[Dams In South Africa](http://www.sancold.org.za/index.php/about/about-dams/dams-in-south-africa)

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**HYDROLOGICAL CHARACTERISTICS**

**South Africa is situated in a semi-arid region in the world. The average rainfall for the country is about 450 mm per year, which is well below the world average of about 860 mm per year, and is characterised by large in-season as well as annual variation. As a result, South Africa 's water resources are scarce and extremely limited in extent. In global terms, South Africa is classified as "water short" and moving towards "water stressed".**

**No truly large perennial river such as the Congo , Ganges, Mekong, Nile or Rhine which can serve as a reliable source of water, occur in South Africa . The highly variable rainfall together with the general steep topography and shallow soils, contribute to the flashy character of our rivers. Groundwater is also limited due to the geology of the country, much of which is hard rock with little water bearing capacity. To further aggravate the situation, the spatial distribution of the water resources is highly skewed with 60% of the total annual runoff arising in only 20% of the surface area of the country (eastern parts). The western parts are much more arid than the eastern part of the country.**

**PERSPECTIVE ON WATER REQUIREMENTS**

**The requirements for water are closely linked to population and economic activity, and subject to climatic influences. Primary requirements for basic human needs, which are relatively small quantities, strongly relate to population numbers. The bulk of water use in modern society, however, is driven by economic uses of water and the socio-economic standard of living. In addition to quantity and quality requirements, greater assurances of supply are also required as dependence on the availability of water increases. Typically, the greater the economic returns and other benefits to be gained from the use of water, the more stringent the requirements for a secure supply of water become.**

**In early pastoral times when the population was small and per capita requirements were low, sufficient water could be found from natural springs and streams. Should sufficient water (and other living means) not be available at any time, people would move elsewhere. As development progressed, larger quantities of water were required. In particular, irrigation development was (and often still is) viewed as one of the primary stimulants for economic development. Most irrigation enterprises have reasonable inherent tolerance to bridge fluctuations in water supply, and the full requirements for irrigation therefore need not always be met.**

**Mining and industrialisation brought additional requirements for water to keep the industrial processes going, as well as to meet the associated higher needs of society. With the necessity to constantly maintain production and with little climatic influence on these requirements, water needs to be provided at a relatively constant rate as well as at a high assurance of supply. In South Africa, most of the main metropolitan and industrial growth centres developed around mineral deposits and seaports, remote from major rivers, thereby further exaggerating the differences between the requirements for and availability of water. In contrast, irrigation development naturally occurred where water was available.**

**THE NEED FOR DAMS**

**Population growth, irrigation development and other economic activity in South Africa have long surpassed the stage where the requirements for water can be met from the natural availability thereof.**

**The groundwater resources of the country, although very important for small towns and rural communities, are insufficient to sustain even a significant proportion of the water requirements of South Africa . Therefore, surface water is the main supply source.**

**Due to the high variability in river flow within a year and between years, storage needs to be provided to bridge low flow periods with a degree of assurance as required by the different water use sectors. This is well demonstrated by the different quantities of water which could be abstracted from the Vaal River at the location of Vaal Dam, under different development scenarios.**

**The long term mean annual runoff in the river at this point is about 2 000 million m³ per year. Due to the irregular nature of streamflow, however, annual streamflows of only 10% of the above have been recorded during dry years. Therefore, at most only 10% of the mean annual streamflow (runoff) can be relied upon to be available during any year. However, as a result of the seasonality of streamflow together with shorter duration fluctuations in flow, streamflow in the Vaal River often becomes minimal. It is evident that without regulation, hardly any water can be relied upon to be available in the river for abstraction for all the time. No mining, urban and industrial development or power generation could therefore be supported with water from the river, without storage being provided. Johannesburg would probably have remained a small town.**

**At the other extreme, annual flows of 600% to 300% of the average have occurred during wet years, which spill to the ocean if not regulated. With storage having been created through the construction of Vaal Dam and later Grootdraai Dam, the water which can reliably be abstracted from the Vaal River throughout the year, is increased to nearly 50% of the long term average flow. (Refer to the Appendix for additional exposition of the matter).**

**Because of continued development in the area supplied with water from the Vaal River , and where more than half of the country's Gross Domestic Product (GDP) is generated, the requirements for water have long exceeded what can be harnessed from the Vaal River alone. Water is therefore also transferred to the Vaal River from several adjoining river basins, to augment the water supply capacity in the region.**

**Nationally, the total storage capacity of the major reservoirs in the country currently amounts to about 33 900 million m 3 , which is equal to approximately 70% of the mean annual runoff from the land surface of the country. This storage has been created by the construction of 252 large dams. In addition, some 3 500 dams with a height of greater than 5 m have been registered with the Department's Dam Safety Office.**

**The total water consumption (year 2000) of 13.3 km 3 /year (1 km 3 = 1 million m 3 ) is used as follows: domestic consumption (29 per cent), irrigated agriculture (59 per cent), industry, mining and thermal power generation (8 per cent) and commercial afforestation (which decreases runoff) (4 per cent). Per capita water resource availability is about 1100 m 3 per annum hence the classification of South Africa in terms of international norms as water stressed.**

**The National Government Department of Water Affairs (DWA) is responsible for administering all aspects of the law relating to water resources, the National Water Act, 1998. DWA is responsible for the development and implementation of policies, strategies and regulatory instruments relating to the Act. The National Water Act contains many innovative approaches such as a Reserve for ecological purposes to maintain the ecological health of rivers as well as meeting basic human needs. This Reserve has been estimated to be about 20% of the mean annual runoff and is not available for allocation to other users. DWAF released the first version of the National Water Resource Strategy in September 2004 in terms of the National Water Act. This Strategy has been subjected to an extensive public participation process. The Strategy is available on the DWAF website**[**www.dwa.gov.za**](http://www.dwa.gov.za/)**. DWA is also responsible for planning, developing, operating and maintaining State-owned water resources management infrastructure, and for overseeing the activities of all water management institutions. DWA is also responsible for the administration of dam safety of all water storage dams over 5m in height (including State owned dams). Tailings dam safety is administered by the Department of Mineral Resources in conjunction with DWA.**

**ROLE OF WATER IN WATER DEVELOPMENT**

**IRRIGATION**

**As alluded to above, much of the earlier requirements for water was for irrigation. Most of the dams historically constructed in South Africa were therefore for irrigation purposes. Water resource management in South Africa initially resorted under the Department of Irrigation, which became the Department of Water Affairs with the promulgation the Water Act of 1956. Many Government Irrigation Schemes were developed and subsidies also given, for building of small dams, as a means of stimulating development in this sector. Although some schemes had mixed success, a large and strong irrigation sector was eventually established amongst the farming community.**

**It is imperative to note that, although water is essential to irrigation, the availability of water does not necessarily lead to irrigation development. Many cases in the country can be cited where dams had been built for irrigation, where little or no development realised, because of the lack of other primary success factors. Currently there are almost 300 irrigation schemes in the country in varying states of disrepair. The main reasons for the situation being institutional, social and political rather than insufficient water. (Influencing factors include: inappropriate design and management systems, lack of capacity, land tenure, ownership, access to finance, training, entrepreneurship, lack of interest and others.)**

**URBAN, INDUTRIAL, MINING**

**While the availability of water is likely to stimulate irrigation development, provided that the supporting factors for success are in place, it is unlikely to cause other large scale economic development. Urban, industrial and mining development for example is more dependent on factors providing comparative economic advantages such as markets, technology, transportation, finance, mineral resources and others. Although not a primary stimulant to such developments, water remains an essential input. Should sufficient water not be available, the nature of development will be impacted upon while the scale of development may be seriously constrained. South Africa produces the greatest portion of its electrical power by coal-fired thermal power stations and a highly reliable water source is needed for this sector which supports the economy of the country.**

**IRRIGATION POLICY**

**Currently close to 60% of all water used in the country, goes to irrigation. Most of this water is used by commercial farmers. Approximately 40 000 small-scale farmers, 15 000 medium to large scale commercial farmers, 120 000 permanent workers and an unknown number of seasonal workers are involved in irrigation farming in South Africa . Of particular importance in this regard is that both the economic returns and employment created by the industrial and urban use of water are generally one or two orders of magnitude higher than obtainable from irrigation. In contrast to its large proportionate use of water, irrigated agriculture contributes of the order of 1,5% of the GDP of the country. As the country's water resources are already highly developed and utilised, further allocation of water resources to irrigation development will only be made in exceptional cases as stated in the National Water Resource Strategy.**

**Furthermore the most beneficial irrigation uses of water are mainly for the production of export crops, which is a pure commercial revenue earning use. An exception being the growing of vegetables under irrigation, which, although also commercial, contributes to the local food supply. It is important therefore, that the merits of irrigation for food supply and in particular food security (or self-sufficiency) as is often mooted by the irrigation sector, be carefully considered, and that common ground in this respect exists between the DWA and the National and Provincial Departments of Agriculture.**

**There are many factors contributing to food production, of which irrigation water is but one. Other factors to be considered are the availability of technology, finance, equipment, energy etc, all of which require some degree of international dependence. In an internationally integrated economy such as that of South Africa, a strong and diversified economy together with international political acceptability is probably more important to food security than the production of own food - at the national level, but not necessarily at the local level. All economic uses of water should therefore be applied towards achieving beneficial use in the public interest. (There are cases in which the social benefits of a particular water use at a local level may outweigh the broader economic benefits of a different use - we must be careful not to take only one scale - economic - as the correct scale to use for valuing water use.**

**While irrigation for own food production or for the creation of micro enterprises may be an intermediate stepping stone for the poor, people should ideally be capacitated to progress to full integration into the economy, and with an economy strong enough to absorb them. It is also important to recognise that people practising irrigation on such small scale, are likely to be highly dependent thereon. A disruption in water supply may cause their whole livelihood to disappear, with potential disastrous consequences. Water for such developments should therefore be at a high assurance of supply (rather than from farm dams and other informal sources of supply).**

**The National Department of Agriculture is presently considering an agricultural Policy, in which an irrigation policy also features. While objectives of this irrigation policy such as equitable and efficient utilisation of water are in line with DWA initiatives, some of the Provincial Departments of Agriculture may have perspectives on expansion of irrigation which are not shared by the DWA. Synchronisation of the respective goals, objectives and priorities is thus essential. This is already partly being addressed through the Provincial Irrigation Action Committees (IACs) which are provincial forums for co-ordinating the actions of the Department of Water Affairs , Agriculture (both National and Provincial), and Land Affairs.**

**SMALL AND LARGE DAMS**

**Storage in several small dams is normally far less efficient from a water resources perspective than the equivalent storage in a larger dam, because of less favourable evaporation characteristics and the generally poor level of operational management applied. The evaporative surface area of a number of small dams is normally much (often several fold) greater than the surface area of a single large dam with the same total storage capacity. The cost efficiency and economic viability of small dams are typically less favourable than for large dams, as a result of the benefits of scale achievable with larger developments and as large developments are more selectively located at the limited good dam sites available in nature. Small dams also rarely meet the requirements with respect to releases for downstream use and for environmental purposes, mainly because of a previous lack of legislative requirements.**

**While small dams can be environmentally acceptable and beneficially utilised under particular circumstances, great caution should be exercised to guard against unwanted impacts of small dams on larger national infrastructure (existing and future), which typically serve the higher value and strategic uses of water. In certain cases, however, small dams (or farm dams) may still be the best or the only viable option for increasing the utilisation of runoff. This situation would normally occur in less regulated rural catchments with little competition for the water from higher value users, or where the impacts of the small dams can be contained at an acceptable level. The Mzimvubu catchment in the former Transkei and the Koue Bokkeveld area in the Western Cape may serve as examples.**

**In many cases small dams which were advantageous at the time of construction, are now found to be having serious negative impacts on higher value users of water.**

**FUTURE SITUATION**

**Recent projections of population growth are substantially lower than those previously available, largely as a result of the impacts of HIV/AIDS. Expectations of economic growth are also more moderate than before, with the result that the current projections of future water requirements are much lower than previously estimated. This, together with the fact that great inefficiency in the use of water still prevails with many users, resulted in the arrested need for the construction of new dams. The National Water Resource Strategy (2004) indicated that only about 19 major dams may be needed in the period up to 2025 to meet rising water needs.**

**As most of the better dam sites have already been developed, the options remaining are mainly for large and expensive new developments which will generally only be economically viable for urban/industrial purposes. Only under highly exceptional circumstances may the construction of large dams for the purpose of irrigation prove to be viable.**

**While small (farm) dams may be desirable under certain conditions, care should be exercised with respect to the possible impacts on these. It may also occur that farm dams have served their purpose and are not required any longer, in which case consideration could be given to promoting the demolition thereof.**

**Irrigation can still serve to provide primary opportunities for development to people, provided that the other essential success factors are also catered for. It remains prudent, however, to verify whether such irrigation would from a socio-economic perspective represent the best use of water and of other supporting resources under the circumstances. In most cases water for such irrigation should preferably be obtained through the re-allocation of water from existing irrigation, while redistribution of existing irrigation land may offer another alternative.**