Water retention capacity

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SWRT/ Subsurface Water Nets for Improved Soil Health and Plant Nutrition: Experiences from Marange, Zimbabwe

Alliance of Bioversity International & CIAT

Swedish University of Agricultural Sciences (SLU), Sweden

SWRT Sólutions

MICHIGAN STATE UNIVERSITY

Presentation by Prof. George Nyamadzawo (PhD), for the Building UK-Africa Collaboration for Soil Health and Crop Nutrition **online Event hosted by** Innovate UK KTN. https://iuk.ktn-uk.org

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About the Presenter

- Prof G. Nyamadzawo is a Holder of a PhD in Agriculture, Environment and Food System Engineering from the University of Zimbabwe (UZ), an MSc in Agriculture form from Washington State University (WSU), (USA); an MPhil in Agriculture (Soil Science); a BSc (Honors) Soil Science and a Diploma in Education all from the UZ.
- Currently a Consultant at Gasa Nyamadzawo & Associates in Harare, Zimbabwe.
- He has worked as a consultant Agricultural Scientist for the Swedish University of Agricultural Science (SLU) "*Productive Sands*" project, based in Harare, Zimbabwe.
- I have also worked as a consultant Agricultural Scientist for The Alliance of Bioversity International and the International Centre for Research in Tropical Agriculture (CIAT), as a Director Agribusiness and Continuing Education at the UZ and as a Professor of Soil and Environmental Science at Bindura University of Science Education in Zimbabwe.
- He has 80 peer-reviewed publications.
- Research in interest in agricultural water management, tropical agriculture plant production systems, soil fertility and nutrient management, sustainable and regenerative agriculture, quantification of greenhouse gases (GHG) and climate change management in tropical agricultural systems.

Problem

- In marginal and semi-arid areas with sandy soils there is perennial rainfall shortages, poor rainfall distribution and mid–season dry spells occur frequently.
- Sandy soils have; poor soil fertility, low water and nutrient retention, low CEC and low SOC, factor which contribute to poor crop growth.
- Situation has been worsen by extreme weather events associated with climate change and variability.
- In Marange maize yields are as low as 0.4 t ha^{-1}, and can improve 0.8 t ha^{-1} with improve management. As a result most households are food insecure.
- Households are depending on food handouts on a perennial basis, thus burdening the national Government.

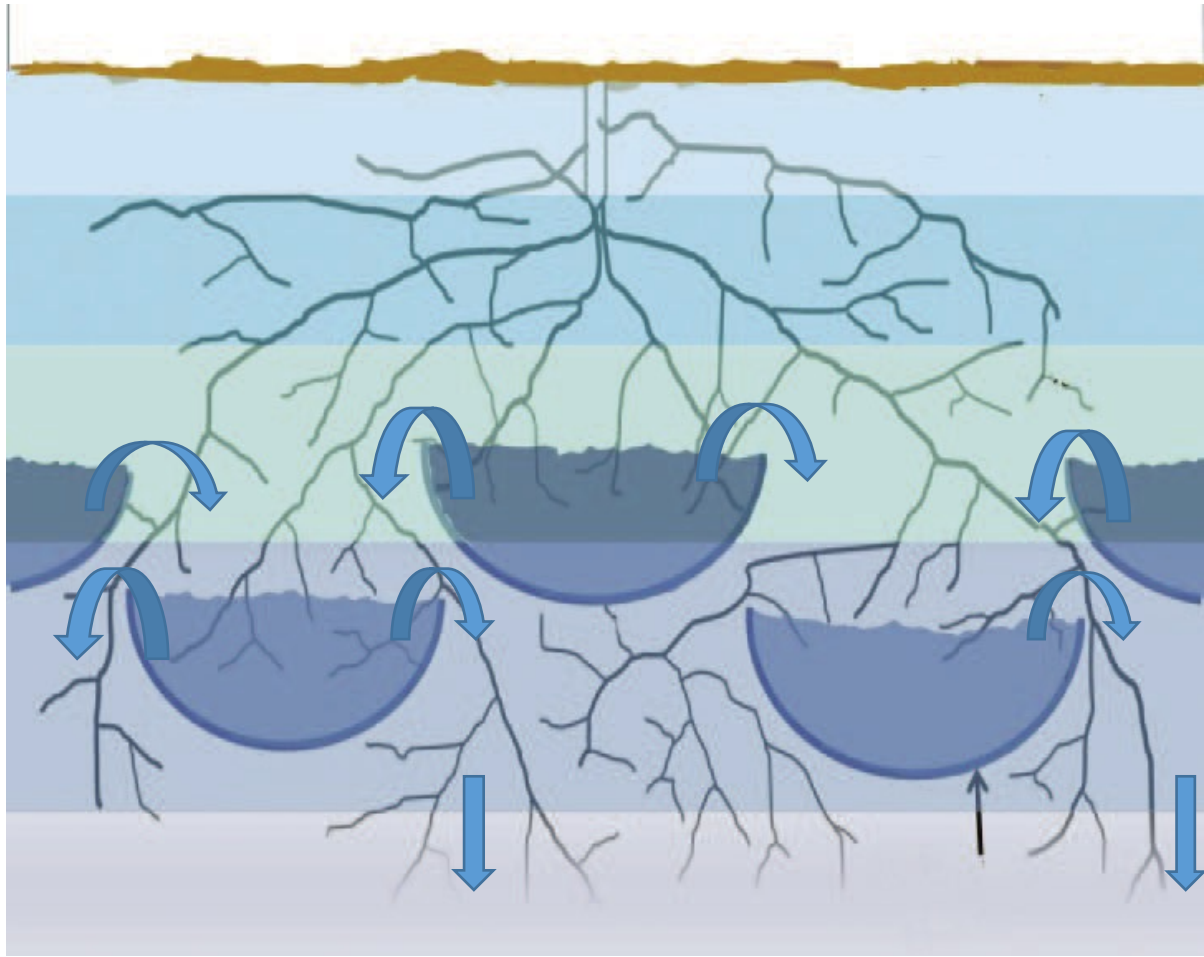
Our Solutions-Innovative low cost field edge (contour based) rain water harvesting technologies

Infiltration pits

Tied contours

Our Innovative solution- Infield subsurface water nets

- Sub-surface water nets (HDPE polymer membrane sheets) are installed below ground to;
- Retain and store water underground.
- Reduce nutrients losses due to leaching.
- Reduce evaporation compared to surface storage.



Installation of SWRT /Subsurface water nets

Installation on SWRT water nets (Mambure emvura)

Depth of installation is determined after capillary rise tests

Sites Description

- Mt Zonwe in Marange is located Agro ecological region v, Long term average rainfall is 383mm/annum
- Sandy soils, derived from granites.
- 2022/23 season 447mm (400mm after planting).
- Varieties Pioneer 30G19 (120 days to maturity), medium maturity.
- Orange maize (ZS500) (115 day to maturity), early maturing variety.

Soil health and plant nutrition strategies used

- Field edge water harvesting- Infiltration pits and Tied contours.
- In-filed- we used SWRT/subsurface water nets.
- Some plots also intercropped with legumes (mbili-mbili concept).
- Basal 300kg/ha compound D, 7 14 7 for NPK.
- Top dressing 250kg/ha AN 34.5% N (split application).
- Adhere to the 4Rs
- Timely weeding (twice)
- Pest and disease management (fall army worm)

Results- Excellent yield under SWRT/subsurface water nets

Maize under SWRT in Marange

Field day, community touring SWRT Plots in Marange

Summary of results

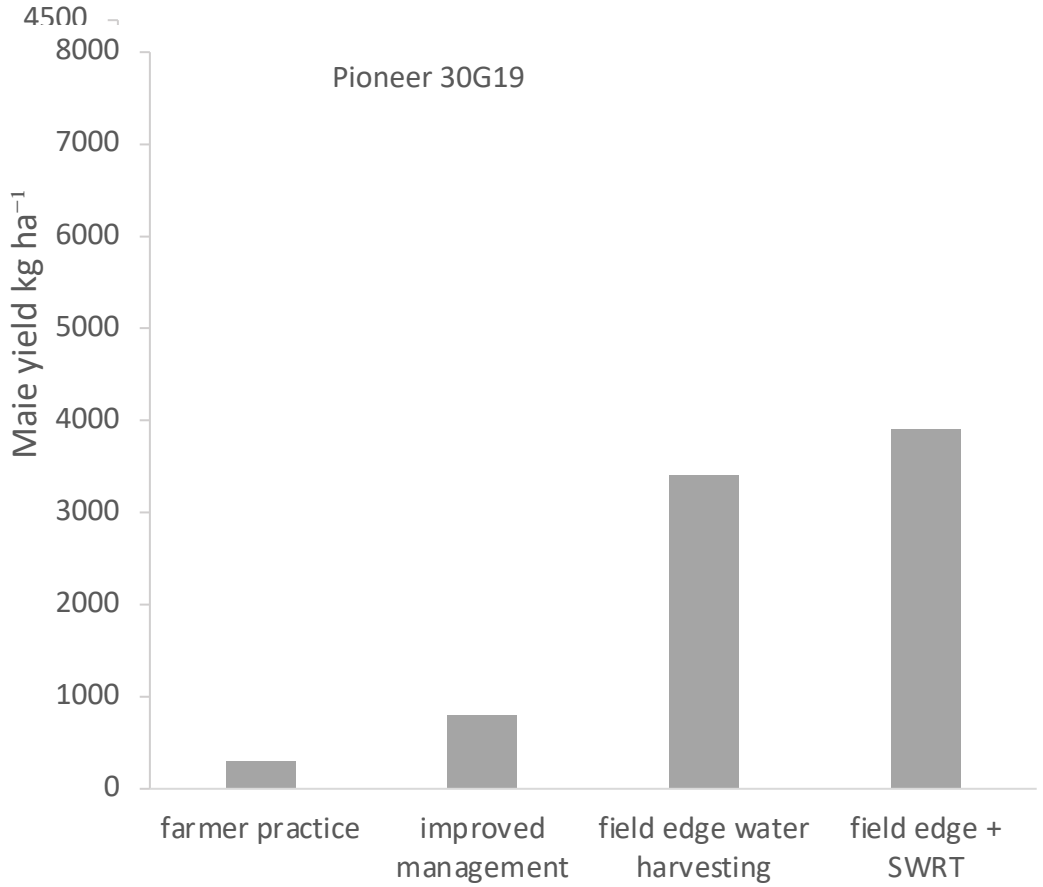
Pioneer 30G19

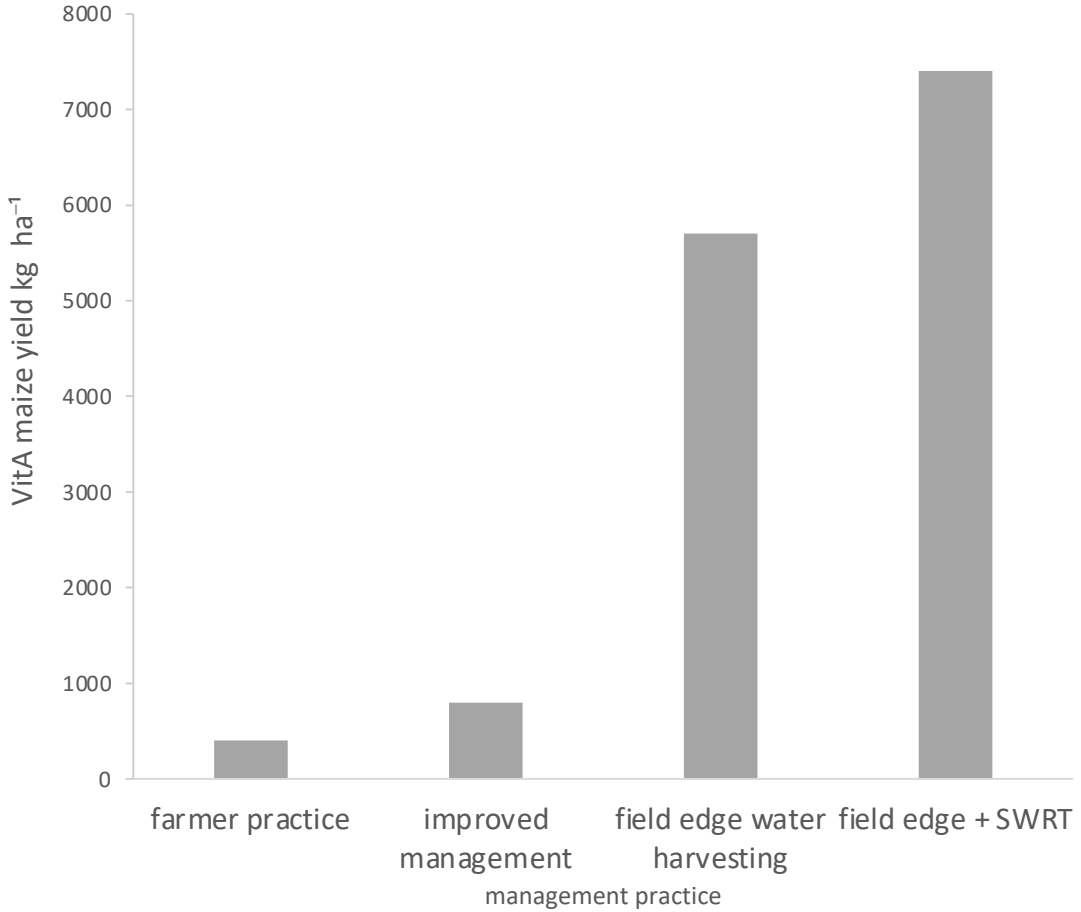
	Field edge + SWRT		Field edge, No SWRT	
Plant Population	37000	74000	37000	74000
Yield t/ha	3.9	3.4	3.4	3.0

Orange (Vitamin A) Maize ZS500

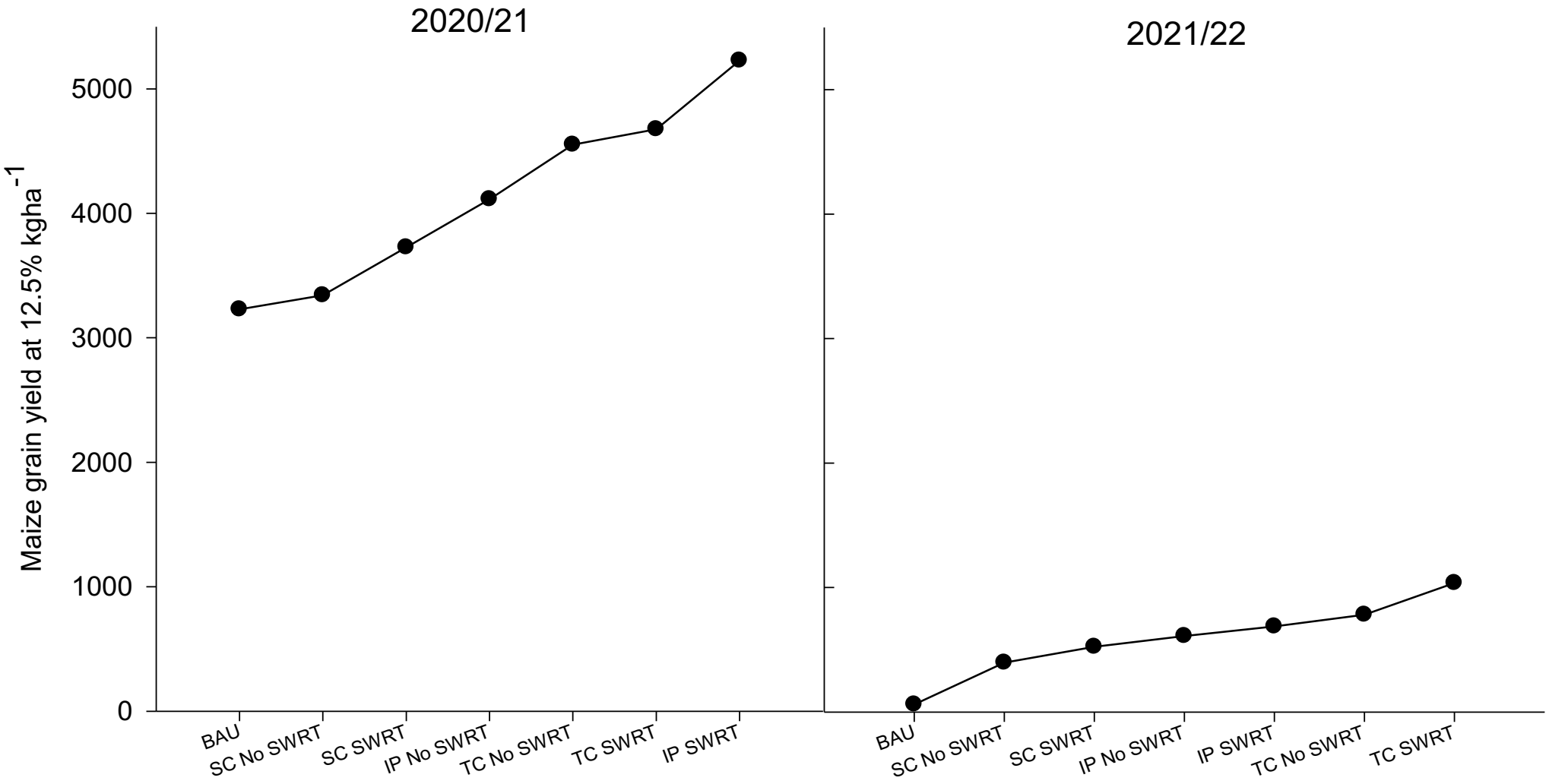
	Field edge +SWRT	Field edge, No SWRT
Plant Population	37000	37000
Yield t/ha	7.4	5.7

Maize yields for from for plots under SWRT (2022-23 season)





Maize yield for 2020-2022 cropping seasons



soil water management

What the community said after field days and tours

- “Come and also install these membranes at my homestead”, Mambo Marange.
- We are waiting for the water nets, “Councilor ward 2” Marange.
- 380 farming Households have signed up to participate, “Ishe Marange”
- This technology can transform semi-arid regions with sandy soils into green belts.

Video Links:

Innovative sub-surface water nets (SWRT) improves maize productivity in low rainfall & semi-arid regions of Zimbabwe.mp4 - Google Drive

From the field: climate-smart agriculture in Zimbabwe | Alliance Bioversity International - CIAT (alliancebioversityciat.org)

Next steps

- We need resources/funding to expand this/these innovation to other regions of the country e.g. through setting up of pilots so that communities can learn from these pilots, thus encouraging adoption.
- We need to support famers in sourcing membranes. In Marange we have 380 farmers who have enlisted to join the programme.
- We need promote the use of membranes together with other innovations, e.g. Pfumvudza (Spring) programme, nutrition gardens etc.
- Expand it to other crops, e.g. sorghum and millet.
- Provide a source for supplementary irrigation for farmers in case there are very long dry spells
- **More research** is still required e.g., performance of this technology in different soils, and evaluation of other innovative sustainable bio-based materials to used as sources of membranes. Development of low cost membrane installation equipment, use of AI and machine learning.

What is needed to cover this In Africa

- We need resources and funding, e.g. to set up pilots in different countries.
- We need capacity building, training of local agricultural and extension staff.
- Use of modern equipment for trenching and installation
- Build the capacity of local communities e.g. training membrane installers.
- We need an integrated approach and working with other institutions, e.g. APNI on plant nutrition, local industries, local Universities and research organization e.g. NAROs and CGIAR.

Thank You