

## Biodiversity and ecosystem services on the African continent – What is changing, and what are our options?

Archer E. <sup>1,\*</sup>, Dziba L.E. <sup>2,25</sup>, Mulongoy K.J. <sup>3</sup>, Maoela M.A. <sup>4</sup>, Walters M. <sup>4</sup>, Biggs R. <sup>5</sup>, Salem M-C. Cormier <sup>26</sup>, Declerck F. <sup>7</sup>, Diaw M.C. <sup>8</sup>, Dunham A.E. <sup>9</sup>, Failler P. <sup>10</sup>, Gordon C. <sup>11</sup>, Harhash K.A. <sup>12</sup>, Kasisi R. <sup>13</sup>, Kizito F. <sup>14</sup>, Nyingi W.D. <sup>15</sup>, Oguge N. <sup>16</sup>, Osman-Elasha B. <sup>17</sup>, Stringer L.C. <sup>18</sup>, Tito De Morais Luis <sup>19</sup>, Assogbadjo A. <sup>20</sup>, Egoh B.N. <sup>21</sup>, Halmy M.W. <sup>22</sup>, Heubach K. <sup>23</sup>, Mensah A. <sup>11</sup>, Pereira L. <sup>24,26</sup>, Sitas N. <sup>5</sup>

- <sup>1</sup> Centre for Environmental Studies/Geography, Geoinformatics and Meteorology, University of Pretoria Cnr Lynnwood Road and Roper Street Hatfield, 0028, South Africa  
<sup>2</sup> South African National Parks, 643 Leyds St, Muckleneuk, Pretoria, 0027, South Africa  
<sup>3</sup> IEL, Montreal, Canada  
<sup>4</sup> Council for Scientific and Industrial Research, Pretoria, 0001, South Africa  
<sup>5</sup> Centre for Complex Systems in Transition (CST), University of Stellenbosch, Private Bag X1 Matieland 7602, South Africa  
<sup>6</sup> Institute of Research for Development, Marseille (IRD), France  
<sup>7</sup> EAT Foundation/Bioversity International, Parc Scientifique Agropolis II, 34397, Montpellier Cedex 5, France  
<sup>8</sup> African Model Forest Network, Yaounde, Cameroon  
<sup>9</sup> Department of Biosciences, Program in Ecology and Evolutionary Biology, Rice University, Houston, TX, 77005, United States  
<sup>10</sup> University of Portsmouth, Richmond Building Portland Street Portsmouth P01 3DE, United Kingdom  
<sup>11</sup> Institute for Environment and Sanitation Studies. College of Basic and Applied Sciences. University of Ghana, Legon, Accra, Ghana  
<sup>12</sup> Biodiversity Central Department, Ministry of State for Environmental Affairs, Cairo, Egypt  
<sup>13</sup> Université de Montréal Faculté de l'aménagement, 2900 Edouard Montpetit Blvd, Montreal, Quebec, H3T 1J4, Canada  
<sup>14</sup> International Centre for Tropical Agriculture (CIAT), Kigali, Rwanda  
<sup>15</sup> Ichthyology Department, National Museums of Kenya, Nairobi, Kenya  
<sup>16</sup> Centre for Advanced Studies in Environmental Law and Policy, University of Nairobi, Nairobi, Kenya  
<sup>17</sup> African Development Bank, Abidjan, Cote d'Ivoire  
<sup>18</sup> School of Earth and Environment, University of Leeds, Woodhouse Lane, Leeds, LS2 9JT, United Kingdom  
<sup>19</sup> IRD, Univ Brest, CNRS, Ifremer, LEMAR, F-29280 Plouzane, France  
<sup>20</sup> Faculty of Agronomic Sciences, University of Abomey-Calavi, 05 BP 1752, Cotonou, Benin  
<sup>21</sup> Earth System Science Department, University of California, Irvine, Croul Hall, Irvine, CA, 92697-3100, USA  
<sup>22</sup> Department of Environmental Sciences Faculty of Sciences, Alexandria University Cairo, Egypt  
<sup>23</sup> Palmengarten and Botanical Garden, Siesmayerstraße 61, 60323, Frankfurt am Main, Germany  
<sup>24</sup> School of Arts and Social Sciences of City, University of London, Northampton Square, Clerkenwell, London, EC1V 0HB, United Kingdom  
<sup>25</sup> Africa Centre for Conservation Ecology, Nelson Mandela University, South Africa  
<sup>26</sup> Centre for Complex Systems in Transition (CST), Stellenbosch University, South Africa and Stockholm Resilience Centre (SRC), Stockholm University, Sweden

\* Corresponding author : E. Archer, email address : [Emma.Archer@up.ac.za](mailto:Emma.Archer@up.ac.za)

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**Abstract :**

Throughout the world, biodiversity and nature's contributions to people are under threat, with clear changes evident. Biodiversity and ecosystem services have particular value in Africa– yet they are negatively impacted by a range of drivers, including land use and climate change. In this communication, we show evidence of changing biodiversity and ecosystem services in Africa, as well as the current most significant drivers of change. We then consider five plausible futures for the African continent, each underlain by differing assumptions. In three out of the five futures under consideration, negative impacts on biodiversity and ecosystem services are likely to persist. Those two plausible futures prioritizing environment and sustainability, however, are shown as the most likely paths to achieving long term development objectives without compromising the continent's biodiversity and ecosystem services. Such a finding shows clearly that achievement of such objectives cannot be separated from full recognition of the value of such services.

**Keywords :** Biodiversity, Ecosystem services, Africa, Degradation, Climate change

## 22 1. Introduction

23 Biodiversity and ecosystem services are facing serious threats globally, impacted by a range of  
24 often interacting drivers, including land use and climate change (IPBES 2019). Africa, a  
25 continent rich in biocultural diversity, is one of the last places on Earth with a significant, intact  
26 large mammal assemblage, and with a unique diversity of indigenous and local knowledge, the  
27 majority of which, as yet, remains largely undocumented. The unrealized potential of Africa's  
28 biodiversity, ecosystem services, spirituality, culture and identities places the continent in a  
29 unique position globally- it can serve as a source for generating development pathways that are  
30 truly sustainable, where people's wellbeing and needs can be met without negatively infringing on  
31 the environment. The continent's rich biocultural heritage is, however, rapidly being exploited to  
32 meet development needs both within and outside of the continent. This has placed Africa in a  
33 vulnerable position with regards to building a resilient future for its citizens, and for those people  
34 and ecosystems that depend on Africa's resources outside the continent.

35

36 In this short communication, we draw on the Intergovernmental Science-Policy Platform on  
37 Biodiversity and Ecosystem Services (IPBES) Regional Assessment Report on Biodiversity and  
38 Ecosystem Services for Africa – worked on by all authors. We show what is changing in  
39 biodiversity and ecosystem services on the African continent. We also identify future pathways  
40 and options for an African continent where long-term development objectives are recognized as  
41 inseparably connected to the conservation of the region's rich biocultural heritage.

42

## 43        2. . Material and approach

44        The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES)  
45        was established in 2012, with the intention of providing the most up to date and independent  
46        assessments of the state of biodiversity and ecosystem services (or nature's contributions to  
47        people) to support decision-making around the world. The Regional Assessment Report on  
48        Biodiversity and Ecosystem Services for Africa forms one of a suite of regional assessments,  
49        alongside those focusing on Asia-Pacific, Europe and Central Asia and the Americas, all of  
50        which were undertaken between 2015 and 2018.

51        The Africa Assessment was produced by 127 experts, including seven Fellows (early career  
52        scientists brought on at the start of the assessment); with support from 23 contributing authors.  
53        Authors were drawn largely from Africa. The report, as well as its Summary for Policymakers,  
54        was approved by the Member States of IPBES at the sixth session of the IPBES Plenary, in  
55        March 2018, in Medellín, Colombia.

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57

## 58        3. What is changing?

59        Over the past several decades, biodiversity and ecosystem services in Africa have become  
60        increasingly threatened by anthropogenic drivers, some of the most important of which include  
61        human migration and political insecurity, climate change, habitat degradation and conversion,  
62        unsustainable harvesting and illegal trade of wildlife, and invasive alien species (MA, 2005; IPBES,  
63        2018). Changes in land use and climate appear to be the most concerning of the drivers (more  
64        detail provided below); with land use change the primary driver of change and loss to date.  
65        Given current vulnerability to climate change in Africa (IPCC 2018), future changes in  
66        biodiversity and ecosystem services are likely to be exacerbated or driven by climate change,  
67        whether acting as a direct driver or in the case of multiple stressors. Natural drivers of  
68        biodiversity decline have also been increasing over the last two decades, including (but not  
69        limited to) diseases, pests and natural disasters (IPBES, 2018), likely as a result of human-driven  
70        environmental changes affecting the region (Daszak et al., 2000). Such increasing impacts have  
71        clear implications for a range of plants, invertebrates, fish, amphibians, reptiles, birds, mammals  
72        and micro-organisms (IPBES 2018).

73

74        Table 1 shows a qualitative assessment of change in intensity of drivers of change in biodiversity  
75        in Africa per sub-region and ecosystem type, as reported by parties to the Convention on  
76        Biological Diversity (CBD). We see here, for example, that climate change and habitat  
77        conversion are increasing in intensity, and may significantly impact both terrestrial/inland waters  
78        and coastal/marine biodiversity in all subregions.

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81

82 Table 1: Changes in biodiversity and the role of underlying direct and indirect drivers in Africa  
 83 shown per subregion and ecosystem type

84

**TABLE 1:** CHANGES IN BIODIVERSITY AND THE ROLE OF UNDERLYING DIRECT AND INDIRECT DRIVERS IN AFRICA SHOWN PER SUBREGION AND ECOSYSTEM TYPE

SUBREGIONS	ECOSYSTEM TYPE	DRIVERS OF BIODIVERSITY CHANGE							
		Direct drivers						Indirect drivers	
		Climate change	Habitat conservation	Overharvesting	Pollution	Invasive alien species	Illegal wildlife trade	Demographic change	Protected areas
CENTRAL AFRICA	Terrestrial/Inland waters	↗	↑	↑	↑	↑	↑	↑	↗
	Coastal/Marine	↗	↑	↑	↗	↗	↑	NI	↔
EAST AFRICA AND ADJACENT ISLANDS	Terrestrial/Inland waters	↑	↗	↑	↗	↗	↑	↑	↗
	Coastal/Marine	↑	↔	↗	↗	↗	↑	↑	↔
NORTH AFRICA	Terrestrial/Inland waters	↑	↗	↗	↗	↑	↔	→	→
	Coastal/Marine	↗	↗	↗	↗	↑	NI	→	→
SOUTHERN AFRICA	Terrestrial/Inland waters	↗	↗	↑	↗	↑	↗	↗	↗
	Coastal/Marine	↗	↗	↗	↗	↑	↗	↗	↗
WEST AFRICA	Terrestrial/Inland waters	↑	↑	↑	↗	↗	↑	↗	→
	Coastal/Marine	↑	↗	↗	↗	→	↑	↗	→

**DIRECTION OF ARROW:** Trend of the respective impact of the driver

High increase
 Moderate increase
 Low increase
 Decrease
 **NI** No information available
 Unchanged/Under control

85

86

87 It is well established that Africa is prone to the adverse impacts of climate change (see, for  
 88 example, Myhre et al., 2013; Wright et al., 2015; Connolly-Boutin & Smit, 2016; Li et al., 2019).  
 89 Temperatures throughout the continent are projected to rise more rapidly than the global rate

90 (IPBES, 2018; IPCC, 2018). In addition, there is a high probability that high intensity extreme  
91 rainfall events will increase in frequency (Akumaga & Tarhule, 2018). The most severe  
92 projections suggest that distribution, migration and population sizes of African plant species  
93 critical for food security (e.g., common bean) are likely to be affected by climate change (see  
94 Hummel et al., 2018). By 2100, it is estimated that climate change could result in significant loss  
95 of certain bird and mammal species (due to range retraction), and cause a decline in productivity  
96 of Africa's lakes by more than 20% (IPBES 2018).

97

98 In addition, climate change impacts on pests and pathogens are likely to significantly affect  
99 human health and the livestock sector throughout the continent (e.g., Bett et al., 2019; IPBES  
100 2018). Negative climate change impacts on marine and coastal environments (e.g. salinization of  
101 water and soil, coastal erosion) pose a substantial risk for fisheries and the regulating and cultural  
102 ecosystem services these systems provide. For instance, extreme ocean warming caused massive  
103 coral bleaching events in 1998 and 2016, which resulted in reef mortality of more than 50% in  
104 certain regions (Obura, 2016), particularly the Western Indian Ocean (Gudka et al., 2018).  
105 Climate change and marine heatwaves (Smale et al., 2019), coupled with marine protected areas  
106 for which spatial data is available covering only 2.6% of Africa's marine jurisdiction (Belle et al.,  
107 2015), increases the impacts of current and future harvesting pressures on marine resources.

108 Land cover change throughout the continent is already driving a loss of key natural assets and  
109 reducing the continent's capacity to support biodiversity. Land cover change includes intensive  
110 agriculture, unregulated conversions of intact forest, mining, and use for urban and infrastructure  
111 development (IPBES 2018). Effectively, we are seeing the impact of competing demand for land  
112 through urban/infrastructure development, extractive industries and agricultural expansion and  
113 intensification – an example here would be development and investment choices that strongly  
114 emphasize expansion and intensification of primary and extractive industries. An estimate of 20  
115 % of Africa's land surface is degraded due to direct drivers of change such as vegetation loss and  
116 adverse impacts on soils, including pollution, erosion, decreased fertility and salinization (Nyingi  
117 et al., 2018). In a significant finding, agricultural expansion appears as a dominant driver of  
118 biodiversity loss with unregulated conversion to agricultural land leading to loss and erosion of  
119 soils, habitats and water catchments, thus hampering Africa's long-term sustainable development  
120 (IPBES 2018). The interactions between land-use and climate change compound the impacts on  
121 biodiversity and ecosystem functioning, with ecosystems in environments that are climatically  
122 challenging displaying lowered resistance to land-use change (Peters et al., 2019).

123

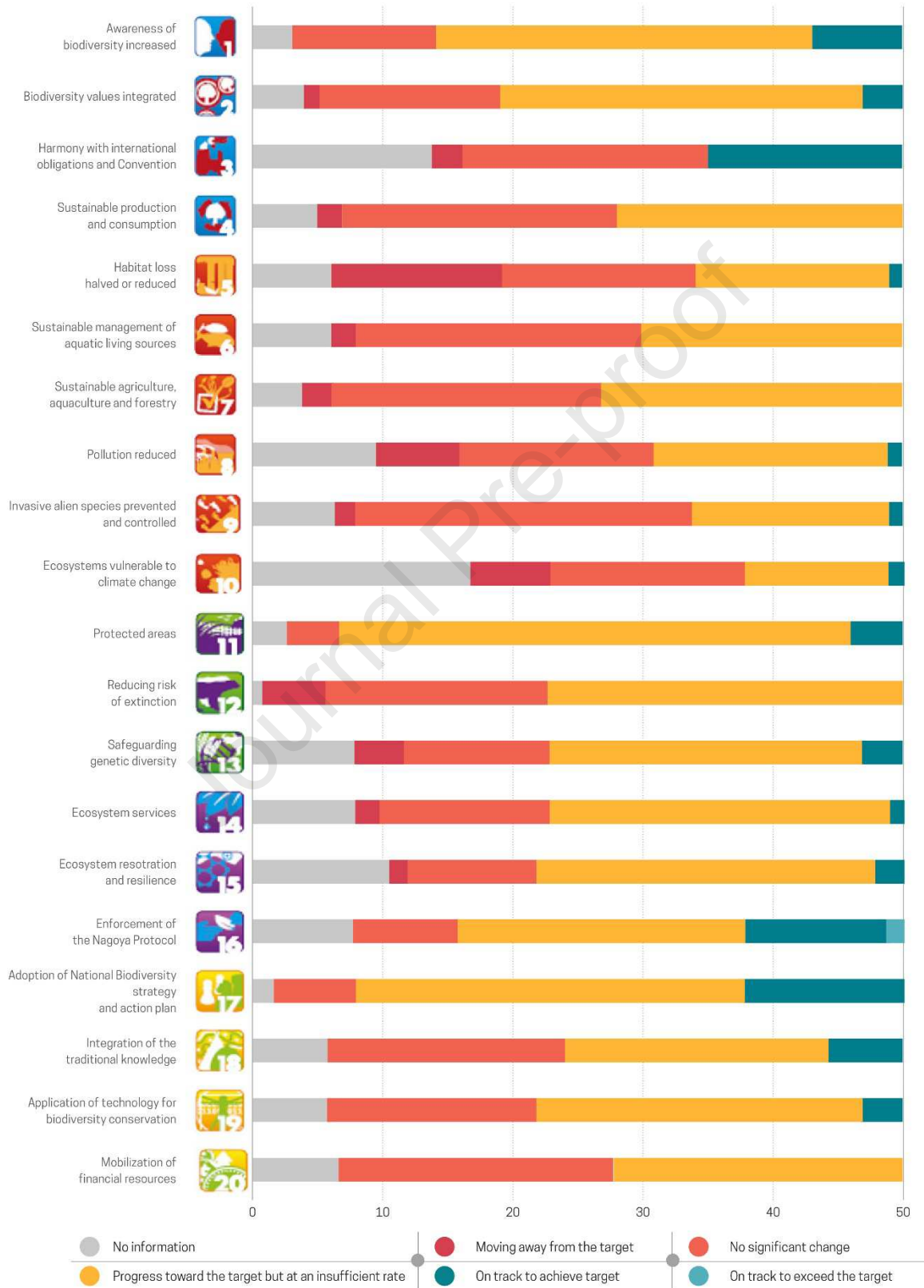
124 Tackling the negative impact of these drivers of change is a critical aspect for sustainable  
125 development on the continent. Most African countries have committed to achieving particular  
126 targets by particular deadlines – including (but not limited to) the Aichi Biodiversity targets and  
127 the Sustainable Development Goals; as well as, for the continent specifically, AU Agenda 2063.  
128 Some countries are progressing well towards their targets and are on track within the mandated  
129 timeframe; others are not (Figure 1). For instance, awareness of biodiversity (Aichi Target 1) has  
130 grown, exceeding the target in some countries (Stringer et al 2018). For Aichi Target 10 which  
131 calls for reduction of pressures on ecosystems vulnerable to climate change however, evidence of  
132 progress is lacking. Information to monitor progress is absent for several countries, while in six  
133 nations, the direction of travel is away from the target.

134

135 Figure 1: Countries' progress towards selected Aichi targets

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FIGURE 1: COUNTRIES' PROGRESS TOWARDS SELECTED AICHI TARGETS



137

138 Figure 1 also shows some progress in the case of Aichi Target 11 – namely, protected areas  
139 (although this finding should be placed in the context that much progress in the case of targets is  
140 still only effected on paper – we discuss more in terms of conservation success stories below).  
141 Thirty-nine countries are progressing towards the target, albeit at an insufficient rate (Stringer et  
142 al., 2018).

143 Opportunities exist to learn from examples of better practice, including how we might be able to  
144 scale up approaches and initiatives worthy of replication. One key example here, shown in Box  
145 1, is the West African Marine Protected Area Network that supports the growth and  
146 maintenance of Marine Protected Areas (MPAs) in West African countries (Failler et al. 2019).

147 Box 1: The West African Marine Protected Area Network

West African MPAs have been set-up initially for the protection of the fish biomass and/or certain emblematic species (turtles, manatees, birds, etc.). With the implementation of the National Determined Contribution in the context of the Paris Agreement on Climate Change, they further play the role of supplying key services for mitigation (blue carbon sequestration mainly) and for adaptation (coastal protection for instance). Overall, their habitats provide about 25% more regulating services than similar ones without special protection (Failler and Binet, 2012). A recent study, for example, showed that the Banc d'Arguin National Park, the largest African coastal MPA, would contribute to 20% of Mauritania's mitigation objective valued at 9 billion euros (with an annual running cost of only 1 million euros). Thus, the government, while recognising the key role of MPA, is taking steps toward the integration of coastal ecosystem services into its NDC (Tregarot et al., 2019). In other words, those measures put in place for the preservation of the biodiversity are now benefiting the society far beyond their initial mandate, with a very high return on public investment.

148

149 Indeed, as shown in Box 1 and elsewhere, protected areas serve as a key example of measures  
150 that are already contributing to the recovery of some threatened species. A further example here  
151 is the African Wild Dog (*Lycyon pictus*) in southern Africa (Davies-Mostert et al., 2009). Prudent  
152 land uses that maintain extensive, well-connected wildlife habitats, and reduce conflict with  
153 farmers through careful herding of livestock, have also been shown to facilitate recovery of the  
154 African wild dog in East Africa (Woodroffe, 2011), while Dube (2020) working in the Waterberg  
155 Biosphere Reserve in South Africa, highlights innovative measures for private landowners to  
156 monitor and track wild dogs, helping to reduce human-carnivore conflict. The example of the  
157 African Wild Dog is particularly interesting, since it includes land ownership and management  
158 that falls outside of, for example, formally designated national and provincial parks.

159 Other measures include control of alien invasive species and restoration of ecosystems (Nyingi  
160 et al., 2018), for example as articulated in the Volta Basin Authority's Strategic Action Plan. As at  
161 2015, 13.4% of the continent's terrestrial and 2.6 % of the marine realm had been declared as  
162 protected areas (Belle et al., 2015); with other sites identified as wetlands of international  
163 importance, significant bird and biodiversity areas, community conserved areas, UNESCO  
164 World Heritage Sites, and Biosphere reserves, amongst others.

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167 **4. Future pathways and options**

168 Understanding the directions of changes to biodiversity and ecosystem services, and their  
 169 contributions to human wellbeing can provide useful insights into how future changes could  
 170 impact progress towards key targets, such as those outlined in the African Union Agenda 2063,  
 171 the Sustainable Development Goals, and the post-2020 Aichi Biodiversity targets. The Africa  
 172 Regional Assessment considered five plausible futures (Table 2) based on an archetype approach  
 173 (Sitas and Harmáčková *et al.* in press) – all underpinned by various assumptions as to what each  
 174 future could look like.

175  
 176 Table 2: The Global Scenarios Group (GSG) archetypes (at the global level) with their key  
 177 characteristics and assumptions. Source: based on van Vuuren *et al.* (2012) (taken with  
 178 permission from Biggs *et al.* 2018)

**TABLE 2:** THE GLOBAL SCENARIOS GROUP (GSG) ARCHETYPES (AT THE GLOBAL LEVEL) WITH THEIR KEY CHARACTERISTICS AND ASSUMPTIONS

<b>GSG ARCHETYPE CATEGORY</b>	 <b>FORTRESS WORLD</b>	 <b>MARKET FORCES</b>	 <b>POLICY REFORM</b>	 <b>LOCAL SUSTAINABILITY</b>	 <b>REGIONAL SUSTAINABILITY</b>
MAIN OBJECTIVES	Security	Economic growth	Various goals	Local sustainability	Regional and global sustainability
GLOBAL POPULATION GROWTH	High	Low	Low	Medium	Low
GLOBAL TECHNOLOGY DEVELOPMENT	Slow	Rapid	Rapid	Ranging from slow to rapid	Ranging from mid to rapid
GLOBAL ECONOMIC DEVELOPMENT	Slow	Very rapid	Rapid	Ranging from mid to rapid medium	Rangin from slow to rapid
TRADE	Trade barriers	Globalization	Globalization	Trade barriers	Globalization
POLICIES AND INSTITUTIONS	Strong national governments	Policies create open markets	Policies reduce market failures	Local steering: local actors	Strong global governance
ENVIRONMENTAL MANAGEMENT	Reactive	Reactive	Both reactive and proactive	Proactive	Proactive

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181 The analysis showed that drivers of adverse changes in biodiversity and ecosystem services will  
 182 increase under all the scenarios (Biggs *et al.* 2018). In turn, such changes are likely to further  
 183 negatively impact on the ability of nature to contribute to human wellbeing and sustainable  
 184 development under most cases, except in regional and local sustainability and supportive policy  
 185 reform. It was unlikely that the African Union Agenda 2063, the SDGs and the Aichi  
 186 Biodiversity would be achieved in three out of the five different futures (see Figure 2). Overall,  
 187 only the regional and local sustainability futures offered pathways that offer Africa the greatest  
 188 chances to meet its development goals in an economic, social and environmentally friendly way  
 189 (Biggs *et al.* 2018).

190 All future scenarios present trade-offs but multiple synergies and policy alignments can support  
 191 the feasibility of more desirable, equitable and sustainable development options. Our assessment

192 demonstrated that the 'Fortress World' scenario was least likely to support Africa in the  
193 achievement of multiple goals and targets. Overall, this future was found to result in failure to  
194 achieve important development goals. Market forces (MF) and policy reform (PR) scenarios,  
195 representing 'Business-as-usual' approaches, offer some potential for achieving multiple policy  
196 goals. Nevertheless, these futures do not adequately support biodiversity conservation, nor the  
197 diverse benefits of nature to human well-being. Conditions under a more 'managed  
198 transformation' type of future, through policies and practices aligned with regional sustainability  
199 and, to a lesser extent, local sustainability, increased the likelihood of reaching a range of  
200 sustainable goals.

201 Taking all the goals, targets and aspirations together, no single scenario option allows Africa to  
202 achieve them all, despite that some pathways appear more desirable for decision makers. If  
203 Africa is to achieve a desirable future (including that envisaged by commitment to targets), it is  
204 critical that development of policy and practice be not only based on inclusive and responsible  
205 economic tools, but also support the conservation and sustainable use of natural resources and  
206 their benefits to people (Figure 2).

207

208

209 Figure 2: Likelihood of achieving key outcomes in Africa under different global  
 210 archetypes

**FIGURE 2:** LIKELIHOOD OF ACHIEVING KEY OUTCOMES (FOR PEOPLE AND PLANET) IN AFRICA UNDER DIFFERENT GLOBAL SCENARIOS ARCHETYPE



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## 214 5. Conclusions: where to from here?

215 As shown, there are options for Africa to balance development goals with protection of  
 216 biodiversity and ecosystem services – in fact, such protection forms the basis for achieving  
 217 development goals and improved human well-being. This may only be achieved, however,  
 218 through a commitment to transformative change. Progress towards achievement of the Aichi  
 219 Biodiversity Targets, SDGs, African Union's Agenda 2063, and the 2°C commitment under the  
 220 2015 Paris Agreement on climate change, whilst helping support aspirations for a prosperous  
 221 Africa, requires a fundamental shift away from the status quo.

222 Such transformative change towards sustainability, in line with aforementioned targets, will also  
223 depend on governance options that are able to harness synergies and deliver multiple benefits  
224 (IPBES 2018). By promoting policy coherence with adequate resources and capacity, and  
225 encouraging adaptive governance approaches that bring together different perspectives, a more  
226 equitable approach to accessing natural resources can ensue, helping to more effectively  
227 distribute costs and benefits. In addition, a more enabling environment that embraces Africa's  
228 diversity will help to ensure justice and fairness in access to the continent's diverse natural  
229 resources. A key finding here is that success stories regarding, for example, species stabilization  
230 or recovery, can not only rely on conservation within formal protected areas. This is, of course,  
231 a long addressed argument – but it is strongly emphasized in our review of those measures that  
232 might be scaled up. Measures that focus, for example, on private landowners or land managers  
233 outside of formally designated protected areas are clearly absolutely key (and must be evidence  
234 based). Africa has an ambitious development agenda that is critically tied to maintaining and  
235 sustainably harnessing its diverse natural systems, biodiversity and ecosystem services – as we  
236 have shown, they cannot be decoupled. In order to achieve this transformative agenda, it is  
237 necessary for all stakeholders to make use of effective policies that minimise trade-offs and  
238 maximise synergies under uncertainty so as to achieve a desirable and prosperous future for  
239 Africa.

240 We cannot conclude this paper without addressing COVID19, and the situation within which  
241 African conservation finds itself (this paper was first submitted in October 2019, and our context  
242 has, of course, changed dramatically). Certain models of conservation in Africa rely, to varying  
243 extents, on international tourism – and the recovery of this sector will be key to it's long term  
244 ability to achieve, for example, those biodiversity targets where regions and countries currently  
245 face difficulties (see, for example, Lindsey et al 2020 and their consideration of how to achieve  
246 conservation on the continent during COVID19, and in the post COVID19 period). In turn,  
247 conservation of biodiversity and ecosystem services is, of course, key to preventing and  
248 controlling zoonotic disease. As stated above, the continent has an ambitious development  
249 agenda – one that, along with the world at large, now faces possibly it's greatest economic  
250 challenge to date. To quote Lenzen et al in their recent paper in PLOSONe – 'How humanity  
251 reacts to this crisis will define the post pandemic world' (Lenzen et al 2020: 1). We can truly say  
252 that the post pandemic conservation world will help define our future, as a continent and as a  
253 planet.

254

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259

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**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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