A collection of items including a chessboard, medals, a compass, and glasses. The chessboard is in the top left, with several pieces visible. There are two medals: one with a red ribbon and a star, and another with a blue ribbon and a star. A compass is in the bottom left, and a pair of glasses is in the center. The background is a light-colored, textured surface.

**Treated Domestic
wastewater use for
Agriculture Irrigation in
Zimbabwe: Is it a viable
economic venture? A
Case of Bulawayo
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Presentation outline

- ◆ Introduction
- ◆ Policy and By-Laws in Zimbabwe on wastewater use(S.I. 274 of 2000: Waste & effluent disposal)
- ◆ Study area and background
- ◆ Findings
- ◆ Social acceptance
- ◆ Implication on Public and environmental Health
- ◆ Economic benefits
- ◆ Proposed management model



Introduction

- ◆ Urban wastewater use in agriculture is becoming more common and widespread practice due to the increasing water shortage and the threat to food security especially among the urban resource limited farmers



Introduction cont..

- ◆ Wastewater is an important resource for urban irrigation (water scarcity)
- ◆ Reduced productivity in rural areas
- ◆ most urban utilities generate a lot of wastewater from their treatments plants which they have problems in managing




Policy and By- Laws

- ◆ Obstacles to wastewater use are real but not insurmountable.
- ◆ WHO/ZINWA published guidelines for the safe use of wastewater and excreta in agriculture and aquaculture to protect the public.
- ◆ Environmental Management Act (Chapter 20:27)
- ◆ S.I. 247 of 2000, Water, (Waste and effluent disposal)
- ◆ Waste & solid waste disposal Regulation S.I 6 of 2007
- ◆ Municipal By- Laws (Bulawayo City)



Background to study

- ◆ The City of Bulawayo- (1894) is the second largest city.
- ◆ Matabeleland province, a semi arid and drought prone region.
- ◆ Was a centre of commercial and industrial activities.
- ◆ The City of Bulawayo in 1991/92 survived through the severest drought in 'Living Memory'.



Why wastewater use in Bulawayo

- ◆ The need for a reliable agricultural water supply is therefore critical. –watershed effect
- ◆ Options such as use of effluent from treatment plants for agriculture is one feasible way-
Bulawayo City Council-MAS type
- ◆ Future trends, quantity and quality considerations (Water demand Management).



Why this study

- ◆ Uncontrolled use of wastewater for production of crops by residents hence the need to:
- ◆ Improve and inform safe and sustainable long term production of crops that comply with existing standards (heavy metals)
- ◆ Protection of users and consumers (balancing public & environmental health)



Study area

- ◆ The study area is Luveve Gum Plantation area in Bulawayo, the second largest city of Zimbabwe.
- ◆ drought prone, semiarid Matebeleland region of Zimbabwe.
- ◆ an average rainfall of 460mm per annum and a population of 1 million.



Study area

- ◆ The effluent comes from two treatment plants and these are the Pumula and the Luveve plants, which converge, and discharge into 375mm pipe and delivers effluent into an earth made tank at the farm
- ◆ 4.5Mm³ -5Mm³/day
- ◆ Sandy soils are the prominent soils in the farming area



Study area

- ◆ The farming area is about 350 acres with a total of 1100 farmers who were chosen on social backgrounds from most of the Bulawayo high residential locations. Each farmer has about 100m X 5m plot to cultivate











Objectives

- ◆ To determine the physical and biological characteristics of the treated domestic effluent used for urban agriculture irrigation in Bulawayo.
- ◆ To assess the levels of lead (Pb) and cadmium (Cd) in soils and crops under irrigation with treated domestic wastewater effluent in Bulawayo.



Objectives

- ◆ Assess the suitability of the effluent used in comparison to existing guidelines and standards for urban agriculture irrigation.
- ◆ To quantify potential socio-economic benefits of wastewater use in small scale urban agriculture irrigation in Bulawayo.
- ◆ To propose a management strategy for sustainable utilisation of treated domestic wastewater for irrigated agriculture in Bulawayo.



Starting off

- ◆ Baselines
- ◆ MPAP (Multi Actor Action Planning and Policy making Process.



Findings

- ◆ Social acceptance:
- ◆ different perceptions regarding waste with some expressing deep disgust and others expressing practical preferences
- ◆ However, the ultimate behaviour is partly determined by survival economics
- ◆ Majority not comfortable in using wastewater products- due to mis information.



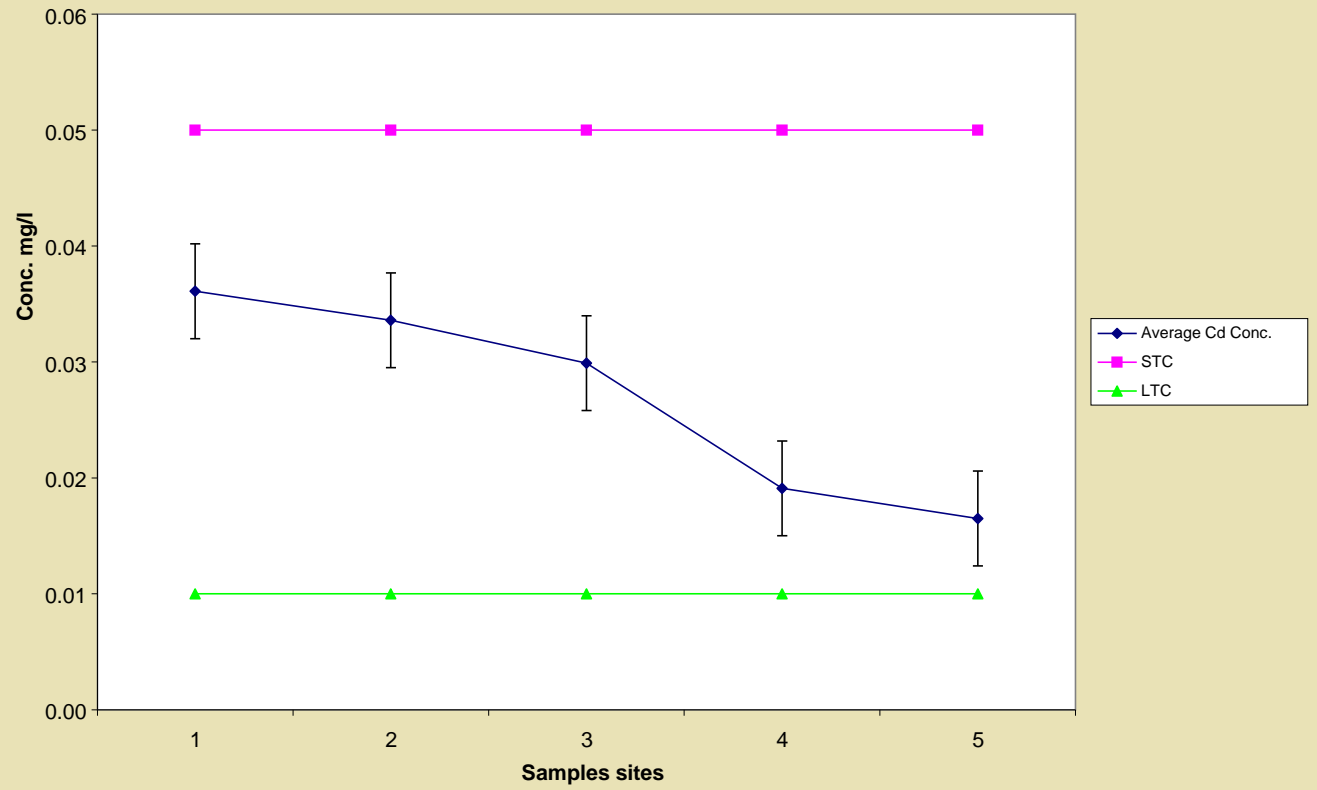
Findings

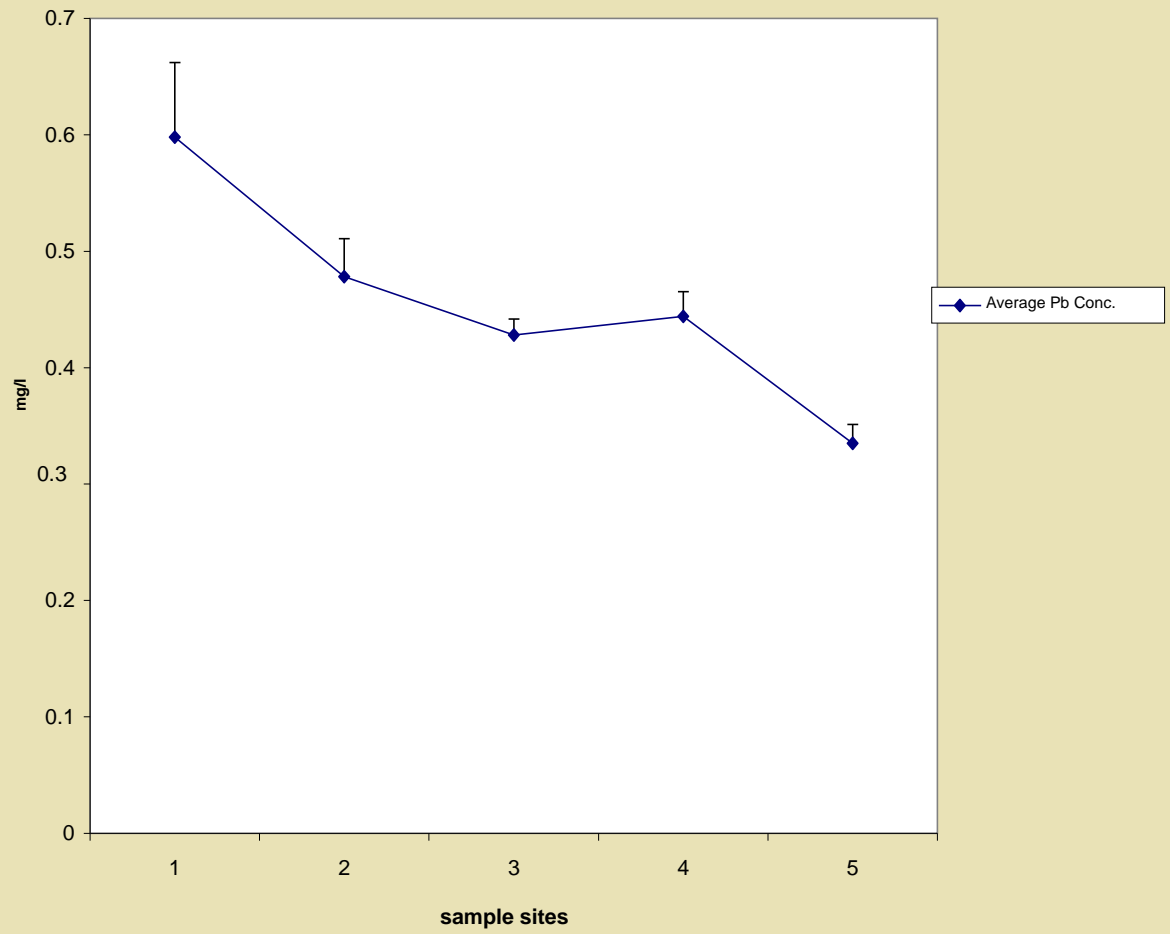
- ◆ Chemical parameters:
- ◆ Nitrogen in the effluent wastewater was found to be in the range of 7mg/l to 13mg/l with mean nitrogen concentration of $11.5\text{mg/l} \pm 4.4$.
- ◆ A Variation of total phosphorus concentration in the effluent was observed and a mean of $13.5\text{mg/l} \pm 14.9$



Findings

- ◆ Cadmium concentration in the effluent was measured and a mean concentration of $0.027\text{mg/l} \pm 0.01$ was observed
- ◆ Total mean Lead in the effluent was found to be 0.45 mg/l and the concentration of effluent ranged from 0.2 to 0.91mg/l with a standard deviation of 0.186







Findings

- ◆ The mean faecal coliform 5836 cfu/100ml and 7291 cfu /100ml that was observed is above both the WHO and national recommended standards for irrigation



Findings

- ◆ The soil pH ranged from 6.69 to 7.83 pH units for the field and 6.93 to 8.1 pH units for the control depths. The average pH was 7.35, 7.33, 7.72 and 7, 35 pH units for the 0-10cm, 10- 20cm, 20-30cm field and 7.35 control respectively.



Findings

- ◆ The total nitrogen concentrations of the soil were generally low. The field soil nitrogen for all depths ranged from 26.31 to 32.21 mg/kg where as for the control it ranged from 22.41 to 26 mg/kg.



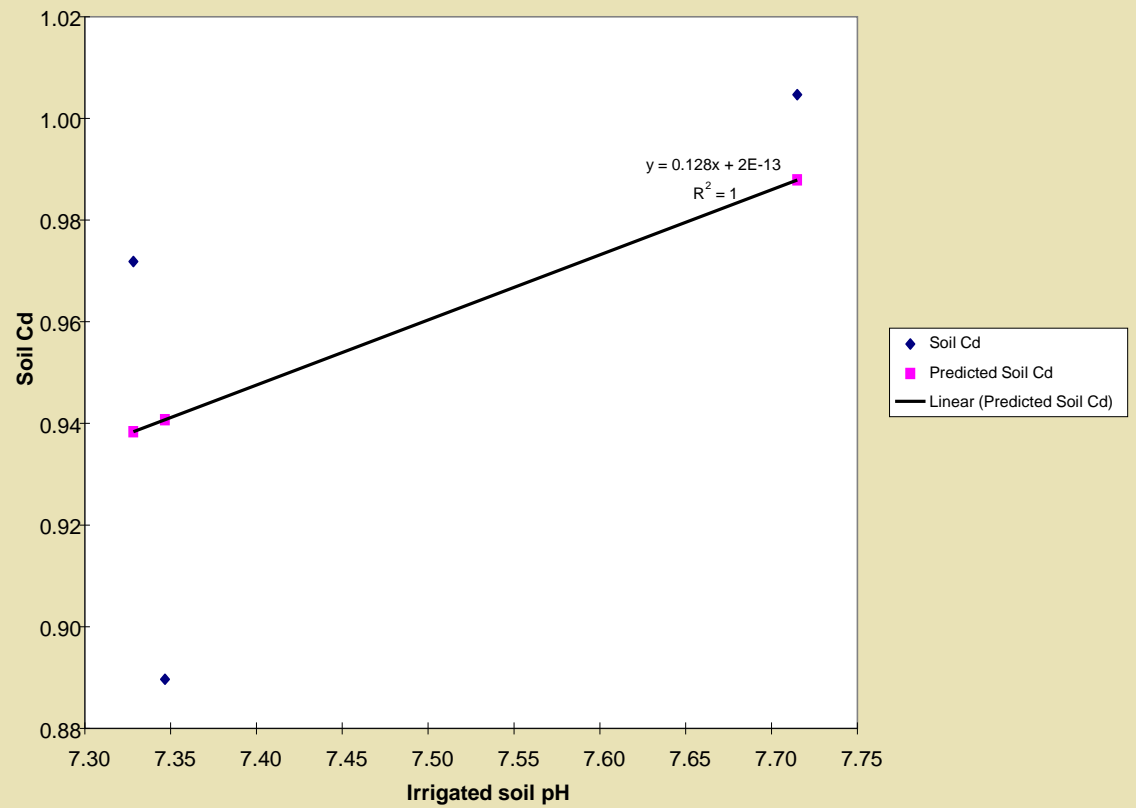
Findings

- ◆ The average phosphorus value in the soil was 114 mg/kg for the 10cm in the field and 124.9 mg/kg for all depths in the field

Findings

- ◆ The average cadmium value was found to be 0.95mg/kg in the field for all depths







Heavy metals in crops

- ◆ Heavy metals were determined in the edible parts of the selected crops namely Chomolia, maize (*zea mays*) and beans (*Vicia faba*) which are mostly grown in the area



Heavy metal (mg/kg)		
Crop	Cd	Pb
Chomolia (leaf)	-	-
Beans (fruit)	-	-
Maize (seed)	-	-
Recommended safety standards	0.05	0.4



Economic benefits

- ◆ Applying the conventional market based approach to calculate the monetary income each plot holder was estimated to earn US\$ 20 per month from vegetables, US\$50 from sugar beans and US\$250 from green mealies. This looks at the current cost of commodities in the market and use it calculate the monetary value



Economic benefits

- ◆ Estimated annual income from each plot was calculated to be US\$ 540.
- ◆ as a conservative figure



Economic benefits: fertiliser contr

- ◆ Nitrogen: = 92kg/ha/year
- ◆
- ◆ Phosphorous: = 108Kg/ha/year
- ◆
- ◆ Potassium: = 281.6 Kg/ha/year.



Challenges

- ◆ Quality of wastewater
- ◆ Availability
- ◆ Legality
- ◆ Land tenure



Consideration for proposed use.

- ◆ quality classes in order to guide the user to the potential advantages as well as problems associated with its use and to achieve optimum crop production.
- ◆ The water quality classifications are only indicative guidelines and their application will have to be adjusted to conditions that prevail in the field.



So how can we go forward

- ◆ By engaging into urban agriculture through the use of wastewater.
- ◆ Consider the following
 - ◆ Crop rotations
 - ◆ Restricted and unrestricted
 - ◆ Cereals the first options
 - ◆ Maize- Wheat- Sorghum
 - ◆ Soyabeans
 - ◆ Pastures for beef cattle.



Getting started

- ◆ Policies
- ◆ Financing the venture (contact farming)Vegetables
- ◆ Technical assessments- land availability, soil types and types of crops, wastewater quality

Implementation

- ◆ A management company (the driver) with options of partnerships arrangements



conclusion

- ◆ Would you eat crops grown using wastewater.
- ◆ THANK YOU

