

SOUTH AFRICA

LAND & WATER USE



TABLE 1
Areas and percentage change of land cover groups between 1990 and 2013/14 for South Africa.

Land cover group	1990 Area (km²)	2013-14 Area (km²)	Change (%)
Waterbodies (WB)	16900	15730	-0.124
Wetlands (WTL)	11511	7737	-0.400
Indigenous Forest (INF)	2872	3261	0.041
Thicket / Dense bush (TDB)	49848	62559	1.349
Woodland / Open bush (WOB)	75092	91543	1.746
Grassland (GRS)	201374	195144	-0.661
Low shrubland (LSB)	282515	281646	-0.092
Mines (MNS)	2168	2460	0.031
Bare non-vegetated (BNV)	106414	99588	-0.724
Plantations / Woodlots (PWD)	14392	14018	-0.040
Cultivated commercial annuals (CCA)	88172	82170	-0.637
Cultivated perennial (CPE)	3639	7630	0.424
Cultivated subsistence (CSB)	14889	15399	0.054
Low shrubland (LSB)	51898	41581	-1.095
Urban	20619	21835	0.129

WARMS DATABASE (updated up to August 2016)

The highest water use volumes were registered at National level for taking water (18.5 billion m³ a⁻¹) and for storing water (5.2 billion m³), followed by disposal of waste (4.5 billion m³ a⁻¹), discharging wastewater (1.2 billion m³ a⁻¹), removing underground water (1.1 billion m³ a⁻¹) and afforestation (1.0 billion m³ a⁻¹). A minor water use was found to be irrigation with wastewater at about 0.3 billion m³ a⁻¹.

By water resource types, water is taken mainly from water schemes (50.8%), rivers/streams (27.8%), boreholes (13.5%), dams (6.4%) and spring/eyes (1.0%).

The highest water withdrawals per sector are for agricultural irrigation (12.0 billion m³ a⁻¹ or 64.8% of the total), water supply services (2.7 billion m³ a⁻¹ or 14.7%), urban industry (2.5 billion m³ a⁻¹ or 13.3%), mining (0.8 billion m³ a⁻¹ or 4.3%) and non-urban industry (0.3 billion m³ a⁻¹ or 1.6%).

General trends in water use at national scale are a reflection of population size, degree of urbanisation, economic activities, geography and land use.

Industrial water use is the highest in Gauteng and Western Cape. A large portion of non-urban industrial water use is in KwaZulu-Natal and Mpumalanga. Discharging wastewater is associated with urban areas and industry. Large scale irrigation with wastewater is limited to Breede-Gouritz (0.15 billion m³ a⁻¹) and Eastern Cape (0.07 billion m³ a⁻¹).

Water use for mining is the highest in Mpumalanga (0.4 billion m³ a⁻¹), followed by North West (0.1 billion m³ a⁻¹), Lower Vaal (0.09 billion m³ a⁻¹), Gauteng (0.07 billion m³ a⁻¹) and Free State (0.05 billion m³ a⁻¹). Removing underground water is mainly associated with dewatering mines.

In all provinces, the largest water use is for agricultural irrigation, except Gauteng. Water use for aquaculture is by far the most represented in Mpumalanga (0.03 billion m³ a⁻¹). Water use for livestock watering is negligible compared to other sectors (0.3% of total countrywide). By far the largest water use in power generation is in Limpopo (0.03 billion m³ a⁻¹). The largest volumes of water registered for recreation (0.04% of total countrywide) are in North West and Eastern Cape.

NATIONAL LAND COVER (NLC) MAPS of 1990 & 2013/14:

Changes in land cover were recorded between 1990 and 2013/14 with increases in woodland/open bush (+1.746%) and thicket/dense bush (+1.349%), whilst bare non-vegetated land (-0.724%) and grassland (-0.661%) decreased. More profitable perennial crops (+0.424%) increased at the expense of annuals (-0.637%). Urban areas increased by +0.129%. A concern is the decrease of areas under wetlands (-0.400%) and fynbos (-0.661%).

The largest areas of the country are covered by **low shrubland (281,646 km²)** and **grassland (195,144 km²)** (Figure 1).

FIGURE 1
Land cover groups based on the National Land Cover (NLC) map of 2013/14 for South Africa.

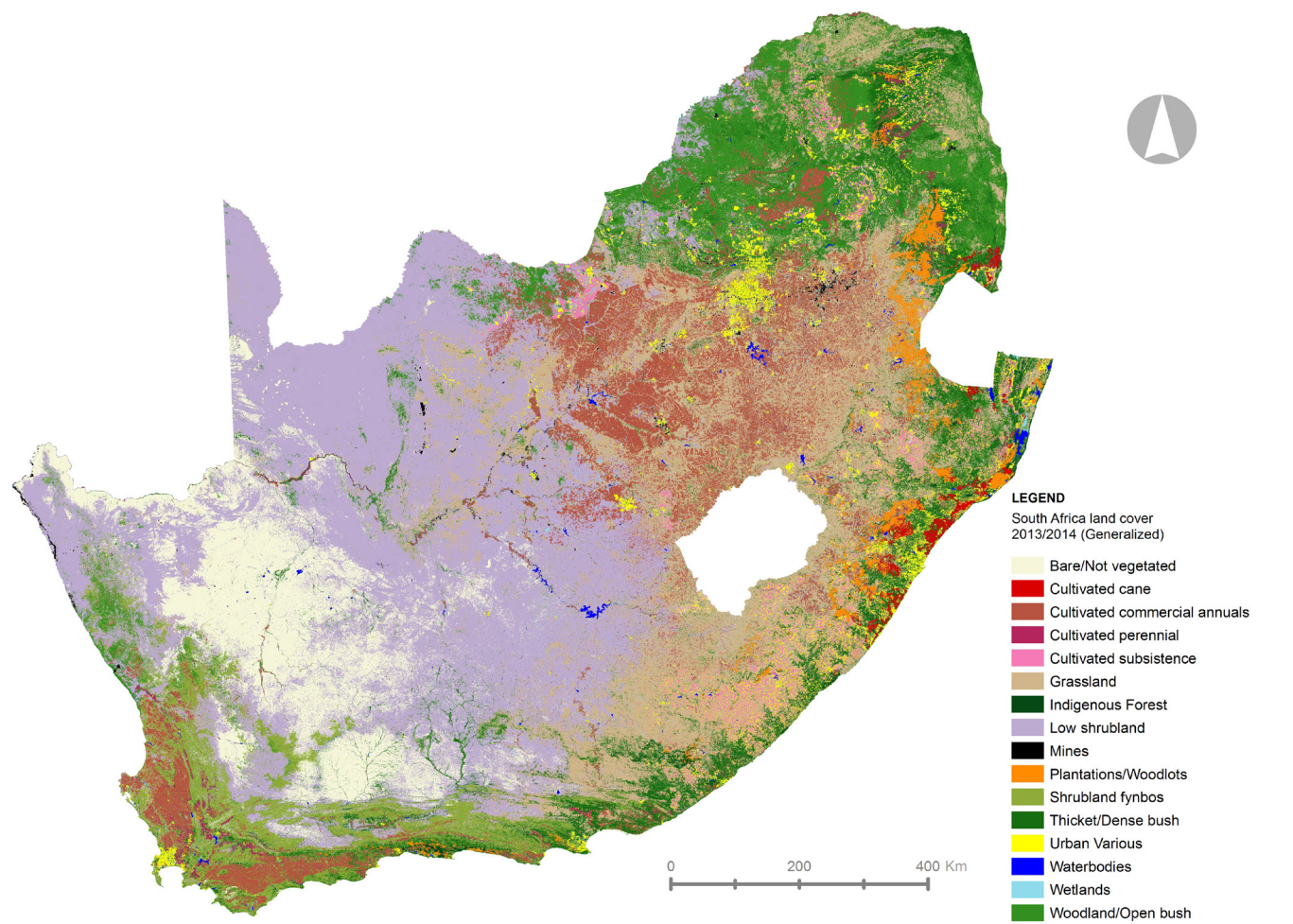


FIGURE 2
Annual ETLook evapotranspiration (ET) in 2014/15 for South Africa.

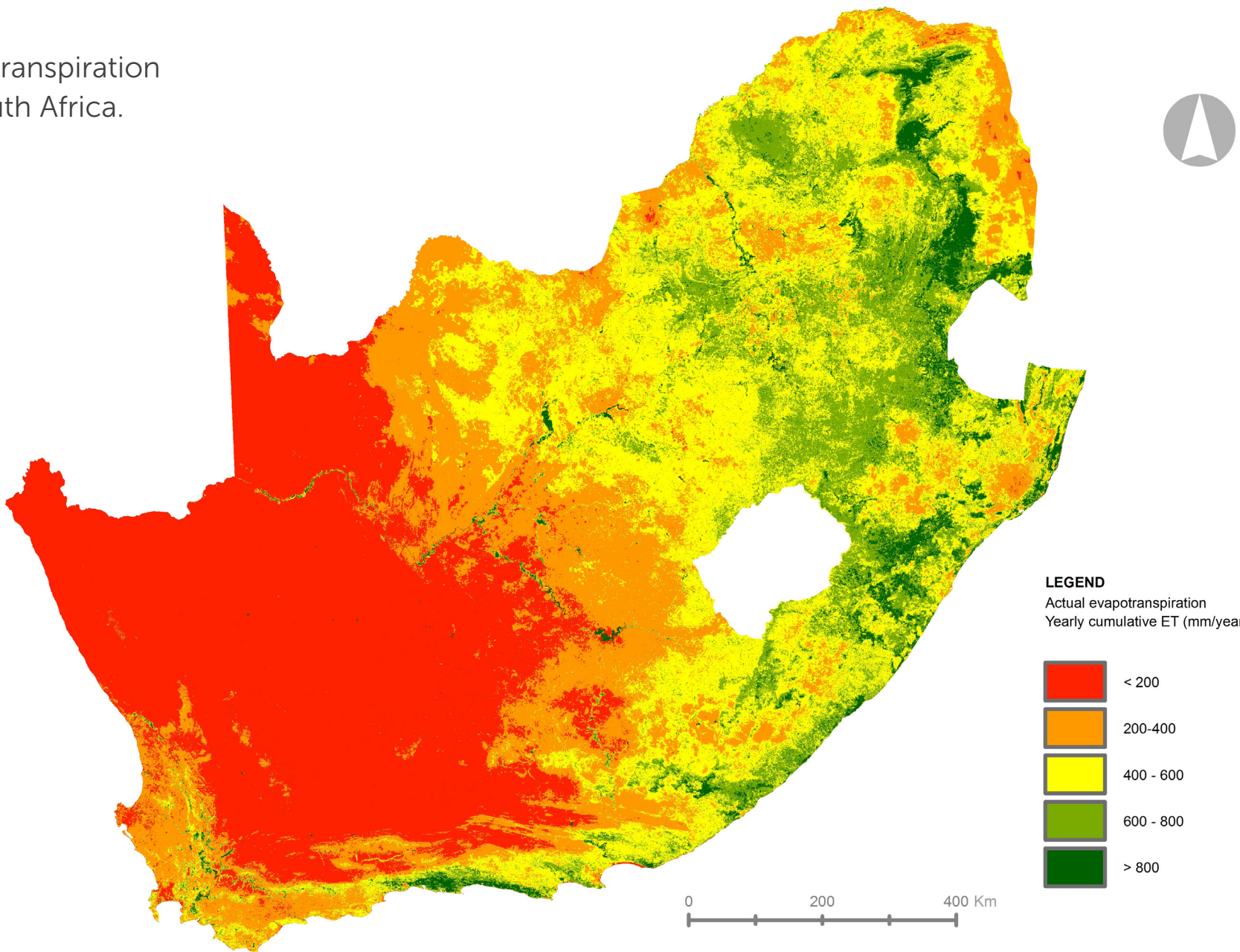


TABLE 2
Water use statistics for land cover groups based on annual ETLook data in 2014/15 for South Africa.

Land use	Water use statistics						
	MEAN mm (a⁻¹)	MEDIAN (mm a⁻¹)	MIN (mm a⁻¹)	MAX (mm a⁻¹)	STD (mm a⁻¹)	AREA (km²)	CUM (Mm³ a⁻¹)
Waterbodies (WB)	1463	1779	2	3066	806	3443	5037
Wetlands (WTL)	618	615	3	2969	308	7686	4749
Indigenous Forest (INF)	848	864	34	2684	219	3255	2762
Thicket / Dense bush (TDB)	532	537	2	3066	212	62184	33094
Woodland / Open bush (WOB)	435	445	2	3066	177	91181	39667
Grassland (GRS)	489	494	2	3036	158	194768	95156
Shrubland fynbos (SHF)	257	229	2	2457	160	41577	10677
Low shrubland (LSB)	201	167	2	3066	136	278296	55996
Cultivated commercial annuals (CCA)	520	525	2	3031	180	82168	42768
Cultivated perennial (CPE)	752	720	7	2795	339	4077	3066
Cultivated subsistence (CSB)	513	507	19	2965	139	15371	7880
Cultivated cane (CC)	787	776	145	2359	201	3545	2790
Plantations / Woodlots (PWD)	837	838	12	2920	222	14008	11725
Mines (MNS)	285	295	2	2999	175	2450	698
Bare non-vegetated (BNV)	49	25	2	3036	92	97383	4786
Urban industrial (UIIND)	351	346	5	2652	154	420	148
Urban commercial (UC)	349	349	5	2598	146	393	137
Urban residential (UR)	411	423	4	2672	158	2327	957
Urban informal (UIINF)	331	329	6	2562	114	1901	630
Urban Others (UO)	438	431	6	2870	128	16792	7354
Total						923224	330075

ETLOOK ANNUAL EVAPOTRANSPIRATION (ET) DATA (from August 2014 to July 2015)

- ET is variable depending on geographic location, climate and land cover, with a strong gradient from West to East (Figure 2). Based on machine learning techniques (Random Forest (RF) and Classification and Regression Tree Analysis (CART)), rainfall and land use are the strongest drivers of ET, followed by soil clay content that determines the soil water retention capacity and plant available water during droughts.
- Besides waterbodies, the highest median annual water use per unit area was from indigenous forest (864 mm a⁻¹), plantations/woodlots (838 mm a⁻¹), cultivated cane (776 mm a⁻¹) and cultivated perennials (720 mm a⁻¹). The lowest was from bare non-vegetated land (25 mm a⁻¹), low shrubland (167 mm a⁻¹), shrubland fynbos (229 mm a⁻¹) and mines (295 mm a⁻¹) (Table 2).
- In absolute terms, cultivated annual crops consume less water (42,768 Mm³ a⁻¹) than grassland (95,156 Mm³ a⁻¹) and low scrublands (55,996 Mm³ a⁻¹) depending on the area covered.
- Substantial variation in ET occurs for the same land cover, as evidenced by ranges in maxima and minima, and the standard deviations in particular for cultivated perennials and wetlands, due to the high spatial variability of these types of vegetation, specific geographic and climatic conditions.
- The volume of water registered in WARMS for sector agriculture – irrigation is 11,997 Mm³ a⁻¹ (12,097 m³ a⁻¹ including aquaculture and livestock watering). The volume of water consumed from cultivated land (subsistence, perennial, commercial annuals and cane) is 56,618 Mm³ a⁻¹. The satellite observations include both irrigated and rainfed land; not all water users are registered in WARMS.
- The volume of water evaporating from non-agricultural vegetated land amounts at 245,458 Mm³ a⁻¹, and it outweighs by far the agricultural water consumption estimated with ETLook and the volume of water registered in WARMS for agriculture.
- The total volume of water registered in WARMS for industry (urban and non-urban), urban (excluding industrial and/or domestic) and water supply services is 5,508 Mm³ a⁻¹. The total volume of water that evaporates from urban land uses (residential, industrial, commercial, informal and others) is 9,130 Mm³ a⁻¹.
- Water use per province is shown in Table 3. It is highly dependent on climatic region and size of province.

TABLE 3
Overview of annual ETLook data for 2014/15 per province in South Africa.

Province	Area	Evapotranspiration			
	Km²	%	Average (mm a⁻¹)	Total (Mm³ a⁻¹)	%
Eastern Cape	169626	14.0	526	70678	16.6
Limpopo	122452	10.1	681	64359	15.1
Free State	128612	10.6	513	60499	14.2
KwaZulu-Natal	92062	7.6	613	55688	13.0
North West	116078	9.6	547	51095	12.0
Mpumalanga	78691	6.5	686	49807	11.7
Northern Cape	362020	29.9	215	39904	9.3
Western Cape	126182	10.4	348	25772	6.0
Gauteng	16927	1.4	587	9242	2.2

GUIDELINES AND RECOMMENDATIONS

- Although most water is abstracted for agriculture, non-agricultural vegetated land consumes more water from vast areas of land. Non-commercial and non-conservation land under vast thicket/dense bush, woodland/ open bush, grassland and low shrubland can be traded off to reduce the burden on water resources.
- Incentivizing smart farming practices may reduce the water volumes used in agriculture.
- Discharging wastewater, removing underground water and disposing waste are substantial water uses due to industrial and mining activities. It is recommended that mining houses remediate wastewater and re-use it for irrigation, power generation, fire-fighting and other non-potable uses in close vicinity to the wastegenerating streams.
- Increased industrial development will likely impact on industrial water use and other sectors. The existing pool of wastewater streams can potentially become an available water–reuse source to reduce the burden on natural resources. There is scope to increase the wastewater reuse because only a fraction of wastewater is reused for irrigation (1.5% of water taken). Such practice is under-utilized in arid and semiarid regions, especially Lower Orange, Lower Vaal or North West.
- The limited use of boreholes leaves scope for increased groundwater use as well as conjunctive use of surface water and groundwater. The Limpopo province is the highest user of borehole water.
- The total volume of water that evaporates from urban areas is almost double the water supplied to industry and domestic users. There may be therefore a case for capturing some of the rain water before it reaches the ground and evaporates in urban areas (e.g. rain water harvesting).
- A concern is the decrease of areas under wetlands (-0.400%) and fynbos (-0.661%). Conservation efforts need to be strengthened to prevent loss of biodiversity.

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Water Authorisation and Registration Management System (WARMS)
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NASA/GMAO Modern Era Retrospective Analysis (MERRA)