SUSTAINABLE SOIL MANAGEMENT FOR FOOD SECURITY AND BETTER NUTRITION

Baba Mutala Edem*[1] and Edward Yeboah[1]

[1]Council for Scientific and Industrial Research-Soil Research Institute, PMB-Academy Post Office Kwadaso -Kumasi-Ghana

***Correspondence: babamutala@yahoo.com**

PRESENTED BY:

Baba Mutala Edem

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Objectives of review

- Identify the main problems confronting the sustainable management of soils in sub-Saharan Africa (SSA)
- Identify/outline some policies and interventions implemented to remediate degraded lands in SSA
- Efforts made to sustainably manage salt-affected soils in the sub-region and
- Technological interventions being implemented to improve soil health and improve food security in SSA.

Presentation outline

- Objectives
- Methodology
- Results

Methodology

RESEARCH QUESTIONS
PICO and SPIDER

Search strategy

Inclusion and exclusion criteria (ONLY SSA)

Validate idea is not a duplication of a previous concept or publication

Data bases:
Science direct/Elsevier
Google
FAOstat
Research gate
National databases
Other published data and reports

Statistical analysis

Methodology ctd.
(Simplified prisma flow)

Google (n=180)
ScienceDirect(n=85)
Scopus(n=100)
Google scholar (n=50)
www.FAOstat.com (databases)

National databases (n=25)
Research gate (n=60)
World bank annual reports (n=5)
Institutional databases (n=30)

Total Number of Articles
(n=535)

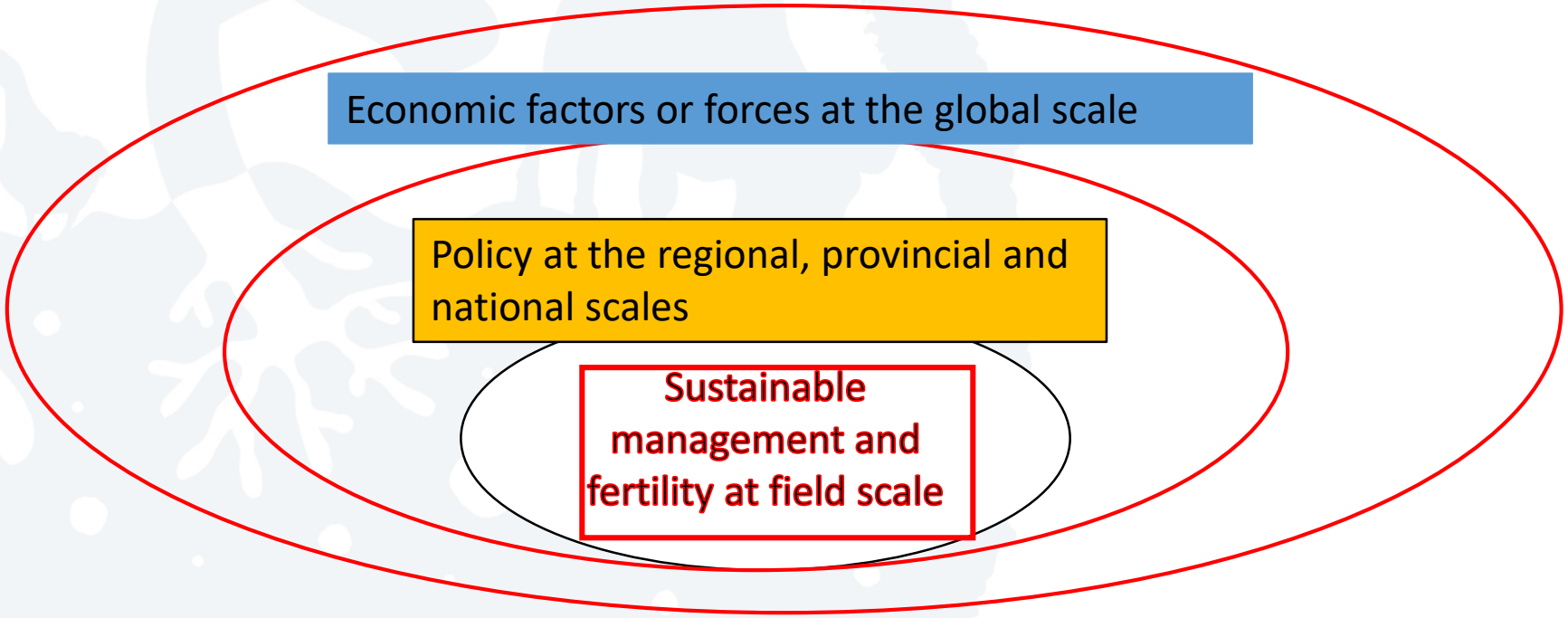
Duplicate articles excluded
(n=100)

Title and abstract screening
(n=335)

Articles excluded
(n=50)

RESULTS
influences of SSM at the smallholder level

- Sociopolitical and economic drivers determine (1) where, (2)which (3) how many people live in a given region.



Drivers of soil constraints in SSA

- SOM decline
- Erosion(wind, water)
- Deterioration of soil physical and chemical structure
- Biological deterioration (loss of micro-biodiversity)
- Soil nutrient mining driven by poverty.
- (Source: FAO, 2010, Jessica *et al*., 2020 and Ashley et al, 2020)

Specific soil constraints (Tully et al.,2015)

Fig. 1.0 constraints to soil fertility in SSA

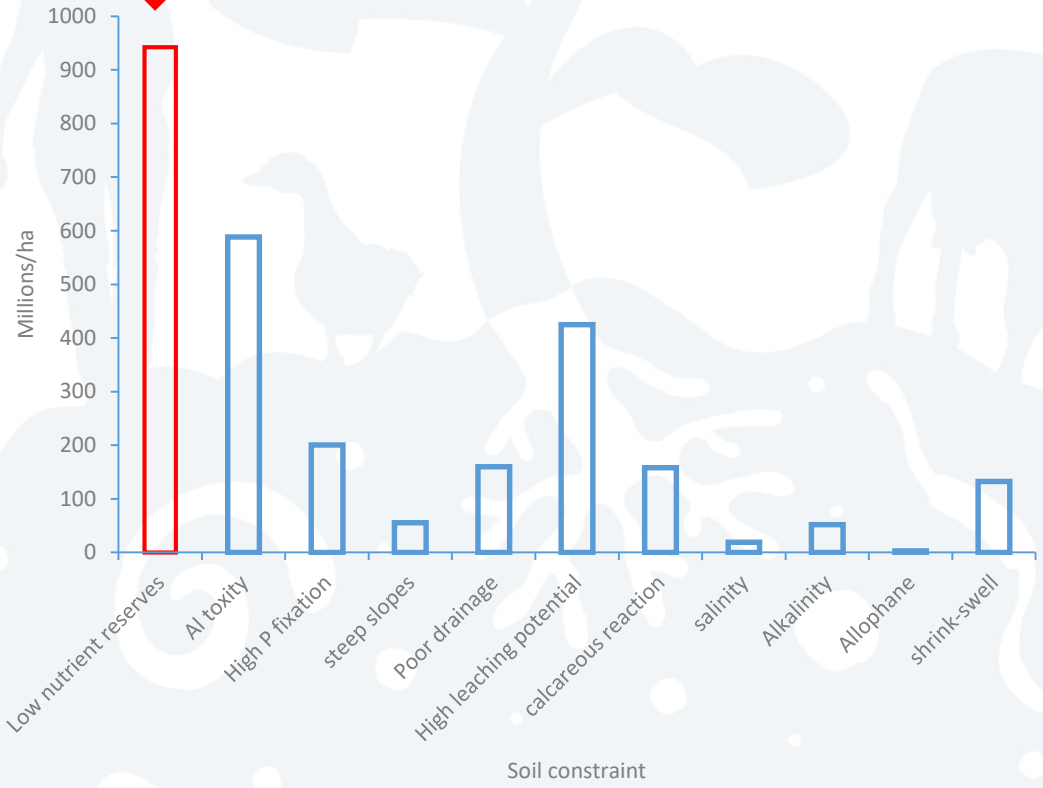
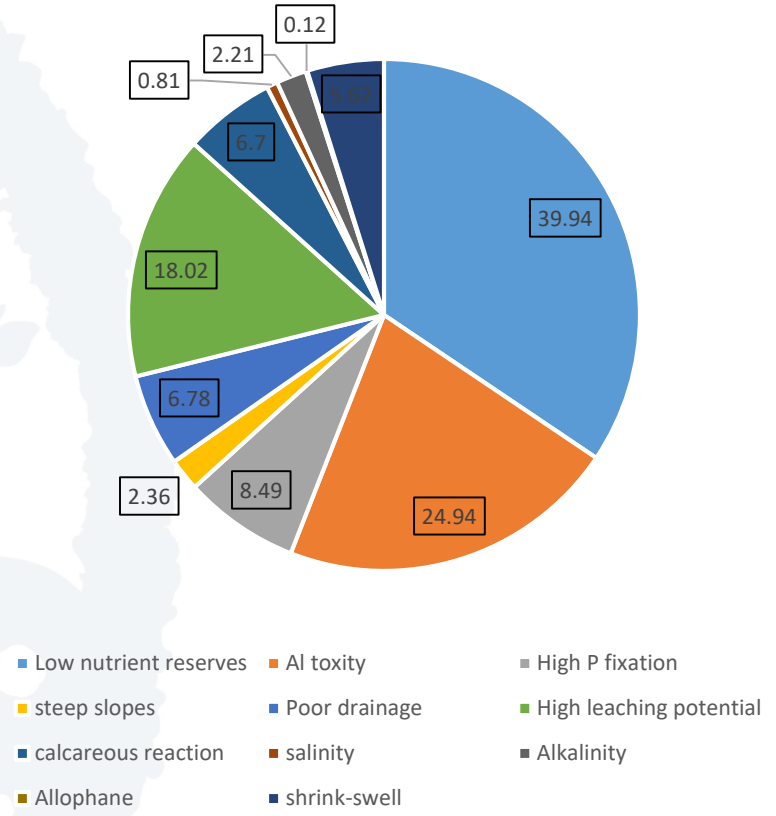


Fig. 2.0 Percent of Land under each constraint (SSA)



Status of food security in Africa source: FAOstat.com

Fig. 3.0
Severe food insecurity

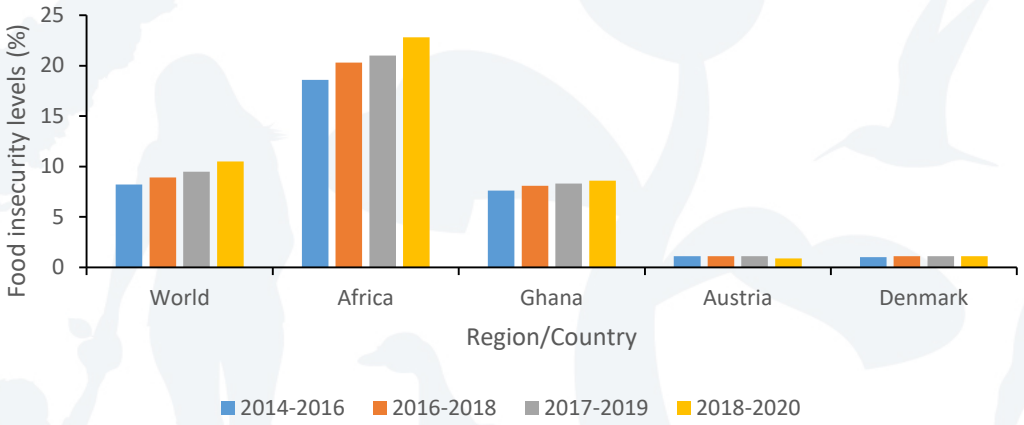


Fig 4.0 Mild food insecurity

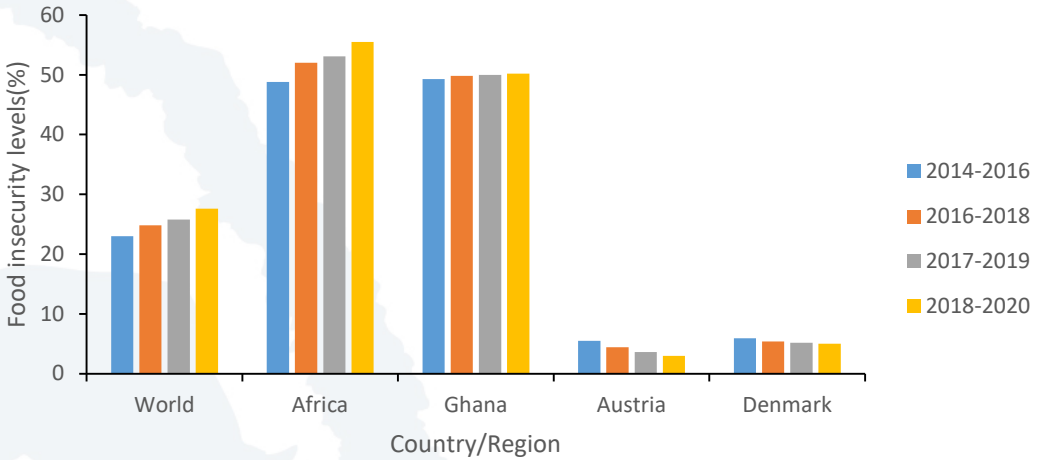


Fig. 5.0 Average Protein Supply by origin

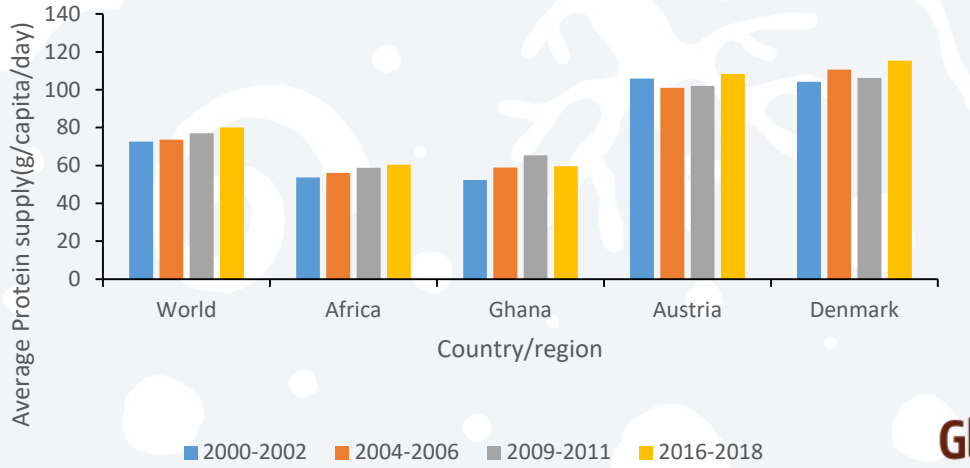
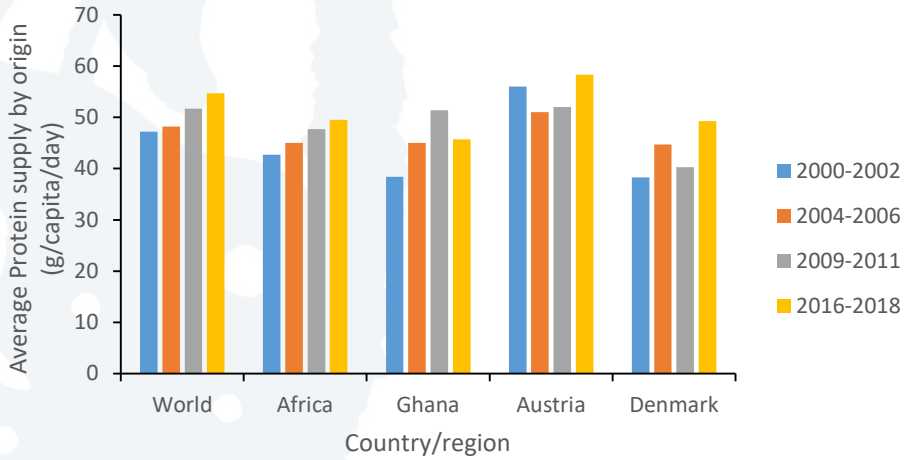


Fig 6.0 Protein supply from non-animal origin



Dietary supply and malnutrition (Source: FAOstat.com)

Fig. 7.0 Average dietary supply adequacy

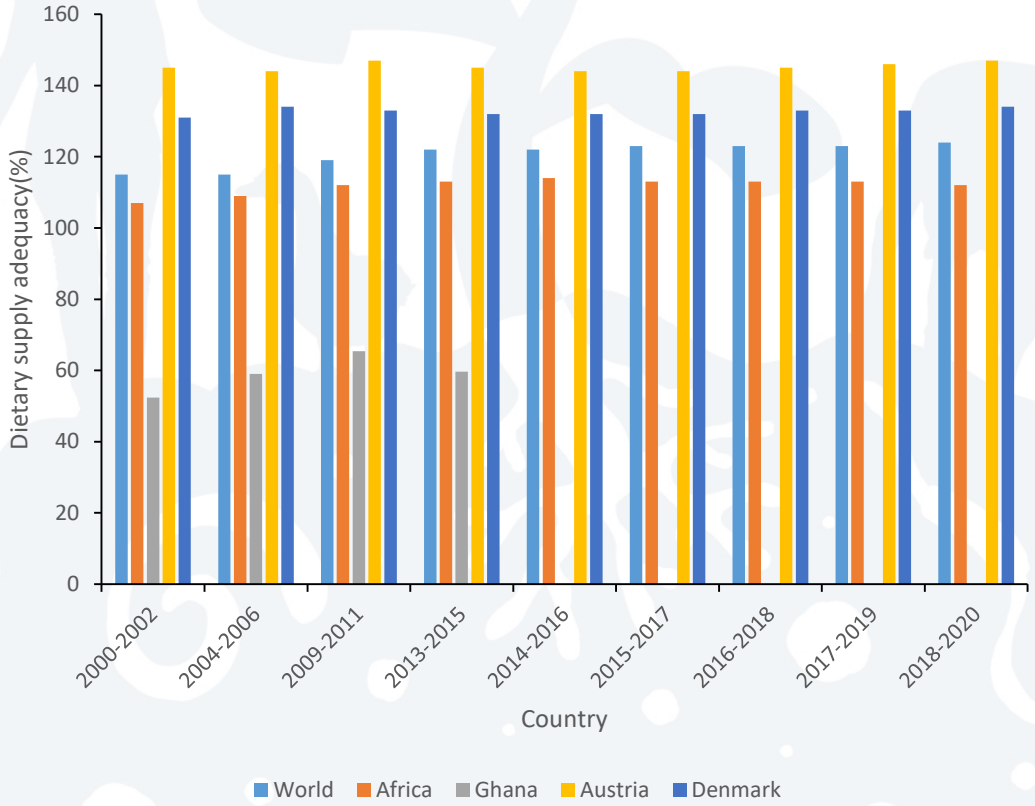


Fig. 8.0 Number of Children under 5 yrs who are stunted

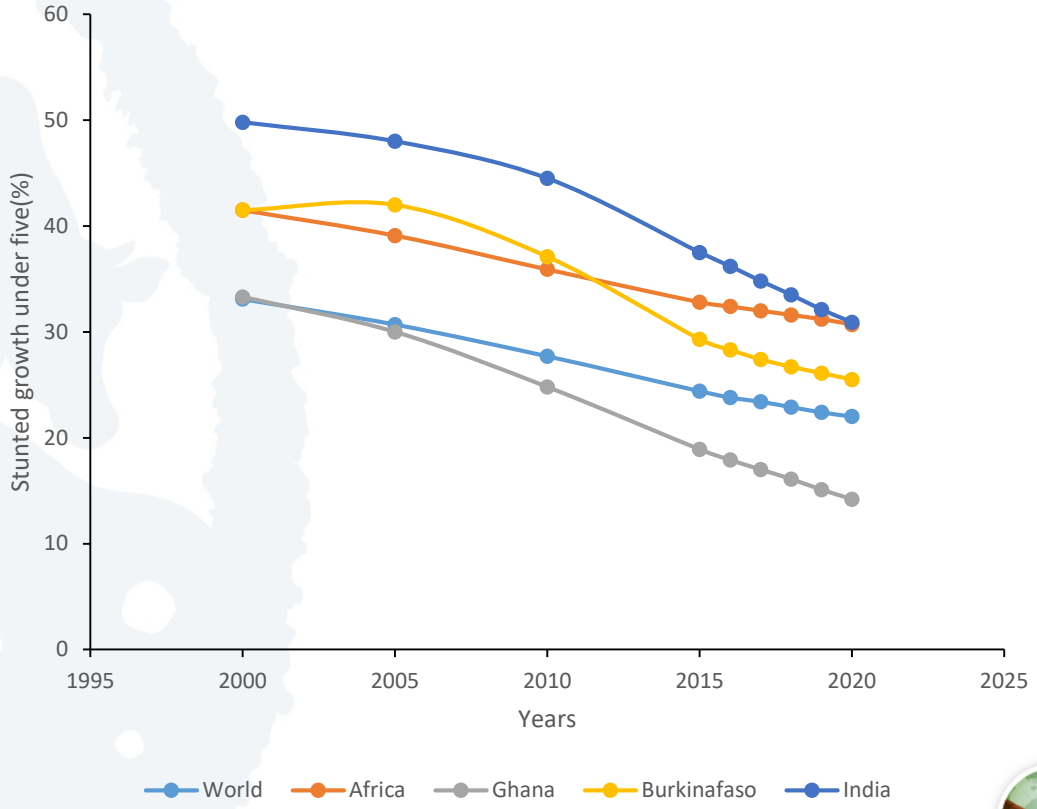


Fig. 9.0 Prevalence of undernourshment(% of population)

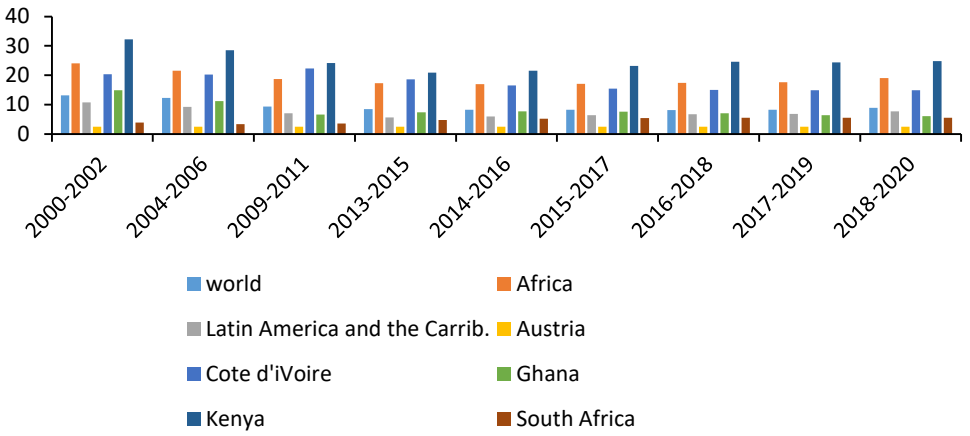
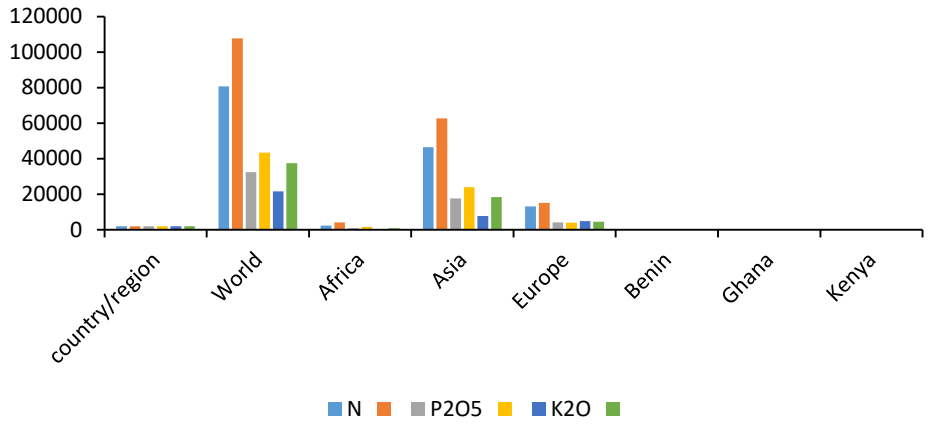


Fig. 10 Inorganic Fertilizer use by nutrient(Thousand tonnes)



Country	2000	2005	2010	2013	2014	2015	2016	2017	2018
Australia	8.7	7.5	5.3	7.7	7.4	3.7	4.3	4.3	4.7
Austria	10	9.8	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Benin	1	1	1	1	1	1	1	1	1
Burkina Faso	6.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Ghana	4.3	4.9	5.5	5.8	5.9	6.3	6.3	6.3	6.3
Kenya	12.9	21.2	26.5	26.5	26.5	26.5	33.2	33.2	33.2

Table 5.0 Water stress (%)

Table 1.0 Nutrient balances of SSA compared to other regions of the world (kg/ha) FAOstat.com

Year	N from Atm.	BNF	Manure-N	Inorg-N	Crop removal	Total[1]
World	11.1	21.9	17.4	69.3	54.3	65.4
Africa	6.5	6.5	5.5	15.4	20.2	13.7
Ghana	7.4	7.3	2.8	7.5	25.6	-0.6
Burkinafaso	4.8	8.7	9.7	9.3	18.8	13.7
Kenya	5.4	6	11	9.5	25.4	6.5
Togo	7.7	3.4	6.8	1.5	14.2	5.2
India	21.1	16.3	13.3	104.1	54.1	100.7

1: represents soil N reserves

Sustainable management practices

- Areas under forests (under the assumption that forest management sustains the soil and builds SOM) (Introduction of cover crops and alley cropping systems in Ghana and Kenya)
- Areas under organic agriculture (dietary patterns are forcing a more organic way of managing farming systems)
- Areas where substantial animal manures are added to the soil(Technologies are being introduced to enhance nutrient quality of pastures)
- Areas under biological N-fixation (Tithonia and N-fixing legumes are being introduced into farming systems in Ghana)
- Areas under less soil moisture stress… government of Ghana introducing the one village one dam policy.

Table 3.0 Soils under forest land or being reclaimed by afforestation (Percent of total land area). FAOstat.com

Region/country	2000	2010	2019
World	4158049.5	4106316.9	4063843
Africa	710048.8	676015.4	640606.6
Ghana	8848.6	7942.9	7978.5[a]
Burkinafaso	7216.5	6716.5	6266.4
Kenya	3961.2	3616.3	3611.1
Togo	1268.5	1238.9	1212.2
India	67591	69496	71893.6

a: Government tree planting intervention

Table 4.0 Areas under organic agriculture (Percentage of total agriculture area) FAOstat.com

Year	2004	2005	2010	2014	2015	2016	2017	2018	2019
World	21891.7	29211.2	45307.1	45307.1	5096714	57714.1	69540.8	71116.6	72213.3
Africa	624.2	952.9	1023.6	1263.1	1682.5	1800.6	2031.7	2006.8	2018.5
Ghana		17.3	12	15.6	23.4	21.3	15.3	29.7	31.3
Burkinafaso	0	0.3	13.8	20.1	23.9	27.3	58.9	56.7	87.5
Kenya		2.3	4.8	4.9	150.5	154.5	177.2	154.5	154.5

Table 5.0 Challenges confronting SSM and rehabilitation of soils/ solutions

• challenge	• Solution
• SLOW RESPONSE OF SOILS TO NUTRIENTS (e.g. the sandy soils!)	• Improved land tenure systems!
• High cost of inputs	• Land use planning, demarcation into grazelands and farms.
• Population dynamics	• Improved manure collection (incentivization)
• Low availability of manure	• Improved fallows
• Inaccessibility to fertilizer markets/Gender	• Introduction and education on BNF
• Low understanding of biochar	• Subsidies and accessible markets
	• Training on biochar

Governmental Policies

- Most governmental policies focus on boosting yields rather than any strategy to preserve soils (e.g. seed and fertilizer subsidies in Malawi, Zimbabwe and Ghana).
- E.g. the modernizing agriculture policy of the government of Ghana focused on:
- Attempts have also been made to regularize land tenure and improve land acquisition(E.g. The Land administration project, LAP I&II)
- Structural adjustment policies of the ‘80’s focused on reducing governmental controls on agriculture
- So far no specific policy exists in SSA which focuses on SSM

STATE OF SALSODIC SOILS IN AFRICA

- Salt-affected soils are either naturally occurring or human induced.
- In Africa, majority of the saline soils are naturally occurring and common in arid and semi-arid environments which favor salinization
- Agriculture is very prevalent on these soils often with low outputs
- Responses to fertilization on these soils are very low and unprofitable
- Irrigation induced salinity is not a problem since not very large swaths of cropland are irrigated in SSA/Africa as a whole

Technologies being promoted to address salt stress in SSA

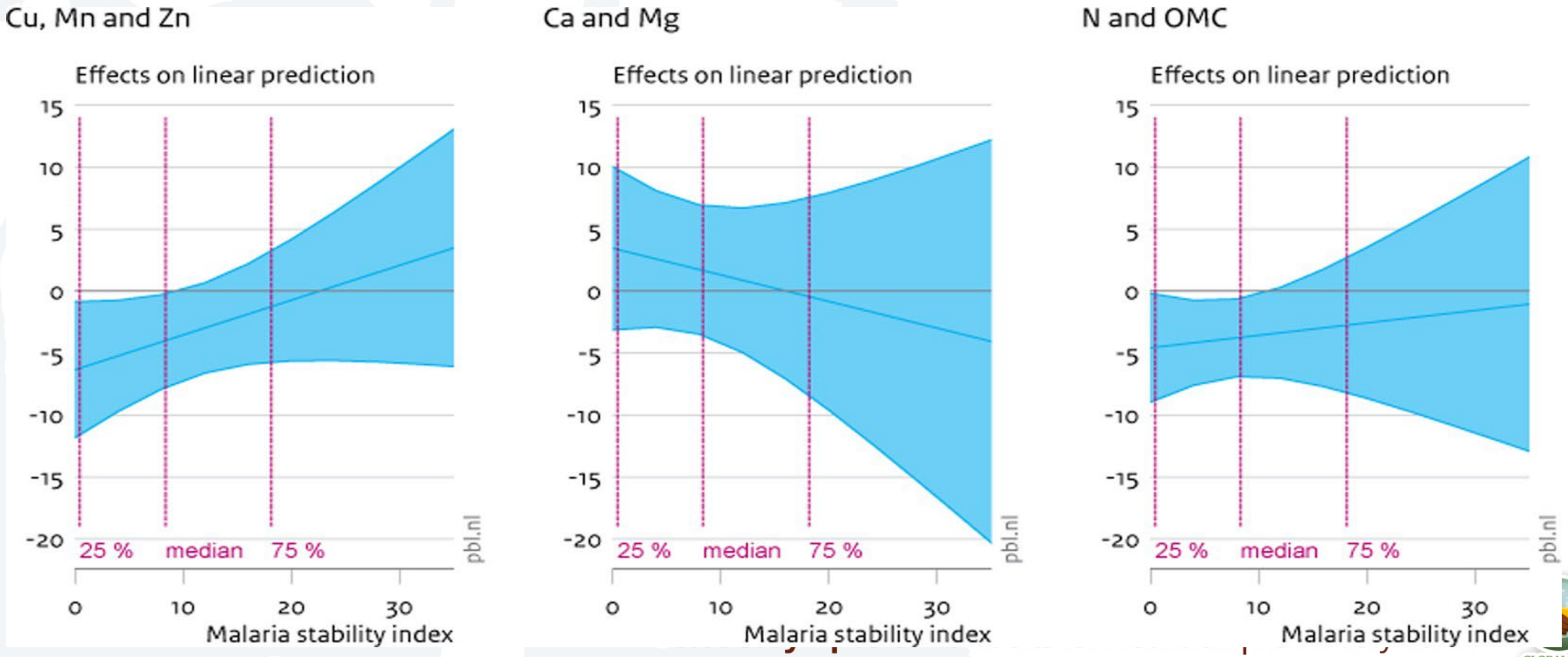
- Promotion of SOC/SOM addition or retention to the soils
- Encouraging ISFM
- Checking erosion and land manipulation
- Managing soils biologically (introducing legumes into saline soil systems)
- Biochar systems introduction
- Promotion of organic products
- Crop rotations
- Mapping of salt-affected soils

Successes achieved so far with organic resource mgt in SSM

- Reports of in increased soil structure, improved infiltration and increased SOM levels have been reported throughout SSA (Kathering et al, 2015)
- Livelihoods have been improved through the improvement of soil fertility (Smaling et al, 2002)
- The introduction of BNF has resulted in increased maize and the yields of other cereals (Merckx et al, 2002)
- The introduction of biochar has improved upon soil acidity and reduced P-fixation in soils (Frimpong et al, 2018; Yeboah et al. 2018)
- Conservation agricultural practices are yielding positive benefits to both soil and end-users.

SSM and better nutrition source (Ezra et al, 2019)

Fig. 2.0 effects of good soil nutrition and human health in SSA



Effects of better soils on nutrition

- In their study, Ezra et al, (2019) observed that. Soils with high levels of N, OM, Cu-Zn-Mn, Ca and Mg have the following effects on children in SSA
- Reduce child mortality
- Reduce malaria incidence
- Reduced stunting
- Reduced incidence of child wasting

Conclusions

- Sustainable soil management in SSA is key to the maintenance of food security as evidenced from this presentation and other researches carried out by others.
- The main challenge to the SSM is the lack of policy to help the SSM agenda
- SOM build up and combating erosion is the main solution to fighting soil degradation.
- There is the need to improve upon the micro nutrient status of soils as it has a direct link to malnutrition.
- Organic forms of soil management is increasing

Thank you !