

The Jonkershoek Research Catchments: History and Impacts on Commercial Forestry in South Africa

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Introduction

By the 1850s, European settlers were over-exploiting of South Africa’s indigenous forest resources for timber. As a result of rising concerns, authorities began a programme of afforestation (usually a grassland or *fynbos* conversion) using exotic species, particularly pines (*P pinaster* initially), eucalypts and some acacias (*A. mearnsii*). By the 1900s it was clear that these plantations were affecting streamflow, with numerous complaints by farmers. A programme of research into “*the influences of forests on water conservation and allied problems*” was endorsed by the 1935 Fourth Empire Forestry Conference held in Cape Town. By 1936 construction was underway on weirs in the Jonkershoek State Forest and a programme of research was developed, with Dr CL Wicht as Founder and Research Director of the Jonkershoek Forestry Research Centre.

Experimental Design

The experimental design was based on the classic paired-catchment principle used at Emmental in Switzerland and Wagon Wheel Gap, Colorado, USA. The principle of this approach is that the streamflow from two untreated catchments are compared, so as to establish their natural relationship. One is then treated, i.e. planted to trees. The change in the relationship between the two catchments after afforestation could then be ascribed to the treatment or influences of afforestation. Twenty nine raingauges, of which 12 were continuously-recording measured what water was going into the catchments and 8 continuously-recording weirs (6 remain operational) measured what was coming out.

Catchment areas range from 27 – 246 ha, with relatively steep slopes and strong rainfall gradients, caused by orographic forcing in incoming north-west frontal systems during the winter months (the Western Cape having a Mediterranean climate). Mean annual rainfalls of about 1200 mm on the lower slopes can go as high as 3 000 mm/a (and 3 600 mm on the Dwarsberg at the top of the valley). The percentages of catchment afforested ranged from 36 – 98% with pinus species, mostly *P radiata*.

Results

The onset of streamflow reductions was evident at ~5 years, and is strongly associated with plantation age, up to a peak reduction occurring at ~15 years, followed by a gentle decline in water use. A rule of thumb is 30-40 mm streamflow reduction per 10% of catchment planted, at peak water use.

Discussion

South African forest hydrology experiments are world renowned and key papers from these research efforts are still cited in the international literature (e.g Bosch and Hewlett, 1982). The Stream-flow Reduction Activities (SFRA) policy and Working for Water programme that emanated from these experiments are used worldwide as examples. More than 400 papers and conference proceedings have been produced using data collected within these research catchments. Other national impacts include:

- Regulation of the R22 billion/a forest industry. The commercial forest industry today derives benefit in export markets from the Sustainable Forest Certification (FSC) that the industry is able to achieve, in part because of previous catchment research and implementation of research findings imposed on the industry.
 - Legislation related to SFRA, riparian zone management and forest rotation regimes streamflow
 - Outputs such as *Gush Tables*, *CSIR Flow Reduction Curves* and *Handy Reference Manual* regarding streamflow reduction, used for allocating permissible plantation areas to catchments,
 - Validation of hydrological models,
 - Initiation of the Working for Water programme (R1.5 billion+) to date, and
- The down-side of these developments is that the forest industry mostly dislikes the impacts this research has had because of the constraints and water charges imposed on it that other crop types do not bear.

Conclusions and Summary

The above results are a very brief introduction to the experimental outcomes. The South African forest hydrology research has had a big impact on land-use and allocation of land for plantation establishment in South Africa. It is a great example of *science in action*, where the results of science have been used for policy formulation and land-use regulation, which we believe to have lead to greater sustainability of water resource availability in South Africa.

References

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