

Agricultural water management

Paying more due to pollution – The impact of algae on SA's fruit and wine sector

South African wine (and fruit) consumers may soon be faced by a different kind of 'sin tax' in the form of raised consumer prices if the freshwater algae choking some of the country's irrigation channels cannot be brought under control.

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Scientists at the CSIR have calculated the Rand value of the impact of algae pollution on commercial agriculture in the Berg River, in the Western Cape. This value not only comes in handy when comparing different ways to manage the problem, but it also provides a glimpse of how much the price of deciduous fruit and wine grapes could increase if nothing is done about the problem.

The study was undertaken in the Dwars River, which is a tributary of the Berg River. Its source lies within the Banghoek valley between the northern side of the Jonkershoek valley and the Drakenstein Mountain range and is part of G10C quaternary catchment with an average rainfall is 877 mm/year and a mean annual runoff of 96.7 million m³/year. The geology of the source areas is Peninsula sandstone formation from the Table Mountain group which forms coarse, sandy, low-nutrient soils and is characterised by dark brown, humic-acid tinted water with a low pH. The riverbed is typically rocky due to high water flow rates, especially in winter which removes finer sediments except in sheltered locations. The middle and lower reaches has significantly lower flow rates and consequently more sand and sediment from the alluvial and colluvial deposits.

It is in these middle and lower reaches where algae growth has become a problem for commercial agriculture, which has led to a CSIR research project tasked to find a solution for the algae problem. Part of this study focused on calculating the Rand value of the problem – i.e. the focus of this article.

It is intuitively understood that pollution mitigation strategies tends to increase the production cost of agricultural enterprises. Commercial agriculture in the area is dominated by deciduous fruit and wine grape industries. Tree census data confirmed that



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plums represent 70% of hectares under deciduous fruit while 355 hectares is covered with vines. Consequently, plums were taken as representative deciduous fruit while no distinction was made on cultivar level for neither plums nor vines.

The cost implications of algae pollution were determined in close collaboration with farmers because each farmer manages the impacts slightly differently. Farmers in the study area were asked to explain the impacts of algae pollution on their business and what they do to manage the problem. They were asked to try and distinguish between a 'heavy' load and a 'normal' algae pollution load since it was understood that algae is always present in the water and that differences in concentration levels are actually the distinguishing factor that affect farming practice and hence profitability.

The cost implications were systematically captured in a spreadsheet which was fed into a standard crop enterprise budget for plums and vines. These budgets are based on industry information (data obtained from leading input suppliers and agri-databases maintained by Hortgro, SAWIS,

VINPRO, Nulandis and KaapAgri) and provide an indication of the gross farm income also known as 'income at the farm gate'. It was noted that these crop enterprise budgets already account for the 'normal' pollution load and that last mentioned could be used as a point of departure to compare against a 'heavy' pollution load scenario.

Most farmers were aware of the direct relationship between bio-available phosphate (nutrient enrichment) and algae growth. Although algae poses no direct threat to crops, its impact is felt via increased operation and maintenance cost of irrigation infrastructure. It thus came as no surprise that although pollution loads vary throughout the year, algae affects farmers only during the irrigation. Algae not only obstructs and clogs strainers, intake valves and manifolds, but also places a higher load on impellers and bearings of pumps, while decreasing the volume delivered per pump-hour. Micro-jets and dripper lines are also clogged which leads to uneven and thus suboptimal moisture management in orchards and could affect crop yield if not cleaned.

Standard practice to manage algae comes down to more frequent cleaning of the complete irrigation system. Although, all irrigation systems requires a minimal amount of cleaning and flushing prior to the irrigation season, the challenge here was to differentiate between cost relating to standard practice vs. cost relating to high algae loads. Farmers were asked to systematically describe the steps in their standard practice of dealing with algae within a typical pump station on their farm and to explain the difference between a 'high' and 'low' load scenario. The following table summarises the basic difference between a normal and high algae load scenario:

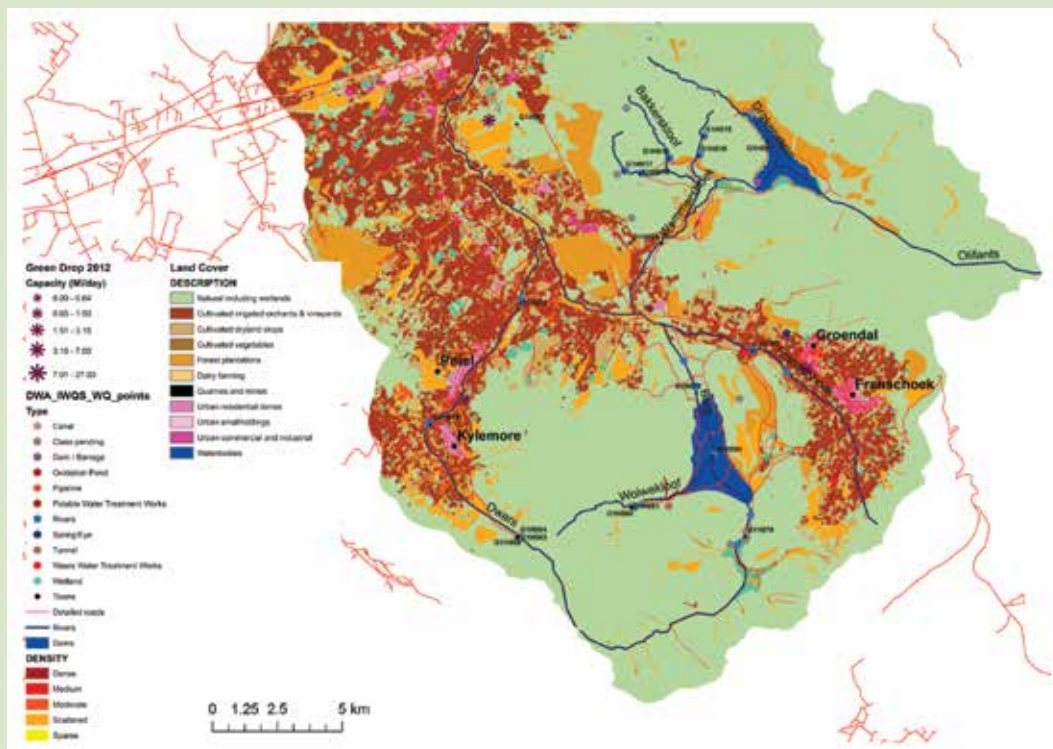
Activity	Normal load scenario	High load scenario
Servicing of pumps	Every third year	Every second year
Replace filter sand	Every third year	Annually
Clean strainers, disc filters and sand filters	Once a week	Daily
Required man-days per hectare per week to clean micro jets and drippers (during irrigation season)	1	7

The following table presents the time and or energy component associated with each activity (as reported by the respondents)

Activity	Time required
Clean strainer and foot valve	15 minutes
Clean disc filter	10 minutes
Backwash sand filter	10 minutes and 0.55 kilowatt
Transport	20 minutes

Some additional input variables being used to do the calculation:

- The irrigation season lasts for 20 weeks (i.e. 120 days).
- Farm labour cost is R15 per hour.
- A typical pump station serving 10 hectares consists of a strainer, foot valve, 3.3 kilowatt pump, Conn 80 sand filter and an Arkal disc filter.
- Electricity cost is R1.20 per kilowatt hour.



The study area.

Farmers mentioned that the service cost of their irrigation pumps is approximately R9 000, which implies that the annual service cost for a pump under low load conditions is approximately R3 000 per year and R4 500 per year under high load conditions, i.e. an R1 500 per year difference. Filter sand costs R1 875 per filter, which implies an annual cost of R625 cost for low and R1 875 for high load conditions, i.e. R1 250 per year difference.

The following table compares the cost implications of the two scenarios:

Activity/input	Low algae load conditions		High algae load conditions		Difference
	Total time during irrigation season	Rand value	Total time during irrigation season	Rand value	
Clean strainer and foot valve	300 minutes	R 75.00	2100 minutes	R 525.00	R 450.00
Clean disc filter	200 minutes	R 50.00	1400 minutes	R 350.00	R 300.00
Backwash sand filter	200 minutes	R 50.00	1400 minutes	R 350.00	R 300.00
Transport	400 minutes	R 100.00	2800 minutes	R 700.00	R 600.00
Electricity	11 kilowatt	R 13.20	77 kilowatt	R 92.40	R 79.20
Servicing		R3000.00		R4500.00	R1500.00
Sand		R625.00		R1875.00	R1250.00
Sub-total: Additional cost due to algae pollution per pump-year					R4479.20
Additional cost due to algae pollution per hectare pump-year (A)					R447.92
Cleaning of micro-jets per hectare per year (B)	960 minutes	R240.00	6780 minutes	R1680.00	R1440.00
Total additional cost due to algae pollution per hectare per year (A + B)					R1887.92

Given an estimated 307 ha of deciduous fruit in the study area, and assuming that all farmers struggle with algae, it was estimated that above-mentioned R1 887 per hectare per year is equivalent to R579 591 per year for deciduous fruit in the study area. This figure could be extrapolated to R98-million per year for the South African deciduous fruit industry (52 000 ha) assuming that all areas struggle equally with algae problems.

Although vines employ drip irrigation while deciduous fruit uses micro jets, the labour component for cleaning these two types of irrigation system is essentially the same. The mitigation strategy for managing algae is therefore essentially the same for deciduous fruit and vines, which implies that the cost per hectare is comparable. Given an estimated 355 ha under vines in the study area, the cost of algae for the wine grapes is estimated at R670 400 per year. This figure could be extrapolated to R188-million per year for the 99 800 ha under wine grapes in South Africa (assuming all regions struggles equally with algae).

Given that the pre-harvest production cost for plums is R61 880 per hectare, the cost of algae pollution represents approximately 3.1% of pre-harvest cost. Pre-harvest production cost for wine grapes is R35 739 per hectare, which implies that the algae problem represents 5.2% of the pre-harvest cost. These figures might seem quite small, but within an industry with extremely small producer profit margins, these figures are substantial. It is likely that these impacts could be given through to consumers, which could imply that consumers could pay more for their fruit if nothing is done to curb the impacts of pollution.

The information generated in this study creates an overarching 'management budget' for algae pollution. This means that any overarching algae management strategy will be worthwhile from a financial perspective if the cost to mitigate the algae pollution impacts for plums and vines is less than R1.3-million per year in the study area. The information generated within this study also presents the initial market potential for tradable pollution permits as a mitigation practice to manage algae pollution in the study area.



Algae has become a significant problem in the Berg River system.