Fog-water harvesting along the West Coast of South Africa: A feasibility study

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Abstract

Many parts of the West Coast of South Africa experience severe water shortages throughout the year. Despite the meager rainfall, however, the region is subject to a high incidence of fog which might provide water for water-poor communities. This paper investigates the fog water potential of the area. Since fog water collection rates are to some extent dependent upon the spatial and temporal characteristics of fog, these aspects were investigated. Pilot fog collectors were erected at six West Coast sites and the water collection rates measured over a three to four year period. It was found that the incidence of fog is mostly confined to the coastal zone below the 200 m contour line with fog frequency decreasing with latitude within this zone. The highest water collection rates were recorded at Cape Columbine where volumes in excess of 2.5 ℓ/m^2 of collecting surface can be expected to be collected per day. Of this, approximately 90% is due to fog deposition alone, while rainfall contributes to the remaining 10%. The quality of the water is good and fit for human consumption.

Introduction

The West Coast of South Africa is one of the most arid parts of the country with the annual rainfall rarely exceeding 250 mm (South African Weather Bureau (SAWB), 1986). Only three perennial rivers traverse the area, namely, the Orange, Olifants and Berg Rivers, with the flow in other smaller rivers varying seasonally and usually having dry beds in summer. Although a number of communities make use of river water either through direct extraction or via pipelines or canals, the main source of water is groundwater through either boreholes, wells or fountains (Rush et al., 2000). This is, unfortunately, not always available in sufficient quantities and is often contaminated with naturally occurring salts or heavy metals (Toens et al., 1999). In view of the high population growth in rural areas and the expected boom in West Coast tourism, it is evident that pressure on existing limited water resources will increase in future. It is clear that there is an urgent need to identify alternative sources of potable water.

Fog is one such source of water. Although its water yielding potential is largely ignored by water provision authorities, it was used extensively in ancient times. The inhabitants of Palestine, for example, built small low circular honeycombed walls around their vines so that the mist and dew could precipitate in the immediate vicinity of the plants (Nelson-Esch, nd). Historically, both dew and fog were collected in the Atacama and other deserts from piles of stones, arranged so that the condensation would drip to the inside of the base of the pile where it was shielded from the day's sunshine (Linacre and Hobbs, 1977). In the Canary Islands, fog drip from trees was the sole source of water for man and animals for many years (Kerfoot, 1968).

One of the earliest documented experiments aimed at determining the volume of fog deposition was conducted by Marloth between 1901 and 1904. He attempted to measure the volume of fog water intercepted by vegetation on Table Mountain by making use of two rain gauges - one was left open in the usual manner while a bunch of reeds was suspended above the other. Between November 1901 and mid-February 1903 the rain gauge collected 126 mm of water while the gauge with the reeds collected 2 028 mm (Marloth 1904, 1907). Since then, it has become standard practice to measure fog precipitation by means of two rain gauges, with a fog-catcher of various designs attached to one of them. Many such experiments have been conducted - the most noteworthy in South Africa and Namibia being by Nagel (1959, 1962), Schutte (1971), Schulze (1975), Nieman et al., (1978) and Snow (1985). All these experiments indicated the considerable potential of fog as a water source.

A number of projects have been initiated which specifically aimed at supplying fog water to communities. The first was implemented at Mariepskop in Mpumalanga, South Africa, during 1969/70 (Schutte, 1971). It was used as an interim measure to supply water to the South African Air Force personnel manning the Mariepskop radar station. Two large fog screens, constructed from a plastic mesh and measuring 28.0 x 3.6 m each, were erected at right angles to each other and to the fog- and cloud-bearing NE and SE winds. During a 15-month period, from October 1969 to December 1970, the screens collected an average of 31 000 of water per month i.e. approximately 11 ℓ/m^2·d. When yields for only foggy days were taken into account, the mean was 23 395 ℓ per month - almost 800 ℓ/d. During the entire period, fog/cloud precipitation exceeded rainfall by a factor of 4.6 but during certain months it was up to 17 times greater (Schutte, 1971).

The second and largest fog water collection project to date was initiated by researchers at the National Catholic University of Chile and the International Development Research Centre in Canada, at a small fishing village in northern Chile in 1987. Here, 75 fog collectors, each measuring 12 x 4 m were erected on a hill overlooking a small fishing village called Chungungo. According to reports, production rates vary from zero on clear days to a maximum of 100 000 ℓ/d. With this arrangement, each of the 330 villagers received about 33 ℓ of clean water per person per day (Schemenauer et al., 1988; Cereceda et al., 1992; Cereceda and Schemenauer, 1993; Schemenauer and Cereceda, 1991; 1994a). In view of the success of this project, similar fog water collection

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