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Appendix A

Supplementary table A1: Overall accuracy (%) and Kappa statistics for the classified images in Imbabazane and Okhahlamba local municipalities, KwaZulu-Natal, South Africa

Year	Imbabazane local municipality		Okhahlamba local municipality	
	Overall accuracy (%)	Kappa statistics	Overall accuracy (%)	Kappa statistics
1984	86.6	0.84	89.1	0.87
1991	92.7	0.91	92.3	0.91
2014	92.7	0.91	88.1	0.86

Supplementary table A2: Class-based accuracy of assessment of the classified land cover maps in Imbabazane local municipality, KwaZulu-Natal, South Africa

Year	Land cover	User accuracy (%)	Producer accuracy (%)	Omission error	Commission error
1984	Shrubland	80.3	94.2	0.1	0.2
	Plantation	97.2	92.1	0.1	0.0
	Grassland	96.2	78.6	0.4	0.0
	Fallow	90.2	98.2	0.0	0.1
	Other	74.5	81.4	0.1	0.1
	Cropland	84.6	100	0.0	0.2
	Settlement	68.1	100	0.0	0.4
	Bare	93.1	75	0.2	0.0
	Water body	85.0	94.4	0.1	0.2
1991	Shrubland	90.8	96.7	0.0	0.1
	Plantation	88.6	91.2	0.1	0.1
	Grassland	97.7	88.1	0.2	0.0
	Fallow	100.0	100.0	0.0	0.0
	Other	94.7	88.6	0.0	0.2
	Cropland	87.5	100.0	0.0	0.1
	Settlement	96.5	96.5	0.0	0.0
	Bare	95.8	95.8	0.0	0.0
	Water body	85.7	94.7	0.0	0.2
2014	Shrubland	82.9	92.6	0.1	0.2
	Plantation	78.0	95.1	0.0	0.3
	Grassland	99.1	87.8	0.3	0.0
	Fallow	89.4	98.3	0.0	0.1
	Other	77.8	93.3	0.0	0.1
	Cropland	100.0	100.0	0.0	0.0
	Settlement	97.8	95.7	0.0	0.0
	Bare	100.0	100.0	0.0	0.0
	Water body	96.2	100.0	0.0	0.0

Supplementary table A3: Class-based accuracy of assessment of the classified land cover maps in Okhahlamba local municipality, KwaZulu-Natal, South Africa

Year	Land cover class	User accuracy (%)	Producer accuracy (%)	Omission error	Commission error
1984	Shrubland	94.4	94.4	0.1	0.1
	Plantation	75.6	100.0	0.0	0.3
	Grassland	96.1	76.8	0.5	0.0
	Fallow	74.0	92.0	0.1	0.3
	Other	73.8	93.9	0.0	0.2
	Cropland	98.4	98.4	0.0	0.0
	Settlement	86.2	98.7	0.0	0.2
	Bare	97.2	79.5	0.2	0.0
	Water body	96.2	100.0	0.0	0.0
1991	Shrubland	85.3	98.3	0.0	0.2
	Plantation	86.2	100.0	0.0	0.1
	Grassland	96.3	83.1	0.3	0.0
	Fallow	87.1	93.7	0.1	0.1
	Other	90.9	96.8	0.0	0.0
	Cropland	98.8	100.0	0.0	0.0
	Settlement	82.2	100.0	0.0	0.2
	Bare	97.6	87.2	0.1	0.0
	Water body	100.0	100.0	0.0	0.0
2014	Shrubland	82.1	94.0	0.1	0.2
	Plantation	82.0	95.3	0.0	0.2
	Grassland	93.0	71.7	0.6	0.1
	Fallow	88.1	88.1	0.1	0.1
	Other	79.5	92.1	0.1	0.2
	Cropland	100.0	98.8	0.0	0.0
	Settlement	87.0	97.8	0.0	0.1
	Bare	100.0	94.4	0.0	0.0
	Water body	89.3	96.2	0.0	0.1

Appendix B

$$L = (P1 + -P1) \left(\frac{P+1}{\sum_{j=1, j \neq i}^{J} P+1} \right) \quad \text{Equation 1}$$

L= expected proportion of land cover 1 if loss to land cover 2 was a random process

P1+ = total percentage of land cover 1 in time 1

P1= persistence of land cover 1

P+1= total percentage of land cover 1 at time 2

$$\text{Observed} - \text{expected} \quad \text{Equation 2}$$

$$\frac{\text{Observed} - \text{expected}}{\text{expected}} \quad \text{Equation 3}$$

Supplementary table B1: Template of cross-tabulation matrix that will be used to compare maps at different points in time (adapted from Pontius et al.¹)

	Time 2			Total time 1	Loss
	Land cover 1	Land cover 2	Land cover 3		
Time 1					
Land cover 1	P ₁ 0 (0) [0]			P ₁₊	P ₁₊ - P ₁
Land cover 2		P ₂ 0 (0) [0]		P ₂₊	P ₂₊ - P ₂
Land cover 3			P ₃ 0 (0) [0]	P ₃₊	P ₃₊ - P ₃
Total time 2	P ₊₁	P ₊₂	P ₊₃	1	
Gain	P ₊₁ - P ₁	P ₊₂ - P ₂	P ₊₃ - P ₃		

Appendix C

Supplementary table C1: Cross-tabulation matrix used to analyse percentage of change in terms of loss (1984–1991) for Imbabazane local municipality, KwaZulu-Natal, South Africa

1991	1984									Total 1984	Loss
	Shrubland	Plantation	Grassland	Fallow	Other	Cropland	Settlement	Bare	Water body		
Shrubland	0.50	0.06	1.45	0.00	0.20	0.00	0.00	0.05	0.01	2.28	1.77
	<i>0.50</i>	<i>0.03</i>	<i>1.60</i>	<i>0.02</i>	<i>0.04</i>	<i>0.00</i>	<i>0.04</i>	<i>0.04</i>	<i>0.00</i>	2.28	1.77
	(0.00)	(0.03)	(-0.15)	(-0.02)	(0.16)	(0.00)	(-0.03)	(0.01)	(0.01)	(0.00)	(0.00)
	[0.00]	[0.97]	[-0.09]	[-1.00]	[4.36]	[-1.00]	[-0.95]	[0.20]	[2.72]	[0.00]	
Plantation	0.03	1.28	1.05	0.00	0.03	0.00	0.00	0.00	0.00	2.40	1.12
	<i>0.02</i>	<i>1.28</i>	<i>1.01</i>	<i>0.02</i>	<i>0.02</i>	<i>0.00</i>	<i>0.02</i>	<i>0.03</i>	<i>0.00</i>	2.40	1.12
	(0.02)	(0.00)	(0.04)	(-0.02)	(0.00)	(0.00)	(-0.02)	(-0.02)	(0.00)	(0.00)	(0.00)
	[0.97]	[0.00]	[0.04]	[-1.00]	[0.16]	[-1.00]	[-1.00]	[-0.83]	[-1.00]	[0.00]	
Grassland	0.60	0.26	71.04	0.64	1.15	0.10	0.27	0.68	0.03	74.76	3.72
	<i>0.50</i>	<i>0.67</i>	<i>71.04</i>	<i>0.55</i>	<i>1.74</i>	<i>0.07</i>	<i>0.79</i>	<i>1.54</i>	<i>0.04</i>	74.76	3.72
	(0.10)	(-0.41)	(0.00)	(0.09)	(-0.59)	(0.03)	(-0.52)	(-0.86)	(-0.01)	(0.00)	(0.00)
	[0.19]	[-0.61]	[0.00]	[0.16]	[-0.34]	[0.47]	[-0.66]	[-0.56]	[-0.31]	[0.00]	
Fallow	0.00	0.00	1.65	0.33	0.03	0.04	0.00	0.04	0.00	2.10	1.77
	<i>0.03</i>	<i>0.03</i>	<i>1.55</i>	<i>0.33</i>	<i>0.08</i>	<i>0.00</i>	<i>0.04</i>	<i>0.07</i>	<i>0.00</i>	2.10	1.77
	(-0.03)	(-0.03)	(0.10)	(0.00)	(-0.05)	(0.03)	(-0.04)	(-0.03)	(0.00)	(0.00)	(0.00)
	[-0.93]	[-0.93]	[0.07]	[0.00]	[-0.62]	[9.86]	[-1.00]	[-0.39]	[-0.63]	[0.00]	
Other	0.31	0.10	7.44	0.35	0.52	0.04	0.03	0.25	0.01	9.05	8.53
	<i>0.25</i>	<i>0.28</i>	<i>14.01</i>	<i>0.23</i>	<i>0.52</i>	<i>0.03</i>	<i>0.33</i>	<i>0.65</i>	<i>0.02</i>	9.05	8.53
	(0.06)	(-0.18)	(-6.57)	(0.12)	(0.00)	(0.01)	(-0.30)	(-0.40)	(-0.01)	(0.00)	(0.00)
	[0.26]	[-0.65]	[-0.47]	[0.50]	[0.00]	[0.27]	[-0.90]	[-0.62]	[-0.29]	[0.00]	
Cropland	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.03	0.02
	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.01</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	0.03	0.02
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	
Settlement	0.00	0.00	0.09	0.00	0.01	0.00	1.30	0.05	0.00	1.45	0.15
	<i>0.00</i>	<i>0.00</i>	<i>0.17</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>1.30</i>	<i>0.00</i>	<i>0.00</i>	1.45	0.15
	(0.00)	(0.00)	(-0.08)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)
	[-0.70]	[-1.00]	[-0.44]	[-1.00]	[0.83]	[-1.00]	[0.00]	[12.89]	[-1.00]	[0.00]	
Bare	0.07	0.03	5.85	0.03	0.14	0.01	0.39	1.29	0.00	7.82	6.53
	<i>0.10</i>	<i>0.12</i>	<i>5.93</i>	<i>0.09</i>	<i>0.14</i>	<i>0.01</i>	<i>0.13</i>	<i>1.29</i>	<i>0.01</i>	7.82	6.53
	(-0.03)	(-0.09)	(-0.07)	(-0.06)	(0.00)	(-0.01)	(0.26)	(0.00)	(0.00)	(0.00)	(0.00)
	[-0.33]	[-0.78]	[-0.01]	[-0.62]	[0.03]	[-0.47]	[1.94]	[0.00]	[-0.50]	[0.00]	
Water body	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.07	0.11	0.04
	<i>0.00</i>	<i>0.00</i>	<i>0.04</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.07</i>	0.11	0.04
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	[7.13]	[0.68]	[-0.11]	[-1.00]	[1.78]	[-1.00]	[-1.00]	[-1.00]	[0.00]	[0.00]	
Total 1991	1.53	1.73	88.63	1.36	2.08	0.19	2.00	2.37	0.12	100.00	
Gain	1.02	0.45	17.59	1.03	1.56	0.19	0.70	1.08	0.05		

**The numbers in grey shading indicate persistence of land cover. The number in italics is the expected if change was occurring at random; non-zero values indicate non-random change. The number in round brackets is the difference between persistence and expected. The number in square brackets is the number in round brackets divided by the expected value.*

Supplementary table C2: Cross-tabulation matrix used to analyse percentage of change in terms of loss (1991–2014) for Imbabazane local municipality, KwaZulu-Natal, South Africa

2014	1991									Total 1991	Loss
	Shrubland	Plantation	Grassland	Fallow	Other	Cropland	Settlement	Bare	Water body		
Shrubland	0.53	0.08	0.72	0.02	0.07	0.00	0.00	0.06	0.02	1.49	0.96
	<i>0.53</i>	<i>0.03</i>	<i>0.59</i>	<i>0.03</i>	<i>0.09</i>	<i>0.00</i>	<i>0.05</i>	<i>0.21</i>	<i>0.00</i>	<i>1.49</i>	<i>0.96</i>
	(0.00)	(0.05)	(0.13)	(-0.01)	(-0.02)	(0.00)	(-0.05)	(-0.15)	(0.01)	(0.00)	(0.00)
	[0.00]	[1.66]	[0.21]	[-0.34]	[-0.27]	[-0.25]	[-0.96]	[-0.71]	[4.93]	[0.00]	
Plantation	0.19	0.52	0.89	0.01	0.07	0.00	0.00	0.00	0.00	1.69	1.17
	<i>0.03</i>	<i>0.52</i>	<i>0.71</i>	<i>0.03</i>	<i>0.10</i>	<i>0.01</i>	<i>0.06</i>	<i>0.26</i>	<i>0.00</i>	<i>1.69</i>	<i>1.17</i>
	(0.16)	(0.00)	(0.18)	(-0.02)	(-0.03)	(-0.01)	(-0.06)	(-0.26)	(0.00)	(0.00)	(0.00)
	[5.12]	[0.00]	[0.25]	[-0.67]	[-0.26]	[-1.00]	[-1.00]	[-0.99]	[-1.00]	[0.00]	
Grassland	1.65	1.83	73.70	1.99	2.23	0.27	1.89	4.23	0.16	87.95	14.26
	<i>1.76</i>	<i>1.70</i>	<i>52.30</i>	<i>1.92</i>	<i>1.81</i>	<i>0.27</i>	<i>3.02</i>	<i>3.58</i>	<i>0.19</i>	<i>87.95</i>	<i>14.26</i>
	(-0.12)	(0.14)	(21.40)	(0.08)	(0.43)	(-0.01)	(-1.13)	(0.64)	(-0.03)	(0.00)	(0.00)
	[-0.07]	[0.08]	[0.41]	[0.04]	[0.24]	[-0.03]	[-0.38]	[0.18]	[-0.14]	[0.00]	
Fallow	0.00	0.00	0.61	0.63	0.03	0.05	0.00	0.01	0.00	1.34	0.71
	<i>0.02</i>	<i>0.02</i>	<i>0.57</i>	<i>0.62</i>	<i>0.02</i>	<i>0.00</i>	<i>0.03</i>	<i>0.04</i>	<i>0.00</i>	<i>1.34</i>	<i>0.71</i>
	(-0.02)	(-0.02)	(0.03)	(0.01)	(0.01)	(0.05)	(-0.03)	(-0.03)	(0.00)	(0.00)	(0.00)
	[-1.00]	[-1.00]	[0.06]	[0.01]	[0.53]	[17.62]	[-0.98]	[-0.67]	[-0.63]	[0.00]	
Other	0.16	0.06	1.33	0.06	0.20	0.01	0.03	0.19	0.01	2.03	1.84
	<i>0.05</i>	<i>0.05</i>	<i>1.49</i>	<i>0.05</i>	<i>0.98</i>	<i>0.01</i>	<i>0.08</i>	<i>0.10</i>	<i>0.01</i>	<i>2.03</i>	<i>1.84</i>
	(0.11)	(0.01)	(-0.16)	(0.01)	(-0.78)	(0.00)	(-0.06)	(0.09)	(0.00)	(0.00)	(0.00)
	[2.24]	[0.21]	[-0.11]	[0.10]	[-0.80]	[0.09]	[-0.70]	[0.93]	[0.43]	[0.00]	
Cropland	0.00	0.00	0.05	0.06	0.01	0.06	0.00	0.00	0.00	0.18	0.12
	<i>0.00</i>	<i>0.00</i>	<i>0.09</i>	<i>0.00</i>	<i>0.00</i>	<i>0.06</i>	<i>0.01</i>	<i>0.01</i>	<i>0.00</i>	<i>0.18</i>	<i>0.12</i>
	(0.00)	(0.00)	(-0.04)	(0.06)	(0.00)	(0.00)	(-0.01)	(-0.01)	(0.00)	(0.00)	(0.00)
	[-1.00]	[-1.00]	[-0.42]	[16.22]	[0.68]	[0.00]	[-1.00]	[-0.86]	[-0.74]	[0.00]	
Settlement	0.01	0.00	0.23	0.01	0.01	0.00	2.37	0.28	0.01	2.92	0.54
	<i>0.01</i>	<i>0.01</i>	<i>0.45</i>	<i>0.02</i>	<i>0.02</i>	<i>0.00</i>	<i>2.37</i>	<i>0.03</i>	<i>0.00</i>	<i>2.92</i>	<i>0.54</i>
	(0.00)	(-0.01)	(-0.22)	(-0.01)	(-0.01)	(0.00)	(0.00)	(0.25)	(0.01)	(0.00)	(0.00)
	[-0.26]	[-0.91]	[-0.50]	[-0.50]	[-0.44]	[-1.00]	[0.00]	[8.19]	[6.98]	[0.00]	
Bare	0.06	0.01	1.44	0.04	0.04	0.01	0.17	0.51	0.01	2.28	1.77
	<i>0.05</i>	<i>0.05</i>	<i>1.48</i>	<i>0.05</i>	<i>0.06</i>	<i>0.01</i>	<i>0.08</i>	<i>1.07</i>	<i>0.01</i>	<i>2.28</i>	<i>1.77</i>
	(0.01)	(-0.04)	(-0.04)	(-0.01)	(-0.02)	(0.00)	(0.09)	(-0.56)	(0.00)	(0.00)	(0.00)
	[0.30]	[-0.89]	[-0.03]	[-0.16]	[-0.35]	[0.01]	[1.02]	[-0.53]	[0.13]	[0.00]	
Water body	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.08	0.12	0.04
	<i>0.00</i>	<i>0.00</i>	<i>0.04</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.08</i>	<i>0.12</i>	<i>0.04</i>
	(0.00)	(0.00)	(-0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	[2.25]	[-0.92]	[-0.39]	[1.72]	[10.08]	[-1.00]	[-0.78]	[-0.18]	[0.00]	[0.00]	
Total 2014	2.60	2.50	78.98	2.83	2.67	0.40	4.46	5.29	0.28	100.00	
Gain	2.07	1.98	5.28	2.20	2.47	0.34	2.09	4.78	0.21		

*The numbers in grey shading indicate persistence of land cover. The number in italics is the expected if change was occurring at random; non-zero values indicate non-random change. The number in round brackets is the difference between persistence and expected. The number in square brackets is the number in round brackets divided by the expected value.

Supplementary table C3: Cross-tabulation matrix used to analyse percentage of change in terms of loss (1984–1991) for Okhahlamba local municipality, KwaZulu-Natal, South Africa

1991	1984									Total 1984	Loss
	Shrubland	Plantation	Grassland	Fallow	Other	Cropland	Settlement	Bare	Water body		
Shrubland	0.50	0.00	0.66	0.00	0.05	0.00	0.00	0.06	0.00	1.28	0.78
	<i>0.50</i>	<i>0.00</i>	<i>0.67</i>	<i>0.04</i>	<i>0.01</i>	<i>0.01</i>	<i>0.00</i>	<i>0.03</i>	<i>0.01</i>	<i>1.28</i>	<i>0.78</i>
	(0.00)	(0.00)	(-0.01)	(-0.04)	(0.03)	(-0.01)	(0.00)	(0.03)	(-0.01)	(0.00)	(0.00)
	[0.00]	[3.74]	[-0.02]	[-0.94]	[2.45]	[-0.61]	[-0.91]	[0.95]	[-0.73]	[0.00]	
Plantation	0.045	0.05	0.11	0.00	0.01	0.01	0.00	0.00	0.00	0.23	0.17
	<i>0.01</i>	<i>0.05</i>	<i>0.15</i>	<i>0.01</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.01</i>	<i>0.00</i>	<i>0.23</i>	<i>0.17</i>
	(0.04)	(0.00)	(-0.03)	(-0.01)	(0.01)	(0.00)	(0.00)	(-0.01)	(0.00)	(0.00)	(0.00)
	[7.89]	[0.00]	[-0.24]	[-0.86]	[2.42]	[0.94]	[-1.00]	[-0.88]	[-0.82]	[0.00]	
Grassland	2.20	0.04	74.32	3.01	1.23	0.65	0.16	2.61	0.27	84.49	10.17
	<i>1.81</i>	<i>0.06</i>	<i>74.32</i>	<i>2.91</i>	<i>1.04</i>	<i>0.95</i>	<i>0.37</i>	<i>2.30</i>	<i>0.74</i>	<i>84.49</i>	<i>10.17</i>
	(0.39)	(-0.02)	(0.00)	(0.10)	(0.19)	(-0.29)	(-0.21)	(0.31)	(-0.47)	(0.00)	(0.00)
	[0.22]	[-0.37]	[0.00]	[0.03]	[0.18]	[-0.31]	[-0.56]	[0.14]	[-0.63]	[0.00]	
Fallow	0.02	0.00	1.91	1.00	0.13	0.18	0.01	0.10	0.01	3.35	2.35
	<i>0.07</i>	<i>0.00</i>	<i>2.06</i>	<i>1.00</i>	<i>0.04</i>	<i>0.04</i>	<i>0.01</i>	<i>0.09</i>	<i>0.03</i>	<i>3.35</i>	<i>2.35</i>
	(-0.05)	(0.00)	(-0.15)	(0.00)	(0.08)	(0.14)	(-0.01)	(0.01)	(-0.02)	(0.00)	(0.00)
	[-0.76]	[-1.00]	[-0.07]	[0.00]	[2.03]	[3.70]	[-0.59]	[0.10]	[-0.54]	[0.00]	
Other	0.13	0.00	2.86	0.13	0.15	0.06	0.00	0.22	0.03	3.59	3.44
	<i>0.10</i>	<i>0.00</i>	<i>2.93</i>	<i>0.16</i>	<i>0.15</i>	<i>0.05</i>	<i>0.02</i>	<i>0.13</i>	<i>0.04</i>	<i>3.59</i>	<i>3.44</i>
	(0.03)	(0.00)	(-0.07)	(-0.03)	(0.00)	(0.01)	(-0.02)	(0.09)	(-0.01)	(0.00)	(0.00)
	[0.30]	[-0.09]	[-0.02]	[-0.19]	[-0.02]	[0.16]	[-0.77]	[0.66]	[-0.21]	[0.00]	
Cropland	0.00	0.00	0.50	0.17	0.04	0.51	0.00	0.03	0.02	1.28	0.77
	<i>0.02</i>	<i>0.00</i>	<i>0.65</i>	<i>0.04</i>	<i>0.01</i>	<i>0.51</i>	<i>0.00</i>	<i>0.03</i>	<i>0.01</i>	<i>1.28</i>	<i>0.77</i>
	(-0.02)	(0.00)	(-0.15)	(0.13)	(0.03)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
	[-0.83]	[-1.00]	[-0.23]	[3.54]	[1.95]	[0.00]	[-1.00]	[0.16]	[1.26]	[0.00]	
Settlement	0.00	0.00	0.03	0.00	0.00	0.00	0.40	0.10	0.01	0.55	0.14
	<i>0.00</i>	<i>0.00</i>	<i>0.12</i>	<i>0.01</i>	<i>0.00</i>	<i>0.00</i>	<i>0.40</i>	<i>0.01</i>	<i>0.00</i>	<i>0.55</i>	<i>0.14</i>
	(0.00)	(0.00)	(-0.09)	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)	(0.00)	(0.00)
	[-0.57]	[-0.82]	[-0.78]	[-0.53]	[-0.70]	[-0.22]	[0.00]	[18.34]	[2.50]	[0.00]	
Bare	0.01	0.00	3.05	0.39	0.07	0.10	0.02	0.57	0.06	4.28	3.70
	<i>0.11</i>	<i>0.00</i>	<i>3.21</i>	<i>0.18</i>	<i>0.07</i>	<i>0.07</i>	<i>0.03</i>	<i>0.57</i>	<i>0.05</i>	<i>4.28</i>	<i>3.70</i>
	(-0.10)	(0.00)	(-0.17)	(0.21)	(0.00)	(0.04)	(-0.01)	(0.00)	(0.00)	(0.00)	(0.00)
	[-0.87]	[-0.99]	[-0.05]	[1.14]	[-0.01]	[0.53]	[-0.26]	[0.01]	[0.09]	[0.00]	
Water body	0.00	0.00	0.13	0.00	0.01	0.01	0.00	0.02	0.79	0.96	0.17
	<i>0.01</i>	<i>0.00</i>	<i>0.14</i>	<i>0.01</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.01</i>	<i>0.79</i>	<i>0.96</i>	<i>0.17</i>
	(0.00)	(0.00)	(-0.02)	(-0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
	[-0.40]	[-1.00]	[-0.13]	[-0.77]	[2.58]	[2.30]	[0.24]	[2.11]	[0.00]	[0.00]	
Total 1991	2.92	0.10	83.56	4.71	1.68	1.53	0.60	3.72	1.19	100.00	
Gain	2.42	0.05	9.24	3.70	1.53	1.01	0.20	3.14	0.40		

*The numbers in grey shading indicate persistence of land cover. The number in italics is the expected if change was occurring at random; non-zero values indicate non-random change. The number in round brackets is the difference between persistence and expected. The number in square brackets is the number in round brackets divided by the expected value.

Supplementary table C4: Cross-tabulation matrix used to analyse percentage of change in terms of loss (1991–2014) for Okhahlamba local municipality, KwaZulu-Natal, South Africa

2014	1991									Total 1991	Loss
	Shrubland	Plantation	Grassland	Fallow	Other	Cropland	Settlement	Bare	Water body		
Shrubland	0.27	0.06	2.45	0.02	0.07	0.00	0.00	0.02	0.01	2.91	2.64
	<i>0.27</i>	<i>0.02</i>	<i>2.09</i>	<i>0.23</i>	<i>0.13</i>	<i>0.06</i>	<i>0.03</i>	<i>0.05</i>	<i>0.03</i>	<i>2.91</i>	<i>2.64</i>
	(0.00)	(0.04)	(0.37)	(-0.21)	(-0.06)	(-0.06)	(-0.02)	(-0.03)	(-0.02)	(0.00)	(0.00)
	[0.00]	[2.47]	[0.18]	[-0.91]	[-0.46]	[-0.94]	[-0.97]	[-0.62]	[-0.70]	[0.00]	
Plantation	0.00	0.04	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.06
	<i>0.00</i>	<i>0.04</i>	<i>0.05</i>	<i>0.01</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.10</i>	<i>0.06</i>
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	[5.56]	[0.00]	[0.11]	[-0.79]	[-0.22]	[-0.97]	[-0.91]	[-0.98]	[-1.00]	[0.00]	
Grassland	0.65	0.55	70.25	5.01	3.95	1.29	0.33	1.21	0.32	83.57	13.31
	<i>0.63</i>	<i>0.41</i>	<i>70.25</i>	<i>5.24</i>	<i>3.07</i>	<i>1.48</i>	<i>0.58</i>	<i>1.10</i>	<i>0.80</i>	<i>83.57</i>	<i>13.31</i>
	(0.02)	(0.14)	(0.00)	(-0.23)	(0.88)	(-0.19)	(-0.24)	(0.11)	(-0.48)	(0.00)	(0.00)
	[0.03]	[0.34]	[0.00]	[-0.04]	[0.29]	[-0.13]	[-0.42]	[0.10]	[-0.60]	[0.00]	
Fallow	0.01	0.01	1.34	2.49	0.22	0.52	0.02	0.07	0.01	4.69	2.20
	<i>0.02</i>	<i>0.02</i>	<i>1.88</i>	<i>2.49</i>	<i>0.12</i>	<i>0.06</i>	<i>0.02</i>	<i>0.04</i>	<i>0.03</i>	<i>4.69</i>	<i>2.20</i>
	(-0.02)	(-0.01)	(-0.54)	(0.00)	(0.10)	(0.46)	(0.00)	(0.02)	(-0.02)	(0.00)	(0.00)
	[-0.66]	[-0.53]	[-0.29]	[0.00]	[0.85]	[7.91]	[-0.14]	[0.57]	[-0.71]	[0.00]	
Other	0.03	0.01	1.10	0.19	0.25	0.07	0.00	0.01	0.02	1.67	1.43
	<i>0.02</i>	<i>0.01</i>	<i>1.18</i>	<i>0.13</i>	<i>0.25</i>	<i>0.04</i>	<i>0.01</i>	<i>0.03</i>	<i>0.02</i>	<i>1.67</i>	<i>1.43</i>
	(0.01)	(0.00)	(-0.08)	(0.06)	(0.00)	(0.03)	(-0.01)	(-0.02)	(0.00)	(0.00)	(0.00)
	[0.86]	[0.08]	[-0.07]	[0.49]	[-0.02]	[0.87]	[-0.71]	[-0.58]	[-0.14]	[0.00]	
Cropland	0.01	0.00	0.33	0.47	0.19	0.50	0.00	0.01	0.01	1.52	1.02
	<i>0.01</i>	<i>0.01</i>	<i>0.82</i>	<i>0.09</i>	<i>0.05</i>	<i>0.50</i>	<i>0.01</i>	<i>0.02</i>	<i>0.01</i>	<i>1.52</i>	<i>1.02</i>
	(0.00)	(-0.01)	(-0.49)	(0.38)	(0.14)	(0.00)	(-0.01)	(-0.01)	(0.00)	(0.00)	(0.00)
	[0.09]	[-0.93]	[-0.60]	[4.25]	[2.68]	[0.00]	[-0.88]	[-0.64]	[-0.14]	[0.00]	
Settlement	0.00	0.00	0.08	0.01	0.02	0.00	0.45	0.05	0.00	0.62	0.17
	<i>0.00</i>	<i>0.00</i>	<i>0.14</i>	<i>0.01</i>	<i>0.01</i>	<i>0.00</i>	<i>0.45</i>	<i>0.00</i>	<i>0.00</i>	<i>0.62</i>	<i>0.17</i>
	(0.00)	(0.00)	(-0.06)	(0.00)	(0.02)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
	[0.95]	[0.85]	[-0.44]	[-0.05]	[1.75]	[-0.91]	[0.00]	[14.31]	[0.97]	[0.00]	
Bare	0.05	0.00	2.49	0.34	0.23	0.03	0.13	0.42	0.06	3.74	3.32
	<i>0.03</i>	<i>0.02</i>	<i>2.64</i>	<i>0.29</i>	<i>0.17</i>	<i>0.08</i>	<i>0.03</i>	<i>0.42</i>	<i>0.05</i>	<i>3.74</i>	<i>3.32</i>
	(0.01)	(-0.02)	(-0.16)	(0.05)	(0.06)	(-0.05)	(0.10)	(0.00)	(0.01)	(0.00)	(0.00)
	[0.35]	[-0.93]	[-0.06]	[0.17]	[0.34]	[-0.66]	[2.85]	[0.00]	[0.16]	[0.00]	
Water body	0.00	0.00	0.17	0.03	0.08	0.01	0.00	0.02	0.87	1.18	0.31
	<i>0.00</i>	<i>0.00</i>	<i>0.25</i>	<i>0.03</i>	<i>0.02</i>	<i>0.01</i>	<i>0.00</i>	<i>0.01</i>	<i>0.87</i>	<i>1.18</i>	<i>0.31</i>
	(0.00)	(0.00)	(-0.08)	(0.00)	(0.06)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
	[0.51]	[-0.96]	[-0.32]	[0.03]	[4.05]	[0.87]	[-0.35]	[1.71]	[0.00]	[0.00]	
Total 2014	1.03	0.67	78.26	8.55	5.01	2.42	0.94	1.80	1.30	100.00	
Gain	0.76	0.63	8.01	6.07	4.77	1.92	0.50	1.38	0.42		

*The numbers in grey shading indicate persistence of land cover. The number in italics is the expected if change was occurring at random; non-zero values indicate non-random change. The number in round brackets is the difference between persistence and expected. The number in square brackets is the number in round brackets divided by the expected value.

Appendix D

Supplementary table D1: Transition level results for Imbabazane local municipality for 1984–1991 and 1991–2014, KwaZulu-Natal, South Africa

Transition from	To	1984–1991		Transition	1991–2014		Transition
		Transition intensity (% of 1991 category)	Uniform intensity (% of 1991 non-to category)		Transition intensity (% of 2014 category)	Uniform intensity (% of 2014 non-to category)	
Shrubland	Plantation	0.51	0.26	Targeted	0.14	0.04	Targeted
	Grassland	0.23	0.26	Avoided	0.04	0.04	Avoided
	Fallow	0.00	0.26	Avoided	0.03	0.04	Avoided
	Other	1.38	0.26	Targeted	0.11	0.04	Targeted
	Cropland	0.00	0.26	Avoided	0.03	0.04	Avoided
	Settlement	0.01	0.26	Avoided	0.00	0.04	Avoided
	Bare	0.31	0.26	Targeted	0.05	0.04	Targeted
	Water body	0.96	0.26	Targeted	0.26	0.04	Targeted
Plantation	Shrubland	0.32	0.16	Targeted	0.32	0.05	Targeted
	Grassland	0.17	0.16	Targeted	0.05	0.05	Avoided
	Fallow	0.00	0.16	Avoided	0.02	0.05	Avoided
	Other	0.19	0.16	Targeted	0.12	0.05	Targeted
	Cropland	0.00	0.16	Avoided	0.00	0.05	Avoided
	Settlement	0.00	0.16	Avoided	0.00	0.05	Avoided
	Bare	0.03	0.16	Avoided	0.00	0.05	Avoided
	Water body	0.00	0.16	Avoided	0.00	0.05	Avoided
Grassland	Shrubland	5.58	4.68	Targeted	2.75	2.95	Avoided
	Plantation	2.14	4.68	Avoided	3.19	2.95	Targeted
	Fallow	6.70	4.68	Targeted	3.07	2.95	Targeted
	Other	7.88	4.68	Targeted	3.64	2.95	Targeted
	Cropland	7.59	4.68	Targeted	2.87	2.95	Avoided
	Settlement	1.93	4.68	Avoided	1.84	2.95	Avoided
	Bare	4.12	4.68	Avoided	3.48	2.95	Targeted
	Water body	3.22	4.68	Avoided	2.52	2.95	Avoided
Fallow	Shrubland	0.02	0.26	Avoided	0.00	0.03	Avoided
	Plantation	0.02	0.26	Avoided	0.00	0.03	Avoided
	Grassland	0.27	0.26	Targeted	0.03	0.03	Targeted
	Other	0.21	0.26	Avoided	0.05	0.03	Targeted
	Cropland	2.78	0.26	Targeted	0.59	0.03	Targeted
	Settlement	0.00	0.26	Avoided	0.00	0.03	Avoided
	Bare	0.26	0.26	Targeted	0.01	0.03	Avoided
	Water body	0.09	0.26	Avoided	0.01	0.03	Avoided
Other	Shrubland	2.95	1.24	Targeted	0.27	0.08	Targeted
	Plantation	0.81	1.24	Avoided	0.10	0.08	Targeted
	Grassland	1.20	1.24	Avoided	0.07	0.08	Avoided
	Fallow	3.63	1.24	Targeted	0.09	0.08	Targeted
	Cropland	2.82	1.24	Targeted	0.09	0.08	Targeted
	Settlement	0.23	1.24	Avoided	0.02	0.08	Avoided
	Bare	1.48	1.24	Targeted	0.16	0.08	Targeted
	Water body	1.66	1.24	Avoided	0.12	0.08	Targeted

		1984–1991			1991–2014		
Transition from	To	Transition intensity (% of 1991 category)	Uniform intensity (% of 1991 non-to category)	Transition	Transition intensity (% of 2014 category)	Uniform intensity (% of 2014 non-to category)	Transition
Cropland	Shrubland	0.00	0.00	Avoided	0.00	0.01	Avoided
	Plantation	0.00	0.00	Avoided	0.00	0.01	Avoided
	Grassland	0.00	0.00	Avoided	0.00	0.01	Avoided
	Fallow	0.10	0.00	Targeted	0.09	0.01	Targeted
	Other	0.00	0.00	Avoided	0.01	0.01	Targeted
	Settlement	0.00	0.00	Avoided	0.00	0.01	Avoided
	Bare	0.00	0.00	Avoided	0.00	0.01	Avoided
	Water body	0.00	0.00	Avoided	0.00	0.01	Avoided
Settlement	Shrubland	0.01	0.02	Avoided	0.02	0.02	Avoided
	Plantation	0.00	0.02	Avoided	0.00	0.02	Avoided
	Grassland	0.02	0.02	Avoided	0.01	0.02	Avoided
	Fallow	0.00	0.02	Avoided	0.01	0.02	Avoided
	Other	0.04	0.02	Targeted	0.01	0.02	Targeted
	Cropland	0.00	0.02	Avoided	0.00	0.02	Avoided
	Bare	0.31	0.02	Targeted	0.23	0.02	Targeted
	Water body	0.00	0.02	Avoided	0.20	0.02	Targeted
Bare	Shrubland	0.64	0.96	Avoided	0.11	0.08	Targeted
	Plantation	0.21	0.96	Avoided	0.01	0.08	Avoided
	Grassland	0.94	0.96	Avoided	0.08	0.08	Avoided
	Fallow	0.37	0.96	Avoided	0.07	0.08	Avoided
	Other	0.99	0.96	Targeted	0.06	0.08	Avoided
	Cropland	0.51	0.96	Avoided	0.08	0.08	Targeted
	Settlement	2.81	0.96	Targeted	0.16	0.08	Targeted
	Water body	0.47	0.96	Avoided	0.09	0.08	Targeted
Water body	Shrubland	0.05	0.01	Targeted	0.01	0.00	Targeted
	Plantation	0.01	0.01	Avoided	0.00	0.00	Avoided
	Grassland	0.01	0.01	Avoided	0.00	0.00	Avoided
	Fallow	0.00	0.01	Avoided	0.01	0.00	Targeted
	Other	0.02	0.01	Targeted	0.02	0.00	Targeted
	Cropland	0.00	0.01	Avoided	0.00	0.00	Avoided
	Settlement	0.00	0.01	Avoided	0.00	0.00	Avoided
	Bare	0.00	0.01	Avoided	0.00	0.00	Avoided

Supplementary table D2: Transition level results for Okhahlamba local municipality for 1984–1991 and 1991–2014, KwaZulu-Natal, South Africa

		1984–1991			1991–2014		
Transition from	To	Transition intensity (% of 1991 category)	Uniform intensity (% of 1991 non-to category)	Transition	Transition Intensity (% of 2014 category)	Uniform intensity (% of 2014 non-to category)	Transition
Shrubland	Plantation	0.54	0.11	Targeted	0.40	0.12	Targeted
	Grassland	0.11	0.11	Avoided	0.14	0.12	Targeted
	Fallow	0.01	0.11	Avoided	0.01	0.12	Avoided
	Other	0.40	0.11	Targeted	0.06	0.12	Avoided
	Cropland	0.04	0.11	Avoided	0.01	0.12	Avoided
	Settlement	0.01	0.11	Avoided	0.00	0.12	Avoided
	Bare	0.22	0.11	Targeted	0.04	0.12	Avoided
	Water body	0.03	0.11	Avoided	0.03	0.12	Avoided
Plantation	Shrubland	0.22	0.02	Targeted	0.02	0.00	Targeted

		1984–1991		1991–2014			
Transition from	To	Transition intensity (% of 1991 category)	Uniform intensity (% of 1991 non-to category)	Transition	Transition Intensity (% of 2014 category)	Uniform intensity (% of 2014 non-to category)	Transition
	Grassland	0.02	0.02	Avoided	0.00	0.00	Targeted
	Fallow	0.00	0.02	Avoided	0.00	0.00	Avoided
	Other	0.08	0.02	Targeted	0.00	0.00	Avoided
	Cropland	0.05	0.02	Targeted	0.00	0.00	Avoided
	Settlement	0.00	0.02	Avoided	0.00	0.00	Avoided
	Bare	0.00	0.02	Avoided	0.00	0.00	Avoided
	Water body	0.00	0.02	Avoided	0.00	0.00	Avoided
Grassland	Shrubland	10.76	8.83	Targeted	2.75	2.66	Targeted
	Plantation	5.56	8.83	Avoided	3.56	2.66	Targeted
	Fallow	9.12	8.83	Targeted	2.54	2.66	Avoided
	Other	10.44	8.83	Targeted	3.42	2.66	Targeted
	Cropland	6.08	8.83	Avoided	2.32	2.66	Avoided
	Settlement	3.90	8.83	Avoided	1.55	2.66	Avoided
	Bare	10.03	8.83	Targeted	2.93	2.66	Targeted
Fallow	Water body	3.23	8.83	Avoided	1.06	2.66	Avoided
	Shrubland	0.09	0.35	Avoided	0.04	0.10	Avoided
	Plantation	0.00	0.35	Avoided	0.05	0.10	Avoided
	Grassland	0.33	0.35	Avoided	0.07	0.10	Avoided
	Other	1.07	0.35	Targeted	0.19	0.10	Targeted
	Cropland	1.65	0.35	Targeted	0.93	0.10	Targeted
	Settlement	0.14	0.35	Avoided	0.09	0.10	Avoided
Other	Bare	0.39	0.35	Targeted	0.16	0.10	Targeted
	Water body	0.16	0.35	Avoided	0.03	0.10	Avoided
	Shrubland	0.65	0.50	Targeted	0.12	0.07	Targeted
	Plantation	0.46	0.50	Avoided	0.07	0.07	Targeted
	Grassland	0.49	0.50	Avoided	0.06	0.07	Avoided
	Fallow	0.40	0.50	Avoided	0.10	0.07	Targeted
	Cropland	0.58	0.50	Targeted	0.12	0.07	Targeted
Cropland	Settlement	0.12	0.50	Avoided	0.02	0.07	Avoided
	Bare	0.83	0.50	Targeted	0.03	0.07	Avoided
	Water body	0.39	0.50	Avoided	0.06	0.07	Avoided
	Shrubland	0.02	0.11	Avoided	0.05	0.05	Avoided
	Plantation	0.00	0.11	Avoided	0.00	0.05	Avoided
	Grassland	0.09	0.11	Avoided	0.02	0.05	Avoided
	Fallow	0.51	0.11	Targeted	0.24	0.05	Targeted
Settlement	Other	0.33	0.11	Targeted	0.17	0.05	Targeted
	Settlement	0.00	0.11	Avoided	0.01	0.05	Avoided
	Bare	0.13	0.11	Targeted	0.02	0.05	Avoided
	Water body	0.25	0.11	Targeted	0.04	0.05	Avoided
	Shrubland	0.01	0.02	Avoided	0.01	0.01	Avoided
	Plantation	0.00	0.02	Avoided	0.01	0.01	Avoided
	Grassland	0.00	0.02	Avoided	0.00	0.01	Avoided
Bare	Fallow	0.01	0.02	Avoided	0.01	0.01	Avoided
	Other	0.01	0.02	Avoided	0.02	0.01	Targeted
	Cropland	0.02	0.02	Avoided	0.00	0.01	Avoided
	Bare	0.40	0.02	Targeted	0.12	0.01	Targeted
	Water body	0.07	0.02	Targeted	0.01	0.01	Targeted
	Shrubland	0.07	0.55	Avoided	0.20	0.15	Targeted
	Plantation	0.00	0.55	Avoided	0.01	0.15	Avoided
Water body	Grassland	0.52	0.55	Avoided	0.14	0.15	Avoided
	Fallow	1.18	0.55	Targeted	0.17	0.15	Targeted
	Other	0.62	0.55	Targeted	0.20	0.15	Targeted
	Cropland	0.97	0.55	Targeted	0.05	0.15	Avoided
	Settlement	0.47	0.55	Avoided	0.61	0.15	Targeted
	Water body	0.69	0.55	Targeted	0.18	0.15	Targeted
	Bare	Shrubland	0.01	0.02	Avoided	0.02	0.01
Plantation		0.00	0.02	Avoided	0.00	0.01	Avoided
Grassland		0.02	0.02	Avoided	0.01	0.01	Avoided
Fallow		0.01	0.02	Avoided	0.01	0.01	Avoided
Other		0.09	0.02	Targeted	0.07	0.01	Targeted
Cropland		0.08	0.02	Targeted	0.03	0.01	Targeted
Settlement		0.03	0.02	Targeted	0.01	0.01	Avoided
	Bare	0.08	0.02	Targeted	0.04	0.01	Targeted

Appendix E

Supplementary table E1: Summary of survey responses ($n=30$) of the locals in Imbabazane local municipality, Kwazulu-Natal, South Africa. The data show these relating to both socio-economic and political dynamics.

Theme related to question asked	Proportion of respondents (%)		
	Increased	Decreased	Remained the same
1. Changes in the number of homesteads	90	10	0
2. People following cultural practices in recent times compared to before	10	66.7	23.3
3. Who had authority to govern land use before 1994?	Chief	Government	Other people
	60	0	40
4. Does culture affect land use?	Yes	No	
	80	20	

Supplementary table E2: Summary of survey responses ($n=30$) of the locals in Okhahlamba local municipality, Kwazulu-Natal, South Africa. The data show these relating to both socio-economic and political dynamics.

Theme related to question asked	Proportion of respondents (%)		
	Increased	Decreased	Remained the same
1. Changes in the number of homesteads	100	0	0
2. People following cultural practices in recent times compared to before	3.3	90	6.7
3. Who had authority to govern land use before 1994?	Chief	Government	Other people
	96.7	0	3.3
4. Does culture affect land use?	Yes	No	
	60	40	

Reference

1. Pontius Jr RG, Shusas E, McEachern M. Detecting important categorical land changes while accounting for persistence. *Agric Ecosyst Environ.* 2004;101(2–3):251–268. <https://doi.org/10.1016/j.agee.2003.09.008>