Resilience and Economic Benefits of Water Harvesting and Changing Planting Dates in Maize Systems of Semi-arid, Tanzania

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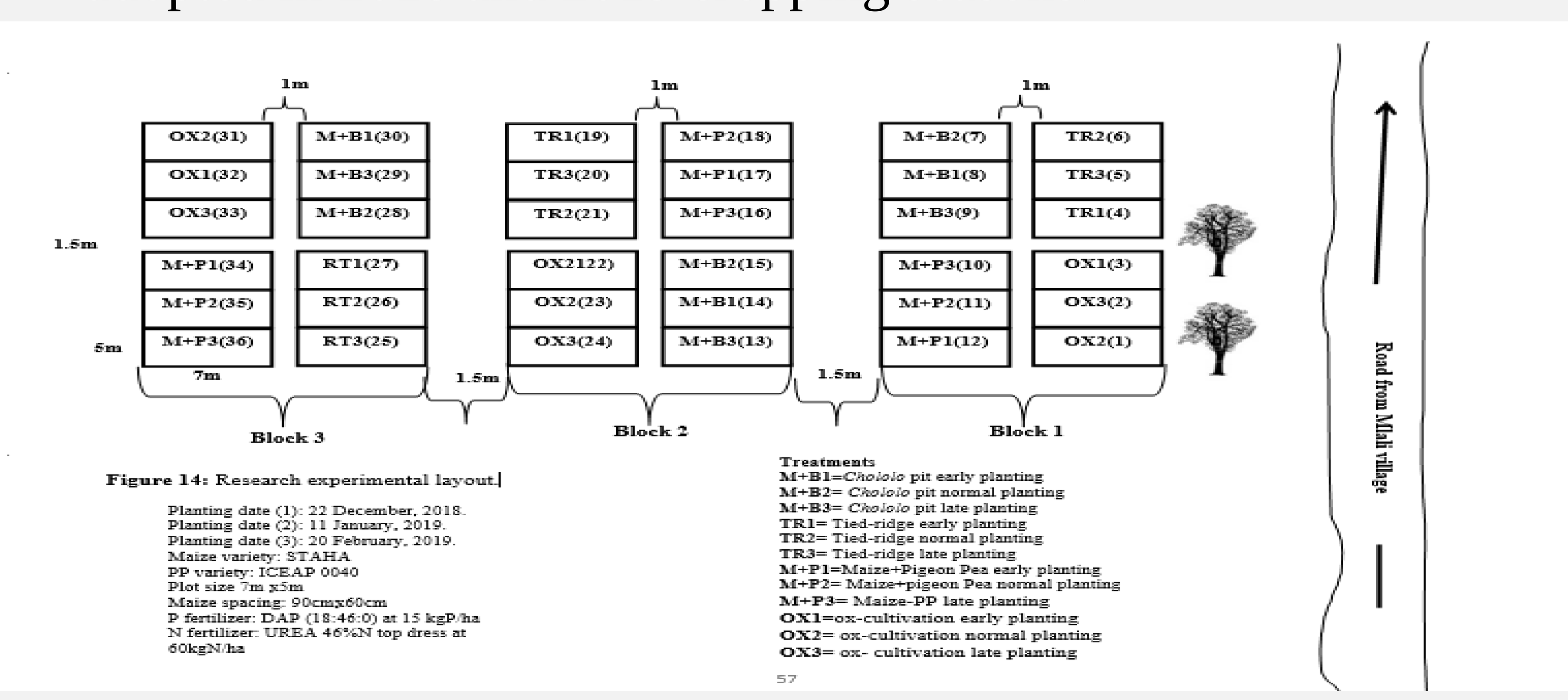
❑ Introduction

In sub-Saharan Africa (SSA), climate variability and poorly adapted farming practices threaten food security, economic growth and development among rural households. Unpredictable rainfall challenge smallholder farmers to determine the appropriate timing for planting and result in crop failure and declining crop yields. Due inadequate information on the resilience and economic benefits of rain water harvesting technologies and planting dates in semi-arid conditions. We tested the resilience and economic benefits of selected management practices (ox-cultivation/control, tied ridges, *Chololo* pits and intercropping) and planting dates (early, normal and late) replicated three times.

❑ Materials and Methods

- A split plot experimental design, with three replications was adopted in 2018 and 2019 cropping seasons.



Results and Discussion

- The long-term annual rainfall was below average by 40% which lead to declined yield at 6% in 2019 cropping season due to droughts.

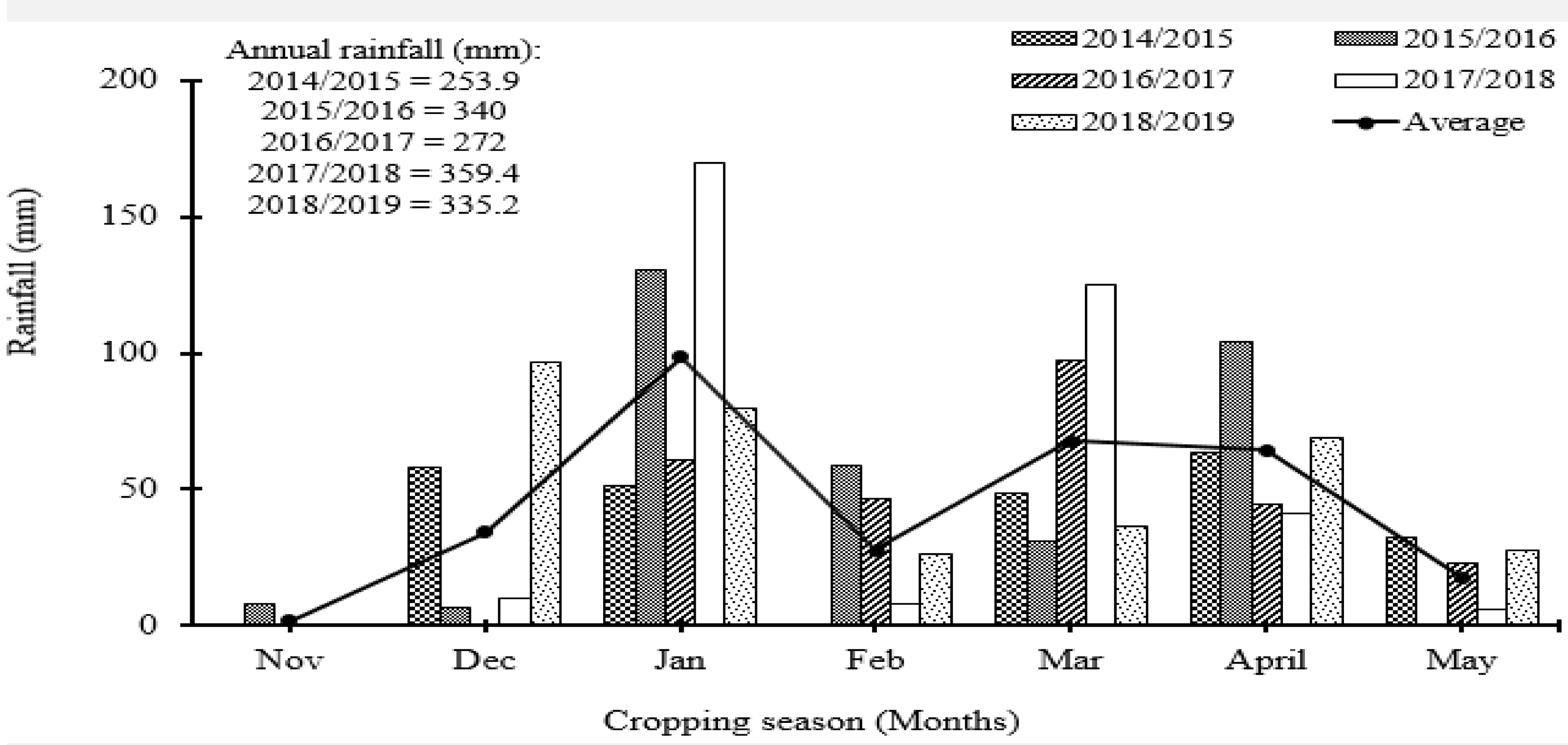


Fig. 2: Site specific Rainfall distribution data for 2014-2019

- *Chololo* pits and tied ridges demonstrated the highest resilience on soil moisture retention at 10.8% and 13% that influenced maize growth and yield (Fig. 3).
- *Chololo* pits at early and tied-ridges at late planting dates significantly (p = 0.047 and p = 0.001) increased maize grain yield (3.1 and 3.6 t ha^{-1}) in 2018 and 2019 cropping seasons respectively.
- Maize growth and grain yield increased significantly across *Chololo* pits at early and tied-ridges at late planting dates that led to reasonable economic benefits
- Similar practices had higher economic benefits of average margin rate of return of 89.82% and 83.64% also marginal net return of 426.05 USD/ha and 460.92 USD/ha in 2018 and 2019 cropping seasons respectively.

ACKNOWLEDGMENTS

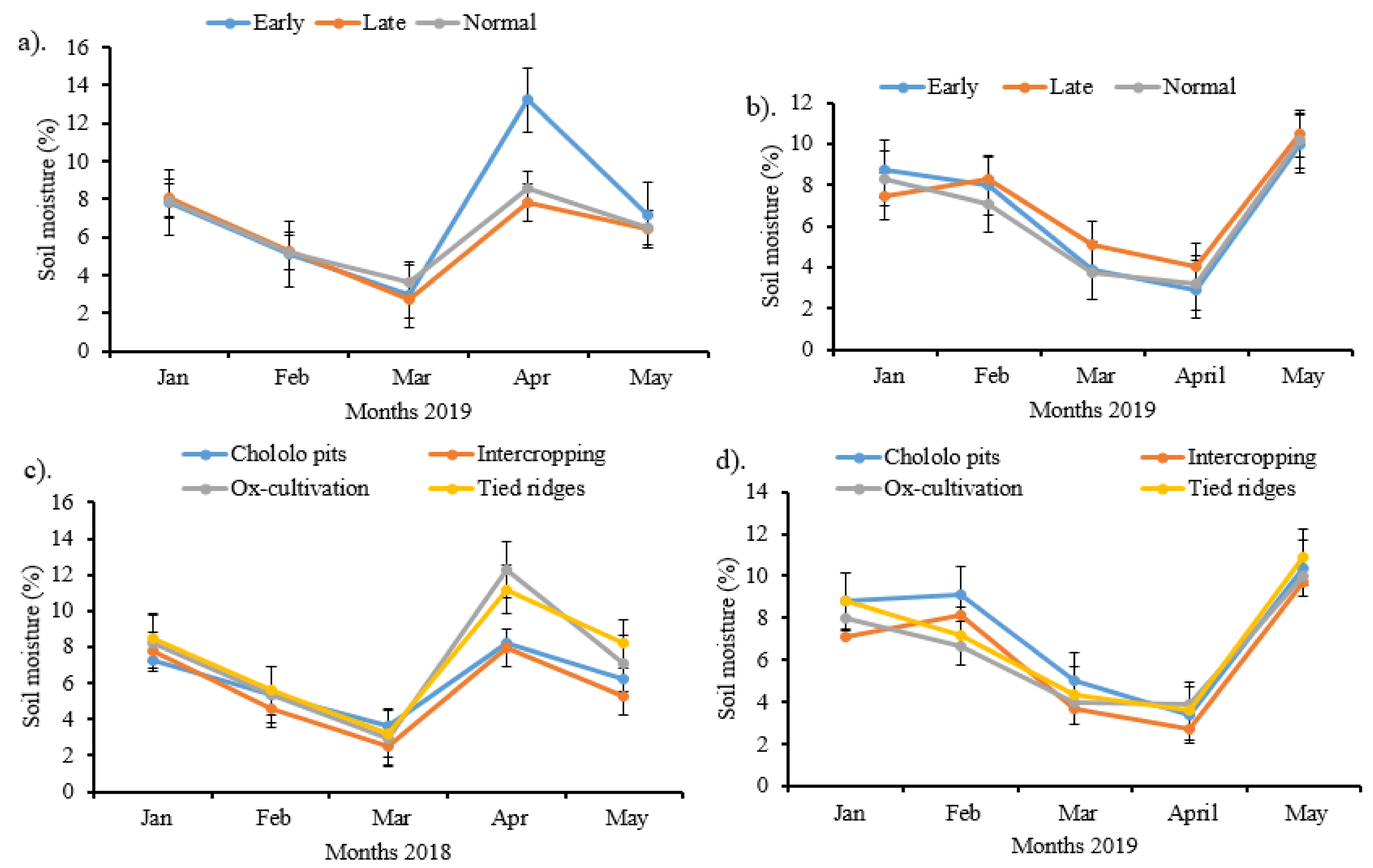
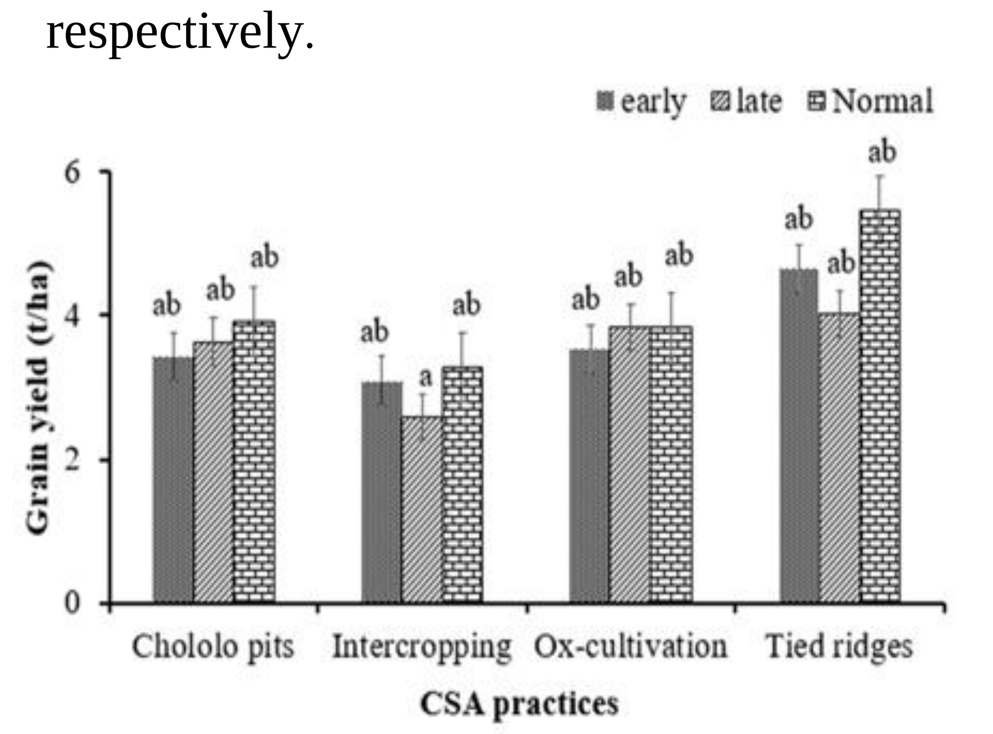


Fig. 3 (a), (b), (c) & (d): Effects of Planting dates and Rain water harvesting (CSA) practices on soil moisture in 2018 and 2019 cropping seasons respectively.



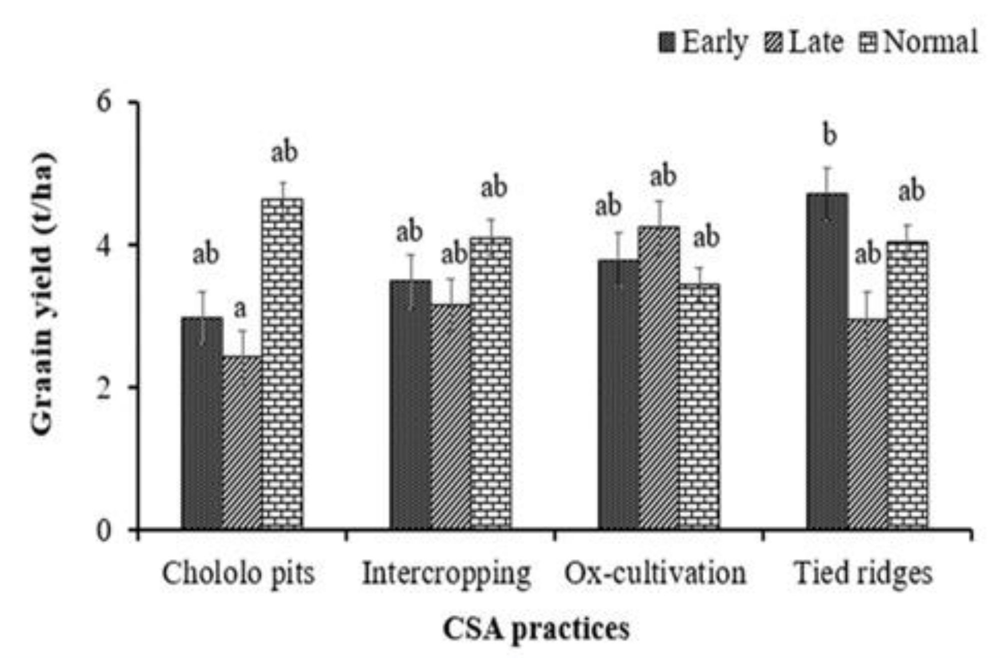
YIELD: MAIZE GRAIN 2018

CSA practice: (p = 0.049)

PD: (p = 0.046)

CSA x PD: (p > 0.05)

CSA practice	Grain yield	Planting date	Grain yield
IC	2.9	Early	3.7
OX	3.7	Normal	4.1
TR	4.7	Late	3.5
CP	3.8		



YIELD: MAIZE GRAIN 2019

CSA practice: (p > 0.05)

PD: (p = 0.01)

CSA x PD: (p > 0.05)

CSA practice	Grain yield	Planting date	Grain yield
IC	1.7	Early	2.3
OX	2.0	Normal	1.4
TR	2.3	Late	2.8
CP	2.7		

Fig. 4: The effects of CSA/RWH practices, planting date and their interaction on maize grain yield for the 2018 and 2019 cropping seasons

Table 1: Total variable costs, marginal net return and marginal rate of returns (USD ha^{-1}) for the CSA practices and planting dates for 2018 and 2019 cropping seasons. NB: 1 USD = 2300 TZS

Practices (P)	2018 Cropping season TVC (USD/ha)	2018 MNR (USD)	2018 MRR (%)	2019 Cropping season TVC (USD/ha)	2019 MNR (USD)	2019 MRR (%)
Intercropping	509.86	269.35	52.83	485.52	-52.47	10.81
Ox-cultivation	501.22	474.17	94.60	480.14	35.08	7.31
Tied ridges	515.30	715.22	138.80	510.52	75.40	14.77
Chololo pits	526.17	480.79	91.38	510.52	206.09	40.37
Planting dates (PD)						
Normal	501.22	575.39	114.80	485.57	-134.18	27.63
Early	501.22	457.21	91.22	485.57	125.65	25.88
Late	501.22	418.60	83.52	485.57	240.17	49.46

CONCLUSION

- *Chololo* pits and tied ridges water RWH practices demonstrated resilience on soil moisture despite the decrease annual rainfall at 40% in 2019 cropping season.
- RWH and planting dates are critical issues to consider in designing and deciding practices to adopt under climate variability.
- *Chololo* pits at early and tied ridges at late planting dates could be the best option among smallholder farmers to reduce the negative impacts of climate change in semi-arid areas.