

MICROPLASTIC IN FRESHWATER ENVIRONMENTS

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WHY PLASTIC?

Durable Lightweight Inert Raw material availability Low melting point

- Food security
- Fuel economy
- Medical technology



- Durability product lifetime >>> intended use period.
- Low production cost \rightarrow high availability \rightarrow low value
- High volumes waste management issues
- Lightweight economic viability of recycling

MICROPLASTICS: OUTLINE

Small plastic noted in 1990s marine samples'Microplastic' first mentioned in 2004 (Thompson *et al.*)Research picked up from 2008 (mostly marine)

Plastic particles | µm - 5 mm

Primary – microbeads, pellets, recyclate Secondary – litter wear, tyre wear, synthetic fibres



MICROPLASTICS: SOURCES

Microbeads – Cosmetics; sandblasting abrasive Primary pellet leaks Tyre wear Litter breakdown Textile wear

FRESHWATER MP RESEARCH IN AFRICA

- China 31% of global plastic production; Africa is their greatest export target.
- Africa rapid population growth (3.5% p.a.), cheap imports, poor waste management (~88.5% mismanaged waste).

Research history:

- 2016: Great lakes study Nile perch, Nile tilapia (Biginagwa; 2016)
- 2018:WRC report Microplastic in Gauteng riverine and drinking water (Bouwman et al., 2018)
- o 2018: Bloukrans River (Eastern Cape) sediment and larvae (Nel et al., 2018)
- o 2019: Gaining momentum first freshwater study from Nigeria (Ebere et al., 2019)
- 2020 onwards: Other African regions coming to party (mostly coastal countries) Morocco, Ghana, Uganda etc.
- Great Research gaps: Congo River Basin, Blue Nile, several Rift Valley Lakes.

FRESHWATER MP RESEARCH IN SOUTH AFRICA



o 2018: Boukrans River sediment and larvae (Nel et al.)

- 2018: Riverine & drinking water from Gauteng (Bouwman et al.)
- 2019: Orange-Vaal system (Weideman et al.)
- 2020: CSIR Science review of SA Marine plastic.
- 2021: Gauteng WWTP samples characterised (Vilakati et al.)

Source: C Verster Macroplastic in the Mooi River, North West



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PRETORIA, JOHANNESBURG 'BESMET' Waterskok

Plastiek in drinkwater

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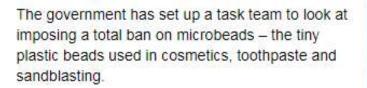
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Melanie Gosling, Correspondent news24

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This comes after a Water Research Commission study found microplastic pollution in tap water in Johannesburg and Tshwane, as well as in all rivers tested in Gauteng and in borehole water in the North West province.

The study, conducted by researchers at North-West University, recommended a ban on the manufacture, importation and use of microbeads in South Africa.

In response, the Department of Environmental Affairs (DEA) has set up a task team of officials from the departments of trade and industry, health and science and technology to examine the possibility of phasing in a microbead ban.



Government considering ban on microbeads after Gauteng drinking water is found to be contaminated



Impact of WRC report on Gauteng microplastics, 2018

of the."

Microplastic in freshwater environments -A scoping study (Bouwman et al.)

FRESHWATER MP IN SOUTH AFRICA

- Method variability results hard to compare.
- River water and sediment results relatively similar to global picture.
- High pollution levels in Vaal and Orange
 River systems.
- MP pollution corresponds with surrounding landscape pollution levels.



Source: C Verster Microbeads from the Klip River, Gauteng.

LAND-BASED SOURCES AND PATHWAYS OF MARINE PLASTICS IN A SOUTH AFRICAN CONTEXT

Source: C Verster Macroplastic in the Klip River, Gauteng

- I. 15 000 40 000 tonnes of plastic to the oceans from South Africa p.a. x6 less than previous estimate.
- 2. Riverine sediments major sinks for plastic en route to the ocean.
- 3. Management of treated waste-water sludge, as well as the state of WWTPs are key concerns. Up to 40% of the country's waste water is untreated and data and management practices of sludge are unavailable.
- 4. Major data gaps in the South African waste sector.

LAND-BASED SOURCES AND PATHWAYS OF MARINE PLASTICS IN A SOUTH AFRICAN CONTEXT

27. Jambeck J, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. Mar Pol. 2015;347(6223):768-71.

30. South African Department of Environmental Affairs (DEA). South African state of waste. A report on the state of the environment. Final draft report. Pretoria: DEA; 2018.

31. Rodseth C, Notten P, Von Blottnitz H. A revised approach for estimating informally disposed domestic waste in rural versus urban South Africa and implications for waste management. S Afr J Sci. 2020;116(1/2), Art. #5635, 6 pages. https://doi.org/10.17159/sajs.2020/5635

Total household waste 12.7 MT ³¹						
Unmanaged <i>3.67 MT</i> (29%)			Managed 30 10.5 MT 31 without tyres 9 MT (71%) Comparable with SoWR (30) 11.2 MT with tyres			
Other (89%) SoWR (30) data extrapolated	Plastic 440 000 t (11%) SoWR (30) ratio, data from Rodesth <i>et al.</i> (32)		Other (89%) ³⁰	Plastic and tyres <i>1.3 MT</i> (11%) ³⁰		
	Inland	Co = 100 000 t coastal mismanaged plastic		Tyres³⁰ 729 613 t 729 0f which 660 000 t (91%) is disposed		st N 495 000 t (43.7%) recycled
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MICROPLASTICS: DYNAMICS

- \odot Seasonal variability
- \circ Localised sources
- Flow rate determines amount of MP in sed vs. in water column
- Riverbeds MP temporary sinks (and 2° source)
- Major contributors: Untreated wastewater & mismanaged waste

Source: C Verster Macroplastic in the Klip River, Gauteng



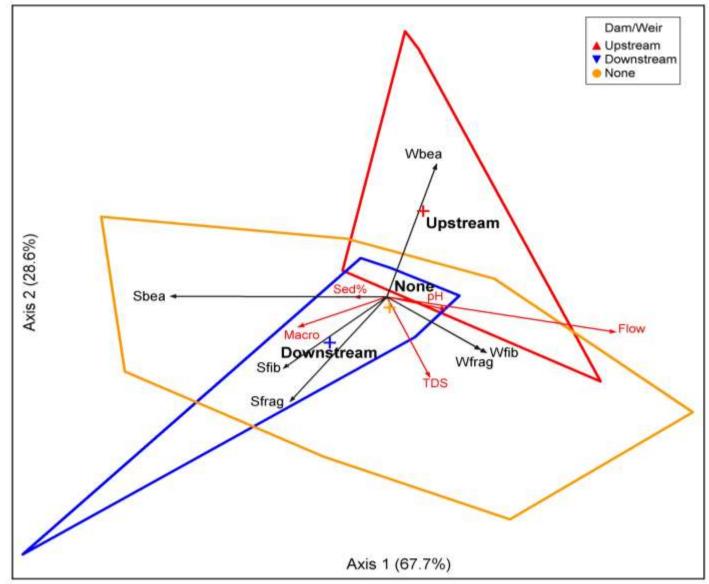
VAAL SYSTEM

Definite distinction between upstream and downstream sites – deposition.

Fragments and fibers in surface water \neq sediment frags and fibs

Beads in sediment \approx I/Flow

Beads distributed differently between water ad sediment of same site.



Vaal River system – January & July; water and sediment NMS of sites with relation to dams and weirs (Verster, Unpublished)

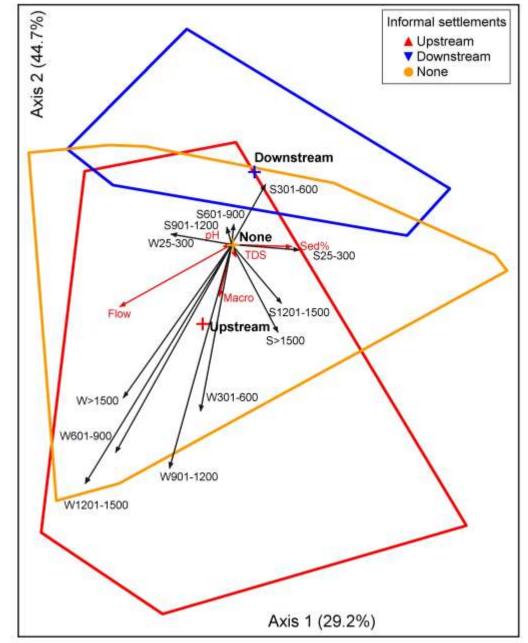
VAAL SYSTEM

MP profile different downstream of informal settlements.

Low flow causes deposition in sediment.

Smaller fragments (along with sand and clay particles) get deposited downstream from informal settlements.

Higher flow rate causes larger fragments to stay in suspension in water column.



Vaal River system – January & July; fragments in water and sediment NMS of sites and fragment size classes with relation to informal settlements (Verster, Unpublished)

- Africa starting to catch up since 2020
- Streamlining of methods and reporting units needed.
- High levels of MP found in SA freshwater and river sediments
- Rivers are possible sinks for MP

