformation. KZN Department of Agriculture and Rural Development.
- KZN Treasury. 2015. Estimates of Provincial Revenue and Expenditure 2015/16 for the financial year ending 31 March 2016. Presented to Provincial Legislature 10 March 2015. Retrieved from: <http://www.treasury.gov.za/documents/provincial%20budget/2015/4.%20Estimates%20of%20Prov%20Rev%20and%20Exp/KZN/KZN%20-%20EPRE%20-%20Full%20Document.pdf>. Accessed online on 29 March 2017.
- Mbatha, S. and McHunu, K. 2016. Tracking peri-urban changes in eThekweni Municipality – beyond the ‘poor–rich’ dichotomy. *Urban Research & Practice*: 1-15. doi: 10.1080/17535069.2016.1143960.
- Quantec Regional Standardised dataset. 2015. Retrieved from: www.quantec.co.za
- Road Traffic Management Corporation. 2017. Road Traffic Report Calendar. 1 January to 31 December 2016. Department of Transport. Retrieved from: <http://www.rtmc.co.za/images/docs/Calender/Calendar2016/Calender%202016%20report.pdf>. Accessed on 5 July 2017.
- Rode, P., Floater, G., Thomopoulos, N., Docherty, J., Schwinger, P., Mahendra, A. and Fang, W. 2014. Accessibility in cities: transport and urban form. Retrieved

from:<https://files.lsecities.net/files/2014/11/LSE-Cities-2014-Transport-and-Urban-Form-NCE-Cities-Paper-03.pdf>

South African Police Services. 2016. 'Crime statistics 2015/16'. Retrieved from: https://www.saps.gov.za/services/crimestats_archive.php

Scott, B. 2017. Budget Speech 2017/18. Province of KwaZulu-Natal. ISBN: 1920041133. Retrieved from: http://www.gov.za/sites/www.gov.za/files/speech_docs/Budget%20Speech%20English%202017-18.pdf

StatsSA. 2013. National Household Travel Survey 2013. Statistical release P0320. July 2014. Pretoria. Retrieved from: <http://www.statssa.gov.za/publications/P0320/P03202013.pdf>. Accessed on 5 July 2017.

StatsSA. 2016. General Household Survey (GHS) Series Volume VII: Housing from a human settlement perspective. Report 03-18-06 (2002-2014).

TIPS. 2016. The Real Economy Bulletin, Provincial Review. Trade and Industrial Policy Strategies (TIPS). Retrieved from: https://www.tips.org.za/images/The_REB_Provincial_Review_2016_KwaZulu-Natal.pdf. Accessed online on 29 March 2017.



ANC
TOGETHER
WE CAN
BUILD BETTER
COMMUNITIES

11. Waste

11.1 Introduction

Since the Kwa-Zulu-Natal (KZN) State of Environment Report (SoER) 2004, the most notable change in South African waste management is increased regulation. The foundation of waste management legislation is the National Environmental Management: Waste Act (Act No. 59 of 2008) (NEMWA). NEMWA and a multitude of laws provide for integrated waste management (IWM) to reduce or eliminate the adverse impacts on the environment. The KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA) is mandated with regulating general waste and monitoring hazardous waste. The national Department of Environmental Affairs (DEA) regulates hazardous waste.

Inappropriate waste management can cause health, safety, environmental and economic hazards and risks. Waste disposed to landfills is the least desirable in the waste management hierarchy, while reducing and avoiding waste are the most desirable methods and are followed by re-using, recovery and recycling.

The KZN 2004 SoER listed key challenges identified in the White Paper on Integrated Pollution and Waste Management (DEAT, 2000) as: i) the lack of priority for waste management; ii) fragmented legislation and ineffective enforcement; iii) unacceptable safety, health and environmental practices; and iv) the absence of IWM options. The introduction of NEMWA and its regulations was to resolve the challenges identified in the white paper. IWM planning is instituted in NEMWA. This Act and other laws enacted in relation to waste management since 2004 are shown in Table 50.

Table 50: Waste-related legislation in effect since 2004⁵²

Year	Legislation	Type	Description
1989	Environmental Conservation Act (ECA)	Act	Act No. 73 of 1989: Waste Tyre Regulations 2008 (G31901 GN R. 149) 13 February 2009.
1998	National Environmental Management Act (NEMA)	Act	Act No. 107 of 1998: Regulations for admission of guilt fines: NEMWA 2008 (Act No. 59 of 2008) (G39024 GN R. 635) 24 July 2015. (Regulations apply only to offences in terms of the NEMWA that relate to general waste and are not applicable to hazardous waste or priority waste.)
2008	ECA	Regulation	Prohibition of use, manufacturing, import and export of asbestos and asbestos-containing materials (G30904 GN R. 341) 28 March 2008.
2009		Policy	National Policy in Thermal Treatment of General and Hazardous Waste (G32439 GN 777) 29 July 2009.
2011	NEMWA	Regulation	National Domestic Waste Collection Standards (G33935 GN 21) 21 January 2011.
2011		Policy	National Policy for the Provision of Basic Refuse Removal Services to Indigent

⁵² Waste in South Africa is also governed by: The South African Constitution (Act No. 108 of 1996); Hazardous Substances Act (Act No. 5 of 1973); Health Act (Act No. 63 of 1977); National Water Act (Act No. 36 of 1998); Municipal Structures Act (Act No. 117 of 1998); Municipal Systems Act (Act No. 32 of 2000); Mineral and Petroleum Resources Development Act (Act No. 28 of 2002); and Air Quality Act (Act No. 39 of 2004).

Year	Legislation	Type	Description
			Households (G34385 GN 413 of 2011) 22 June 2011.
2011			National Waste Management Strategy November 2011.
2012	NEMWA	Regulation	National Waste Information Regulations (G35583 GN R. 625) 13 August 2012.
2012 and 2013	NEMWA	Regulation	Waste Classification and Management Regulations (G35572 GN R. 612) 10 August 2012 and amended (G36784 GN R. 634) 23 August 2013.
2013	NEMWA	Regulation	National Norms and Standards for the Disposal of Waste to Landfill (G36784 GN R. 636) 23 August 2013.
2013	NEMWA	Regulation	National Standards for the Scrapping or Recovery of motor vehicles (G37087 GN 925) 29 November 2013.
2013	NEMWA	Regulation	National Standards for the Extraction, Flaring or Recovery of Landfill Gas (G37086 GN 924) 29 November 2013.
2013	NEMWA	Regulation	National Norms and Standards for the Storage of Waste (G37088 GN 926) 29 November 2013.
2014	NEMA	Regulation	Regulations to phase-out use of Polychlorinated Biphenyls (PCBs) materials and Polychlorinated Biphenyl (PCB) contaminated materials (G37818 GN R. 459) 10 July 2014.
2014	National Environmental Management: Waste Amendment Act (NEMWA)	Act	Act No. 26 of 2014
2014	NEMWA	Regulation	Norms and Standards for the Remediation of Contaminated Land and Soil Quality (G37603 GN 331) 2 May 2014.
2016	NEMWA	Regulation	National Pricing Strategy for Waste Management (G40200 GN 904) 11 August 2016.

Trends from 2004 to 2017 are presented in this chapter to show the outlook of waste management in KZN. The waste management indicators used in this Report are listed in Table 51.

Table 51: Indicators used in the assessment of the waste management in KwaZulu-Natal

Indicators	Description and Comment
Number of Annual Performance Reports produced.	Having IWMPs at provincial, district and local level is a statutory requirement in terms of the NEMWA. The provincial IWMP drafted in 2012 was not adopted and a second draft IWMP is being drafted in 2017. Six out of 10 districts (including 1 metro) and 40% of local municipalities have IWMPs (KZN, 2012).
Number of hazardous waste sites and facilities.	There are 33 licensed hazardous waste facilities and 21 of these facilities have a H:H rating (IWMSA, 2011). The risk that hazardous waste is being disposed of illegally, or to general waste sites, exists.

Indicators	Description and Comment
Amount of general and hazardous waste produced provincially per year.	In 2016, 530 361 tonnes of hazardous waste per annum were disposed in KZN (SAWIC, 2017). This is a 3 760% increase since 2004, when hazardous waste was first recorded in the National Waste Information System. ⁵³
Percentage of licensed municipal landfill sites.	The percentage of authorised municipal general waste sites has increased.
Amount of waste to landfill per annum.	Currently estimated at 3 398 932 tpa of general waste disposed in KZN (SAWIC, 2017). SAWIC ⁵⁴ reports more waste was being recovered/recycled than being disposed in the landfill in 2016.
General waste produced per capita per annum and amount of waste recycled per annum (in tonnes).	In KZN 158 kg/capita/annum is produced, which makes up 9% of the total waste generated in South Africa (DEA, 2012). There was 52 431 688 tpa of recycled waste in KZN in 2016 (SAWIC, 2017).
Level of gases at landfill sites.	The level of gases emitted from landfill sites that are harmful to the surrounding communities and create a bad odour.
Provincial customer units (households) receiving a waste-collection service.	In KZN 1 512 830 customer units received basic solid waste management services in 2015, while 683 842 customer units received free basic solid waste management services and therefore 45.2% benefitted (StatsSA, 2015b).
Provincial waste-collection capacity of local municipalities.	

11.2 Drivers

Population growth, urbanisation, manufacturers' designing of items for single use and consumer behaviour for more modernised goods are drivers for increasing the quantity and complexity of waste. Unmanaged disposal of waste causes pollution and degradation of the natural environment, and poses health and other risks. The more affluent the Province's population becomes, the more tonnes of waste are generated and the more complex the waste stream becomes. Figure 48 shows that an increase in population has a direct correlation to the increase of waste generated and the increase of recyclables available. If more recyclables can be recovered from the waste stream, more economic opportunities can be created.

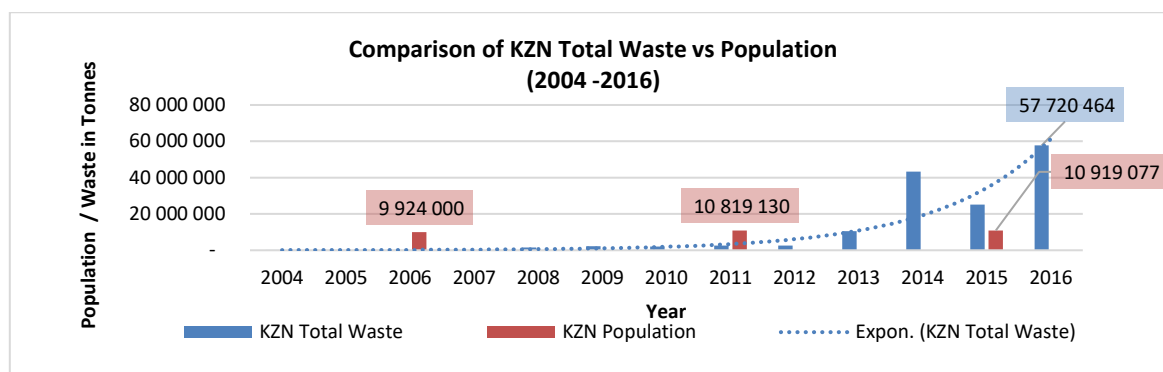


Figure 48: KZN comparison of total waste generated versus population growth

Sources: SAWIC (2017); StatsSA Census (2012); StatsSA, Community Household Surveys in 2005 and 2015

⁵³ Data is of hazardous waste disposed in licensed hazardous landfills.

⁵⁴ Figures used from SAWIC are reported on the SAWIC website on May 2017. There are known discrepancies in SAWIC data as there is limited verification or compliance monitoring of facilities entering data in the database; data duplication in some instances; poor response in reporting; or limited access to the database. SAWIC is a live database and reporting to SAWIC is still limited. For purposes of this document data has been used from SAWIC to give a general estimation of waste statistics for KZN Province.

More stringent waste management regulation is required to decrease the negative impact that waste has on a healthy environment and to increase positive economic benefits from the waste sector. The regulation of IWM in South Africa is through the promulgation, implementation and enforcement of NEMWA. The implementation of waste management regulatory requirements is aimed at ultimately achieving effective waste management.

11.3 Pressures

Evolving IWM regulation presents a need for increased: i) awareness of new legislation; ii) permitting, record keeping and reporting systems; iii) financial resources; and iv) monitoring and enforcement requirements. New regulations are a pressure for EDTEA as their waste management functions include administering standards and targets; authorising; advising municipalities; compliance monitoring and enforcement; and regulating (i.e. permitting of all general waste sites and waste activities) (Madubula and Makinta, 2014).

The KZN Draft IWMP of 2012 has not been implemented yet as no budget was allocated, which is an additional pressure for KZN. Regardless, KZN's Draft IWMP of 2012 is currently being updated by the EDTEA as part of their five-year review process. The challenge with adopting IWMPs at a local municipal level is that there is no full cost recovery for the waste management service provided. Slow adoption of IWMPs by municipalities is a pressure, as municipalities experience difficulties in finding additional revenue sources to fund and implement the plan. In addition, funding for IWM activities competes with other essential priorities when the municipality allocates budgets.

The DEA acknowledges that waste management in South Africa has traditionally suffered from pervasive under-pricing, meaning that the costs of waste management are not fully internalised, and waste disposal is preferred over other methods (Badul, 2014). Managing waste in this way creates a market failure in that waste and recyclable materials are undervalued, resulting in more waste ending up in landfills and dumping sites. By apportioning the right value to waste, more markets and trade in recyclable goods will be created that consequently will provide more income generating opportunities (Badul, 2014). In 2004, the majority of municipal solid waste was landfilled. In 2017, more waste was recycled or recovered than disposed to landfill (SAWIC, 2017). However, the economic market for selling recyclable materials could be improved.

In 2015, job creation was said to be the KZN citizens' priority area as unemployment was the main driver for poverty in the Province (StatsSA, 2015a). There is therefore pressure to create more job opportunities from the IWM value chain and the potential in the sector needs to be investigated. Analysing the value chain of IWM is required for finding cost-effective and innovative solutions to maximise economic and environmental benefits. In addition, there is pressure on the government to create more jobs and economic benefits in the formal waste management sector value chain, as the informal waste sector is not functioning optimally.

11.4 State

The state and trends of KZN waste management from 2004 to 2017 are analysed in this section. The KZN SoER of 2004 presented the state of generation, collection and disposal of solid waste, which is now compared with 2017 data. Statistical data provided in the SoER 2004 preceded the promulgation of NEMWA and the creation of the South African Waste Information System (SAWIS). This means that data may not always be comparable between these sources.

11.4.1 Waste generation

Since 2004, waste generation and the recording of these data have increased in the Province. The KZN Waste Information System (WIS) was rolled out in 2007/8; however, limited data on licensed waste activities have been captured in the SAWIS since 2004. The 2004 SoER reported that waste generation had increased from 1 926 000 tonnes per annum (tpa) in 1998 to 1 936 752 tpa in 2004.

Figure 49 shows that from 2004 to 2013 less solid waste was generated compared to that reported in SoER 2004. This is because in 2004 only one licensed waste disposal facility was reporting to the SAWIS and new regulations came into effect between 2008 and 2013. There was a large increase in the number of licensed waste facilities recording data from 2013 onwards. In 2016, the South African Waste Information Centre (SAWIC) reported that the total waste generated was 57 720 464 tpa. The total waste stream generated in 2016 comprised 67% hazardous waste (38 898 677 tpa) and 33% general waste (18 821 787 tpa) (Figure 49). This means that between 2004 and 2016, there was an astonishing 3 760% increase in the amount of waste generated. The substantial increase is due to better reporting and monitoring of waste management information as well as an actual increase in the amount of waste generated.

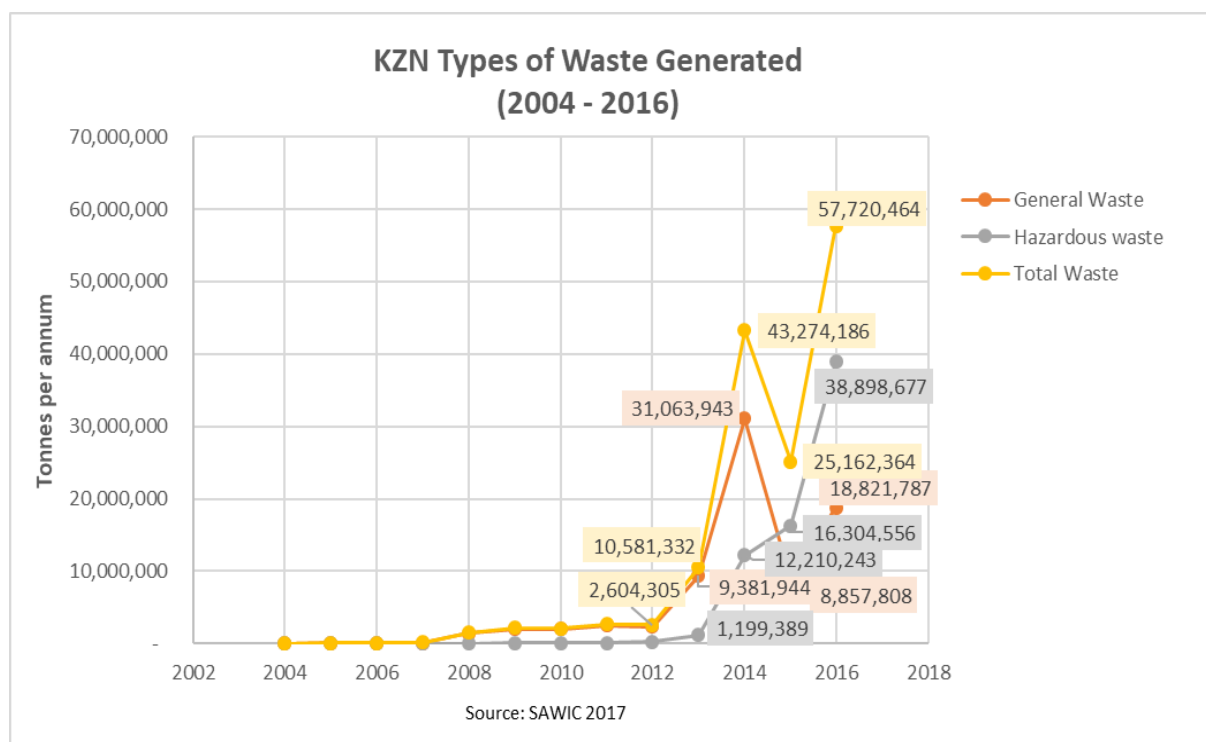


Figure 49: KZN annual waste generation in tonnes per annum
Source: SAWIC, 2017

In the 2004 KZN SoER, the average volume of waste generated per capita in eThekweni was reported as approximately 1.2 kg per person per day, while in uMkhanyakude this value was 0.02 kg per person per day (average of urban plus rural is 0.61 kg per person per day). The DEA National Waste Information Report (2012) reports that in 2012 the average (rural and urban) volume of waste generated per capita in KZN was 0.43 kg/capita/per day.

Several problematic waste streams exist in KZN; for example, in many local communities, disposable nappies are a common concern. These nappies are not recyclable or biodegradable and, in rural areas, these are frequently illegally dumped in unlicensed community facilities because no alternative

services are available. This contributes greatly to an increase in insects and potential disease vectors, and raises other potential health issues related to water pollution.

Figure 50 shows that the majority of the total waste generated is either recovered or recycled in KZN. In 2014, the disposed waste tpa was much higher, which may indicate inconsistency in the data reported to SAWIC. SAWIC data also indicate that there was a limited amount of waste disposed of post 2012, which indicates limited reporting. However, the overall amount of waste recovered or recycled is increasing rapidly as there is a greater economic market for recyclables.

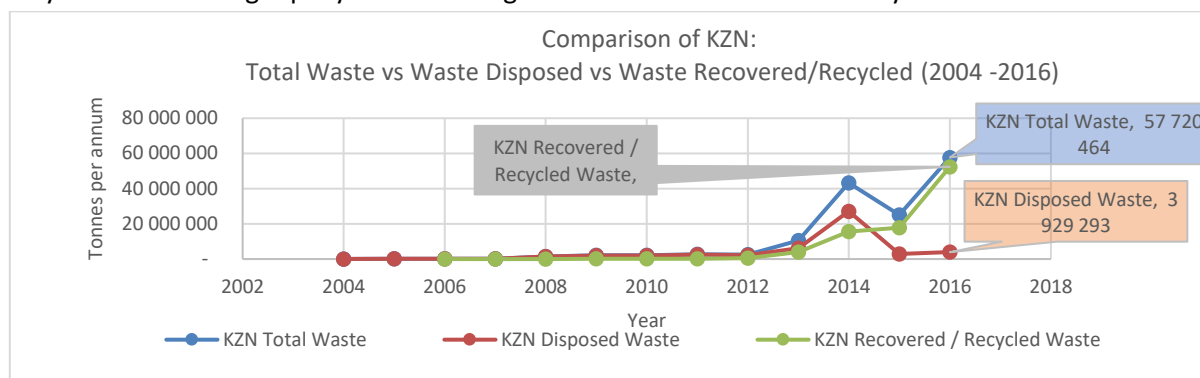


Figure 50: Total waste vs waste disposed vs waste recovered/recycled (2004-2016)

Source: SAWIC (2017)

11.4.2 Collection

Refuse removal is one of the basic service delivery offerings by government and free basic refuse removal service is offered to households registered on local municipality indigent registers. The Free Basic Refuse Removal Guidelines were developed to offer this service to the poorer population. In the KZN SoER of 2004, refuse removal was not recognised as a basic service delivery provision. Waste generation amounts are monitored by the Province to ensure that waste collection and disposal are implemented according to the legal requirements in South Africa. The NEMWA National Domestic Waste Collection Standards, promulgated in 2011, are applicable to all domestic waste collection services in South Africa. The level of service to be provided by a municipality is also described in the standards.

The enactment of the National Waste Collection Standards (NWCS) specifies the type of refuse collection standards for several types of municipalities and allows for communal refuse dumps in rural municipalities where kerbside collection is not achievable. As per NWCS S3, the service levels differ between areas, depending on the practicality and cost efficiency of delivering a service. On-site appropriate and regularly supervised disposal (applicable mainly to remote rural areas with low-density settlements and farms supervised by a waste management officer) is acceptable in the NWCS.

The trend of household waste management methods since 1996 is shown in Figure 51. More households are having their waste removed by local authorities or private contractors, while the use of a communal dump or own refuse dump has also slightly increased since 1996. There is a steady decline in the percentage of households not using a particular disposal method as only 2% of households reported not having a disposal method in the 2011 census.

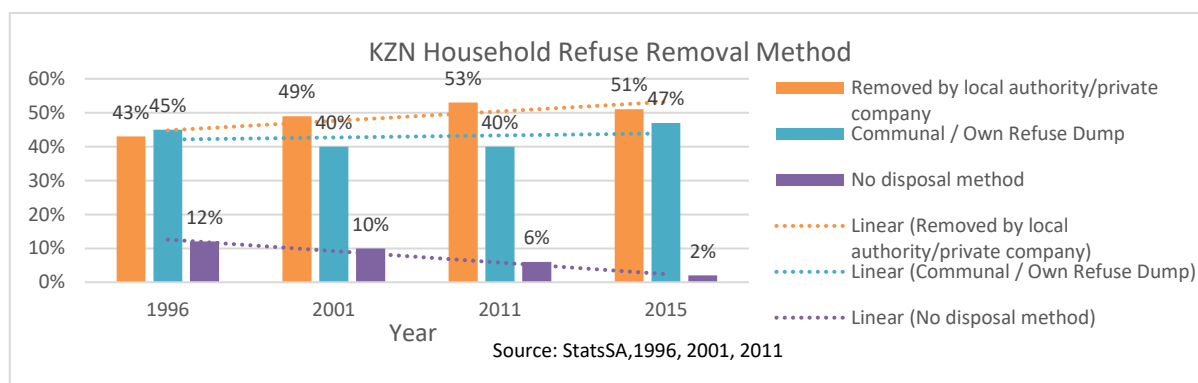


Figure 51: Trends in KZN household refuse removal methods

There has been an increase in refuse removal service offered provincially as recorded in the censuses 1996, 2001 and 2011, when services increased from 43% to 49% and up to 53% in 2011. Alternatively, 47% of the Province's households are disposing of their waste in communal or own refuse dumps or are using no disposal methods (i.e. burning or littering their waste) (6% in 2011). In 2015, there were 1 512 930 consumer units⁵⁵ receiving a basic solid waste management service in the Province, which was a 4% increase from 2014 (StatsSA, 2015a). Also in 2015, 683 842 poor consumer units benefited from having a free basic solid waste management service (StatsSA, 2015a).

The expansion of waste services and cost recovery for municipalities present a challenge. Legally, municipalities must provide refuse removal services to all households, even poor ones. Municipalities are experiencing difficulties in providing services to all households as a result of limited revenue generated by ratepayers. Hence, the operational revenue received must be supplemented from elsewhere in the municipal budget. The budget allocated for waste management comprises the operational revenue received and other sources. Municipalities should do full cost accounting of their refuse removal service. Local and district municipalities may require support from provincial operating revenue to subsidise their waste management budget.

11.4.3 Disposal

Illegal dumping still occurs in the Province; however, no consolidated data were available on the number of dumpsites. Thirty-five per cent of households felt that they were experiencing a problem with littering in KZN (StatsSA, 2015b). Littering can be an environmental risk but is also unsightly and can attract disease vectors and pests such as rats and flies. Waste disposal is the least preferred waste management method in the waste hierarchy. The number of licensed waste disposal sites continues to rise with the implementation of NEMWA and its regulations. Waste management licences require that up-to-date records are kept and reported on annually, which is improving the monitoring of received and recycled waste.

The amount and type of waste disposed to licensed landfills in KZN are indicated in Figure 52. Data show inconsistency in the amount of data reported to SAWIS and an increase in the amount of landfill waste disposal.

⁵⁵ A consumer unit or billing unit is an entity to which the service is (or would be) delivered, and which receives one bill if the service is billed. It is alternatively known as a delivery point. (This concept is often referred to as a household by municipalities. However, this is not strictly correct, as households and consumer units do not coincide one to one, particularly in blocks of flats; on stands where there are multiple households in the same dwelling; or in additional dwellings, such as garden flats and backyard rooms; and in the case of public taps).

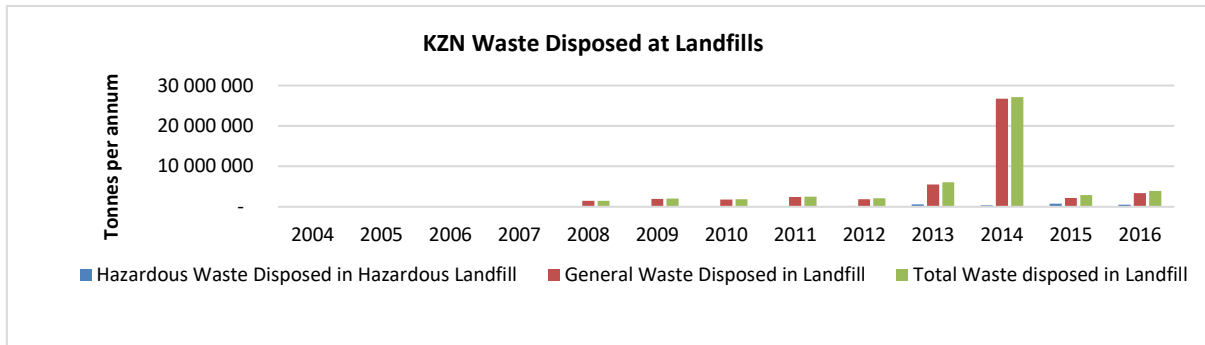


Figure 52: Amount and types of waste disposed to licensed landfill

Source: SAWIC (2017)

11.4.4 Recycling

As shown in Figure 53, the amount of waste being recycled per annum in KZN has been increasing since 2011, to the point where more waste is treated by recovery or recycling than is disposed of. Only 2.8% of households collect waste for recycling and 24% of these households sell their waste (StatsSA, 2015b). There are many waste pickers who sort household waste prior to waste being collected by a waste service.

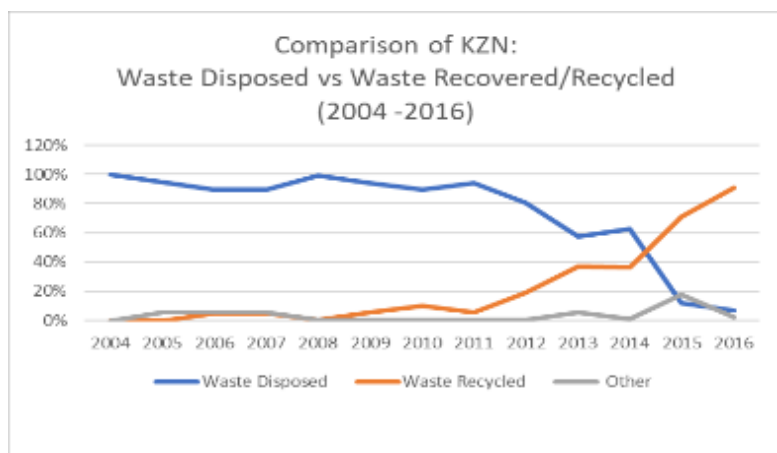


Figure 53: Proportion of waste disposed of, recovered and recycled between 2004 and 2016

Source: SAWIC (2017)

The location of some of the general and hazardous waste disposal facilities in KZN, plotted in Google Earth from SAWIC website licensing data, is shown in Figure 54.



Figure 54: Location of some of the general landfills in KZN

Hazardous waste may be incorrectly disposed in general landfill sites or illegally dumped, causing harm to the environment as all hazardous waste must be disposed in a licensed hazardous waste facility. Electronic waste generation is on the rise and electronic waste is considered hazardous waste. Electronic waste is produced by a more affluent population and creates more pressure to have appropriate disposal systems in place or recycling/re-use facilities installed. From 2001 to 2011, the proportion of households owning radios or landline/telephones decreased, while there was a large increase in the proportion of households owning televisions (47% to 67%), computers (7% to 16%), refrigerators (47% to 63%) and cell phones (28% to 88%), with access to the internet increasing from 0% to 34% in the Province (StatsSA, 2012).⁵⁶ National censuses 2001 and 2011 show an increase in the use of electricity for lighting (61% to 78%), cooking (48% to 68%) and heating (46% to 58%) (StatsSA, 2012). The increase in use of electricity means an increase in electronic and general goods used in a household that will eventually enter the waste stream.

11.4.5 Waste management planning

The EDTEA drafted the first KZN Integrated Waste Management Plan (IWMP) and *status quo* in 2012. Up until 2012, provincial waste planning was conducted by the Department of Health. The KZN provincial government, however, did not adopt the provincial IWMP. The IWMP not being adopted by the Province is a concern as this means a budget was not allocated to implement the plan. Without a budget, the IWMP is ineffective in providing waste management functions. This Draft IWMP consolidates IWMPs for its ten district municipalities and the eThekweni Metropolitan Municipality. In 2012, there were 32 designated waste management officers in the Province. In addition, six of the ten districts had active District Waste Management Forums.

NEMWA stipulates that an IWMP is to have an annual performance review and a new IWMP may be developed every five years, if necessary. The Province reviews its draft IWMP annually and the latest IWMP is being prepared in 2017. EDTEA's Pollution and Waste Division of its Directorate for Environmental Planning and Co-ordination Services submits quarterly reports to the DEA as part of its Annual Performance Plan reporting, Outcome 10 reporting and waste management licensing statistics (KZN, 2012).

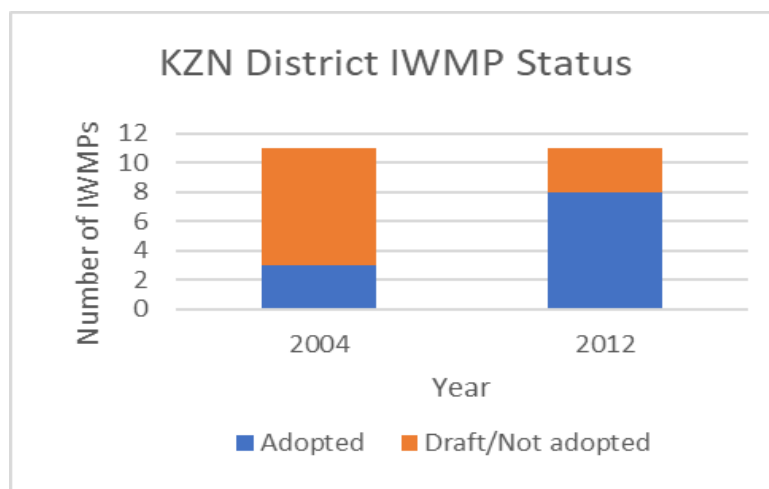


Figure 55: KZN status of district IWMPs

Sources: Summary of Waste Management Facilities and Policies (2012), Sivest (2004) and DEA

NEMWA regulates that IWMPs be developed at local and district municipality level. In KZN, waste management planning has been slow to reach compliance with NEMWA. Adoption and implementation of IWMPs is presented in Figure 55, which shows that the adoption of IWMPs is

⁵⁶ Retrieved from: <http://northernnatalcourier.co.za/52189/where-do-dead-devices-go/>

increasing among KZN district municipalities. In 2012, 8 out of 11 districts had adopted their IWMPs. The lack of adopted IWMPs at the provincial and municipal level also impacts on the refuse removal service offered by municipalities. By mid-2017, only 39% of the KZN local municipalities had adopted IWMPs (SAWIC, 2017). Some district IWMPs suffice for a local IWMP should the local IWMP not be available yet.

A provincial Hazardous Waste Management Plan (HWMP) was prepared in 2013 prior to the enactment of the regulations pertaining to hazardous waste management and was also not adopted as the new regulations specify hazardous waste management as a national function.

11.5 Impacts

In the 2004 KZN SoER, it was stated that solid waste had the potential to impact natural systems and humans, but impacts differed between rural and urban areas. In rural areas, much of the waste is either burnt and buried or disposed of at community sites that are not managed and do not have basic requirements such as fencing. In urban areas, landfill sites may not be located appropriately or managed per best practice. Risks and potential impacts on society and the environment include: disease and injury; nuisance issues; degradation of natural systems; and impact on infrastructure and service delivery. The potential negative environmental impacts of poor waste management in terms of physical, biophysical and socio-economic conditions are presented in Table 52.

Table 52: Summary of negative environmental impact of poor waste management

	Environmental Aspect/Impact
Physical Environment	Climate Landfills and waste dumps produce GHG emissions that contribute to climate change.
	Soils Hazardous chemicals contaminate the soil and harm plants that absorb the contamination. The health of humans that eat plants and animals that have been in contact with polluted soils can be negatively affected.
	Surface/Groundwater Waste disposed in water bodies can negatively change the chemical composition of the water. Leachate is a liquid that forms as water trickles through contaminated areas. Leachate forms a harmful mixture of chemicals that may result in hazardous substances entering surface- and groundwater or soil. Litter also contaminates surface water.
	Air Quality Toxic emissions from burning, decomposing or disposed waste can be released in the atmosphere, contaminating the air quality. This can lead to negative health impacts as contaminants are absorbed through the lungs. Decomposing waste and leachate have a foul odour.
Biophysical Environment	Land Disposed waste in a landfill or dump creates a large mass of unusable rubbish that can destroy the environmental and economic value of an area.
	Biodiversity Waste pollution negatively impacts on aquatic and terrestrial ecosystems. Fauna can also be impacted negatively by polluted water.
	Visual Accumulation of waste is unsightly and decreases the scenic value of an area.
Socio-Economic Environment	Socio-economic Waste pollution impacts on people's surroundings. Poor waste management leads to degradation of the environment where it is dumped and creates a smelly and unsightly mess. This pollution can impede economic development in an area. The waste generated can create beneficial economic opportunities.
	Human Vulnerability

<p>Poor waste management poses a health risk to humans. Exposure to waste can have a negative impact on human health. NEMWA divides waste into two classes, based on the risk the waste poses, where:</p> <ul style="list-style-type: none"> • general waste does not pose an immediate hazard or threat to health or to the environment, and includes domestic waste, building and demolition waste, business waste and inert waste; and • hazardous waste contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within the business waste, residue deposits and residue stockpiles.
--

Increased regulatory requirements for achieving IWM stopped many policy issues on how this function would be financed, as shown in Box 5. Finance for waste management is limited because the cost of the re-use removal service is paid for by households on their municipal bill and not all households pay their monthly bill, nor are all households charged the same amount to receive solid waste removal services. Hence, the cost to provide waste management services is typically subsidised by the Equitable Share Grant, MIGs, or through assistance from national, provincial or district government. The impact of increased regulation is being mitigated as the system of full cost accounting for IWM planning is developed in the country.

Box 5: Policy Issues of Financing of Waste Management in South Africa

- The implications of classifying waste management as a free basic service (FBS).
- The lack of a standardised approach for setting appropriate and equitable tariff structures for waste management services.
- 'Ring fencing' funds from the Municipal Infrastructure Grant (MIG) for capital expenditure on specific infrastructure.
- The distribution of funding for waste management across the three tiers of government (national, provincial and local government).
- Ambiguous functions, powers and institutional arrangements across government, which affect access and budgetary control of waste management projects.
- Poor optimisation of operational and maintenance costs of waste management projects in municipalities.
- Poor costing of capital, operational, maintenance and environmental implications of waste management projects in municipalities.
- The lack of and/or poor implementation of adequate financial and asset management systems for waste management assets and infrastructure within municipalities.
- Failure to operate waste management services with sustainable cost recovery models, especially in indigent municipalities.
- Lack of clear guidance on sources and requirements for alternative financing of waste management projects.
- Lack of will to develop and implement innovative waste management projects in municipalities that will provide for job creation, improved service delivery, cost reduction and revenue creation (FFC, 2013).

11.6 Responses

The last KZN SoER (2004) stated that there was a weak regulatory system for managing waste, but currently IWM is regulated by NEMWA and extensive other legislation. At a local level, two pilot waste minimisation clubs were operational from 1998 to 2000. The private sector dominated the recycling industry, with minor financial inputs from the local authorities. Primary recyclables in the 2004 waste stream included: paper and packaging industries, plastics, aluminium, glass, oil and rubber (scrap

tyres). Informal sector waste often used recyclables to make items such as bags, mats, toys and other items that are either used in the household or sold.

In 2017, there are more licensed waste facilities in the Province and more facilities reporting to the SAWIS. Implementation of the waste hierarchy, where waste disposal is the least preferred method, is dominated by recovery and recycling of waste. This means more waste is being diverted from entering the landfill, hence increasing the life of landfills. To achieve an IWM system, many activities must be coordinated by both the private and public sector for the system to be effective.

Waste needs to be managed with a “cradle to grave” approach to achieve effective waste reduction. The packaging industry is strictly regulated by NEMWA, the Infrastructure Development Act (Act No. 23 of 2014) and the National Water Amendment Act (Act No. 27 of 2014). However, more effort is required by the industry to reduce packaging waste. Waste reduction innovation⁵⁷ is occurring in the following areas:

- re-using and recycling materials;
- anaerobic digestion;
- waste to energy;
- zero waste – waste avoidance;
- extended producer responsibility;
- waste fighting climate change;
- waste to energy;
- source separation of waste;
- sorting technology⁵⁸;
- bans on plastic;
- from paper to digital;
- “biodegradable” plastics;
- mandatory composting;
- sustainable innovation;
- 3-D printing;
- energy from organic waste; and
- growing issues with e-waste.

Recycling provides a livelihood for an increasing number of people in urban areas; however, given the informal nature of the sector, statistics on the full socio-economic value are limited (KZN PGDS, 2016). The Province estimates that around 85 000 people make a living as waste pickers, where the average waste picker can earn an income of up to R120 per day (KZN PGDS, 2016). As assessment of waste

⁵⁷ Retrieved from: <http://www.treehugger.com/corporate-responsibility/10-recycling-and-waste-management-trends-watch-out-near-future.html>. Accessed on 20 March 2017.

⁵⁸ Retrieved from: <https://waste-management-world.com/a/1-innovations-in-waste>. Accessed on 20 March 2017.

pickers in Durban by a non-profit organisation estimates that between R2 400 and R3 360 per month is earned per waste picker (KZN PGDS, 2016). This is a substantial amount of income that is generated from informal collecting, sorting and selling of re-usable and recyclable materials. However, poor work conditions and limited protection are a challenge for waste pickers. This service could be formalised and subsidised to offset more cost-negative environmental impacts. In rural areas, the potential exists for increased income opportunities but access to markets is a limiting factor. More data are needed about waste recovery and recycling outside of eThekweni to understand the economic value of the sector. It is estimated that only 25% of waste from informal settlements reaches the formal waste stream (KZN PGDS, 2016); hence, the recovery and recycling rate can be greatly improved.

Cost recovery of waste could be placed on manufacturers for materials used. Excessive use of packaging plastic could be replaced with biodegradable packaging options. If not, the manufacturer or customer would pay. This could curtail such unsustainable trends.

The Expanded Public Works Programme (EPWP) has many programmes to create work opportunities and to promote IWM. EPWP projects in the waste sector include: construction of waste transfer stations and buy back/recycling centres, material recovery and composting facilities, labour-intensive landfill construction, food for waste and litter cleansing.

South Africa is at the forefront of e-waste management in Africa and the country is likely to be the first on the continent to develop an e-waste management system. E-waste offers opportunities for job creation and economic development, and contributes to scaling up of recycling technology (eWASA, 2008). The *Best Practice Guidebook for Small E-Waste Businesses* (GIZ, 2014) in South Africa was developed to promote SMMEs in developing e-waste businesses and guides the user on the best way to extract valuable recyclables from e-waste. It also highlights when and how different components of e-waste become hazardous. KZN has established a compact fluorescent light recycling plant (KZN PGDS, 2016) and the possibility of other recycling and re-use facilities being established should be assessed. In addition, consumer deposits could be put into place to encourage retailers to return deposits to consumers when e-waste is recycled.

The KZN PGDS (2016) mentions that the Province should mainstream commitments of COP21 in terms of rolling out the provincial Municipal Waste to Energy Protocol, which will also contribute to GHG emission reductions. The waste sector is said to offer opportunities for the generation of alternative energy from municipal (sewage sludge and mixed paper), industrial (wood, bagasse and pulp) and agricultural waste. eThekweni Municipality has a landfill gas-to-electricity project, which became operational on two landfill sites in 2010. The project is also registered as the second Clean Development Mechanism (CDM) project in the country. Expansion of landfill gas-to-energy projects is on the rise in the Province (KZN PGDS, 2016). The Waste Management Flagship Program is one of the six flagship programmes in Durban. A *Waste to Energy Technologies Guideline* for municipalities has been developed by the Province (KZN PGDS, 2016).

Already in 2009, the eThekweni Municipality developed a *Sustainable Waste Management Guideline* to assist all waste generators on how they can contribute to more sustainable waste management in the future. In 2009, a non-profit organisation called USE-IT was established by eThekweni Municipality to research and develop waste beneficiation technologies in the Municipality. USE-IT assists with diverting waste from landfills and aims to create as many green jobs as possible. The USE-IT model relies on building mutually beneficial public private partnerships to promote green economic development, which creates jobs and effects real savings. USE-IT has created 2 419 jobs since 2009.

The KZN PGDS (2016) states that local municipal capacity is needed in environmental and waste management technical expertise. The National Planning Commission Economic Diagnostic sets out critical factors in employment and growth and recognises that a reduction of solid waste, particularly at the municipal level, is needed. Hence, there is a promotion of increased job creation in the waste management sector.

11.7 Conclusion and Recommendations

The trends pertaining to waste management in KZN are summarised in Table 53 below.

Table 53: Summary of waste management trends within KZN Province

Indicators	Trends
Implementation of IWMPs through Integrated Development Plans	Increasing
Number of hazardous waste sites and facilities	Increasing
Amount of hazardous waste produced per sector per year	Increasing
% of licensed municipal landfill sites	Increasing
Amount of waste to landfill per annum	Decreasing
% of waste producers reporting to recycle	Increasing
General waste produced per capita per year	Increasing
Provincial waste collection capacity	Increasing

Finalisation of the current provincial IWMP is needed to ensure that the IWMP budget is built into the provincial budgetary planning process and actions need to be planned for when budget will be available. The Province should provide oversight and guidance to the IWMPs for municipalities. If municipal IWMPs are finalised without foresight of how these will be integrated into their budgets, then the Province should advise municipalities on how to do this. Capacity building at municipal level on NEMWA requirements is needed by the Province. Limited capacity may be due to inadequate financial resources; however, the Province and national government can assist in training on NEMWA. The Province needs to monitor compliance with NEMWA and work with local municipalities to achieve compliance. Licensed landfill sites and waste management facilities have continuous monitoring of their facilities to comply with their waste management licence. This monitoring data should be constantly updated in the SAWIS and reported on to have continuous improvement in waste management.

There should be an awareness campaign for citizens to stop illegal dumping and to promote the waste hierarchy. Citizens should be able to report illegal dumps and the Province should provide a system for collecting this information. Once records of illegal dumps are kept, remediation of these dumps can be planned. Clean-up campaigns and awareness about littering is needed to keep the Province clean. Environmental management inspectorates are needed and should be trained in the requirements of NEMWA.

Promotion of recycling is needed. However, for recyclers to be incentivised there needs to be a promotion of recycling value chains in the Province, as recycling is only viable if there is a viable market for waste streams recycled.

11.8 References

- Badul, J. 2014. Waste Management Act New Provisions. Department of Environmental Affairs Directorate: Chemicals and Waste Management, Presentation.
- Retrieved from: www.saatca.co.za/DNN/LinkClick.aspx?fileticket=rP1U2kKEw0Q%3D&tabid=124
- Department of Environmental Affairs and Tourism. 2000. White Paper on Integrated Pollution and Waste Management for South Africa.
- Department of Environmental Affairs. 2017. South African Waste Information System website statistics.
- Department of Environmental Affairs (DEA). 2012. Draft National Waste Information Baseline Report, Department of Environmental Affairs, Pretoria, South Africa.
- ERLN Economies of Regions Learning Network. 2016. Case Study 3: USE-IT: Innovation in the Waste Value Chain, 20 October 2016.
- Finlay, A and Liechti, D. 2008. e-Waste Assessment South Africa. e-Waste Association of South Africa (eWASA). South Africa.
- GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit, the German Federal Enterprise for International Cooperation). 2014. Electronic Waste South Africa (eWASA) The Best Practice Guidebook for Small E-Waste Businesses. Pretoria, South Africa.
- Institute of Waste Management South Africa (IWMSA). 2011. Landfill Seminar 2011, Conference Proceedings.
- IQ Business. 2014. Fibre Processing and Manufacturing Sector Education and Training Authority (FP&M SETA), Packaging Sector: A Profile of the Packaging Sub-Sector.
- KwaZulu Natal Industrial and Business News. 2017. Global Recognition for Durban Recycling, 23 February 2017. Retrieved from: <http://www.mediaevents.co.za/?p=866>
- KwaZulu Natal Province (KZN). 2012. Integrated Waste Management Plan, Draft Version 2.0 (Document for Public Review), October 2012.
- KwaZulu Natal Provincial Growth and Development Strategy (KZN PGDS). 2016. Durban, KwaZulu Natal.
- KwaZulu Natal Province. 2004. State of Environment Report (SoER), Durban, South Africa.
- Madubula, N. and Makinta, V. 2014. Chapter 6: Financing of Waste Management in South Africa. South Africa Fiscal and Finance Commission.
- South African Waste Information Centre (SAWIC). 2017. Retrieved from: <http://sawic.environment.gov.za/>
- Statistics South Africa. 2016. Mid-Year Population Estimates 2016. Statistical release P0302, 25 August 2016. Pretoria, South Africa.
- Statistics South Africa. Non-financial census of municipalities for the year ended 30 June 2015. Pretoria, South Africa.

Statistics South Africa. 2015b. Performance of municipalities 2015 (Service Delivery, Indigent, and Employment Numbers from Municipalities). Pretoria, South Africa.

Statistics South Africa. 2015. Statistical Release. General Household Survey, 2015.

Statistics South Africa (StatsSA). 2012. Census in Brief. Pretoria, South Africa.

Statistics South Africa. 2011. Mid-year population estimates 2011. Statistical release P0302, 27 July 2011. Pretoria, South Africa.

Statistics South Africa. 2006. Mid-year population estimates 2006. Statistical release P0302, 1 August 2006. Pretoria, South Africa.

Statistics South Africa. 2001. Census in Brief. Pretoria, South Africa.

Statistics South Africa. 1996. National Census. Pretoria, South Africa.

van der Merwe, M., Lombard, J., Lombard, R., and Lombard, R. 2009. Sustainable Waste Management Guidelines. Lombard and Associates. Greening Durban 2010. eThekweni Municipality.



12. Energy

12.1 Introduction

This chapter outlines the energy drivers, pressures, state, environmental impacts and responses for the KwaZulu-Natal (KZN) Province. Energy includes both direct use of coal, oil and liquid fuels and use of electricity. The aim is to provide an assessment of the current state of energy in the Province through the analysis of the energy-related indicators listed in Table 54.

Table 54: Indicators used in the assessment of the energy in KwaZulu-Natal

Indicators	Description and/or comments
Household energy source.	Identifies the preferred source/s of energy used for residential cooking, heating and lighting purposes.
Electricity consumption per sector.	Identifies the main electricity users within the Province.
Renewable energy generation as percentage of total electricity consumption.	Facilitates the comparison of the output from renewable energy projects with the electricity requirements of the Province.
Electrification levels.	Gives an overview of access to electricity in the Province.
Energy use per capita, and per gross domestic product (GDP).	Useful for comparing energy consumption in the Province with similar economies.
Liquid fuel sales	Provides an indication of the provincial consumption of liquid fuels.

Energy has been identified as one of the drivers for environmental change in the Province. While the large South African electricity-generation facilities are located outside KZN, the Province contains important industrial activities that rely on energy conversions from coal, biomass, oil and wood. Electricity is largely used for residential and commercial purposes, although in some cases households rely on wood, coal or paraffin. A significant amount of fuel is also required for transportation, especially in the eThekweni Metro Municipality and other large cities. Given its favourable geographical location on the Indian Ocean, KZN plays an important role in the exportation of coal through the Richards Bay Port, as well as the importation and refining of oil in Durban. Furthermore, methane-rich natural gas is transported directly from Secunda in Mpumalanga to Durban, via Richards Bay, through Transnet's Lilly Pipeline.

12.2 Drivers

Population increases, demographics and the economic growth of the Province drive its energy needs. Moreover, factors such as the predominantly rural character of the Province, poverty and the spatial characteristics of the settlements pose challenges for the efficient supply of the Province's energy needs.

12.2.1 Population growth and demographics

In 2016, there were an estimated 2.7–2.8 million households in KZN (StatsSA, 2016), a growth of 1.5% over the last 5 years (Quantec Standardised Regional Dataset, 2015). This growth is reflected in the increase in KZN's population, which has risen steadily over the last two decades. Recent studies indicate that the population in 2015 was at 10.8 million, as discussed in Chapter 9 of this Report.

A growing population demands more energy and increases pressures on energy resources as well as the natural environment. For example, the share of the populace demanding improved housing in the Province is rising, which will require more energy for construction and maintenance purposes. In

addition, this will lead to an increased demand for appliances as electricity becomes available. A growing population and a growing economy may also translate into increased provincial capacity to produce goods and services for both domestic and foreign markets, leading to increased energy demands.

12.2.2 Provincial rural character and poverty

Fifty-one per cent of the population in KZN is characterised as rural. The dispersed settlement character makes service delivery difficult and expensive. In addition, the Province has a high poverty rate of approximately 45%.

There tends to be a two-way causal relationship between poverty and the lack of access to adequate and affordable energy forms or energy-efficient appliances. Poor people who lack access to cleaner and affordable energy are often trapped in a repetitive cycle of deprivation, limited income or the means to improve their living conditions. At the same time they use significant amounts of their very scarce income on expensive and unhealthy forms of energy such as paraffin lamps, charcoal and candles.

Over 32% of the population is concentrated in the eThekweni Metro, which is the economic hub of the Province. As a result of high poverty concentrations in the rural areas, a significant portion of the population travels to urban centres in an effort to improve their livelihood. Reactive urbanisation increases pressures on existing, burdened infrastructure, further compounding the energy supply challenge in the Province.

12.2.3 Economic growth of the Province

Energy is a direct and indirect input for most processes in the agriculture, industry and services sectors within the Province. In 2013, KZN ranked as the second-largest provincial economy after Gauteng, contributing just over 16.5% of national Gross Value Add (GVA). The main economic sectors are manufacturing, finance, insurance, real estate and business services, wholesale, and retail/catering and accommodation. The states of these sectors within the Province's economy are discussed in detail in Chapter 9. In addition, KZN's proximity to Gauteng enables rail, pipelines and roads to traverse relative short distances to key in-land transportation infrastructure such as City Deep.

As a result of the growing provincial economy in the sectors, there is an increase in demand for energy for transportation purposes. Increased GVA raises standards of living and, correspondingly, the demand for personal travel and freight transport to meet consumer demand for goods. The economic growth of a society has been found to have a direct relation with its energy requirements (IEA, 2016). Energy will play an increasingly important role to retain economic growth, specifically within the sectors discussed above. This includes access to both affordable and reliable electricity as well as efficient modes of transportation.

12.2.4 Spatial challenges

KZN is one of the most mountainous areas in South Africa. In addition, the rural character of the Province and dispersed settlement pattern make service delivery extremely difficult and costly. As a result, there are a number of spatial challenges in the Province that impact on availability, access to and the affordability of energy (KZN, 2016b). These challenges are grouped into Legacy Challenges, Current Challenges and Future Risk Challenges, as detailed in Table 55.

Table 55: KwaZulu-Natal's spatial challenges for adequate energy provision

Type	Challenge(s)	Environmental considerations
Legacy Challenges	<ul style="list-style-type: none"> Scattered settlements, poor rural accessibility and uneven distribution of services Land tenure and restoration 	Owing to limited access to electricity and lack of affordability, rural settlements continue to use natural resources or cheaper alternative fuels.
Current Challenges	<ul style="list-style-type: none"> Poverty distribution Unsustainable settlement patterns Regional infrastructure needs 	Typical impacts of unsustainable natural resource use include: <ul style="list-style-type: none"> destruction of ecologically important land and high potential agricultural land; threatening of biodiversity due to the destruction or fragmentation of important habitats; and increased GHG emissions and in-door air pollution.
Future Risk Challenges	<ul style="list-style-type: none"> Climate change Food security 	<ul style="list-style-type: none"> Natural resources such as wood as energy for cooking or heating might be used unsustainably. Food security might decrease, because supply chains become more vulnerable, increasing food prices. Vulnerable communities may use their resources on a subsistence basis rather than a sustainable basis.

12.3 Pressures

The energy pressures within KZN predominantly relate to the use of environmental resources used to generate energy and are largely a result of human activities. These activities support the growth of industrial activities, for transportation purposes and for use in the residential sector. In addition, KZN's energy pressures are influenced by the demand for fuels at both national and international levels.

12.3.1 Energy requirements to support growth of industrial activities

The economic base within the Province is diverse, being driven largely by the manufacturing sector and supported by tertiary services such as tourism, finance, insurance and business, transport, storage and communication (KZN, 2016). The manufacturing sector is specifically geared for exporting activities and services. The industrial sector in the Province was greatly affected by the 2008 economic crisis and has not managed to recover at the same pace as other provinces in the country. This has left a number of key industries, such as textiles and clothing, stagnant (KZN, 2016). Since these are labour-intensive industries, the Province recognises the need to grow its industrial sector.

With a view to contributing to economic growth, the Province has defined a strategy for industrial diversification that is based on exploration of oil and gas as part of a strategy for: identifying and exploiting new energy sources, revitalising the agriculture and the agro-processing value chain, and advancing beneficiation and adding value to the Province's mineral wealth.

No operational coal-fired power stations exist in the Province and industrial activities rely primarily on electricity from the grid, back-up diesel generators, and energy conversions or steam from sources such as biomass, oil and wood. The combustion of these fuels releases GHGs and also emits air pollutants such as particulate matter, sulphur oxides, nitrogen oxides and carbon monoxide, which are all harmful to humans, animals and soils. The South Durban Industrial Basin, Richards Bay and smaller

industrial areas in Pietermaritzburg, Estcourt and Newcastle are reported to be areas of concern (see also Chapter 4 on air quality). The development of renewable energy in KZN could mitigate emission and pollutant risks. Such developments would also be aligned with national priorities that seek to assist South Africa to become a low carbon and climate-resilient society.

Opportunities to contribute to electricity production or generation to the national grid have not yet been fully exploited. The Province remains highly vulnerable from an energy security point of view, which constrains economic growth. This can, however, be addressed through maximising contributions from renewable energy, generated in particular through the use of abundant biomass in the Province (KZN, 2016b).

12.3.2 Energy requirements for transportation

KZN has two of the largest ports in the country, which together account for the majority of South Africa's imports and exports. However, increasing economic and population growth, at both provincial and national levels, has put KZN's primary network under pressure and continues to do so considering that the Province is such a critical link in South Africa's supply chain.

In recent years, the high cost of motorised transport (largely a result of rising oil prices) has emerged as a major societal pressure, especially for the poor who require transport to take their agricultural produce to the market and to take up employment. In KZN's rural areas, poor road conditions and networks limit the availability of motorised transport.

The pressures of energy requirements for transportation are evident in KZN, where vehicle emissions are one of the main sources of air pollution. Emissions arise from the combustion of transport fuels and include carbon monoxide, nitrogen oxides, volatile organic compounds and particulates. These emissions are more common during intersections and at peak times, and increase as more vehicles are on the roads, with heavy congestion and as the average age of the vehicle fleet increases.

12.3.3 Energy requirements in the residential sector

Energy is used in the residential sector for heating, cooling, lighting, cooking and water heating as well as for the powering of many other appliances and equipment. Income levels and energy prices influence the ways in which energy is consumed in the residential sector, as do various other factors, such as location, type of building, household characteristics, weather, equipment types and efficiencies, access to delivered energy, availability of energy sources and energy-related policies.

In KZN, high temperatures during summer, coupled with high humidity, increase the demand for cooling and consequently increase energy use within the Province. In addition, KZN is recognised as a major tourism destination. This equates to a range of accommodation options available throughout the Province, further impacting on energy demand at certain times of the year. Energy demand for tourism-related infrastructure also contributes to the energy pressures in KZN.

The residential sector has pressing demands for energy. On the one hand, there are energy needs in terms of basic service delivery and, on the other, there are energy needs in terms of high-income residential development for tourism and property investment purposes. This dichotomy will increase pressures on the Province in terms of equitable service delivery and economic growth.

12.3.4 Increase in demand for fuels at national and international levels

KZN plays an important role in the provision of energy from fossil fuels for South Africa, particularly with regard to the exportation of energy commodities (such as oil and coal) from its ports. The Province also hosts two large oil refineries, a number of operating coal mines and a methane-rich gas pipeline that transports gas from Secunda to Durban. The increase in the demands for fossil fuels at national and international levels will increase pressures on the entire system to deliver higher quantities of fuel. The impacts of these activities could result in increased potential polluting activities within the country, particularly those associated with coal extraction and the transportation and refining of fuels in KZN.

There are various environmental impacts that result from the coal export activities, such as the release of dust during handling and storage as well as the potential for contaminated run-off water, which could pollute downstream water sources. Further to these impacts, abandoned mines in the Province pose further environmental threats related to the release of dust and contaminated water. Additionally, these mines threaten soil quality, which, in turn, impacts on biodiversity, agriculture and other sectors.

Oil refining generates large quantities of carbon dioxide (CO₂) due to the extensive energy requirements of the process. From a national perspective, the quantities of lead and sulphur present in petrol have reduced since 2006. To comply with such regulations, the refining process has become even more energy intensive. Fortunately, it is expected that the emissions from the refining process will be mitigated by the reduced levels of emissions that result during the combustion of those fuels as lead and sulphur levels have been regulated.

12.4 State

KZN has a number of different energy carriers that have changed over time. This section should be read in combination with the biodiversity (Chapter 5), climate change (Chapter 3) and air quality (Chapter 4) chapters to obtain a holistic understanding of their interactions.

12.4.1 Energy carriers

While KZN imports most of its energy requirements, the Province also has primary energy processing and transport activities that support energy supplies and demands in other provinces.

12.4.1.1 Sources of energy for provincial consumption

The main sources of energy for the KZN Province are imports of electricity, crude oil and petroleum products. The Province also has local coal reserves, biomass, hydro, wind and solar potential.

The electricity generation in South Africa largely occurs in coal-fired power stations, typically located in proximity to the coal-rich areas of Mpumalanga, Gauteng and Limpopo. Although KZN consumes almost 20% of the national electricity generation, most of the direct impacts on water, air and land that result from coal-fired power plants will be experienced outside the Province. Such a dependence on external electricity generation also makes the Province vulnerable to unreliable electricity supply, which aggravates existing pressures related to constrained economic activities and investor confidence in KZN.

The estimated energy volume sourced by the Province in 2015 was around 353 Petajoules (the distribution of the energy carriers is presented in Figure 56⁵⁹), which translates roughly into an annual energy use of 33 gigajoules per capita.

After electricity, diesel and petrol are the main sources of energy in the Province. More than 60% of the provincial consumption of diesel and petrol occurs within the eThekweni Metro Municipality, where energy consumption almost doubled from 2004 to 2011. This has mostly been driven by the transport sector, which is the largest contributor of GHGs in the city (SACN, 2016). Considering the commercial and industrial activities that take place in the Municipality, eThekweni has therefore embarked on numerous programmes and activities towards sufficient, efficient and sustainable energy provision, as outlined in the eThekweni Energy Strategy.

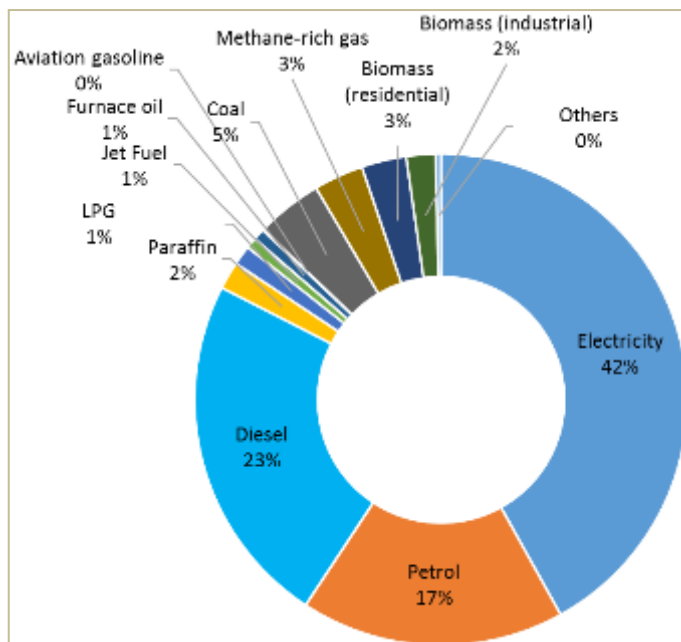


Figure 56: Energy carriers for the KwaZulu-Natal Province

12.4.1.2 Provincial generation and renewables

Renewable energy and energy-efficient industries and activities are important means for reducing the negative economic, social and environmental impacts of energy production and consumption. Renewable and energy-efficiency measures also reduce the dependency on national grid electricity, thereby making the Province less vulnerable to shortages or interruptions of electricity supplies. KZN is working towards the rapid development of private- and public-sector energy-related projects through the KwaZulu-Natal Energy Agency.

Wind, solar, biomass (most notably sugarcane fibre) and waste-to-energy offer the most potential for renewable energy generation in the Province (DoE, 2015). The Province has prepared resource maps to identify the potential areas for the installation of solar, wind and biomass-related technologies. Hydro sources are another important potential generation resource in the Province. KZN, together with the Eastern Cape Province, contains the best potential for the development of small (<10 MW) hydropower plants in the country. These could be either standalone projects or combined with other renewable sources. In addition, some parts of the KZN coastline have shown wave energy potential in term of ocean currents and the thermal gradient of the sea. The Province is also developing a Bioenergy Action Plan for KZN, which looks at how energy from biomass can be utilised and sold back onto the

⁵⁹ The information has been obtained for the year 2015, where estimates have been used in the absence of data. As the main gaps lie in the values of coal and biomass consumption, these values may be underestimated. Coal sales per province are not publicly available. The value for coal presented corresponds with the value estimated for the eThekweni Metro Municipality in 2011, cited in the State of the South African Cities Report (SACN, 2016). Residential biomass refers to wood used by households for cooking or heating purposes, estimated from the national 2011 Census. Industrial biomass is representative of the usage of bagasse and biomass from some sugar and paper mills, although many more companies may also be using bagasse, wood, paper sludge or pulp waste from wood processing for energy generation.

grid. The study considers actions at municipal level, based on time-of-use tariffs, with a view to enhancing the feasibility of biomass projects in the Province.

A summary of the current and planned private sector energy projects within the Province, as at 2015, is presented in Table 56. The current generation capacity within the Province is around 75 MW, of which 56 MW originates from renewable energy projects (0.8% of the total electricity from the grid used by the Province).

Table 56: Summary of private sector energy projects in the Province for 2015

Name	Type	Capacity	Name	Type	Capacity	
A Newcastle co-generation plant	Combined cycle gas turbine (gas)	18 MW	O Land rover	Rooftop PV	0.15 MW	
B Ingula Pumped Storage Power Station	Pumped storage	1332 MW **	P Lipam corporation PV plant	Rooftop PV	0.124 MW	
C Marianahil Landfill Gas to Energy	Gas to electricity	1 MW	Q Hilton Hotel	Solar PV Plant	0.02 MW	
D Bisasar Road Landfill Gas to Electric	Gas to electricity	6.5 MW	R Sitho	Solar PV	0.0115 MW	
E Mkuze Biomass Plant	Biomass	16.5 MW	S Unhloti Primary School	Solar PV	0.01 MW	
F Dube Tradeport	Solar PV	0.71 MW	T Avon OCGT project	OCGT	670 MW *	
G Amatikulu Biomass Power Plant	Biomass	5 MW	U Colenso Coal Power Station		750 MW *	
	Biomass	91 MW *	V Eston Sugar Mill Power plant		60 MW *	
H NCP Alcohols	Steam turbine	0.5 MW	W Empangeni Wind Project	Wind	100 MW *	
I Dew Water	Wind turbine	0.01 MW	X Sappi Saicor Co-Gen	Biomass	5 MW	
J Ethekwini various projects (planned)		*	Y Tongaat Hulett Sugar		9 MW	
K Sachet Manufacturing	Rooftop PV	0.03 MW	Z Mtutuba	Biomass	4.5 MW	
L Belgotex	Rooftop PV	1 MW	AA Illovo Sugar	Power plant	5 MW	
M Hazelmere	CPV plant	0.5 MW	BB Mooi River small hydro project	Small hydro	0.4 MW	
N Man truck plant	Rooftop PV	0.58 MW				
Key:		Total generation capacity (excluding pumped storage and planned projects)			74.5 MW	
* Planned project		Total generation capacity from renewables (excluding planned)			56.0 MW	
** Pumped storage is not generation		Total generation capacity (including planned projects, excluding pumping storage)			1745.5 MW	
Non-renewable		Total energy projects in the province (including planned projects, including pumping storage)			3077.5 MW	
					Estimated electricity generation from renewables	328 742 MWh
					Electricity distributed to KZN (2015)	41 079 000 MWh
					Renewable Energy generation as percentage of total electricity consumption	0.8%

Source: KZN (2016)

The Provincial Growth and Development Strategy has set a 2030 target for alternative energy generation of 2 000 MW, demonstrating KZN's commitment to transitioning the country to a lower carbon and climate-resilient society.

12.4.1.3 Local extraction, transformation and distribution of energy infrastructure

The Province contains five coalfields in the northern regions where anthracite, bituminous and thermal coal is mined. The production rates of the few operating mines are low (about 2.5 million tonnes), and are almost insignificant compared to the national coal rates (Pooe and Mathu, 2011). The Richards Bay Port has a dedicated section for the storage, handling and loading of coal for shipment, from which 75 million tonnes of coal were exported in 2015 (P&S, 2016).

Refineries and gas comprise the other forms of energy conversions in the Province. There are two large oil refineries operating in the South Durban Industrial Basin, with capacities of 180 and 120 thousand barrels per day respectively. The existing gas supply via Transnet's Lilly pipeline has a capacity of 23 petajoules per annum. An additional gas source is proposed via a liquefied national gas terminal in the Port of Richards Bay, and may provide a new gas network to supply alternative gas markets.

Potential gas markets in KZN include a proposed IPP CCGT power station, Avon Open Cycle Gas Turbine (OCGT) power station (currently under construction), new customers in the Richards Bay Industrial Development Zone (IDZ) and existing and new markets in KZN (148 Million GJ/year) (Transnet, 2015). Shale gas, present in the Midlands of KZN, is another source of energy that may be extracted in the Province and that is currently being considered (MCF, 2016). However, the fracking and extraction of petroleum products leave a negative environmental footprint. The National Carbon Capture and

Storage initiative has identified the Zululand geological basin as one of two possible pilot sites. Carbon Capture and Storage is an energy-intensive process.

12.4.2 Usage

The type of user informs the demand profiles and the opportunities for energy-efficiency interventions. Different types of users also use different types of technologies, which have different and varying impacts on the environment.

12.4.2.1 Electricity consumption per sector

eThekweni Metro Municipality's electricity consumption per sector is illustrated in Figure 57 (SEA, 2015). The largest consuming sector is transportation. Most of the energy in this sector is provided by fossil fuels, and a small amount of electricity is used for the operation of trains. The large energy consumption in the transport sector is representative of the traditionally dispersed nature of South African settlements, which result in long commuting distances.

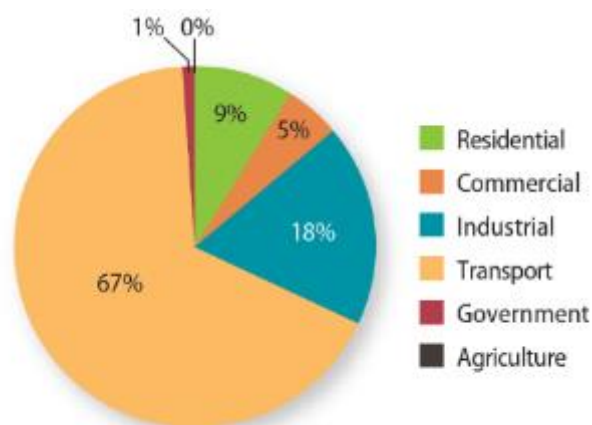


Figure 57: Energy consumption by sector in eThekweni Metro Municipality

The large industrial activities in the Municipality have high recorded energy demands. Industrial energy consumption is also expected to be large in other provincial areas with significant industrial activity such as Richards Bay, Pietermaritzburg, Estcourt and Newcastle.

The residential sector of eThekweni Municipality is the third-largest consumer. Distinct from the transportation and industry sectors, the residential sector significantly impacts generation capacity, which is driven by the residential demand profile.

12.4.2.2 Electrification levels

The percentages of households connected to the main electricity⁶⁰ supply in KZN are presented in Figure 58. The increasing trend is clearly illustrated, with the provincial rate of increase trending higher than the national average. Additionally, the greatest potential for non-grid connections is found within the KZN and the Eastern Cape provinces.

Despite sufficient supply capacity, it is not feasible to connect some remote rural areas to the national electricity grid. As such, solar home systems have been introduced to close the gap in the Province (DoE, 2015). Overall, there is a high rate of electrification in KZN. The 2016 Community Survey (StatsSA, 2016b) concluded that ~90% of the households in KZN have access to electricity for lighting, from either the grid or an alternative means.

⁶⁰ The term 'main electricity supply' refers to general-purpose alternating-current (AC) electric power that is supplied to households (or grid-connected facilities). This percentage may seem low when compared to published electrification rates, as it only includes grid connections and no other alternative provision of electricity.

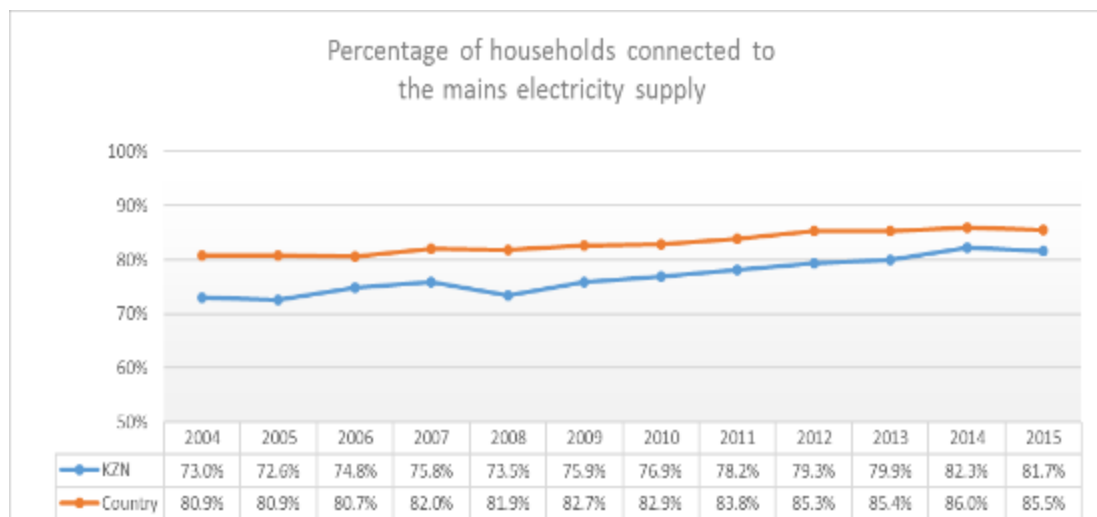


Figure 58: Percentage of households connected to the mains electricity supply

12.4.2.3 Electricity delivery

Eskom is responsible for the national electricity grid as well as for the majority of electricity generation and bulk delivery. The company typically sells bulk electricity to municipalities that subsequently ‘on-sell’ and distribute electricity to households and business within the municipality. This retail model is often a means of additional municipal income. However, KZN has a large proportion of municipalities that do not engage in electricity re-sales. In poorer areas, municipalities often do not have the technical capacity or funds to connect households to the grid and there is also less scope to generate revenue from supplying electricity to these households. Eskom therefore provides the supply and distribution role directly. This is a major concern in some areas, as the financial viability of many municipalities “could be tenuous” if they are not able to resell power bought in bulk from Eskom (M&G, 2015).

12.4.2.4 Household energy use

When there is constrained grid availability or accessibility, or access to electricity is unaffordable, many of KZN’s inhabitants resort to meeting their energy needs by using other energy sources such as wood or paraffin, which can be purchased or collected from surrounding areas. These choices impact on local air quality, indoor pollution and increased risks of fires and paraffin poisoning. These risks are aggravated in densely populated informal

NETFIT (Net Feed-in Tariff) is a concept developed by the CSIR energy centre and funded by the German Development bank. Once finalised, NETFIT will allow KwaZulu-Natal building owners to be compensated for excess energy that owners feed into the grid. The excess energy will be generated by privately owned, small-scale PV facilities installed on roof spaces. The intention is for the NETFIT concept to become a national programme, to be implemented in other municipalities.

settlements. The proportion of households in the Province that does not use electricity is presented in Figure 59, where energy alternatives used are listed as well.

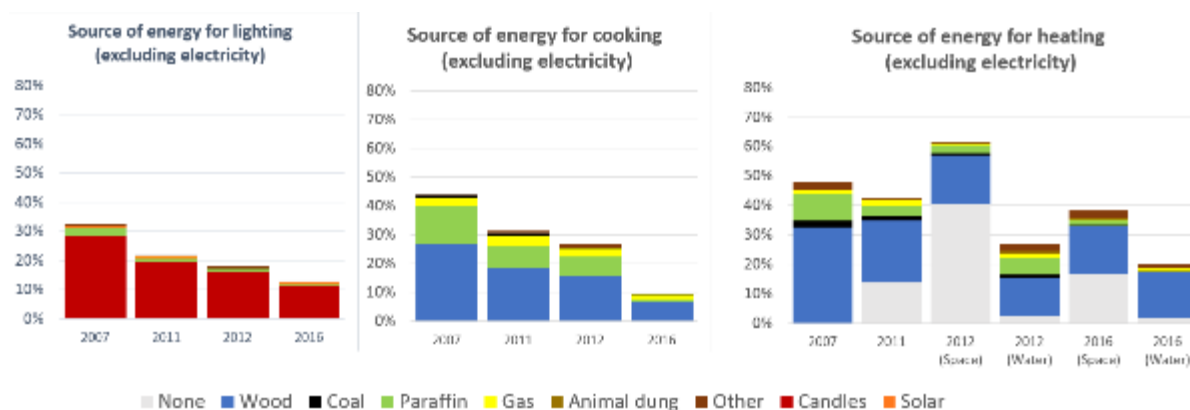


Figure 59: Percentage of households within KZN using fuels for lighting, cooking and heating
Sources: StatsSA (2011, 2012, 2016a)

For lighting purposes, candles are the most-used energy source, followed by paraffin. Wood and paraffin have been the preferred choices for energy provision for cooking activities within the non-electricity user segment; however, in 2016 the position of paraffin in the Province was overtaken by gas. Wood, often unsustainably sourced, is clearly the most common choice for heating purposes.

Overall, there is a downwards trend in the use of unsustainable fuels at residential level that reflects the efforts made by the Province to improve the quality of life of its inhabitants. However, the task is complex, and there are still some parts of the population with limited options for their energy needs.

12.4.2.5 Liquid fuels

Although the sales of fuels may not reflect the location where the combustion of those fuels takes place, sales volumes are a good estimator of the liquid fuel consumption for the Province (Figure 60).

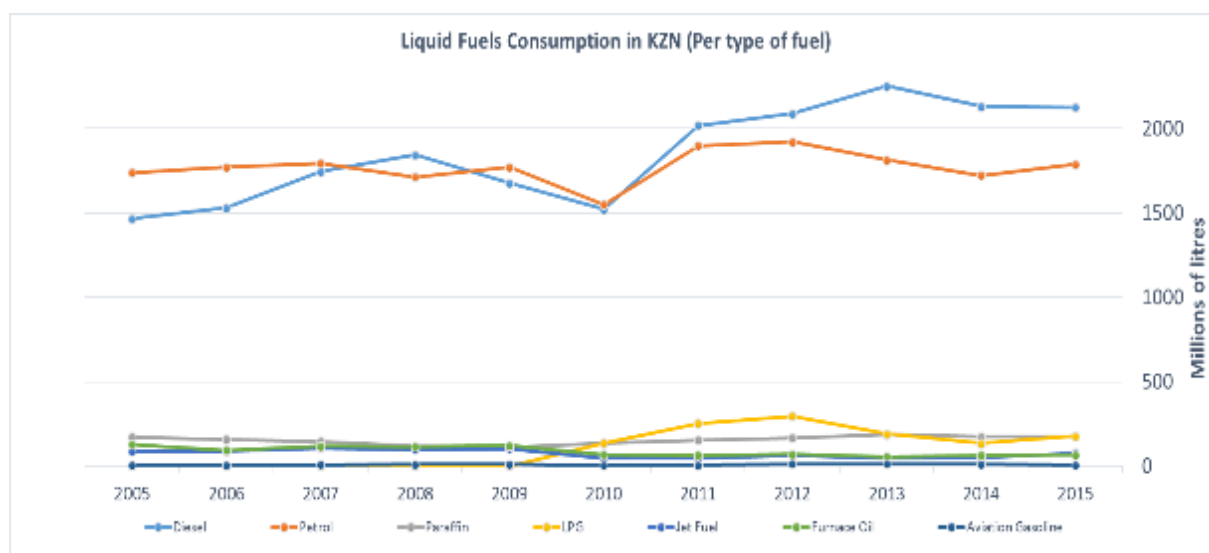


Figure 60: Liquid fuels sales in KwaZulu-Natal for the period 2005 to 2015
Source: DoE (2015)⁶¹

⁶¹ Data gathered from the DoE statistical releases, available from the year 2005 until 2015.

Diesel and petrol are the fuels most sold within KZN, due to the large transportation needs of the Province. When looking at the specific fuels, diesel consumption has increased over time whereas petrol consumption has reduced. Notably, a marked reduction in sales, across all the fuels, occurred in 2010. This may have been influenced by the reduction in the quantities of freight and exports related to the 2008 financial crisis, which significantly affected global production and exportation of commodities.

12.5 Impacts

The energy drivers and consequent pressures in KZN have the potential to affect the Province's energy profile. The energy drivers and pressures are associated with a range of environmental impacts, which may fall within the provincial boundaries or outside of them, depending on where the extraction of commodities and their transformation into secondary energy forms occur. These interrelated dimensions of energy generation and use (the full value chain) can impact upon environmental features such as air quality, GHGs, water resources, land use, biodiversity and ecosystem health.

12.5.1 Air pollution

Poor air quality results from the emission of pollutants into the atmosphere. The major pollutants include particulate matter, sulphur dioxide, nitrous oxides and volatile organic compounds. These pollutants pose health risks to human and animal respiratory systems, and in some cases can trigger various cancers. In the case of energy provision in KZN, one or more of these pollutants is typically found in the surroundings of quarries and industrial areas, in proximity to roads and ports, as well as in dense and low-income settlements. These areas are related to the locations where coal is extracted and transported, where fuels are stored and refined, and where material quantities of fuels are combusted for transportation, household or industrial uses.

Indoor air pollution from small-scale combustion of solid and liquid generates high levels of particulate matter, carbon monoxide and, in some instances, sulphur dioxide, depending on the fuel choice. Increases in electrification rates may reduce the consumption of other fuels at household level. While still emissions intensive, electricity generation has the opportunity to improve air quality through the use of non-fossil fuel alternatives.

12.5.2 Biodiversity

Biomass is a typical fuel used for household, commercial and industrial purposes. Unsustainable harvesting of biomass can lead to biodiversity loss and ecosystem degradation. Cutting down trees for rural energy (firewood) and the mining of coal resources cause negative environmental impacts such as soil erosion and land degradation, which, in turn, adversely affect agricultural production. Additionally, when wood is not easily available, people turn to alternative combustible materials (e.g. crop stalks or dry dung), which may add further stresses to human health, to other species or the environment (Masekoameng, et al., 2005).

12.5.3 GHG emissions

Carbon dioxide and methane are the most common GHGs linked to the energy value chain. Their increased levels in the atmosphere prevent heat from escaping into space, thereby increasing the temperatures on earth. GHGs contribute to global climate change, which may affect many local environments. As a result of additional electricity demands in KZN and the GHG-intensive nature of our grid electricity, GHGs emitted will contribute to global climate change and consequently may have

local environmental impacts within the Province. These impacts may include increases in ambient temperatures and extreme weather events, and variations in rainfall patterns. Eskom estimated that for the period April 2015 to March 2016, every GWh of electricity consumed released 1 000 tonnes of CO₂ (ESKOM, 2006).

12.5.4 Water

Energy generation is generally water intensive. Water used in the energy value chain may be subject to thermal, physical or chemical contamination.

In KZN, water availability is a major concern, and any energy generation adds pressure on the competition for this resource. Adequate provision of water requires an energy-intensive water pumping system. This means that areas where electricity provision is unreliable are also most likely to have inadequate access to water supplies. For some of the tourist-intensive areas of the Province, unreliable electricity provision is an important concern, as it will reduce the number of visitors and impact on local income levels.

KZN has significant potential for small hydropower generation. Although this type of electricity generation is considerably cleaner and less harmful to the environment, there are still some impacts related to the alteration of the river flow, the linked ecosystems, sediment movements and flooding patterns.

Renewable energy technologies such as wind and solar also use significantly less water than combustion technologies, assisting in preventing the depletion of water and biodiversity resources. Approximately 1.2 litres of water could be saved per kilowatt hour of fossil fuel electricity displaced from the grid (Breytenbach, 2015). However, both wind and solar projects still have environmental footprints due to the land required for construction, as well as the impacts of their operations on avian, insect and bat species.

Another aspect to consider is the water requirement for growing biomass solely for energy generation. Even rain-fed biomass can greatly impact catchment resources. It is therefore more efficient to utilise biomass produced as a by-product in the agriculture and timber industries.

12.5.5 Human settlements

KZN's growing population, coupled with its rural character, will increase pressure on housing availability. Urban sprawl, housing development, transportation and service infrastructure are the physical elements of human settlements that have the most noticeable impact on the natural environment. Growing populations require water, land and other resources, such as electricity. In both urban and rural areas, these demands will significantly increase pressure on the environment with regard to air, soil and water.

Electricity is the largest single source of energy used by urban households for lighting, cooking and heating (DEA, 2006). This illustrates the resource intensity of human settlements, resulting in environmental impacts such as light pollution in urban areas, loss of habitat as a result of development and increased GHG emissions. In addition, the backlog in housing provision and limited capacitated infrastructure in KZN's rural areas exacerbate the impact of energy on the environment. The peripheral location of lower-cost housing makes energy delivery difficult and increases its environmental footprint. In response, the population turns to alternative sources of energy, e.g. unsustainable biomass, which leads to even larger environmental degradation.

12.6 Responses

When considering the energy drivers, pressures, current state and impacts discussed above, it becomes clear that the respective risks are interrelated and should be viewed from a holistic perspective. There are therefore varying levels of responses to these risks, ranging from national programmes to local government responses.

12.6.1 National programmes

The South African government has pro-actively integrated renewable energy into the electricity mix through the Renewable Energy Independent Power Producer Procurement Programme and the Small Projects Procurement Programme. The reduction of regulatory barriers for renewable energy projects, coupled with the decline in the costs of technologies, means that renewable generation options are now cheaper to implement than nuclear or coal. These programmes have stimulated private investment in renewable energy generation at a national level. However, there is only one project in KZN under the large-scale programme as yet, despite the Province's natural resources, specifically biomass.

12.6.2 Provincial response

The KZN Provincial Growth and Development Strategy for 2035 aims to ensure energy security in the Province through the current energy supply, augmented by viable green technologies. One of the strategic objectives pertains to infrastructure development required to ensure access to affordable, reliable, sustainable and modern energy for all.

The three pillars of the Kwa-Zulu Natal Renewable Action Plan are:

- Renewable Energy Generation (including biofuels)*
 - Renewable Energy Manufacturing*
 - Energy Efficiency (starting with official installations)*
-

The strategic interventions to bring this strategy into effect include the:

- formulation of the Provincial Energy Strategy to cover generation, delivery and financial partnership;
- implementation of the Renewable Energy Action Plan;
- development of a Provincial Renewable Energy Strategy; and
- provision of base-load alternative energy supply.

These interventions will provide a framework for renewable energy development in the Province, which is aimed at addressing issues such as land tenure, appropriate technology selection and employment creation as part of creating an enabling environment for energy development.

12.6.3 eThekweni Metro Municipality's response

eThekweni Metro Municipality has developed an energy sector plan as well as the Municipal Internal Energy Management Policy to address energy provision within the City. The aim is to ensure sufficient availability of energy and renewable and alternative energy sources.

Another strategic focus area is the programme for Municipal Energy Efficiency, Savings and Strategy, with dedicated focus on the needs of each sector present in the Municipality (residential; public; industrial, commercial and agricultural; and the transport sector).

The Metro's response showcases recognition of the value of renewable energy, not only from an environmental perspective but also from an economic diversification perspective. This allows for the monitoring of energy and energy-related activities, easing planning and making information available for low carbon initiatives.

The Municipality has been working with the CSIR in the development of the eThekweni's Sustainable Energy Master Plan. The plan outlines a set of actions to assist eThekweni Municipality to obtain 40% of its energy requirements from renewable energy by 2030. The plan includes an energy baseline, a benchmarking exercise and energy-demand projections.

12.6.4 Local government responses

The rural nature of the Province poses challenges in terms of electricity infrastructure roll out. Localised, off-grid energy solutions would therefore be a sustainable alternative to augment the current electricity provision. However, these local municipalities should be supported through technical capacity building and institutional strengthening to enable the implementation of renewable energy projects in these areas.

A number of KZN's local district municipalities prioritise the improvement of an affordable and sustainable electricity supply for their inhabitants. The processes to achieve this goal manifest in a variety of ways, depending on the municipality, its location and access to resources. Primarily, the projects that present the strongest response to local environmental impacts are those that enable the substitution of unsustainable biomass harvesting and use of fossil fuels for combustion with cleaner or renewable alternatives.

Some municipalities have designed specific electricity supply development plans that intend to communicate the local needs to the provincial and national guidelines and budgets for grid and off-grid electricity supply. Other municipalities intend to implement roll-out programmes for alternative energy supply in the district. In many instances, these projects are renewable energy projects and have been conceptualised within a renewable energy plan or strategy. Other local initiatives include the establishment of Integrated Energy Centres to supply affordable energy products such as liquid fuels to communities.

Generating Electricity from Landfill Gas in eThekweni

The gas from two major landfills in the eThekweni Municipal area is being harnessed to generate electricity. The Mariannahill and Bisasar Road landfills have been installed with an electricity-generation capacity of 1 MW and 6.5 MW respectively.



Currently, 50 000 MWh is generated per year, enough to power 3 750 small houses. The CO_{2e} emissions have been reduced by 20 000 tons per month.

12.7 Conclusion and Recommendations

KZN faces a number of energy challenges, particularly related to electricity and fuel access. The main energy drivers, namely population growth coupled with economic development in various energy-intensive sectors, are linked to the pressures of equitable socio-economic development in the Province.

Increased electrification and economic activities impact on the environment. The current state of energy in the Province results in a range of impacts, from air pollution, reduced biodiversity, increased GHG emissions, and a decline in water quality and supply, to community well-being and unplanned human settlements. These impacts are exacerbated by KZN's environmentally sensitive and rural character. Table 57 presents a summary of the current trends in the state of the energy observed in KZN Province.

Table 57: Energy outlook for KZN Province

Indicator	Outlook
Household energy source	In the past decade, the use of electricity for lighting and cooking has increased notably within the Province. In 2007, 67% of households utilised electricity for lighting, which increased to almost 87% in 2016. In addition, the use of electricity for cooking purposes increased from 56% in 2007 to 82% in 2016. The use of electricity for heating has also grown, from 52% in 2007 to 70% in 2016. The use of gas for cooking activities has also increased. Gas is usually considered a transition fuel in the migration of contaminating fuels, prior to the uptake of electricity. The usage of candles, wood and paraffin has decreased, corresponding with the increased use of electricity and gas.
Electricity consumption per sector	The largest energy-consuming sector in the Province is considered to be transport, followed by the industrial and residential sectors. However, limited periodic information reported at provincial level restricts the identification of trends pertaining to this indicator.
Renewable energy generation as % of total electricity consumption	The implementation of small- and large-scale renewable energy projects within the Province has increased slightly during the last 10 years. The renewable energy percentage of total electricity consumption was estimated to be 0.8% in 2015.
Electrification levels	Despite particular challenges related to grid electrification, there has been significant progress in increasing the Province's electrification levels. Connection to mains increased from 73% in 2004 to about 82% in 2015. Access to electricity for lighting (including off-grid) was estimated to be 90% in 2016.
Energy use per capita, and per GDP	Energy use has been estimated at 32.1 gigajoules per capita and 1 190 gigajoules per million rand of GDP. This indicator was calculated for the Province for the first time in 2017.
Liquid fuel sales	The total amount of liquid fuel sales in 2015 was estimated to be around 4.4 billion litres, a significant increase compared to 3.5 billion litres reported in 2005. However, since 2013, a slight decreasing trend has been observed in both petrol and diesel sales.

The general outlook of the state of energy in the Province is favourable. Provincial efforts to improve access to electricity are notable, as is the interest in the advancement of renewables to support the provincial growth and development strategy. In particular, eThekweni Municipality has played an important role in the Province's growth through the conceptualisation and initiation of projects related to renewable energy, energy efficiency and climate change mitigation.

Despite significant efforts at provincial and national levels, some aspects related to energy provision in the Province represent environmental challenges. These challenges predominate in the fields of energy availability, access and affordability, as well as energy security and increasing transportation requirements. The Province does, however, have the opportunity to respond to these impacts by

leveraging its unique resource base of renewable energy potential. Moreover, KZN has an enabling policy environment, which can be built upon to support and grow a low carbon and climate-resilient economy.

Further energy improvements can be achieved through the implementation of adequate responses at municipal, provincial and national levels, which address the challenges of energy provision for a future characterised by a growing demand for energy services. Adequate responses to the Province's energy challenges will significantly contribute to the following advancements:

- reduced energy poverty, resulting in increased well-being of the Province's inhabitants as well as the recovery of the environments degraded by unsustainable energy practices;
- stimulation of opportunities to support economic growth and employment generation in the Province;
- reduced transport-related emissions through biofuels. However, there may be a greater demand for water and competition for land for growing food;
- increased uptake of off-grid solutions to reduce electricity costs as fewer infrastructures are required;
- increased energy productivity in major cities while improving the quality of life of inhabitants; and
- reduced public health expenses related to respiratory diseases.

Several opportunities exist in KZN for the development of renewable energy projects. Local renewable energy sources such as solar, wind and small hydro have not yet developed into independent power producers. Bioenergy in particular represents opportunities, which remain untapped in KZN. It is therefore recommended that KZN pursues opportunities to unlock the renewable energy-generation potential from local biomass, particularly related to the cogeneration of heat and electricity from forestry and agricultural sources.

12.8 References

BP Global. 2013. *BP Energy Outlook 2030*.

Breytenbach, K. 2015. *Head of the Independent Power Producer's Office*. South African Wind Energy Association (SAWEA).

Department of Environmental Affairs and Tourism. 2006. *South Africa Environment Outlook*, Tshwane: Department of Environmental Affairs and Tourism.

DMR. 2014. *Operating and developing coal mines in the Republic of South Africa*, Department of Mineral Resources – Directorate Mineral Economics.

DoE. 2012. *A survey of energy-related behaviour and perceptions in South Africa. The Residential Sector*. Department of Energy, Republic of South Africa.

DoE. 2013. *Overview of Universal Energy Access Strategy*. Department of Energy of South Africa.

DoE. 2015. *Energy Statistics. Fuel sales volume*. South Africa: Department of Energy.

DoE. 2015. *Integrated National Electrification Program (INEP)*. Department of Energy.

DoE. 2015. *State of the Renewable Energy in South Africa*. Department of Energy.

- DoE. 2016. *South African Energy price report*. Pretoria: Department of Energy. Directorate: Energy Data Collection, Management and Analysis.
- ESKOM. 2006. *Integrated Report*. Eskom.
- Financial and Fiscal Commission. 2012. *Technical Report, Submission from 2013/2014 Division of Revenue*. Midrand: Financial and Fiscal Commission.
- IEA. 2016. *World Energy and Outlook Report: Energy and Air Pollution*. International Energy Agencies.
- KZN. 2014. *KwaZulu-Natal Poverty Eradication Master Plan*. Province of KwaZulu-Natal.
- KZN. 2016. *Kwazulu-Natal Situational Overview*. Provincial planning commission. Province of KwaZulu-Natal.
- KZN. 2016b. *2035 Provincial Growth and Development Strategy*. Province of KwaZulu-Natal. Provincial Planning Commission. Office of the Premier.
- M&G. 2015. *Mail & Guardian*. Municipalities are players in the power stakes, 17 July.
- Masekoameng, K., Simalenga, T. and Saidi, T. 2005. Household energy needs and utilization patterns. *Journal of Energy in Southern Africa*, 16(3): 4-9.
- MCF, 2016. *Midlands Conservancies Forum*. [Online]. Retrieved from: <http://www.midlandsconservancies.org.za/prpagefracking.php>
- Noble, M. et al. 2006. *The Provincial Indices of Multiple Deprivation for South Africa 2001*. Oxford: University of Oxford.
- P&S. 2016. *Ports & Ships*. [Online]. Retrieved from: <https://ports.co.za/richards-bay.php>
- Pooe, D. and Mathu, K. 2011. The South African coal mining industry: a need for a more efficient and collaborative supply chain. *Journal of Transport and Supply Chain Management*, 5(1): 316-336.
- Pye, S. and Dobbins, A. 2015. *Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures*. Insight_E. An Energy think tank informing the European Commission.
- Quantec Regional Standardised dataset. 2015. Retrieved from: www.quantec.co.za
- RSA. 2015. *The nine-point plan to growth the South African Economy and create much needed jobs*. [Online] Retrieved from: <http://www.gov.za/issues/nine-point-plan>
- SACN. 2016. *State of South African Cities Report*. Johannesburg: South African Cities Network.
- SEA. 2015. *State of Energy in South African Cities 2015*. Westlake: Sustainable Energy Africa.
- StatsSA. 2011. *Census 2011 – Interactive data in SuperCross*. Pretoria: Statistics South Africa.
- StatsSA. 2012. *Census 2011 Provinces at a glance*. Pretoria: Statistics South Africa.
- StatsSA. 2013. *GHS Series, volume V, Energy, 2002–2012*. Pretoria: Statistics South Africa.
- StatsSA. 2016a. *Statistics South Africa Datasets*. Pretoria: Statistics South Africa.
- StatsSA. 2016b. *Community Survey 2016, Statistical release P0301*. Pretoria: Statistics South Africa.
- StatsSA. n.d. *Electricity generated and available for distribution*. Pretoria: Statistics South Africa.

Transnet. 2015. *Transnet's Long Term Planning Framework, Natural Gas Infrastructure Planning*. Transnet Group Planning.

WHO. 2006. *Fuel for Life: household energy and health*. France: World Health Organization.



Photo credit: Africa Foundation

13. Governance

13.1 Introduction

Governance comprises “the complex mechanisms, processes and institutions through which citizens and groups articulate their interests, mediate their differences and exercise their legal rights and obligations” (UNDP, 1997). Governance is further defined as “the exercise of political, economic and administrative authority in the management of a country’s affairs at all levels”. In KwaZulu-Natal (KZN), governance related to the environment faces particular challenges associated with rapid rates of biodiversity loss and loss of ecological function, which, in turn, impact on society and human well-being. There is legislation that is directly relevant to environmental governance in KZN (

Table 58).

Table 58: Legislative framework related to biodiversity and ecosystem health

Legislation	Relevance to biodiversity and ecosystem health
National Environmental Management Act (No. 107 of 1998)	Provides the general framework for environmental management in South Africa.
National Environmental Management: Biodiversity Act (No. 10 of 2004)	Provides for the management and conservation of South Africa’s biodiversity within the framework of NEMA.
National Environmental Management: Protected Areas Act (No. 57 of 2003)	Provides for the protection and conservation of ecologically viable areas representative of South Africa’s biodiversity and its natural landscapes and seascapes.
National Environmental Management: Waste Act (No. 59 of 2008)	Provides for the management of waste in an effort to protect health and the environment and prevent pollution.
National Environmental Management: Air Quality Act (No. 39 of 2004)	Provides for the regulation of air quality in an effort to prevent pollution and ecological degradation.
National Water Act (No. 36 of 1998)	Provides for the protection, management and use of South Africa’s water resources and includes a provision for an ecological reserve which guarantees a minimum flow of water to maintain critical ecological processes.
National Forests Act (No. 84 of 1998)	Provides for the protection and management of natural forests, including provisions for the specially protected areas such as forest nature reserves and forest wilderness areas.
Conservation of Agricultural Resources Act (No. 43 of 1983)	Provides controls for the utilisation of agricultural resources to promote the conservation of soil, water and vegetation, and for combatting of invasive alien plants.
National Veld and Forest Fire Act (No. 101 of 1998)	Provides for the prevention and combatting of veld, forest and mountain fires.
KwaZulu-Natal Nature Conservation Management Act (No. 9 of 1997)	Provides the institutional structure for conservation in KwaZulu-Natal and establishes control and monitoring bodies including the KZN Nature Conservation Board and the KZN Nature Conservation Service (Ezemvelo KZN Wildlife).
Municipal Systems Act (No. 32 of 2000)	Compels municipalities to strive to ensure that municipal services are provided in an environmentally sustainable manner.
Public Finance Management Act (No. 1 of 1999)	Provides the responsible and accountable expenditure of government finances in South Africa.

The indicators identified for Environmental governance are outlined in Table 59.

Table 59: Indicators used in the assessment of environmental governance in KwaZulu-Natal

Indicators	Description and comments
Environmental governance	The role that various government spheres and departments have in managing different aspects of the environment.
Budgetary allocation for environmental management (as % of total budget)	The amount of budget allocated for key environmental and conservation functions in KZN.
The application of programmes like the KZN Biodiversity Stewardship Programme to secure critical ecological infrastructure in KZN	The number of programmes implemented to improve strategic planning and the understanding of ecological and environmental processes within local government.
The number of initiatives undertaken through cooperation of two or more departments.	Inadequate cooperative governance that results in conflicting priorities within government that often compromise the environment and foreclose on sustainable development opportunities.
The number of projects or programmes for developing and implementing appropriate land-use practices in promoting rural development and land reform.	Prolonged land claim and land reform processes in KZN create uncertainty around land tenure.
Percentage of vacant posts in environment-related departments	The number of essential posts that are vacant in key environmental and conservation positions in KZN.
Number of provincial (marine) protected areas with approved management plans (number of PAs and ha)	The number of protected areas in KZN with a management plan submitted to the MEC for approval in terms of section 39(2) of the National Environmental Management: Protected Areas Act (No. 57 of 2003).
Number of proposed or existing protected areas on land owned by the Ingonyama Trust (number of PAs and ha).	The number of proposed or existing protected areas in KZN on land administered by traditional authorities that is owned by the Ingonyama Trust.

13.2 Drivers

The drivers that impact on environmental governance are primarily associated with pressure on government to address rural poverty, create jobs and develop the economy. Conservation and the environment are often viewed as opposed to this and consequently the environment and biodiversity are not prioritised within government. This situation is exacerbated by government's limited understanding of the value of the environment, how it provides vital services to society and how it supports key development sectors such as tourism, the wildlife ranching sector and agriculture. Non-prioritisation of environment and biodiversity within government policy leads to inappropriate land-use decisions that are largely unsustainable, which result in accelerated habitat loss, land degradation and pollution of the environment. Substantial reductions in annual operating budgets of key government institutions make the impacts on environmental governance even more problematic. Ezemvelo KZN Wildlife, in particular, has received substantial budgetary cuts that reduce the resources and capacity of the KZN government to deliver on key government mandates.

13.3 Pressures

Inappropriate land-use decisions resulting in unsustainable economic development lead to a diminished natural resource base to support society. This may ultimately lead to:

- the displacement and migration of people from areas that are heavily degraded or where much of the natural habitat has been lost;
- increased impacts in the poorest regions where communities are reliant on natural resources as part of their survival and livelihood strategies; and

- greater pressure on government to compensate for the loss of natural resources through the provision of greater municipal services and social support in the form of grants.

Unsustainable economic development ultimately forecloses on sustainable land-use options that are compatible with rural communities' ways of life, such as sustainable rangeland management and agriculture, as well as opportunities associated with the Biodiversity Economy.

13.4 State

13.4.1 Environmental governance

The South African Constitution introduced an environmental right in section 24 within the Bill of Rights, which affords every person a right to an environment that is not harmful to their health or well-being and places an obligation on the state to take "reasonable and other legislative measures" to realise the right. In accordance with the environmental right, all organs of state, including municipalities, are required to take legislative and other measures to give effect to this right. Within KZN, a number of government departments have mandates related to the environment. These include but are not limited to those discussed below.

The KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA) has the mandate to advance environmental sustainability for socio-economic development, through the promotion of sustainable use of the environment. This includes:

- policy coordination and environmental planning, which relates to the development of intergovernmental sector tools and legislative tools such as Environmental Management Frameworks, developed in terms of NEMA;
- compliance and enforcement, in relation to issues such as compliance with environmental authorisations and the issuing of Section 24G enforcement notices in the event of non-compliance;
- environmental quality management, which relates to the processing of environmental impact assessments, the issuing of environmental authorisations, the issuing of Atmospheric Emission Licences and the issuing of waste licences; and
- biodiversity management, which primarily focusses on invasive alien species clearing, as part of the Expanded Public Works Programme (EPWP).

As the mandated provincial biodiversity conservation authority, Ezemvelo KZN Wildlife plays a central role in the protection of the environment and biodiversity, and the maintenance of key ecological functions and processes within KZN. Ezemvelo KZN Wildlife's mandate extends beyond state-protected areas and includes such critical functions as:

- the establishment of a protected area system that is representative of the habitats and species of KZN. As such, Ezemvelo KZN Wildlife has the responsibility for protected area expansion in the Province;
- the protection of biodiversity, which includes ecological processes, habitats and species in KZN; and
- enabling the use of biodiversity and natural resources in a responsible and sustainable way to ensure the continued provision of benefits to society, with a particular focus on vulnerable groups such as poor rural communities.

The Department of Water and Sanitation (DWS) has the mandate to manage South Africa's water resources, which includes:

- maintaining an ecological reserve within river systems in an effort to ensure that critical basic ecological functions continue within water catchments; and
- issuing of water use licences for water abstraction or impacts on water resources, based on an assessment of listed activities.

The Department of Mineral Resources has the mandate to assess the environmental impacts of proposed prospecting and mining activities.

Municipalities have a wide-ranging mandate that is derived from section 152 of the Constitution, which requires municipalities to ensure the provision of services in a sustainable manner and to promote a safe and healthy environment (Middleton, Goldblatt, Jakoet and Palmer, 2011). Municipalities are required to consider a range of environmental matters in their planning, decision-making and service-delivery efforts, including:

- air quality
- waste management
- environmental impact management
- conservation and biodiversity
- marine and coastal management
- water and sanitation

These overlapping and concurrent authorities can create confusion in the effective management of the environment. In addition, there are occasions when the environment is not sufficiently prioritised within the various other mandates of government authorities. An example of this is the conflicting mandate that exists within the Department of Mineral Resources to both promote mining and regulate or restrict it, based on the environmental impacts of particular mining projects. There also appears to be evidence of varied levels of capacity in addressing environmental management at a local government level, with some municipalities having excellent capacity to address environmental issues and others have little or no capacity to do so.

13.4.2 Budgetary allocation for environmental management

Ezemvelo KZN Wildlife is also responsible for the implementation of various legislative functions that relate to international, national and provincial obligations, including:

- the establishment and management of protected areas in terms of the National Environmental Management: Protected Areas Act, No. 57 of 2003;
- the expansion of protected areas to contribute to South Africa's obligations on the Aichi targets, established in terms of the Convention on Biological Diversity;
- the implementation of aspects of the World Heritage Convention Act, No. 49 of 1999, being the management authority of the Maloti-Drakensberg Park World Heritage Site (WHS);
- various aspects of the National Environmental Management: Biodiversity Act, No. 10 of 2004, including the preparation of the Province's systematic conservation plan and other bioregional plans for particular regions of the Province;
- commenting on and providing inputs into the environmental authorisation process undertaken in terms of the National Environmental Management Act, No. 107 of 1998, for

listed activities, particularly in relation to the protection of biodiversity and the maintenance of ecological processes; and

- the issuing of permits required in terms of:
 - The Biodiversity Act (e.g. Threatened or Protected Species (TOPS) permits);
 - The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which relates to the export and import of listed species; and
 - Certificates of adequate enclosure as required for wildlife ranching ventures in terms of the Game Theft Act, Act No. 105 of 1991.

The organisation also plays a more direct role in various economic sectors, in particular the tourism and wildlife sectors as the protected areas that it manages form some of the major attractions for domestic and international wildlife tourism in the Province. In many ways, these protected areas also define the character and natural beauty of the Province. It is thus imperative to maintain the operational capacity of Ezemvelo KZN Wildlife so that it can continue to fulfil these functions.

For the 2016/17 financial year, Ezemvelo KZN Wildlife received a budget cut of 19% from the previous year's budget and this percentage cut is likely to continue for the 2017/2018 and 2018/2019 financial years. This drastic reduction of the budget will force Ezemvelo KZN Wildlife to curtail some of its key activities and will compromise its ability to fulfil its mandate. The majority of budgetary cuts have been on capital infrastructure upgrades and maintenance, as the payroll costs are greater than the organisation's subsidy and require increased expenditure of the income that it generates. This may, in turn, limit the income-generating ability of Ezemvelo KZN Wildlife as the reduction in its ability to provide adequate infrastructure and facilities for tourists will result in decreased visitor numbers to its protected areas.

In contrast to this, although the environmental budget of EDTEA reduced slightly in the 2015/2016 financial year compared to the 2014/2015 financial year, from R933 million to R922 million, it increased in the 2017/2018 financial year to R956 million (EDTEA, 2016; Zikalala, 2017).

13.4.3 Environmental authorisations

Previously, Ezemvelo KZN Wildlife made inputs into and commented on all applications for environmental authorisation in the Province, focussing particularly on the impacts of proposed developments on biodiversity and ecological processes. More recently, however, it has lost the resources and capacity to make inputs into every application for environmental authorisation and has therefore limited itself to commenting only on those applications that impact directly on protected areas. Accordingly, it has adopted a 2 km buffer around protected areas, in which it will comment on applications for environmental authorisation (Figure 61). This means that Ezemvelo KZN Wildlife no longer makes input into or comments on the impacts on biodiversity and ecological processes for the majority of proposed developments in KZN. There is therefore significantly less oversight over and technical input into decisions on whether to approve an application for environmental authorisation or not. The implication of this is that it is likely that considerably more impacts associated with activities listed in terms of the National Environmental Management Act (NEMA) are arising and are not being effectively avoided or mitigated in KZN.

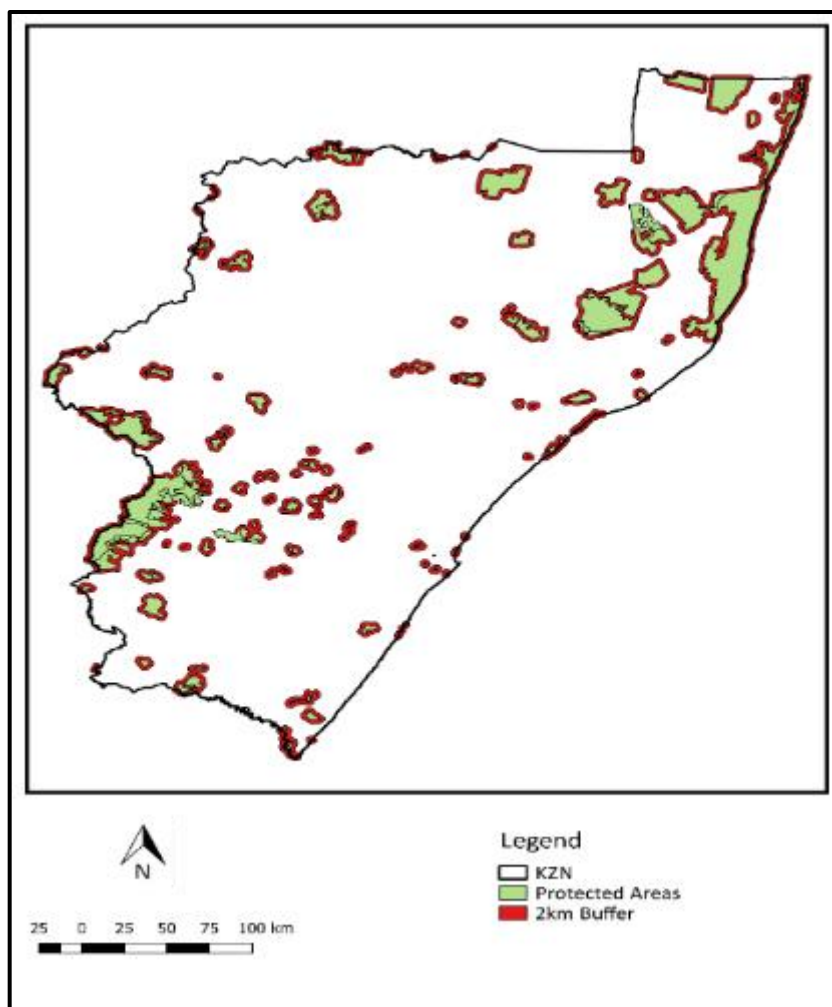


Figure 61: Protected areas and a 2 km buffer around them in KwaZulu-Natal

Source: National PA database (2015)

13.4.4 Vacant posts

Owing to the current economic climate, in which South Africa is in an economic or near-economic recession, a freeze has been placed by the National Treasury on the filling of vacant government posts. EDTEA filled 208 posts out of the 242 posts approved as of 31 March 2016, which represented 34 vacant posts or 14% vacancies (EDTEA, 2016).

Because of the budgetary cuts that Ezemvelo KZN Wildlife has experienced, it is further difficult to fill vacant posts as the money may not be available to cover salaries in these posts. This is a particular concern when critical posts such as protected area managers and other field staff like field ranger posts are vacant. In cases where hospitality staff posts in Ezemvelo KZN Wildlife are vacant, it also means that the ability to generate revenue through tourism is compromised by a lack of capacity to meet visitor needs in various protected areas. In the case of field staff such as field rangers, the challenges posed by growing levels of poaching, particularly of rhinos, make vacancies within these posts more problematic. Lack of staff hinders Ezemvelo KZN Wildlife's ability to combat the threat of rhino poaching, which has seen an exponential increase in recent years (see Figure 23 in the Biodiversity chapter – Chapter 5). The number of vacant posts and the types of posts that are vacant thus impede effective environmental and biodiversity conservation governance in KZN.

13.4.5 Protected area management plans

Ezemvelo KZN Wildlife, as the mandated biodiversity conservation authority in KZN, is responsible for the preparation and implementation of management plans for state-protected areas in the Province. The number of approved management plans in place is a good indicator of governance, as they demonstrate Ezemvelo’s efforts to comply with its legislative obligations and ensure appropriate management and oversight of protected areas. Within KZN there are 42 protected areas with up-to-date approved management plans (Figure 62).

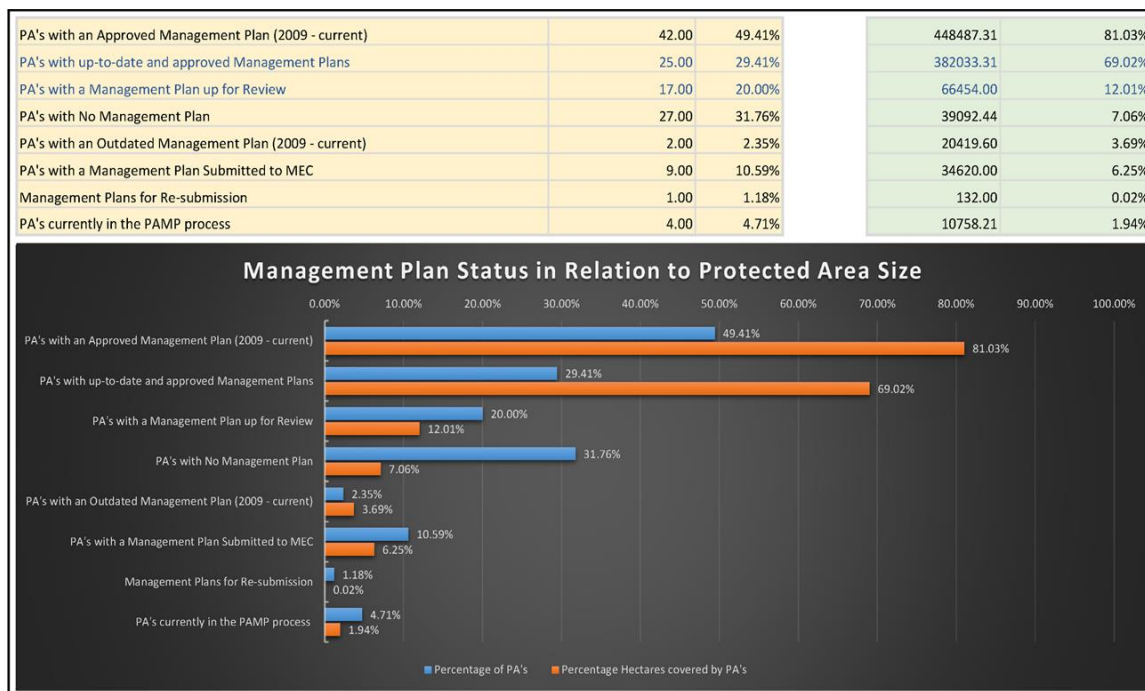


Figure 62: Status of management plans for state-protected areas in KwaZulu-Natal ⁶²

There are 27 protected areas that are considered to have no management plans, as their management plans date back to the 1970s or 1980s. The remainder are management plans that are being prepared, have been re-submitted to the MEC or are being submitted to the MEC for approval (Figure 62). It must be noted that the 42 protected areas that have approved management plans cover over 81% of the terrestrial surface area of state-protected areas in the Province, meaning that the protected areas without management plans are generally smaller reserves (Figure 62).

13.4.6 Protected areas on Ingonyama Trust land

A strong focus of the KZN Biodiversity Stewardship Programme is on creating new protected areas that can provide opportunities for economic development and job creation in areas that are administered by traditional authorities. This is also a focus of the Land Reform and Biodiversity Stewardship Initiative, which is jointly implemented by the Department of Environmental Affairs (DEA), the Department of Rural Development and Land Reform (DRDLR) and the South African National Biodiversity Institute (SANBI) in partnership with provincial conservation authorities such as Ezemvelo KZN Wildlife. Land that is administered by traditional authorities in KZN is held by the Ingonyama Trust in terms of the KwaZulu Ingonyama Trust Act, 1994 (Figure 63).

⁶² The authors wish to acknowledge the assistance provided by Magda Goosen from Ezemvelo KZN Wildlife in providing data on management plans for state-protected areas within KZN.

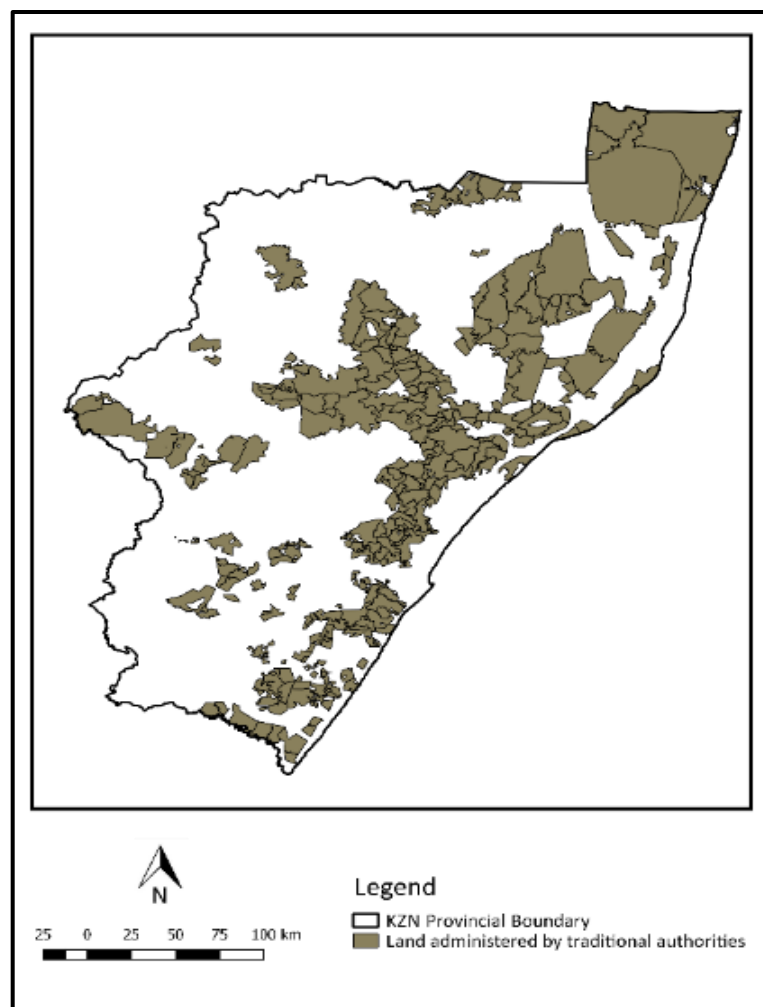


Figure 63: Land administered by traditional authorities in KwaZulu-Natal

Source: Ingonyama Trust Board

The Ingonyama Trust holds over 3.1 million hectares of land in KZN, which constitutes over 33% of the Province's land area. Given the extent of its landholdings, it is imperative that biodiversity conservation efforts focus on the Ingonyama Trust land, both in an effort to secure remnant natural habitat and ecological processes and in support of sustainable economic development. As a result, a number of protected areas are being developed in partnership with traditional authorities in KZN (Table 60).

Table 60: Protected areas being established on land administered by traditional authorities

Site	Traditional Authority	Declaration status	Size (ha)
uMgano Community Project	Mbandala Traditional Authority	Declared nature reserve	1 874
Mduna Royal Game Reserve	Owned directly by the Ingonyama Trust Board	Declared nature reserve	7 719
Upper uThukela	Amangwane Traditional Authority and Amazizi Traditional Authority	To be declared as two nature reserves	44 525
Bhekula-Tshanini	Tembe Traditional Authority	To be declared as two nature reserves	4 806
Total size (ha)			58 924

In addition to the protected areas that have been declared or are in the process of being declared on land administered by traditional authorities, a number of protected areas are being established on land that has been successfully claimed through the land restitution process (Table 61).

Table 61: Protected areas being established on land restitution sites

Site	Community Trust	Declaration status	Size (ha)
Somkhanda Game Reserve	Emvokweni Community Trust	Declared nature reserve	11 603
Nambiti Private Game Reserve	Senzo'kuhle Nkos'uNodada Communal Property Trust	Declared nature reserve	8 223
Mabsao Community Project	Mgundeni Trust	To be declared as a protected environment	1 478
Babanango Valley Game Reserve	Emcakwini Community Trust	To be declared as a nature reserve	13 000
Munyawana Conservancy	Makhasa Community Trust and Qhubekani Mngobokazi Community Trust	To be declared as a nature reserve	23 000
Total size (ha)			57 304

Thus, in total, over 116 000 hectares of land that is communally owned in KZN has been or is in the process of being declared as protected areas. It must be noted that these areas of land contain critical remnant biodiversity in the Province, including a number of critically endangered vegetation types, as well as threatened and endemic species, such as black rhino and bearded vulture.

As an example of the importance of land and the potential it has to drive economic development, Nambiti Private Game Reserve, near Ladysmith, contributes to several protected area targets, and protects a number of rare and threatened species. Perhaps of greater importance, however, is that the Reserve is utilised for tourism, limited hunting, live game sales and venison production; has a monthly turnover in excess of R4.5 million; and employs approximately 250 people, many of whom are in skilled or semi-skilled occupations. The game reserve thus makes a considerable economic contribution in an area of high rural poverty and unemployment.

The Upper uThukela site provides a further example of the importance of such communally owned sites (Figure 64). The site, which links two parts of the Maloti-Drakensberg Park WHS, Royal Natal and Cathedral Peak, has the same natural and cultural values as the surrounding WHS. Moreover, it includes the main watershed of the Tugela River, the largest river in KZN, and is critical for the protection of strategic water resources in the Province.

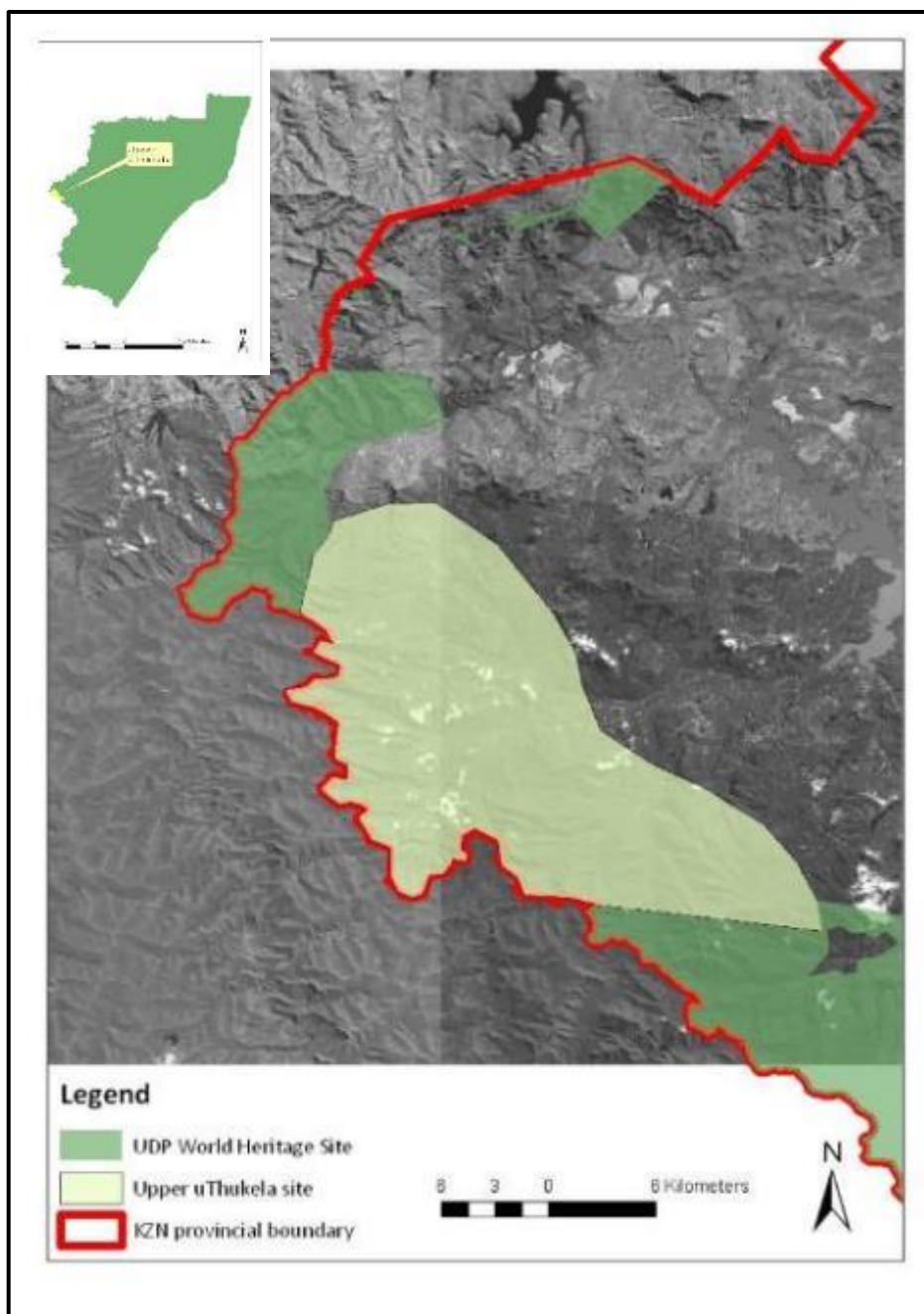


Figure 64: The Upper uThukela Biodiversity Stewardship Site

Source: Ezemvelo KZN Wildlife (2016)

13.4.7 Conflicting priorities of government

Although cooperative governance is difficult to measure, numerous examples exist of land-use practices that are enabled by various national, provincial and local government entities. However, these land-use practices sometimes undermine the ecological integrity of the Province and lead to unnecessary loss of habitat, ecological function and impacts on species. Examples of these types of practices include:

- the prioritisation of mineral exploration and mining over other land uses, which leads to unnecessary impacts on strategic water resources, ecological processes, habitats, species and other more appropriate economic activities;

- inappropriate urban and industrial development that leads to negative impacts on water resources, species and the loss of habitat; and
- inappropriate land-use planning within district and local government, and land administered by traditional authorities, which results in urban sprawl that contributes to habitat loss, has negative impacts on species and exacerbates pollution of the environment.

The proposed Fuleni Coalmine provides an example of inadequate cooperative governance in which inappropriate land use is promoted that may foreclose on more sustainable land-use options. The proposed mine abuts onto the south-eastern boundary of Hluhluwe-iMfolozi Park. In addition, the environmental impact assessment found that the development of the mine would require the relocation of 86 households and the disturbance and relocation of 172 graves.

The proposed mine highlights some of the challenges in achieving effective cooperative governance and enabling decisions to be made on the best land-use options that contribute to sustainable development and the improvement of the livelihoods and well-being of rural communities. Issues associated with cooperative governance include the following:

- The proposed mine falls within an area identified as being of “highest biodiversity importance” in the Mining and Biodiversity Guidelines, which were prepared by the DEA and Department of Mineral Resources to avoid conflicts between biodiversity protection and mining.
- The mine will impact directly on the uMfolozi Biodiversity Economy Node, the flagship project of the Biodiversity Economy, which is being developed as a partnership of the DEA; the DRDLR; various provincial government authorities, including Ezemvelo KZN Wildlife; and several district and local municipalities.

Aside from the negative impacts of the proposed mine on biodiversity and ecological processes, it would have a strongly negative impact on tourism, which is one of the primary regional economic activities. It would also foreclose on opportunities in the Biodiversity Economy, which seeks to assist communities in developing the wildlife sector by focussing on tourism, hunting, live game sales, venison production and the development of ancillary support industries.

13.5 Impacts

Environmental governance in KZN is becoming less effective, primarily as a result of ineffective cooperative governance, inappropriate land-use planning and diminishing resources and capacity in key government institutions. This is happening at a time of extremely high rates of habitat loss, which are undermining the ecological integrity and functioning of the Province, in which effective environmental governance is urgently needed.

13.5.1 Ineffective environmental governance

Competing priorities, limited integrated land-use planning and a poor understanding of the importance of key ecological processes contribute to inappropriate decision-making by government, thereby undermining the ecological integrity of KZN. The primary impact of this is that opportunities associated with more appropriate and sustainable land uses are being excluded. This results in a reduced ability of the government to provide for the needs of KZN’s population and a greater demand for services to compensate for the loss of ecological function. The ultimate outcome of this will be inadequate water

resources, loss of natural resources and compromised ecological functions that are unable to support society's needs and the levels of economic development required to sustain the Province's population.

13.5.2 Diminishing resources for environmental governance

The considerable budgetary cuts that are being imposed on environmental government departments and entities such as Ezemvelo KZN Wildlife exacerbate the levels of ineffective environmental governance in KZN. This will result in a reduced ability of provincial and local governments to:

- implement protected area expansion efforts through the KZN Biodiversity Stewardship Programme, particularly on communally owned land, which is one of the primary mechanisms to secure remnant habitat and ecological processes in the Province;
- support key government programmes that address the loss of habitat and ecological integrity, and encourage sustainable development, including the Natural Resource Management Programmes and the Biodiversity Economy;
- respond to applications for environmental authorisation, which will lead to greater impacts on biodiversity, the loss of habitat and ecological function;
- manage protected areas, which will result in impacts on biodiversity and tourism and associated losses of economic opportunities; and
- pro-actively work with stakeholders outside of protected areas to encourage land-use practices and activities that are compatible with the protection of natural resources and the maintenance of ecological processes.

13.6 Responses

The impacts and challenges outlined above compromise environmental governance in KZN. There are, however, a number of encouraging initiatives that could enable more effective environmental governance and could demonstrate the implementation of effective cooperative governance. These initiatives could provide sustainable opportunities for rural economic development that, in turn, could lead to employment, promote entrepreneurship and consequently lead to improved livelihoods.

13.6.1 Increased efficiency and revenue generation

Given the budgetary challenges that government departments and several environmental NGOs are facing, new and innovative approaches to biodiversity conservation will have to be developed to improve efficiencies and revenue-generating opportunities. To some extent, it may be possible to leverage income-generating opportunities through the Biodiversity Economy. Through the Biodiversity Economy, concessions and leases are provided for the establishment and operation of lodges. New revenue streams are also developed such as through venison production from commercial sales in culling excess animals in protected areas. Opportunities for partnerships should also be explored to develop relationships that support both government departments and environmental NGOs in achieving their mandate. This may include assistance in the direct management of (marine) protected areas and in the biodiversity stewardship.

13.6.2 Improved land-use planning

The National Environmental Management: Biodiversity Act (NEMBA) makes provision for the determination of geographic regions as bioregions and for the publication of bioregional plans for the regions (section 40). The bioregional plan should include requirements for the management of biodiversity and components of biodiversity in the region. Ezemvelo KZN Wildlife has worked closely with district municipalities in KZN to initiate the process to develop bioregional plans for all districts in the Province. As an initial step, biodiversity sector plans, which are the precursor to the bioregional plans, have been developed and have been approved by the Ezemvelo KZN Wildlife Board. It is intended that these plans will inform municipal planning processes and will be embedded in planning instruments such as the spatial development frameworks of municipalities to better inform biodiversity and ecological issues as part of the land-use planning process. This initiative should lead to more effective land-use planning, in which development in ecologically sensitive areas is avoided, key ecological processes are maintained and important remnant biodiversity is protected.

13.6.3 Integrated biodiversity and agricultural planning

Through the enactment of the new Spatial Planning and Land Use Management Act, No. 16 of 2003 (SPLUMA), land-use schemes are required to be extended into rural areas. To ensure that areas or features that have been identified as important for the persistence and maintenance of species, habitats, ecosystems, biodiversity patterns and ecological processes are protected, Ezemvelo KZN Wildlife has developed planning products, such as the biodiversity sector plans, to assist municipalities in incorporating biodiversity into their land-use schemes (Ezemvelo KZN Wildlife, 2016). The guidelines that Ezemvelo KZN Wildlife has developed acknowledge that biodiversity sector plans could be seen as potentially conflicting with other land uses or constraining economic or social development within the districts. Accordingly, it has partnered with the KZN Department of Agriculture and Rural Development (DARD) to identify areas in which the complementary objectives of protection of biodiversity and important agricultural assets can be achieved. Such areas can be utilised sustainably for agriculture, whilst protecting biodiversity and critical ecological functions. Through this process, zones that can achieve these combined objectives have been jointly identified and mapped by Ezemvelo KZN Wildlife and the DARD. The intention is that these zones will be used in the development of land-use schemes for local municipalities, one example of which is found in Ulundi Local Municipality (Figure 65).

The two types of zones identified are:

- Agro-biodiversity zones:
 - These zones highlight the importance of both sustainable agriculture and biodiversity conservation due to their high- to moderate agricultural potential and high biodiversity value. In these zones, agricultural practices that are compatible with protecting biodiversity are encouraged. Ploughing of land or further loss of natural habitat is discouraged to maintain the optimal agricultural resources and protect remnant biodiversity.
- Environmental management zones:
 - These are zones with low agricultural potential that do not qualify as agro-biodiversity zones but are important for biodiversity or ecological corridor linkages. The intention is to

create environmental corridors and ecological links as well as to promote sustainable land management for the ecosystem goods and services that the areas provide and the biodiversity they support. Environmental departments and organisations aim to keep these areas in a natural or near-natural state and to allow extensive livestock grazing and sustainable natural resource harvesting.

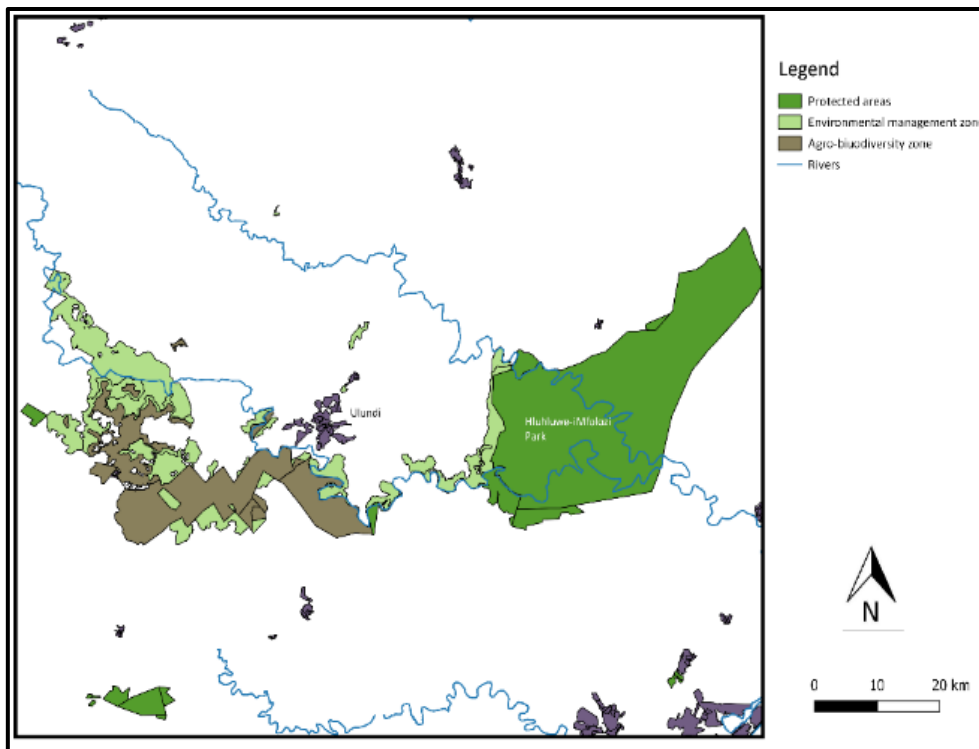


Figure 65: Agro-biodiversity zones within Ulundi Local Municipality

Source: Ezemvelo KZN Wildlife (2016)

13.7 Conclusion and Recommendations

The result of the assessment of environmental governance shows that it is diminishing at a time when rates and levels of loss of habitat and ecological function are unacceptably high (Table 62).

Table 62: Summary of governance trends

Indicators	Trends
Environmental Governance.	Decreasing
Budgetary allocation for environmental management in % of total budget).	Decreasing
Ability to respond to applications for environmental authorisations.	Decreasing
Percentage of vacant posts in environment-related departments.	Increasing
Number of (marine) protected areas with approved management plans.	Stable
Number of proposed or existing protected areas on land owned by the Ingonyama Trust (number of PAs and ha).	Increasing
Conflicting priorities of government	Increasing
Number of environmental management reports compliant with NEMA	Increasing

The key issues that undermine effective environmental governance in the Province are:

- substantial reductions in annual budgets for key government authorities;

- conflicting priorities within government that lead to a lack of cooperative governance and decision-making regarding environmental management; and
- Limited implementation of integrated land-use planning that leads to inappropriate development in ecologically sensitive areas, the loss of natural habitat and compromised ecological functions.

Chapter 3 of NEMA establishes the basis for cooperative governance related to the environment. It requires that relevant national departments that exercise functions involving the environment prepare an environmental implementation plan or an environmental management plan, every four years. The purpose of the plans is to coordinate and harmonise environmental policies, plans and decisions related to the environment, and to enable the Department of Environmental Affairs to monitor the achievement, promotion and protection of a sustainable environment. Chapter 7 of NEMA establishes a duty of care for the environment in which every person who causes pollution or degradation of the environment must take reasonable measures to prevent any further harm to the environment, or in circumstances where such harm is authorised by the law, efforts should be made to minimise and rectify such harm. There are thus strong legal provisions for cooperative governance related to the environment across a wide range of sectors of the government and there are clear obligations placed on individuals and other entities to avoid harm to the environment, and where such harm has occurred to take measures to address it.

Efforts to improve environmental governance in KZN need to focus on more effective cooperative governance, increased capacity of local government to implement environmental governance, and more transparent and integrated decision-making processes in which the environment is prioritised and given due consideration. Government authorities and environmental NGOs also need to become more financially efficient and innovative in the ways in which they derive revenue, in an effort to continue to meet their key mandates.

13.8 References

Department of Economic Development, Tourism and Environmental Affairs (EDTEA). 2016. The KZN Department of Economic Development, Tourism and Environmental Affairs 2015/16 Annual Report. EDTEA, Pietermaritzburg.

Ezemvelo KZN Wildlife. 2016. Ezemvelo KZN Wildlife guideline for the incorporation of biodiversity areas and features into the municipal land use schemes. Ezemvelo KZN Wildlife, Pietermaritzburg.

Ingonyama Trust Board Website. Information retrieved from: <http://www.ingonyamatrust.org.za/>. Accessed on 20 April 2017.

Martindale, G.J. 2016. An assessment of alternatives to the proposed Fuleni Coalmine. A report commissioned by Ezemvelo KZN Wildlife, Pietermaritzburg.

Middleton, J., Goldblatt, M., Jakoet, J. and Palmer, I. 2011. Environmental Management and Local Government. PDG Occasional Paper No.1.

UNDP. 1997. Governance for sustainable human development: A UNDP policy document. United Nations Development Programme, New York.

Zikalala, S. 2017. Department of Economic Development, Tourism and Environmental Affairs, Budget Policy Speech 2017/2018. EDTEA, Pietermaritzburg.

14. Conclusion

14.1 Key Challenges

The KwaZulu-Natal Environment Outlook Report (KZN EOR) provides a *snapshot* of the current state or condition of the environment and allows the people of KZN to take stock of their environmental resources in a changing environment. In doing so, environmental issues and trends in resource use in the Province can be identified and assessed, and priorities can be determined.

Over the past decade, the KZN Provincial Government and the people of KZN have made considerable progress in the area of environmental management. Policies, strategies, programmes, plans and projects, such as the KZN Biodiversity Stewardship Programme, Durban Climate Change Strategy, the Waste Management Flagship Programme, and the Umkomaas Hydro Energy, Biogas and Wonderpot projects, to mention a few, have been developed and implemented. These guiding documents focus on key environmental areas, such as biodiversity, air quality, protected areas, urban and rural development, waste management and disaster management. Efforts to further strengthen and enforce the policy frameworks have increased. Additionally, awareness raising about the environmental challenges the Province faces is recognised by the government as important in getting people's buy-in in mitigating environmental challenges, particularly pertaining to anthropogenic activities such as littering and domestic fuel burning.

Despite the progress made to date, the detailed assessments in the KZN EOR suggest that the ecological footprint of humans in KZN is intensifying, natural resources are being depleted and the condition of the environment is degrading. The 'hot' issue of climate change overarches, and is integrated throughout, the thematic chapters of this Report. For example, the effects of climate change are exacerbated by industrialisation, urbanisation, an increase of motor transport and consumption patterns due to population growth. These sectors contribute to greenhouse gas (GHG) emissions and land conversion for arable agriculture to feed a growing population. Ice caps and glaciers in the Polar Regions are melting due to the rising land and sea surface temperatures, consequently causing sea levels to rise, which will affect the KZN coast. In Durban, current sea-level rise has been 2.7 mm/year over the past 33 years. Increased temperatures will result in a shift in bio-climatic zones, with certain vegetation types and associated species disappearing, being unable to adapt to the fast-changing environment. It is highly likely that agricultural production will be altered and production areas will shift as a result of climate change. Changes in temperature and rainfall patterns affect the production of crops that are currently most suitable for the area. In addition, the predicted increase in storms, floods and droughts will have a considerable impact on the economy of KZN as the damage caused will cost the Province millions of Rand. Currently, extreme weather events already have considerable impact on the vulnerability of the people in KZN, in particular those living in rural areas. This vulnerability is exacerbated by the increased effects of climate change. For example, increased frequency and severity of extreme weather events such as storms and flooding will result in the destruction of shacks and consequently make a large number of people homeless.

Deteriorating air quality as a result of *inter alia* increased car use is affecting people's health by increasing their risk of strokes, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma. Air Quality Management Plans (AQMPs) have not yet been developed for the municipalities of iLembe, uMkhanyakude, Harry Gwala, uMgungundlovu, uThukela, uMzinyathi and Zululand, while AQMPs are being implemented in the King Cetshwayo and Ugu municipalities.

Monitoring provides the necessary sound scientific basis for decision-making, compliance assessment against targets and enforcement actions, and, without AQMPs, this cannot be done.

Similarly, increased pollution contaminates rivers and sea, limiting access to safe drinking water and risking the spread of water-borne illnesses. In freshwater, marine and terrestrial environments, natural resources are being exploited in an unsustainable manner, threatening the functioning of ecosystems and ecosystem health. Land degradation remains a serious problem in the Province and the continued urbanisation that encroaches onto important conservation and agricultural areas worsens the impact. Unsustainable land use and poor agricultural practices contribute to land degradation, the loss of productive agricultural land and less effective provision of ecosystem services. The challenge is therefore to set clear and realistic targets for land-use preferences in fast-developing urban areas, coupled to real and enforceable protection and management strategies.

KZN Province faces a number of energy challenges, particularly those related to electricity and fuel access. Population growth, coupled with economic development in various energy-intensive sectors, is linked to the pressures to equitable development of the Province's socio-economic profile, which is characterised in some areas by extreme poverty. At the same time, basic human needs such as access to drinking water and sanitation facilities are not yet being adequately met, especially in isolated rural communities. Poverty remains deeply entrenched and is on the increase in some areas, while inequality and unemployment levels remain unacceptably high. It has been demonstrated that people become more reliant on the natural environment as poverty levels increase, but their vulnerability and lack of resilience to environmental degradation and pollution also increase.

14.2 Scenarios

In this section, two potential scenarios are presented for each theme (Table 63). Scenario 1 describes the projected future state of environment for the Province should trends continue and no actions are taken to address the critical issues at hand. Scenario 2 describes the projected future desired state of environment for the Province should adequate interventions occur.

Table 63: Outline of scenarios without (scenario 1) and with (scenario 2) interventions

Theme	Environmental change	Scenario 1: Inadequate intervention	Scenario 2: Adequate intervention
Climate Change	<p>Medium term (2050): Temperatures in coastal regions will increase by 1-2°C and inland regions by ~3-4°C.</p> <p>Long term (2100): Temperatures in coastal regions will increase by ~3-4°C and inland regions by ~6-7°C.</p>	<ul style="list-style-type: none"> • Crop failure due to heat and/or extreme weather events. • Fish stocks deplete due to overfishing and warming of sea surface temperatures affecting migrations. • Poorer communities more heavily affected. 	<ul style="list-style-type: none"> • Addressing current levels of habitat degradation and loss, and maintenance of critical ecological infrastructure. • Maintenance of food security through the resilience of functioning ecosystems and their ability to adapt to climate change. • Implementation of ecosystem-based adaptation measures such as urban greening or rehabilitation of wetlands. • Adequate strategies for adaptations to the effects of climate change such as sea-level rise. • Diversification of livelihood strategies.
Air Quality	Elevated PM ₁₀ concentrations are observed in most major urban centres in the Province.	<ul style="list-style-type: none"> • Unrestricted growth in transport and domestic burning emissions. • An increase in ambient NO₂ and PM₁₀. • Increasing the risk of suffering from diseases such as strokes and cancer. 	<ul style="list-style-type: none"> • Improved efficiency in urban design (compact cities), public transport and electricity/energy provision. • Institution and implementation of air quality management plans in all municipalities. • Implementation of green infrastructure systems such as urban greening. • A decrease in ambient NO₂ and PM₁₀. • Lower risk of suffering from diseases such as strokes and cancer.
Biodiversity and Ecosystem Health	Degradation of ecosystems and loss of habitat undermines ecological integrity and resilience that underpins human livelihoods and economic development in the Province.	<ul style="list-style-type: none"> • Loss of biodiversity, including key species. • Reduced functioning of ecosystems. • Limited provision of ecosystem services. • An increase in habitat fragmentation and invasive alien species. • A decrease in natural areas remaining and areas of high endemism. • A decline in the status of terrestrial and river/aquatic ecosystems. 	<ul style="list-style-type: none"> • The integration of biodiversity into planning and decision-making processes. • The expansion of protected areas on private and communal land that contributes significantly to rural economic development and job creation. • Improved protection of wildlife and biodiversity.

KwaZulu-Natal Environment Outlook Report 2017

Land Modification	Degradation of land and consequent productivity as well as loss of ecosystems undermines ecological integrity and resilience that underpins human livelihoods and economic development in the Province.	<ul style="list-style-type: none"> • Soil erosion. • Reduced ability of land to produce food. • Reduced functioning of ecosystems. 	<ul style="list-style-type: none"> • Improved sustainable land-use management practices. • Increased productivity of food.
Freshwater Resources	Deteriorating water quality has impacts on human and environmental health throughout the Province.	<ul style="list-style-type: none"> • Unrestricted abstraction from rivers exacerbated by prolonged droughts. • Contaminants from industrial effluent and other chemicals result in poor water quality. • Unplanned urbanisation in sensitive areas. • Loss of biodiversity, including key freshwater species such as <i>Tilapia</i> species. • Limited communication between water authorities and municipalities ongoing. 	<ul style="list-style-type: none"> • Improved water resource planning and management. • Improved efficiencies in the utilisation of water. • Sustainable water usage and greywater infrastructure systems. • Improved water quality. • Improved access of basic services such as safe drinking water. • Improved communication between water authorities and municipalities.
Marine and Coastal Resources	Changes in marine and coastal resources affect food security and income generation from tourism.	<ul style="list-style-type: none"> • Increased food insecurity and loss of economic potential resulting from collapsed fisheries. • Loss of biodiversity, including key species such as corals. • Decline in ecosystem functioning resulting in loss of productivity. • Unplanned urbanisation in sensitive areas resulting in a 'coastal squeeze'. • Loss and inundation of sandy beaches. • Unrestricted oil and gas exploration, and sand mining. • Increase in plastics and pollution due to increase in sewage plants and effluent into the sea. • Sea level rise due to the effects of climate change. 	<ul style="list-style-type: none"> • Protection of key habitats that provide spawning and nursery areas for fisheries through the establishment of Marine Protected Areas (MPAs) and effective estuary management systems. • Healthy ecosystems lead to growth in food security. • Decrease in pollution. • Sustainable management practices for extracting natural resources. • Growth in tourism due to clean and safe beaches, marine-related activities (such as SCUBA) and marine wildlife attractions.
Economics	An increase in poverty puts pressure on the environment as more people	<ul style="list-style-type: none"> • Unemployment levels increase. 	<ul style="list-style-type: none"> • Integration of environmental considerations into economic planning

	rely on ecosystem services to provide an income.	<ul style="list-style-type: none"> • Decreased opportunities for people to afford school/tertiary education fees. • Limited family planning programmes lead to an increase in unplanned and teenage pregnancies, exacerbating population growth and putting pressure on household heads to provide income. • Partially skilled teachers who are placed in positions they are not qualified for. 	<p>and development, driving ecologically and economically sustainable growth.</p> <ul style="list-style-type: none"> • Development of economic opportunities that are appropriate to their environment, e.g. through programmes like the Biodiversity Economy. • Reduced unemployment levels. • An increase in opportunities for people to afford schools/tertiary education. • Adequate family planning will lead to fewer unplanned and teenage pregnancies, and less pressure on household heads. • Improved quality of teaching and learning.
Human Settlements	Human settlements have a direct effect on the immediate environment.	<ul style="list-style-type: none"> • Habitat loss/degradation due to unplanned human settlements. • Continued land tenure issues. • Growth of human settlements will result in the spread of water-borne diseases due to contaminated drinking water. • Increase in the need for basic services and road planning. • Limited family planning programmes lead to an increase in unplanned and teenage pregnancies, exacerbating population growth and putting pressure on household heads to provide income. • Numbers of people affected by HIV/AIDS will rise. • Increased poverty and crime. 	<ul style="list-style-type: none"> • Integrated land-management use across the Province. • Enhanced resilience of new and existing cities, towns and rural nodes to overcome environmental changes. • Access to resources, social and economic opportunities. • Access to goods and services, attracting social and financial investment. • Adequate family planning will lead to fewer unplanned and teenage pregnancies, and less pressure on household heads to provide income. • Awareness surrounding the spread of HIV/AIDS, along with family planning programmes, will lead to a decrease in the number of people affected by HIV/AIDS. • Decrease in crime rates.
Waste	Waste is proliferated through urbanisation and population growth and directly affects the environment.	<ul style="list-style-type: none"> • Unrestricted contamination of soils and surface/groundwater. 	<ul style="list-style-type: none"> • Significant improvements in waste reduction through production processes and packaging.

		<ul style="list-style-type: none"> • Unrestricted toxic emissions from burning, decomposing or disposing waste due to mismanaged disposal practices. • Increased unregistered landfill/disposal sites as the increasing amount of waste cannot be processed timeously. • The scenic value of an area will be lost with the accumulation of waste. • Loss of biodiversity. 	<ul style="list-style-type: none"> • Development and implementation of a provincial Integrated Waste Management Plan (IWMP). • Significant reduction of contaminants seeping through soils and surface/groundwater. • Income generated through waste disposal or recycling. • Improvement in waste disposal management practices. • Scenic value of an area restored. • Growth in scenic and wildlife tourism.
Energy	Population growth and economic activities (particularly those associated with KZN's industrial sector) impact the environment.	<ul style="list-style-type: none"> • Unrestricted electrification, illegal connections and domestic fuel burning. • Unrestricted usage of liquid fuels that contribute to air pollution. • Increased air pollution and greenhouse gas (GHG) emissions. • Decline in water quality. 	<ul style="list-style-type: none"> • Less dependency on the grid. • Income generation through small- and large-scale renewable energy projects within the Province. • Access to electricity, particularly in small communities, through small renewable energy projects. • Improved transport and technology that minimise the use of liquid fuels (such as diesel and petrol).
Governance	Environmental governance may prevent the rapid rates of biodiversity loss and loss of ecological function, which, in turn, impact on society and human well-being.	<ul style="list-style-type: none"> • The budgetary allocations not allocated to address key environmental issues. • Low capacity to address key issues effectively, regarding the authorisation processes. • Inadequate cooperative governance and poor leadership, which result in conflicting priorities within government. • Inappropriate land use and management of sensitive areas, owned by tribal land owners, in need of protective legislation. • Limited capacity in the enforcement of laws. 	<ul style="list-style-type: none"> • Adequate budgetary allocations for capacity within government and environmental NGOs for environmental management. • Sustainable co-management of lands owned by tribal land owners. • Strong leadership that leads to cooperative governance within and between departments. • Compliance with guidelines, regulations and legislation (NEMA) by the public, industry organisations and government bodies.

15. Recommendations

The KwaZulu-Natal Environment Outlook Report (KZN EOR) provides a clear overview of the realities that affect the environment and its people in the Province. It also points to various actions that are required to place the Province firmly on a sustainable path. Challenges in the different chapters brought forth a range of recommendations for action to be taken by the Provincial Government, Local Government, the private sector, local communities and individuals in KZN. To achieve the desired scenario, where adequate intervention is taken to address these challenges (see Table 63), these recommendations should be implemented.

15.1 Recommendations for Issues Identified

Key environmental issues in the Province require dedicated, focussed attention and intervention to prevent the ongoing degradation of environmental resources. Adequate management and development plans, as well as open communication between departments, may aid in addressing the issues in the Province. Table 64 lists the issues and associated recommendations identified by the stakeholders as well as the level of priority they should receive.

Table 64: Recommended actions in terms of priority, indicator and responsible party

Theme	Issue	Recommendation	Priority	Indicator	Responsible
Climate Change	Limited integration of climate change into sectoral departments and strategies, including the Ingonyama Trust	Improve mainstreaming of climate change into sectoral plans at provincial and municipal level through regular coordination between departments and the Ingonyama Trust.	Immediate	The number of sectoral and tribal plans that have incorporated climate change	COGTA, SALGA, Ingonyama Trust, provincial government departments, Office of the Premier
		Allocate adequate budget for training on how to integrate climate change issues into the Provincial and local sectoral plans.	Immediate	Budget spent on implementation of climate change plans	
		Search for additional funding sources to support the mainstreaming of climate change into sectoral plans for other municipalities in the Province.	Immediate		
		Implement the existing climate change strategies and plans for KZN and Durban.	Ongoing		
	Increased climate variability	Provide training and ongoing capacity building to government officials as well as representatives of local communities on innovative techniques and methods, such as ecosystem-based adaptation, to adapt to climate variability.	Ongoing	Precipitation (in mm)	EDTEA, SALGA
		Use indigenous knowledge systems for rehabilitating natural areas.	Ongoing	Land and sea surface temperature (in degrees Celsius)	
		Implement and expand eThekweni's food security plan on urban agriculture.	Ongoing	Sea level rise (in mm)	EDTEA
		Explore opportunities for additional funding for innovative ideas to address the adverse effects of climate change.	Ongoing	The number of technologies implemented to save water	eThekweni Municipality, Dep of Agriculture, EDTEA

KwaZulu-Natal Environment Outlook Report 2017

	Limited awareness on adaptation to climate change	<p>Incorporate climate change adaptation and mitigation into school curricula.</p> <p>Use the Central KwaZulu-Natal Climate Change Compact (CKZNCCC) more actively to share climate change information and experiences among local governments in the Province of KZN to build capacity in the climate change field. A community-based adaptation approach is proposed to achieve this.</p> <p>Use citizen science to enhance awareness on climate change.</p>	<p>Immediate</p> <p>Immediate</p> <p>Immediate</p>	<p>The percentage uptake by farmers of climate-smart agriculture and ecosystem-based adaptation</p> <p>The number of school citizen science projects to adapt to climate change</p>	<p>Civic organisations, Department of Education, EDTEA, Dep of Communication, WWF, WESSA, DACT</p>
	Continued Greenhouse gas emissions	<p>Promote public private partnerships between government and the private sector to address the adverse effects of climate change and invest in the green economy to reduce the emission of GHGs.</p> <p>Source funding and allocate budget to invest in the green economy to reduce GHG emissions.</p> <p>Involve local communities in establishing nurseries and planting trees.</p>	<p>Ongoing</p> <p>Immediate</p> <p>Immediate</p>	<p>Level of GHG emissions (particularly atmospheric CO₂ and methane)</p> <p>Amount of carbon sequestered</p>	<p>DEA</p>
	Increased environmental degradation	<p>Promote closer cooperation between the Ingonyama Trust and the Provincial Government of KZN to address environmental degradation and improve sustainable land-use practices to mitigate the effects of climate change.</p> <p>Develop a strategy on land degradation and land rehabilitation.</p> <p>Implement new methods to combat growth of alien species during droughts.</p>	<p>Immediate/Ongoing</p> <p>Medium term</p> <p>Immediate</p>	<p>The cost of damage (in million Rand) and loss of lives caused by extreme weather events</p> <p>Rate of increase in weeds and alien species</p>	<p>Dep of Agriculture and Rural Development, KZN Ezemvelo, DAFF, the DEA Natural Resource Management (NRM) Unit for Working for Water.</p>
Air Quality	Limited Air Quality Management Plan	<p>Provide ongoing guidance by the national department on documents and training on air quality management to all</p>	<p>Ongoing</p>	<p>The number of improved AQMPs</p>	<p>DEA, EDTEA</p>

KwaZulu-Natal Environment Outlook Report 2017

	(AQMP) development and implementation	<p>authorities. This includes air quality monitoring, a draft strategy to address air quality in low-income settlements, motor vehicle strategy, and the AQMP manual.</p> <p>Increase budget for training to expand the development and implementation of AQMPs across all municipalities in the Province.</p> <p>Provide oversight on AQMP implementation by national and provincial environmental authorities.</p>	<p>Immediate</p> <p>Ongoing</p>	<p>The number of human resources available</p> <p>The number of financial resources available</p>	
	PM ₁₀ from all sources	<p>Promote good access to clean burning fuels. The location of two large petroleum refineries, two sea ports, and rail links in the Province allow for clean local or imported fuels to be accessed and utilised by the industrial and commercial sectors. This can reduce industrial particulate emissions.</p> <p>Allocate funding for the purchase and ongoing utilisation of clean fuels.</p>	<p>Immediate</p> <p>Immediate</p>	<p>Ambient particulate matter (PM₁₀) concentrations</p>	<p>DEA, EDTEA, Department of Energy</p>
	Increased emissions from transport	<p>Promote public private partnerships for fuel efficient and more environmentally friendly transport in the Province.</p> <p>Promote the shift from road to rail.</p> <p>Promote and invest in public transport and alternative ways to release pressure on the roads.</p>	<p>Immediate</p> <p>Immediate</p>	<p>Ambient sulphur dioxide (SO₂) concentrations</p> <p>Ambient nitrogen dioxide (NO₂) concentrations</p> <p>Ambient particulate matter (PM₁₀) concentrations</p>	<p>Department of Energy, Department of Public Works and Transport</p>
	Burning of sugarcane and domestic woodfuel	<p>Supply of renewable and cost-efficient energy to reduce the dependency on the grid.</p> <p>Provide training to local communities to implement and maintain alternative energy technology once received.</p>	<p>Long term</p> <p>Ongoing</p>	<p>The number of people with respiratory problems</p>	

KwaZulu-Natal Environment Outlook Report 2017

		Promote recycling to reduce the amount of domestic burning.	Immediate		
	Limited ambient air quality monitoring	Use the strong air quality expertise at provincial and local levels. Allocate more financial and human resources to provide technical training to government representatives at provincial and local levels on air quality monitoring. Conduct ambient air quality monitoring, using the SAQS system.	Immediate Immediate Ongoing	The number of air quality people at the provincial and local departments Amount of budget allocated	Provincial and local municipalities
Biodiversity and Ecosystem Health	Habitat loss and degradation	Implement the Biodiversity Economy and the flagship Umfolozi Biodiversity Economy Node. These have considerable potential to provide meaningful economic development and job creation in poor rural areas. Accelerate and grow the KZN Biodiversity Stewardship Programme in an effort to undertaken protected area expansion to secure critical biodiversity areas, strategic water sources and other ecological infrastructure vital to the ecological integrity and resilience of the Province. Continue ecological rehabilitation and restoration to allow for better integration of ecological restoration and combatting of habitat degradation.	Immediate Immediate Immediate	Extent of protected areas Extent of natural areas remaining Habitat fragmentation Vegetation types, threat and protection status of vegetation types Status of conserved areas (including Important Bird Areas)	DEA, EDTEA, Ezemvelo KZN Wildlife, DRDLR, Municipalities
	Limited environmental awareness	Use TV spots and newspaper advertisements to promote the protection of local species. Expand environmental education at schools.	Long term	Budget allocated for the Biodiversity Economy and environmental awareness programmes at schools and to the general public	DEA, EDTEA, Department of Education, Department of Communication, Civil Society

KwaZulu-Natal Environment Outlook Report 2017

	Reduction in key and endangered species	Promote biodiversity stewardship, which enables protected area expansion on private and communal land and provides a sound mechanism for protecting species.	Immediate Ongoing	Population trends of selected species Status of areas of high endemism Status of conserved areas (including Important Bird Areas) (ha)	DEA, EDTEA, KZN Ezemvelo KZN Wildlife, WESSA
	Invasive alien species	Further development and improvement of Natural Resource Management (NRM) Programmes, such as the Working for Water Programme, which if effectively implemented has considerable potential to combat invasive alien plant infestations.	Ongoing	The number and type of invasive alien species	DEA, EDTEA, KZN Ezemvelo KZN Wildlife, WESSA
	Limited biodiversity/conservation planning	Systematic conservation (biodiversity) planning is a means to efficiently and effectively identify the highest priority biodiversity values in a landscape in an effort to inform spatial planning and the design of protected areas. Incorporated such plans into the spatial development plans for local and regional areas.	Ongoing	Existence of biodiversity/conservation planning maps and plans	EDTEA
Land modification	Land conversion for development	Promote the implementation of initiatives that focus on the protection of ecological infrastructure. Such initiatives have great potential to unlock the resources required to protect key habitat and ecosystems that provide vital ecological goods and services, in particular those related to water resources. Develop and implement land use plans to protect ecological infrastructure.	Immediate	Extent of natural land cover (in ha) Change in land use (in ha) Identification and conservation of geographical hotspots that provide above	DAFF, EDTEA, Local Municipalities, Land Owners, Ezemvelo KZN Wildlife

KwaZulu-Natal Environment Outlook Report 2017

				average ecosystem services	
	Unsustainable land-use practices	<p>Provide training to farmers on climate-smart agriculture and conservation techniques in farming.</p> <p>Promote improved rangeland management based on successful projects implemented in KZN and the Eastern Cape.</p> <p>Develop a commercial venison industry based on sustainably managed wildlife that has the potential to address issues such as food security and climate change.</p>	<p>Ongoing</p> <p>Immediate</p>	<p>Extent of degraded land</p> <p>Extent of agricultural areas (in ha)</p> <p>Number of initiatives to promote sustainable land use and farming practices</p>	<p>DAFF, EDTEA, Department of Rural Development, Local Municipalities, Land Owners, Ezemvelo KZN Wildlife</p>
	Invasive alien species	<p>Further development and improvement of NRM Programmes, such as the Working for Water Programme. If effectively implemented it has considerable potential to combat invasive alien plant infestations.</p> <p>Monitoring and follow-up whilst maintaining the job-creation aspects of the programme would significantly improve it.</p>	<p>Ongoing</p> <p>Ongoing</p>	<p>Change in area (in ha) of invasive alien species</p> <p>Change in types and number of invasive alien species</p> <p>Ecological carrying capacities</p>	<p>DEA, EDTEA, KZN Ezemvelo KZN Wildlife, WESSA</p>
	Competition for land use	<p>Promote sustainable use of wildlife and natural resources. This has considerable potential to provide meaningful economic development and job creation in poor rural areas.</p>	<p>Ongoing</p>	<p>Extent of mining (in ha)</p> <p>Extent of urban areas (in ha)</p>	<p>COGTA, EDTEA, Department of Rural Development, Local Municipalities, Land Owners</p>
Freshwater Resources	Declining availability of water resources	<p>Improve implementation of the Water Conservation and Demand Management to reduce water wastage and high unaccounted for water levels.</p> <p>Promote the importance of the protection of Strategic Water Source Areas (SWSAs).</p> <p>Improve coordination and integration of water resource planning, monitoring and assessment.</p>	<p>Ongoing</p> <p>Immediate</p> <p>Immediate</p>	<p>Use of water (in m³) per sector</p> <p>Use of water (in m³) per capita</p> <p>The number of initiatives in cooperation with universities</p>	<p>DWS, Umgeni Water, Mhlathuze Water, future WMAs</p> <p>DWS, Umgeni Water, Mhlathuze Water</p>

KwaZulu-Natal Environment Outlook Report 2017

		<p>Improve enforcement of water resources and environmental control measures at national and local government levels.</p> <p>Cooperate with universities on water-saving techniques and research.</p> <p>Invest more in conserving the surface and groundwater resources of the Province to meet current demands while not undermining projected future socio-economic development opportunities.</p> <p>Promote the establishment of water desalination plants.</p>	<p>Long term</p> <p>Ongoing</p> <p>Immediate</p> <p>Ongoing</p>	<p>Increased budget for managing water resources</p>	<p>DWS, WWF, Office of the Premier</p> <p>DWS (Provincial and National), Office of the Premier</p>
	Declining water quality	<p>Coordinate and regulate sanitation and waste management infrastructure to improve water quality-related issues and maintenance of storm water systems.</p> <p>Promote cooperation with universities on water quality techniques and research.</p> <p>Improve coordination, planning and implementation of water infrastructure at provincial and community levels.</p>	<p>Long term</p> <p>Immediate</p> <p>Immediate</p>	<p>Measurement of water quality against standards (in mg/l)</p> <p>Number of pollution disaster events</p>	<p>DWS, Umgeni Water, Mhlathuze Water, future WMAs</p>
	Declining (loss) of natural habitats/ ecosystems	<p>Maintain biodiversity and ecosystems to enhance the environment's ability to improve water resource availability naturally.</p> <p>Increase prioritisation by provincial and local government to fund ecological infrastructure.</p> <p>Increase focus on land-use planning, management and governance to protect and conserve water and the environment.</p>	<p>Immediate</p> <p>Ongoing</p> <p>Immediate</p>	<p>Area of riverine vegetation</p> <p>Percentage of vegetation in important water catchment areas</p>	<p>DWS, Umgeni Water, Mhlathuze Water, future WMAs</p>

KwaZulu-Natal Environment Outlook Report 2017

		Develop biological indicators to measure water quality. Continue removal of alien invasive species through the NRM programme.	Immediate Ongoing		
	Increasing land degradation/soil erosion	Promote implementation of sustainable land-use management practices, to reduce soil erosion and fertiliser use, thereby improving water quality. Provide training on sustainable land-management techniques	Immediate Ongoing	Level of soil erosion caused by floods Siltation in dams affecting water availability and quality	DWS, Umgeni Water, Mhlathuze Water, future WMAs
Marine and Coastal Resources	Decline in marine and coastal resources	Implement the Marine Protected Area Expansion Strategy, which aims to provide a network of MPAs to conserve biodiversity in a cost-effective way.	Immediate	Number of birds at selected estuaries in KZN	DEA
		Improve communication and establish MOUs between governmental, public and private research institutes to promote collaboration and reduce conflicts on resource use.	Immediate	Abundance of key focal species (catch per unit effort or CPUE) Abundance of threatened species and habitats (CPUE)	National and Provincial Conservation Agencies, SANBI
	Reduced Ecological functioning	Ensure proper implementation of the ICM Act, including the implementation of estuarine management plans, determining the estuarine reserve and formalising coastal setback lines. Enhance collection and monitoring of estuaries and coral reefs in KZN.	Immediate Immediate	Estuarine Health (Present Ecological State) Coral Bleaching ('bleaching response' index combines the frequency of bleaching with severity)	Local and Provincial Municipalities, Transnet (in some cases) DEA, SAEON, SANBI

KwaZulu-Natal Environment Outlook Report 2017

	Unsustainable use of coastal resources	<p>Promote appropriate implementation of aquaculture to allow for locally sustainably grown seafood, which may reduce pressure on wild stocks.</p> <p>Allocate funding for cross-boundary cooperation and research as well as knowledge sharing within the western Indian Ocean region.</p> <p>Increase engagement with the Western Indian Ocean Marine Science Association (WIOMSA) to improve regional cooperation in all aspects of coastal and marine sciences and management.</p> <p>Institute long-term datasets to monitor change.</p>	<p>Immediate</p> <p>Ongoing</p> <p>Immediate</p> <p>Immediate</p>	<p>State of important linefish (CPUE)</p> <p>State of crustaceans targeted by trawlers (CPUE)</p> <p>Subsistence harvesting of mussels (CPUE)</p> <p>Expansion of sand mining (in ha)</p>	DAFF, DST, DMR, SAEON
	Reduced protection of the coastal environment	<p>Implement the Marine Protected Area Expansion Strategy, which aims to provide a network of MPAs to conserve biodiversity in a cost-effective way.</p> <p>Improve the protection and monitoring of KZN's coastal resources in the face of climate change.</p>	<p>Immediate</p> <p>Immediate</p>	<p>Number and extent (in km²) of protected areas</p> <p>Enforcement and compliance with fisheries regulations (the number of marine and estuarine patrols)</p>	DEA, DAFF, Ezemvelo
	Pollution	<p>Continue awareness raising through "coastal clean-up events".</p> <p>Improve upstream management of pollutants and plastics.</p> <p>Expand the implementation of projects by community-driven groups such as the Durban uMngeni Conservation Trust (DUCT) and the African Marine Waste Network to remove litter and plastic.</p>	<p>Ongoing</p> <p>Ongoing</p> <p>Ongoing</p>	<p>Volume (in m³) of effluent discharged into the marine environment</p> <p>Amount (in tonnes) of plastics removed from the beaches</p> <p>Condition of invertebrate communities near effluent pipelines (CPUE)</p>	Local Municipalities, Ezemvelo

				Amount of litter in the coastal zone (the number of items collected)	
Economics	Lost revenue opportunities due to environmental degradation	<p>Calculate the financial gain of wildlife and ecotourism to the KZN economy.</p> <p>Calculate the value of ecological infrastructure to the KZN economy.</p>	<p>Immediate</p> <p>Medium term</p>	<p>Annual tourism revenue (in million Rand) of ecotourism to the KZN economy.</p> <p>Sporting event revenue for specific environmental events.</p>	EDTEA
	High population growth rate	<p>Promote involvement of women in education.</p> <p>Promote family planning and women's access to birth-control tools.</p>	<p>Ongoing</p> <p>Ongoing</p>	<p>Percentage of women finalising matric</p> <p>Percentage of women having access to birth-control tools</p> <p>The number of teenage pregnancies</p> <p>The number of women using government grants</p>	Department of Education, SALGA, Department of Agriculture and Rural Development
	High unemployment	<p>Invest in cleaner economic sectors to promote environmentally friendly employment strategies.</p> <p>Use fossil fuel tax to implement public expanded works programmes that focus on environmental programmes.</p> <p>Implement job sharing to increase employment but also shorten the length of the working year for individuals.</p> <p>Promote set up of private sector initiatives.</p>	<p>Long term</p> <p>Long term</p> <p>Immediate</p> <p>Immediate</p>	<p>Employment growth and contribution</p> <p>The number of responses from government to address unemployment</p> <p>The number of private sector initiatives</p>	EDTEA, Department of Education

KwaZulu-Natal Environment Outlook Report 2017

		Promote vocational training at schools.	Immediate	Percentage increase in certified vocational students	
	Growth of unsustainable economic sectors	<p>Increase focus on the green economy, especially waste beneficiation, and other non-resource-intensive industries such as tourism and business services (including business process outsourcing and ICT) to reduce outsourcing to other countries.</p> <p>Develop, implement and monitor regulations and laws to force businesses to comply with environmental standards.</p> <p>Raise awareness of unsustainable lifestyle standards.</p> <p>Revise trade agreements.</p> <p>Implement incentives for Foreign Direct Investment (FDI).</p>	<p>Immediate</p> <p>Medium term</p> <p>Immediate</p> <p>Medium/Long term</p>	<p>Economic sector growth</p> <p>Percentage of growth of skills in green sectors</p> <p>Percentage of people changing to more environmentally friendly lifestyle</p>	EDTEA
	Sustained low economic growth	<p>Promote investment in innovation, education and sustainable industries.</p> <p>Create a link between economic growth and employment.</p>	<p>Long term</p> <p>Immediate</p>	The number of businesses complying with environmental standards	EDTEA
Human Settlements	Population size growth resulting in increased need for basic services	<p>Provide interim services such as electricity, water, sanitation and refuse removal to informal settlements, with subsidised cost-recovery mechanisms.</p> <p>Revive home visits to remove stigma on family planning to stabilise population and household growth.</p> <p>Implement the New Draft White Paper on Human Settlement (2016).</p>	<p>Ongoing</p> <p>Ongoing</p> <p>Ongoing</p>	<p>Population size, growth, density and distribution</p> <p>Net migration into KZN</p> <p>Number and growth of households in KZN</p> <p>Prevalence of HIV/AIDS and TB</p>	EDTEA, Department of Agriculture and Rural Development, SALGA, Department of Health

KwaZulu-Natal Environment Outlook Report 2017

		<p>Promote access to communal gardens and opportunities for urban agriculture for food security.</p> <p>Facilitate land tenure rights in urban and rural areas.</p> <p>Plan for urban sprawl and allocate land for landfill sites, WWTW and other services in SDFs.</p> <p>Allocate space and identify alternatives for graves.</p> <p>Develop a Human Settlement Master Plan for traditional areas.</p>	<p>Ongoing</p> <p>Immediate</p> <p>Immediate/ Ongoing</p> <p>Medium term</p>	<p>Space (in ha) made available for food gardens</p> <p>The number of SDFs that include allocated land for urban sprawl, landfill sites, etc.</p>	
Presence of and perceived employment opportunities resulting in changes in spatial dynamics (rural/urban mix)	<p>Improve urban design in an effort to develop compact cities, avoid urban sprawl and enable equitable access to economic opportunities and services.</p> <p>Invest in public transport to improve mobility between rural, urban and peri-urban areas to increase population movement to and from urban and rural areas, sharing the burden and demand for resources and services.</p> <p>Investment in green jobs, such as tourism, renewable energy and green buildings, to alleviate poverty and income inequality and to reduce the negative impact on the environment.</p>	<p>Medium term</p> <p>Medium term</p> <p>Immediate/ Medium-term</p>	<p>Number of amended spatial plans and frameworks that promote more compact cities</p> <p>Level of public transport access in rural areas</p> <p>Budget allocated to promote green jobs</p>	EDTEA, Department of Agriculture and Rural Development, SALGA	
Increased income inequality and increased poverty	<p>Transform primary and secondary education so students understand environmental issues; special skills training is necessary to change the future projections of inequality.</p> <p>Search for funding for programmes to encourage youth employment.</p> <p>Capacity building for teachers to adapt teaching methods.</p>	<p>Long term</p> <p>Immediate</p> <p>Immediate</p>	<p>Human Development Index (including vocational training)</p> <p>The number of youth entrepreneurship</p> <p>The number of people living below R3 750 per month</p>	EDTEA, Department of Education, SALGA	

				The number of people over the age of 20 with matric or higher	
	Limited transport infrastructure	<p>Invest in moving freight to rail to free up transport budget for community use.</p> <p>Invest in and improve public transport networks and non-motorised alternatives.</p> <p>Improve spatial planning towards densification to make transport cheaper.</p>	<p>Long term</p> <p>Immediate</p> <p>Long term</p>	<p>Access to public transport and mode of transport</p> <p>The number of public and alternative transport options developed</p>	Department of Transport and Public Works, EDTEA
	Increasing crime	Provide social programmes and close relationships with law enforcement officials.	Long term	The number of reported crimes	SALGA
Waste	Limited waste management and services outside the cities	<p>Create jobs through waste management activities.</p> <p>Promote conversion of waste into energy.</p> <p>Introduce private contractors in waste service delivery where the municipal waste department is struggling to meet the demand by the number of households to be served.</p> <p>Implement approaches to waste reduction as part of an overall waste management strategy.</p> <p>Provide training in environmental and waste management technical expertise at the local level.</p> <p>Promote the re-use of organic waste, e.g. for gardens.</p>	<p>Immediate</p> <p>Immediate</p> <p>Immediate</p> <p>Ongoing</p> <p>Ongoing</p> <p>Immediate</p>	<p>Provincial operating revenue for waste management</p> <p>Provincial customer units (households) receiving a waste collection service</p> <p>Provincial waste collection capacity of local municipalities</p> <p>The number of households receiving waste service</p> <p>The number of waste collection centres</p>	COGTA, EDTEA, municipalities

KwaZulu-Natal Environment Outlook Report 2017

		Explore option for the re-use of waste, particularly plastics.	Immediate	The number of initiatives that re-use waste	
Monitoring of received and recycled waste		Promote recycling initiatives and raise awareness of potential recyclable industries or small-scale initiatives.	Immediate	Percentage of licensed municipal landfill sites	Waste facility
		Collect recyclables at the waste disposal facility.	Immediate	Amount of waste (in tonnes) to landfill per annum	
		Improve coordination of recyclers to get necessary volumes for higher returns.	Immediate	Amount of waste (in tonnes) recycled per annum	
		Formalise waste recycling.	Medium term	The number of municipality-driven recycling initiatives	
		Enforce monitoring of gases at landfill sites.	Immediate	Level of gases at landfill sites	
Development, adoption and implementation of Integrated Waste Management Plans (IWMPs)		Enforce the implementation of Annual Performance Reports.	Immediate	The number of ARPs produced	COGTA, EDTEA, municipalities
		Promote compliance with IWMPs at provincial and municipal level so that the plan is budgeted for in the provincial budget and during IDP reviews.	Immediate	The number of IWMPs implemented through IDPs	
		Update IWMPs every five years.	Immediate		
		Mainstream commitments of COP21 in terms of rolling out the provincial Municipal Waste to Energy Protocol, to contribute to GHG emission reductions.	Immediate		
		Develop an Action Plan with costing.			

KwaZulu-Natal Environment Outlook Report 2017

			Medium term		
	Waste management disposal sites (hazardous and general)	<p>Enforce the National Environmental Management: Waste Act (NEMWA) to divert hazardous and medical waste from landfill sites.</p> <p>Increase environmental monitoring and enforcement.</p> <p>Review the buffer areas around landfill sites and water treatment plants.</p> <p>Improve access by local communities to landfill sites by legalising use of ash.</p> <p>Develop a system to quantify e-waste to provide opportunities for job creation and economic development and to contribute to scaling-up of recycling technology.</p>	<p>Ongoing</p> <p>Immediate</p> <p>Immediate</p> <p>Immediate</p> <p>Medium term</p>	<p>The number of licensed hazardous waste disposal sites and facilities</p> <p>Amount of general and hazardous waste to landfill per annum (tonnes)</p> <p>Percentage of increase in licensed waste facilities and landfill sites</p> <p>Rate of increase in buffer zone</p>	DEA, EDTEA
	Development encroachment (planned and unplanned) onto landfill sites brings about health and nuisance impacts	<p>Monitor the health status of people living in proximity of landfill sites</p> <p>Improve spatial planning to allow sufficient space for landfill sites</p>	<p>Immediate</p> <p>Medium term</p>	Percentage of landfill airspace remaining (m ³).	
Energy	Limited access to energy	<p>Promote solar home systems (solar water heating and photovoltaics).</p> <p>Provide training for local maintenance of these systems.</p> <p>Promote unlocking of biomass energy from sugarcane and forestry as renewable energy option.</p>	<p>Ongoing</p> <p>Ongoing</p> <p>Immediate</p>	<p>Electrification levels</p> <p>Household energy source</p>	Department of Energy

KwaZulu-Natal Environment Outlook Report 2017

	Availability of primary energy and energy security	<p>Increase investment in wind, solar, biomass (large and small scale) and micro-hydro energy generation.</p> <p>Promote the use of green technologies to create opportunities to grow the green economy; for example, the local manufacture of parts and systems for sustainable energy provision. Involve people from the communities in implementing and maintaining the systems.</p> <p>Provide training to local communities on implementing, operating and maintaining green technologies.</p>	Medium term	<p>Provincial energy balance</p> <p>Renewable energy generation as percentage of total electricity consumption</p> <p>Energy per gross domestic product</p>	Local Municipalities, EDTEA, COGTA, DWS (because of water-restrictions for hydro-energy)
	Energy affordability	<p>Promote the use of alternatives to electricity for cooking and providing warm water.</p> <p>Promote the development of alternative and green energy sources in addition to electricity.</p>	<p>Immediate</p> <p>Ongoing</p>	<p>Household energy source</p> <p>Portion of household expenditure on energy</p>	Local Municipalities, DEA, ESKOM
	Limited maintenance of the existing energy infrastructure	<p>Promote greater coordination between regulatory authorities.</p> <p>Provide training on maintaining energy infrastructure.</p>	<p>Immediate</p> <p>Immediate</p>	Municipal expenditure on infrastructure maintenance	CETA, EDTEA (for training), TIKZN, the Sugar Industry (for example PAMSA), DARD
	Limited access to reliable and efficient transport	<p>Promoting the implementation of an efficient public transport system in eThekweni could have a significant impact on the reduction of fuel consumption and therefore harmful emissions.</p> <p>Allow for flexibility in the integration of the national and provincial policies regarding energy provision. Doing so could mean that biofuels make an important contribution to KZN.</p>	<p>Medium term</p> <p>Immediate</p>	<p>Liquid fuel sales</p> <p>Mode of transport</p> <p>Average travel time, average distance commuted</p>	Local Municipalities, Transnet, COGTA

KwaZulu-Natal Environment Outlook Report 2017

Governance	Substantial reductions in annual budgets for key government authorities and environmental NGOs	<p>Focus corporate social investment and enterprise development on environment-related issues, thereby enabling much-needed resources to be directed at critical ecological issues whilst enabling economic development, job creation and the establishment of SMMEs within the environmental sector.</p> <p>Raise awareness to enhance the understanding of the role that the environmental sector can play in enabling the corporate sector to meet its obligations in terms of corporate social investment and enterprise development.</p> <p>Include students for research to save costs.</p>	<p>Immediate</p> <p>Ongoing</p> <p>Immediate</p>	<p>The amount of funding allocated for conservation and environmental management</p> <p>The number of people allocated for KZN Ezemvelo</p> <p>Percentages of tasks delegated to local level</p>	KZN Ezemvelo, EDTEA
	Inadequate cooperative governance has resulted in conflicting priorities within government	<p>Increase focus on appropriate land-use practices in promoting rural development and land reform such as the Biodiversity Economy. This has the potential to address rural poverty, food security and climate change adaptation through the development of sustainable land-use practices centred on tourism and the wildlife industry.</p> <p>Promote cooperative governance by involving key government role players.</p> <p>Development of a Provincial SDF.</p>	<p>Immediate</p> <p>Immediate</p>	<p>The number of interactions between government, the private sector, NGOs and communities</p> <p>The number of applications approved against the SDF and biodiversity plans</p> <p>Capacity of government to cooperate and initiate new projects</p>	Local and District Municipalities, Amakhosi, NGOs, Dep of Rural Development
	Limited integrated planning between land administered by traditional authorities and municipalities	<p>Develop bioregional plans, in accordance with sections 40 and 41 of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This has considerable potential to improve environmental decision-making and integrate environmental issues into local government planning.</p> <p>Promote integrated coastal planning.</p>	<p>Long term</p>	<p>The number of cross-referenced government reports with other sectors</p> <p>The number of environmental management plans at local and provincial level</p>	COGTA

KwaZulu-Natal Environment Outlook Report 2017

		Set up institutional arrangements between local and traditional authorities.		The number of MOUs developed	
	Poor strategic planning and limited understanding of ecological and environmental processes within local government	Implement environmental programmes like the KZN Biodiversity Stewardship Programme. Increase capacity of local municipalities to undertake this planning using the NEMA.	Ongoing Ongoing	The number of training workshops provided to local municipalities on environmental strategic planning	M&E unit at COGTA
	Prolonged land claim and land reform processes in KZN create uncertainty around land tenure	Increase focus on appropriate land-use practices Promote cooperative governance by involving key government role players. This is required for the Biodiversity Economy to achieve its potential.	Immediate Immediate	The number of protected areas on community land through the Biodiversity Economy The number of initiatives, projects or programmes for developing and implementing appropriate land-use practices in promoting rural development and land reform	Ingonyama Trust, Dep of Rural Development, EDTEA, COGTA

**The KwaZulu-Natal Provincial Government Outlook Report
was compiled by the Department of Economic Development,
Tourism and Environment Affairs (EDTEA) with support from
EcoAfrica Consultants, Pty Ltd.**

