

Die jaarlikse reënval, afloop en verhoging in afloop met verhoogde reënval vir die Vaalrivier-opvanggebied by Vaaldam

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Samevatting

Volgens gegewens vir die Vaalrivier tot by Vaaldam is daar, ten spyte van die ingewikkelde uitwerking van talle faktore, 'n duidelike neiging vir die jaarlikse afloop om toe te neem in verhouding met die vierde tot vyfde mag van die jaarlikse reënval oor die opvanggebied. 'n Soortgelyke oorheersende verband tussen die gemiddelde jaarlikse afloop en die gemiddelde jaarlikse reënval is voorheen bepaal vir 275 opvanggebiede versprei oor Suid-Afrika. Dit lei tot die gevolgtrekking dat die potensiële verhoging in afloop met verhoogde reënval so groot is en so belangrik is vir toekomstige watervoorsiening in Suid-Afrika dat navorsing oor die kunsmatige stimulasie van reënval met groot toewyding voortgesit moet word totdat finale uitsluitsel oor die praktiese uitvoerbaarheid daarvan al dan nie verkry word.

Die studie van die gegewens het ook getoon dat daar geen noemenswaardige verandering in die reënval oor die opvanggebied was van 1909 tot 1990 nie, maar dat daar 'n relatiewe afname was in die afloop by Vaaldam sedert ongeveer 1948. Dit is ook gevind dat daar 'n neiging is vir beide die getal reëndae en reënval per reëndag om hoër te wees en vir die verdamping om laer te wees in nat jare as in droëjare. Hierdie neigings dra daartoe by dat die jaarlikse afloop relatief veel vinniger toeneem as die reënval. Gemiddeld gee die tydperk Augustus tot Julie 'n beter aanduiding van die hidrologiese jaar vir die Vaaldam-opvanggebied as die tydperk Oktober tot September wat algemeen vir die somerreënstreek aanvaar word.

Extended summary

(The annual rainfall, runoff and increase in runoff with increased rainfall for the Waal River catchment at Vaal Dam)

Estimates of the future demand for water in South Africa indicate that a shortage of water is likely to occur soon after the year 2020. It has been calculated that the mean annual runoff of all the rivers in South Africa amounts to less than 1% of the average annual volume of atmospheric water vapour in movement over the region. Since 1973 the Water Research Commission has supported research such as that of the Weather Bureau at the Bethlehem Precipitation Research Project into the possibility of abstracting some more of the atmospheric moisture by artificial rainfall stimulation and in this connection it is important to assess the likely effect of an increase in rainfall on runoff.

A study of mean annual rainfall and runoff for 275 catchments all over South Africa indicated that runoff increases relatively much more rapidly than rainfall. In order to ascertain whether this tendency also applies to annual rainfall and runoff on a local scale, a study was carried out for the catchment of the Vaal River upstream of the Vaal Dam for the 81 years from 1909 to 1990. Runoff of a river results from rainfall on its catchment but the interrelationship is complicated by factors briefly mentioned in this paper. For the period concerned the variation of runoff with annual rainfall over the catchment was found to be similar to that for catchments in South Africa as a whole. It was established that the annual runoff is approximately proportional to rainfall raised to a power between four and five, which means that an increase (for example) of 10% in the annual rainfall would lead on average to an increase of about 50% in the annual runoff; an increase of 20% in the rainfall would increase runoff by between 100% and 150%.

Other findings in the study were the following:

- Although poorly defined, there is a tendency for the number of rain days in a year and average rainfall per rain day to increase with an increase in total rainfall for the year.
- There is a strong indication that the evaporation for a year or for a particular month in a year is lower in periods of high rainfall than in periods of low rainfall.
- The rainfall over the Vaal Dam catchment does not appear to have changed materially between 1909 and 1990, but there is a clear indication of a decrease in runoff at Vaal Dam since about 1948, quite apart from the effect of major upstream works such as the Tugela-Vaal project and Grootdraai Dam.
- Termination of periods of minimal hydrologic activity varies widely between May and October with the most frequent terminations being in August and July.
- The potential increase in runoff corresponding to an increase in rainfall is so great that it is of the greatest importance for South Africa to continue the research on artificial rainfall stimulation until a final conclusion is reached as to whether it is or may in future be feasible.

1. Inleiding

Raming van die toekomstige watergebruik in Suid-Afrika dui daarop dat dit reeds kort na die jaar 2020 die totale benutbare natuurlike waterbronne van die land sal oorskry. Daar is reeds watertekorte in verskeie dele van die gebied (Dept. van Waterwese, 1986; Du Plessis en Van Robbroeck, 1978; Kriel, 1983a). Van die verskillende moontlikhede om watertekorte te bowe te kom (Kriel, 1983a; Dept. van Waterwese, 1986) is die onttrekking van vog uit die atmosfeer een wat ernstige aandag verdien omdat, as dit prakties uitvoerbaar bevind word, dit die grootste potensiële bron van vars water vir Suid-Afrika deels benutbaar kan maak en omdat dit water sal kan lewer op

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