On-farm techniques to increase resilience against the impact of dry spells on vulnerable sub-Saharan rainfed agricultural systems

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Presentation layout

• Introduction and challenges
• Research approach
• The Converging Evidence Approach
• Results and analysis
• Conclusion
Introduction

• MDGs on food, hunger & poverty. How far is SSA in achieving these?

• Majority of poor rely on rainfed systems;

• Need to manage dry spell occurrences between & during seasons;

• More efficient interventions desperately required for improved food security.
Challenges

• Link between agronomical successes and hydrological processes is not well understood;

• Obtained yields in rainfed systems below 1 t ha\(^{-1}\) against potentials of 3 t ha\(^{-1}\) and more (Rockström et al., 2004, Bhatt et al., 2006)

• Water productivity is a function of soil water and nutrient balances;

• Both are scarce!

• But are we optimising the little that is available?

• More research needed to help vulnerable communities…………
Productivity trends (maize)

Source: FAO (2006)
SSI Programme

- Multi-disciplinary
- 8 PhDs, 2 PDs
- MSc
- 2 catchments (SA and TZ)
- Participatory research
A hypothetical illustration of options for improving agricultural water management in cropping systems (Nyagumbo et al, 2009).
Tanzania research

The Makanya catchment

• Rainfall ~ 500 mm/season,

• Bimodal,

• Predominantly rainfed,

• Increasing trend of dry spells (Enfors 2008; Mul 2009),

• Maize staple food crop.
Tested techniques

- RWH (diversions)
- Ripping
- Fanya juus
- etc
Ripping

Fanya juu

Runoff diversions
Direct observations

- Rainfall
- Runoff
- Soil Moisture
- Soil evaporation
- Runoff
- Yield

Indirect observations

- Geophysical (ERT)
- Modelling
  - HYDRUS2D
  - Spreadsheet
RESULTS
Rainfall and RWH

Cumulative water available [mm]

Date

Site 3

Cumulative water available [mm]

Date

Site 4

Cumulative water available [mm]

Date
Soil moisture variation

![Diagram showing soil moisture variation with distance from the first trench.](image)
Crop productivity

- Grain output (kg m\(^{-2}\))
- Water available (kg m\(^{-3}\))
- Transpired water (kg m\(^{-3}\))
- Economic ($ m\(^{-3}\)) or vice versa?
Crop productivity

Up to 3x grain yield

heterogeneity conditions created
ERT results
Modelling output

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Spreadsheet model output
(a) Current cultivation practices (control)

(b) *fanya juu* technique (without diversion)

(c) *fanya juu* technique (with diversion)

(d) reduced spacing to 3m

(e) increased spacing to 20m
Conclusions

• Heterogeneity conditions created by the tested techniques facilitate diversity and, hence, increased scope for resilience against dry spell impacts;

• Productivity increases with more combinations of CA and water diversions;

• Unproductive processes still high, regulate infiltration to what is required by plants (storage);

• Upstream-downstream interactions not sufficiently addressed; Is there possibility of conflicts?

• Socio-economic questions still exist on viability of the techniques at household level;

• How is success of adoption and uptake measured?
Acknowledgements

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