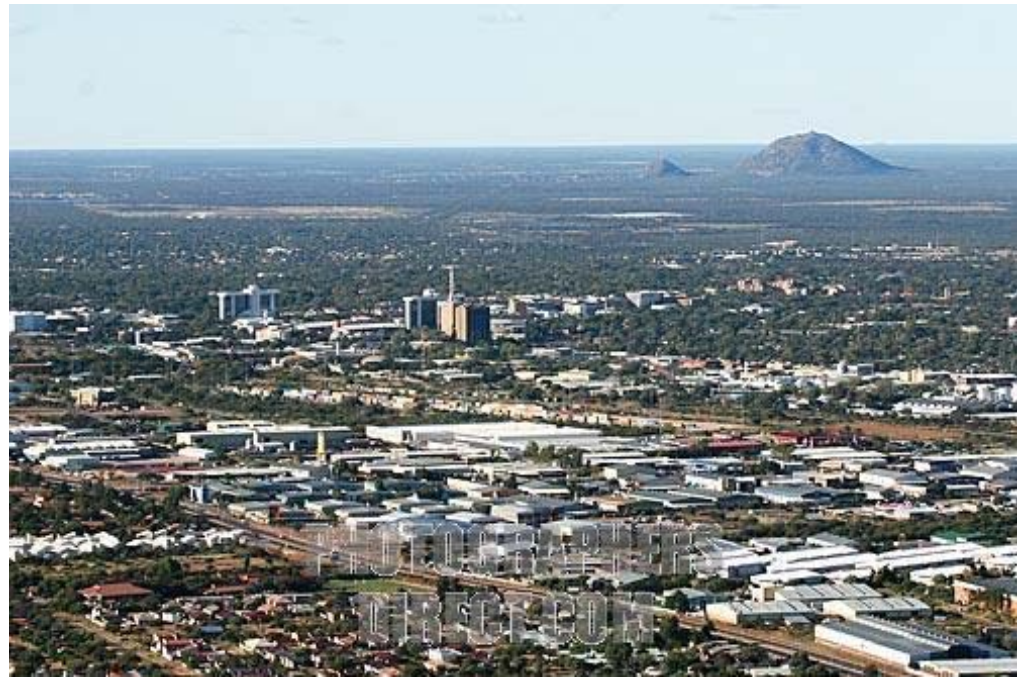


# Wastewater Production, Treatment, and Use in Gaborone, Botswana

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**Gaborone, Capital City of Botswana**

# Botswana brief

- Total population approximately 2 million
- 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%)

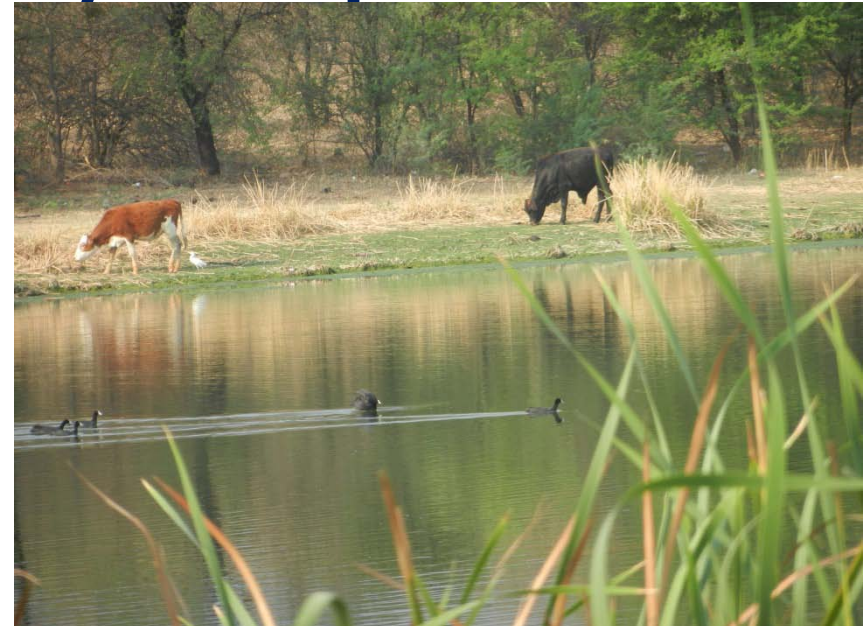


# Wastewater production and treatment

- Gaborone, the capital city of Botswana, has a population of about 300 000
- Per capita water demand about 0.2 m<sup>3</sup> per day
- total water consumption was about 50ML/day (2008)
- Sewage treatment plant has a capacity of 65ML per day
- Current inflow average 57ML per day
- Outflow estimated to be about 50ML per day
- Uses Activated Sludge treatment process
- Treated (digested) sludge is disposed of after dewatering and drying – used for fertilizing lawns
- Wastewater is treated twice
  - Activated sludge
  - Stabilization ponds

# Wastewater use and/or disposal

- Effluent is held in stabilization ponds – the former treatment process
- From the 3 pond series most effluent goes into another set of lagoons
- Some effluent flows into a wetland in Gaborone Game Reserve and into Notwane River
- Ponds have become an IBA as well as an important watering site for livestock
- From 2<sup>nd</sup> lagoon effluent is pumped to feed an irrigation scheme
- Crops include: cabbage, tomatoes, spinach, butternut, green pepper, maize, beet root, carrot, rape, olives, roses
- Effluent priced at P0.67 (R0.72 m<sup>-3</sup> )
- Vegetables sold to traders including supermarkets



# Wastewater use and/or disposal





Largest

SUPERMARKET chain in Botswana

**CHOPPIES**

VALUE FOR MONEY

WELCOME

**CHOPPIES**

# Wastewater use and/or disposal



**Some effluent is used to water 2 golf courses, a golf driving range**



**City and residents also use some effluent for watering gardens**





# Two types of irrigation



Spray irrigation used on golf courses



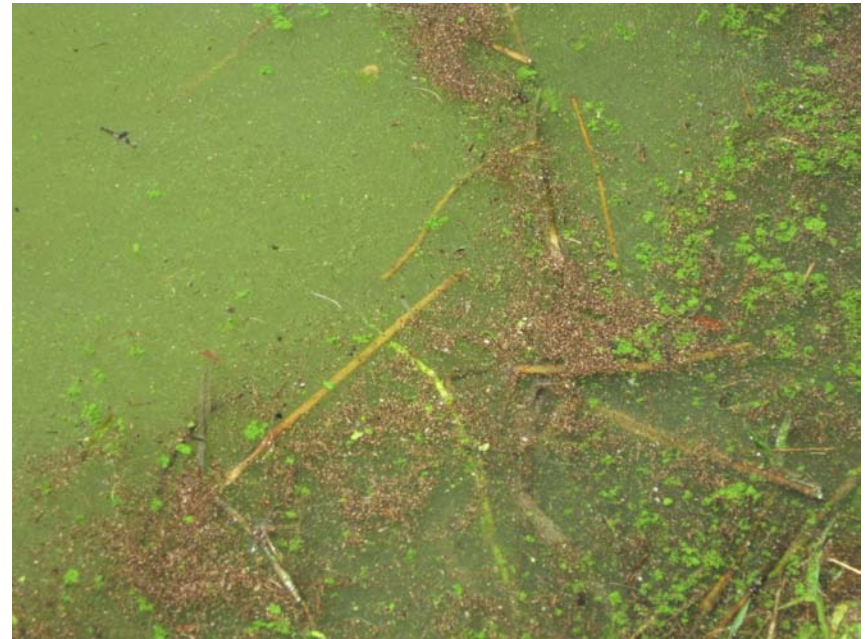
Drip irrigation – used on all vegetables, e.g. butternut above

# Regulations and implementation of guidelines

- See Excell file.
- Most of the parameters of major concern are within “acceptable limits”
- N & P in effluent could benefit agriculture in requiring less use of artificial fertilizers
- Excess nitrates may lead to succulence in vegetables – spinach, rape, cabbage
- BUT N & P concentrations are high enough to cause algal blooms especially in hot season

# Challenges

- Attitudes & perceptions
- Demand vs supply
- Water quality
- Eutrophication
- Algal blooms
- Harmful algal blooms
  - Blooms of *Microcystis sp.*
  - Produce algal toxins called microcystins (hepatotoxins) known to be lethal to animals
  - Microcystins also seem to affect plant growth & development



# Government's approach to wastewater management

- Improvement in reticulation of households to the municipal sewer system in all cities, towns and major villages
- Improved treatment process for reuse and even recycling
- There are over 60 wastewater treatment works country-wide
- 2006 estimates:
  - total inflow = 24.5Mm<sup>3</sup>
  - total outflow = 12.3Mm<sup>3</sup>
  - 20% reused for irrigation
- Inclusion of wastewater into national water accounts
- estimated that if adequately treated, wastewater could contribute about 16% of the country's available water resources.