



Increasing Water Security for the Ramotswa Aquifer Area through Concerted and Efficient Reuse of Wastewater Effluent

H M Masundire, D D Shushu and B T Kambai



Background facts on Botswana

- “ Total population of 2 024 787 (2011 census)
- “ 989 179 male and 1 035 608 female!
- “ rainfall ranging from a high of 550 and low of 200 mm per year
- “ estimated annual average evaporation rate of 1400 mm
- “ Botswana is a water stressed country
- “ contribution by agriculture to the national GDP (currently standing at 2%)



 Gaborone Dam failed! (May 2015)





24 July 2015 – Immediate release

- “ With effect from 1 August, 2015
- “ Water rationing increased from 3 to 4 days per week
- “ Current demand 125 million litres per day
- “ Current Supply
 - 19 million litres per day from Bokaa Dam (currently at 3.5%)
 - 9.7 million litres per day from Molatedi Dam in South Africa
 - 160 million litres per day from North-South Carrier
- “ 3 days managed demand at 110 million litres per day

City of Gaborone

- Gaborone plus surrounding villages of Tlokweng and Mogodisthane has a population of about 422 000 (2011 Census)
- Per capita water demand about 0.2 m³ per day
- total water consumption was about 50000cum/day (2008)
- Sewage treatment plant has a capacity of 90 000 cum per day
- Current inflow about 60 000cum/day
- Outflow about 30 000 cum/day
- Activated Sludge treatment process
- Treated (digested) sludge is disposed of after dewatering and drying – used for fertilizing lawns



Wastewater

- Wastewater is treated twice
 - Activated sludge
 - Stabilization ponds
- From the ponds
 - Some discharged
 - Some re-used





Re-use of wastewater (USEPA, WHO)

- ” Agriculture
 - . Food crops
 - . Orchards and vineyards
- ” Pasture
- ” Forestation
- ” Groundwater recharge



Cost of water

- “ Water tariffs:
- “ P2.35/l for first 10kl;
- “ P7.05/l for next 10kl
- “ P9.00 for next 10kl
- “ P12.45/l for all above
- “ Wastewater tariff: P0.6/l

Re-use of water - Gaborone

“ Landscaping and golf courses





Horticulture

- " Fruits
- " Olives





Horticulture – cereals & vegetables



lettuce



Supplied to 'Veggieland'

 cabbage



 Spinach



 butternut



” **Other crops**

” Beetroot

” Carrots

” Tomatoes

” Beans

” Green pepper



Local Enterprise Authority (LEA) – Glen Valley Horticulture

Incubator

- “ Training of farmers in re-using wastewater in horticulture
- “ Started in 2008
- “ Uses 160 cum per day Sept – Feb
- “ Uses 40-60 cum per day March-August
- “ Gross input – about BWP750 000/yr
- “ Gross revenue – about BWP3 million
- “ US\$1 = BWP9.5
- “ Greenhouses, net-houses & tunnels



Green houses – controlled environment



60 000 tonnes from 6000 plants (Linda Masina)



Net houses



40 000 tonnes from 4032 plants (Linda Masinta)



Cherry tomatoes





Early girl tomatoes



Supplied to "Pik N Pay"

Two types of irrigation



Spray irrigation used on golf courses



Drip irrigation – used on all vegetables, e.g. butternut above

How much is re-used?

- “ About 100 trucks fetch about 4 500cum/day from this monitored point
- “ Golf courses (2) have own abstraction points
- “ Other vendors collect water from numerous other points
- “ Need to get an accurate estimate of re-use but could be about 20%
- “ More gardening downstream in Odi and Matebele villages



Ramotswa Wastewater Treatment

- “ Population about 35000
- “ Oxidation ponds
- “ No data on inflow/outflow




Ramotswa wastewater treatment plant



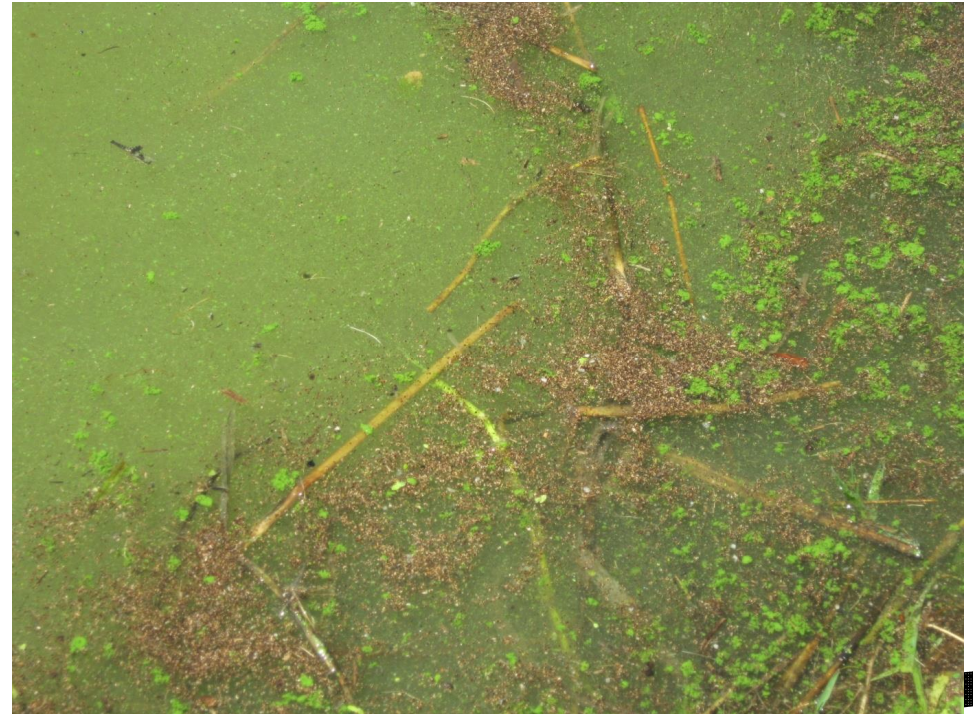


Looking ahead

- “ No inflows expected till next rain season
 - “ Observed shift/delay in onset of rainy season from October to December
 - “ Wastewater demand increasing
 - “ It is the only surface water available for use in landscaping and irrigation
 - “ Reuse of treated wastewater reduces demand on potable water whether from surface or groundwater sources
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Some challenges

- “ Consumer resistance
- “ Harmful algal blooms (*Microcystis* sp)
- “ Mycrosystins (neuro- and hepatotoxins)
- “ Lethal in small doses in lab mice
- “ Tomatoes, beetroot, spinach do take in mycrocystins (0.001 –0.0016µg/kg)
- “ Quantities found to be well below WHO exposure limit (**0.04µg/kg/day**)
- “ Possibility of bioaccumulation and/or biomagnification



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