Carbon and water dynamics in maize-based system under different tillage practices in the savannahs of Ghana

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Outline of presentation

- Introduction
- Materials and Methods
- Results and Discussions
- Conclusions and Recommendations

Introduction

- Population increase

Require

Increased food production

- population Increased to 11.2 billion by 2100

(United Nation, 2017)

- **Extreme weather conditions threatens food production**

Introduction cont'

Maize yield obtained by farmers are low

Main cause

- Low soil fertility
- Limited use of external inputs

- **1.4 t ha^{-1} <6 t ha^{-1}**

(Adu et al, 2018)

Introduction cont'

ISFM

Farmers

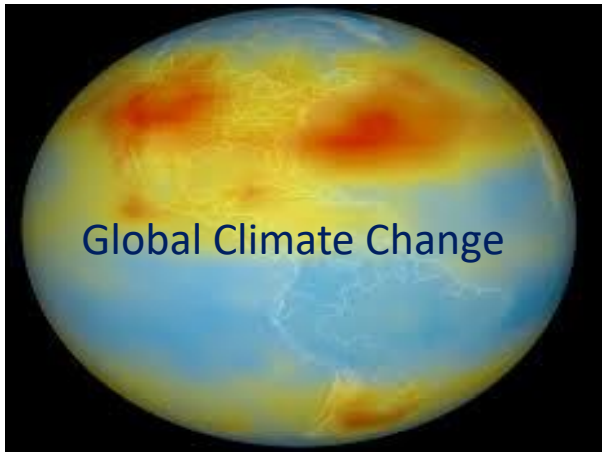
Proven

Sustain maize yield

Potentially

CO_2

Contributing



Source: www.nrdc.org

Introduction cont’

- There is lack of information regarding the effects of tillage and ISFM practices on C dynamics in the Guinea Savannah Zone of Ghana

- Commercially available system to measure CO_2 is capital-intensive

Introduction cont'

➢ Objectives

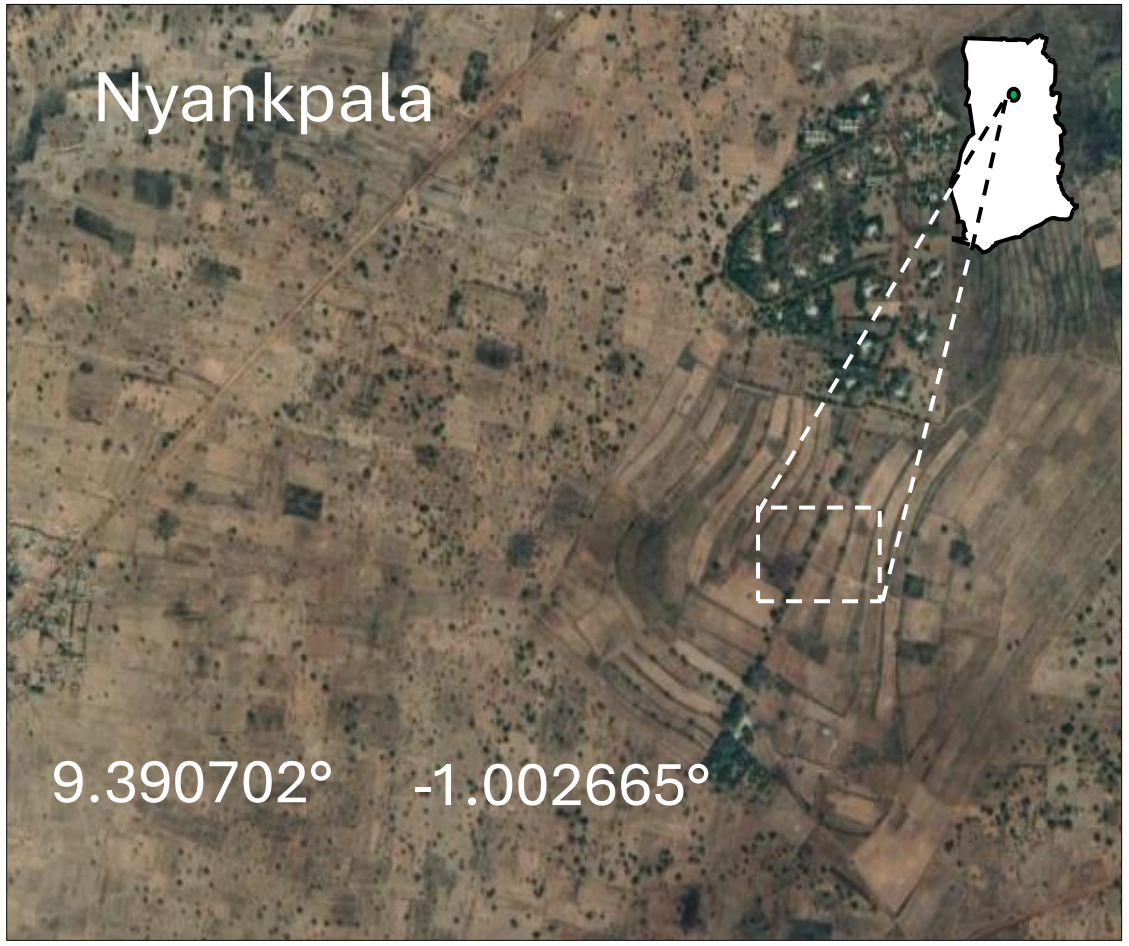
- Examine the influence of tillage systems and combined application of organic and inorganic fertilizers on CO_2 emissions, WUE and NECB.

- Investigate the effects of tillage systems and combined use of organic and inorganic fertilizers on maize yield .

Materials and Methods

- **study sites**

- **Temperature: 26 °C**
- **precipitation: 1100 mm**
- **Soil: Acrisols**



Materials and Methods

➢ Treatments and design

- Split plot Design
- 3 Replications
- Plot size : 6 m x 5.6 m

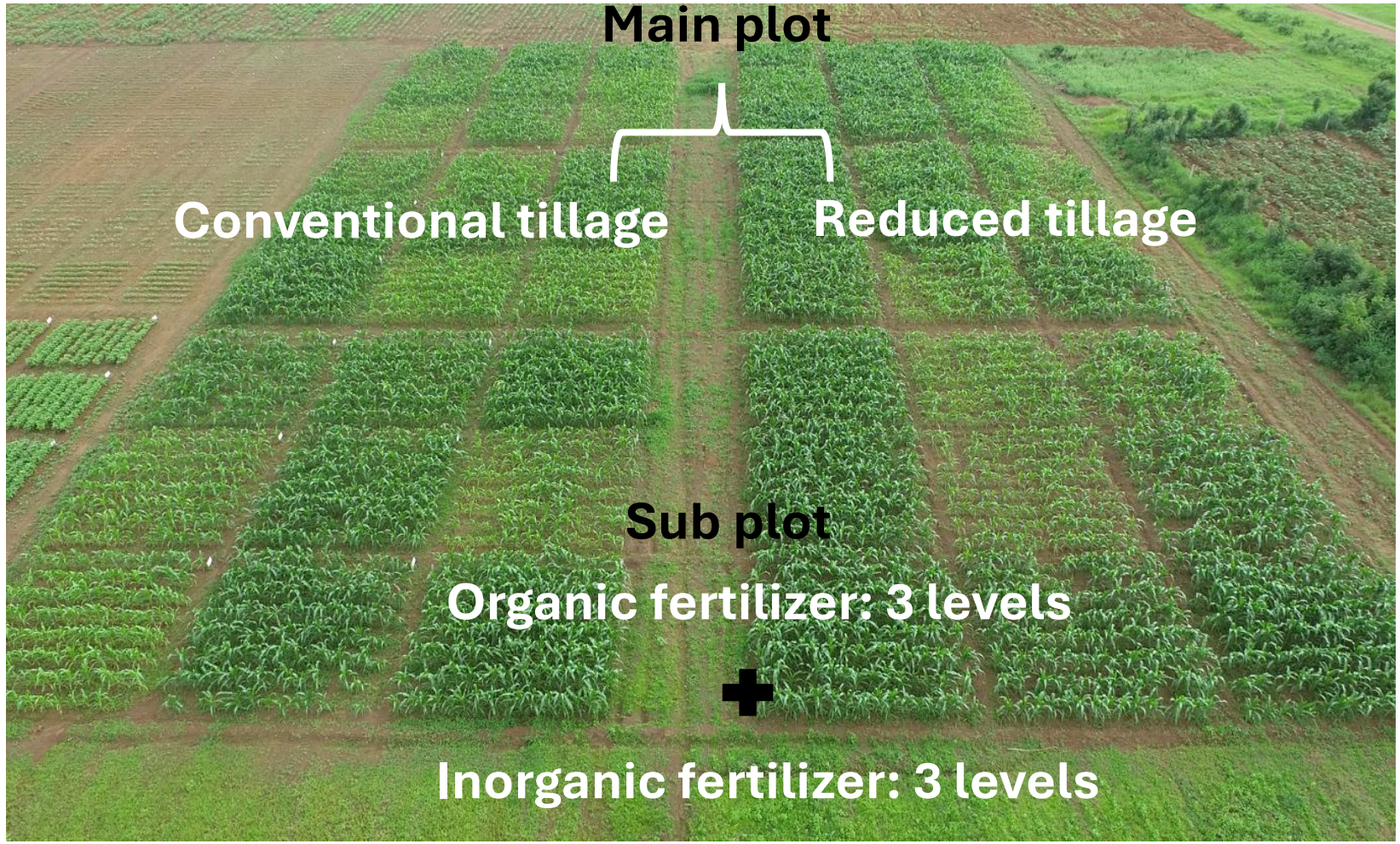
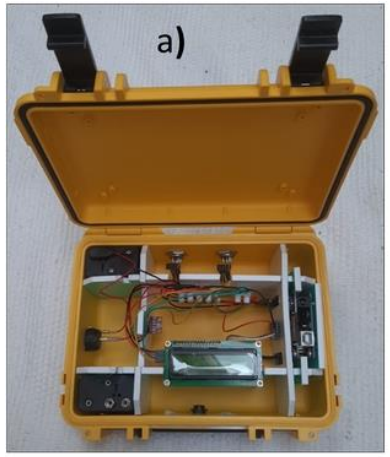


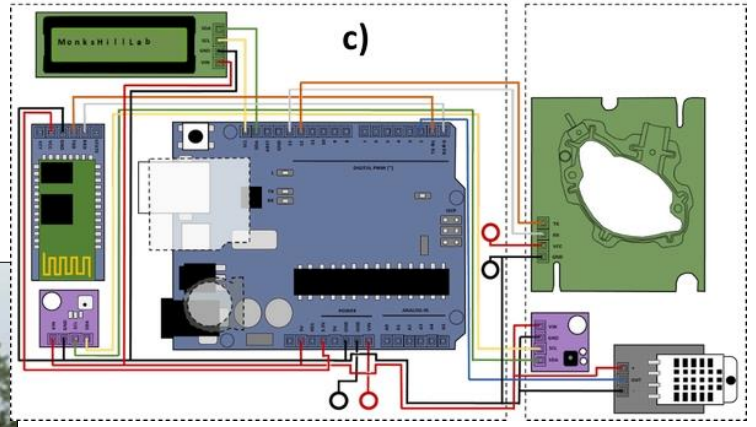
Table 1: Selected soil physical and chemical properties in the study area

Parameter	Unit	Values
pH H_2O (1:2)		5.8
OC	%	1.053
N	%	0.015
P (Bray 1)	mg/kg	4.249
K	mg/kg	84
Ca	$Cmol^+ kg^{-1}$	1.6
Mg	$Cmol^+ kg^{-1}$	0.3
Sand	%	45.52
Silt	%	48.16
Clay	%	6.32

Carbon dioxide and ET measurement

Net ecosystem exchange





Ecosystem respiration

Campaign

- Done fortnightly.

Materials and Methods

➢ NECB Estimation

- $\mathrm{NECB} = \mathrm{NEE} + \mathrm{C_{input}} - \mathrm{C_{output}}$ (Smith et al, 2010)

- NEE- cumulated net ecosystem exchange
- C_{input}- organic fertilizer application (C)
- C_{output}- harvested biomass (C)

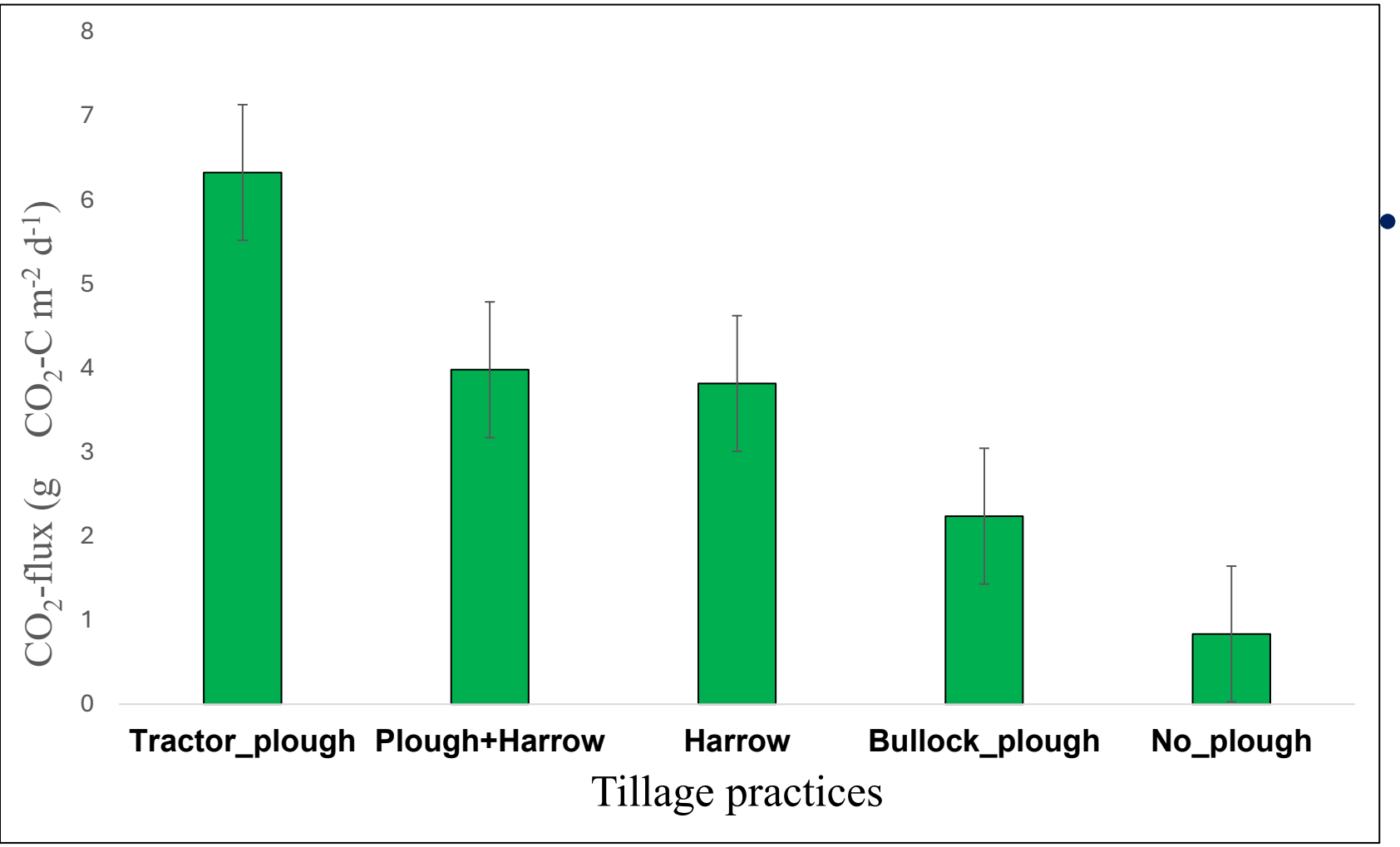
Materials and Methods

➢ Data analysis

- The R statistical software (3.6.3) was used for all the CO_2 calculations

- Agronomic data were subjected to analysis of variance (ANOVA) using GenStat (12th Edition) and the treatment means were compared using the Duncan's Multiple Range Test at ($P < 0.05$).

Results and Discussions



- **Conventional tillage emitted 65% & 87% CO_2 than minimum tillage and No tillage, respectively.**

Figure 1: CO_2 emission under different tillage practices in Nyankpala, Northern Ghana

Results

- FT_90 had the highest Reco with lowest seen in NM_0 treated plot
- Similar trend was observed on the GPP parameter.
- FM_90 gain more C than the rest of the treatments.
- All the treatments except for NM_0 and NM_90 were C sink.
- FT_90 utilized water efficiently

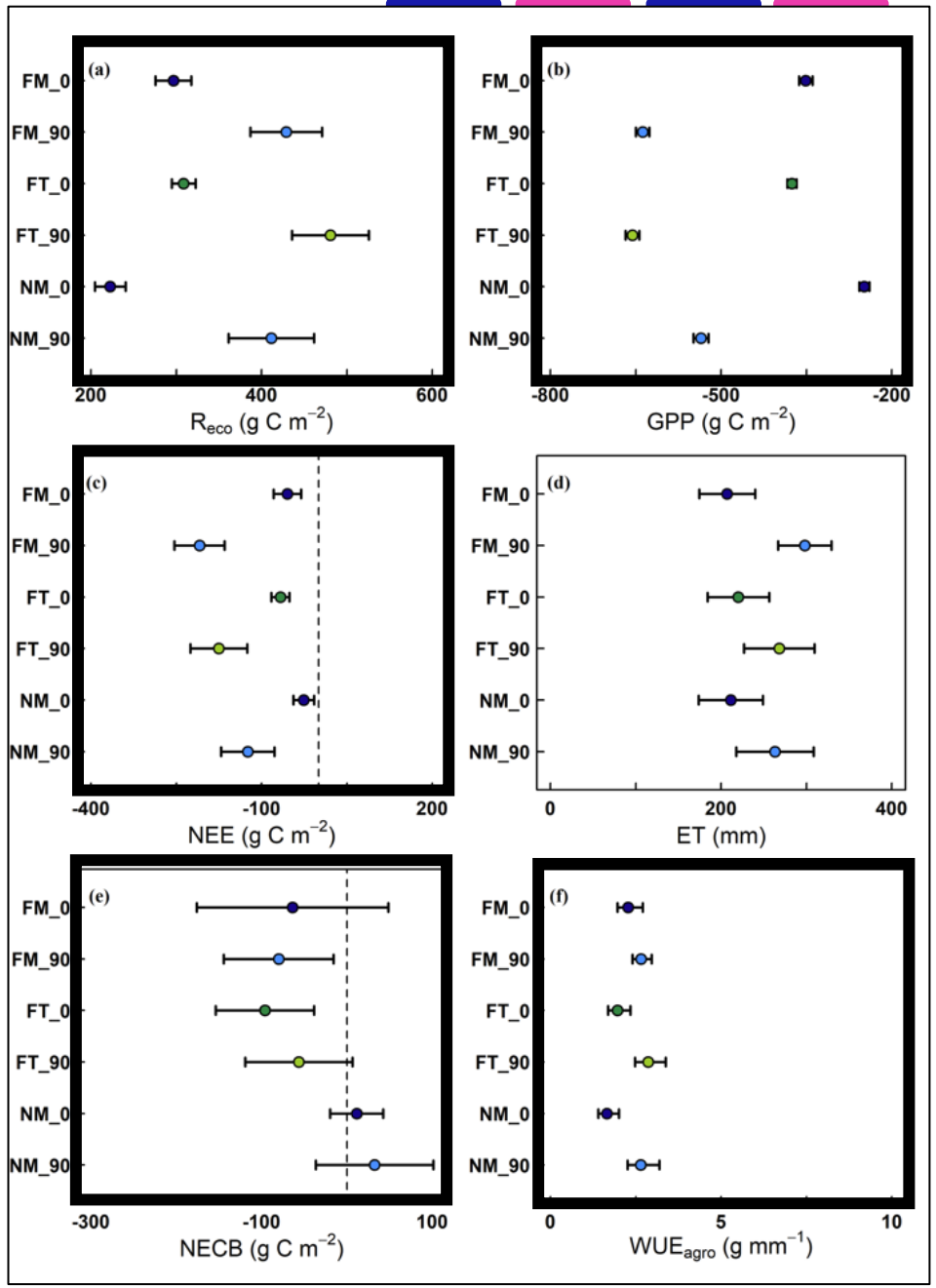


Figure 2: Parameters on reduced tillage system

Results

- NM_90 had the highest Reco with the lowest seen in NM_0.
- FT_90 produced the highest GPP and FM_0 gave the lowest.
- FT_90 gain more C than the rest of the treatments.
- All the treatments under conventional tillage were C sink.
- FT_90 used water efficiently.

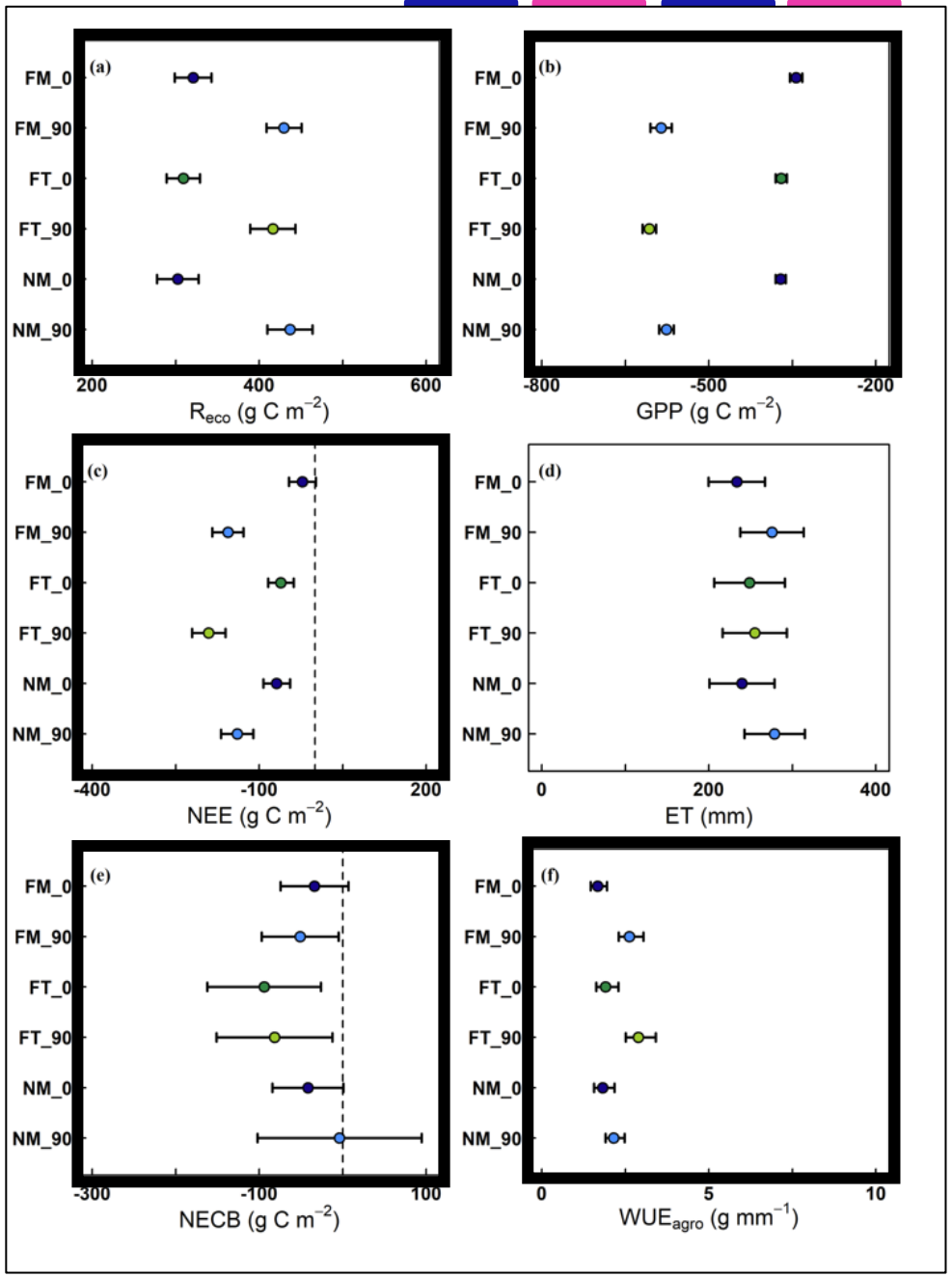


Figure 3: Parameters on conventional tillage system

➢ Grain yield

- Fertisol at 5 t ha^{-1} + 90-60-60 kg NPK ha^{-1} produced the highest yield irrespective of the tillage practices

- No amendment plot gave the lowest yield

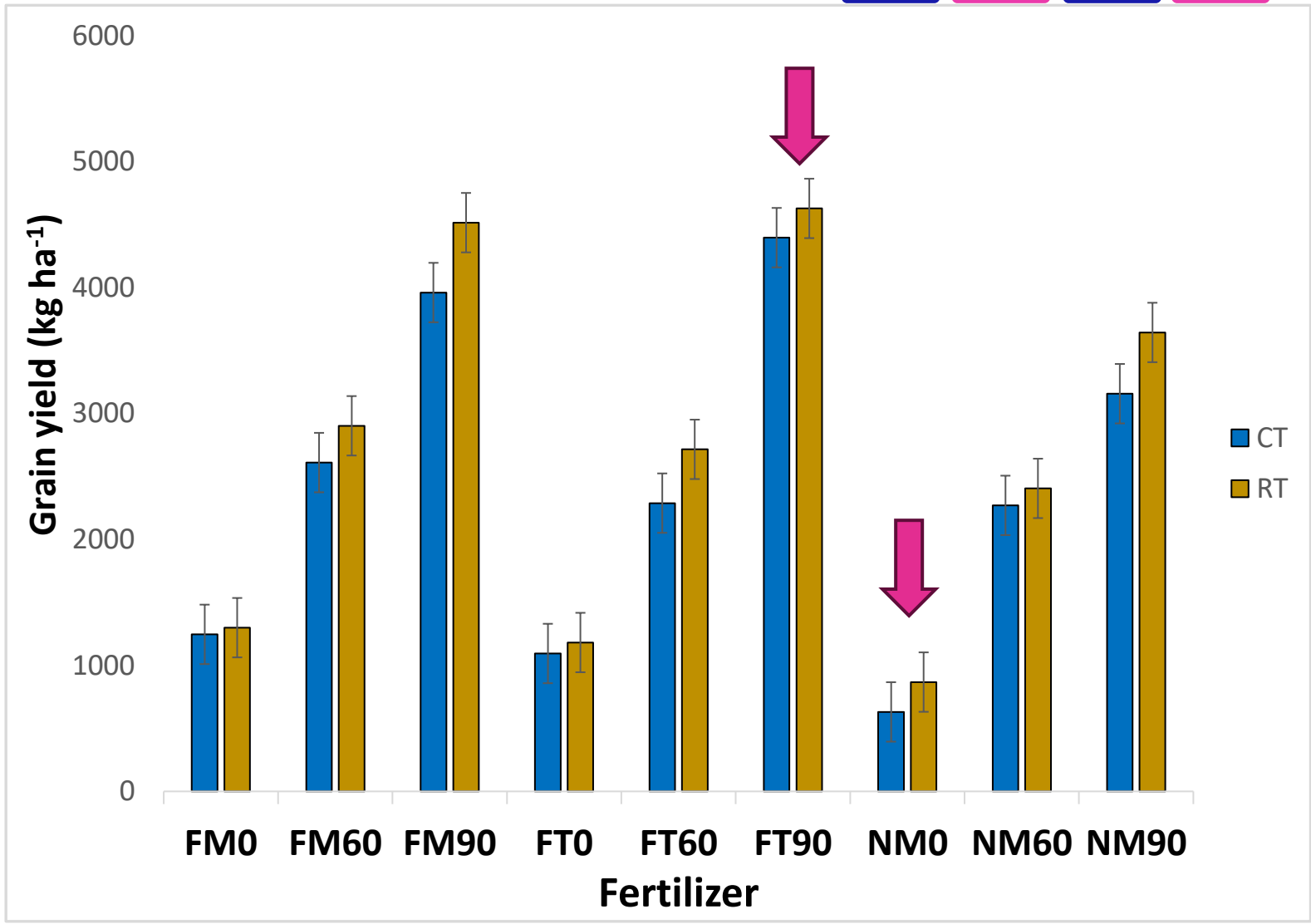


Figure 4: Grain yield on reduced and conventional tillage as influence by ISFM practices in Nyankpala, Ghana

Conclusions

Fertisoil/FYM at 5 t ha^{-1} and 90-60-60 kg NPK ha^{-1}

- Reduced CO_2 emission
- Sequester C (Carbon sink)
- Utilized water efficiently

Irrespective of tillage practice

Enhanced maize yield and improve soil health

Farmyard manure/Fertisoil 5 t ha^{-1} + 90-60-60 kg NPK ha^{-1}

Recommendations

- Preliminary, we recommend the use of organic (farmyard manure at 5 t h^{-1}) and inorganic (90-60-60 kg NPK ha^{-1}) fertilizers for maize sustainability in the study area.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Thank you for your attention !!!