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AMENET dialogue: Climate Change and Governance: General Trends and African Countries

Climate-Smart Agriculture as a Low Carbon Tool in Africa

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Outline

- Low carbon development: a bibliometric analyses (global perspective)
- Research Questions
- Materials and Methods
- Results
- CSA as a low carbon tool in Africa
- Conclusions and way forward

Introduction

- Low carbon development has its roots in the UNFCCC adopted in in Rio in 1992, which provides voluntary or obligatory GHG reduction targets (Wimbadi & Djalante, 2020).

- low-carbon development is a pattern of political and economic development that aims at achieving environmental sustainability, economic growth and societal transformation (Zhao et al., 2019).

- The concept of low-carbon development has recently attracted attention from various countries and researchers.

Research Questions

- How has low carbon development research advanced over the years?

- What are current research hotspots in low carbon development research?

Materials and Methods

- A bibliometric analyses examined the impact of low carbon development research using VOSviewer.

- Two decades of low carbon development data (2000-2021) from Web of Science

- Search strings and combinations:

"low carbon development" OR "carbon neutral" Or "zero carbon" OR "low emission development strategies" OR "low-carbon pathways" OR "low carbon pathways "OR "low carbon growth" OR "low-carbon growth"

- Evolutionary analyses, Citation analyses and keyword co-occurrence analyses.

Materials and Methods Cont..

- Search results link:

https://www.webofscience.com/wos/woscc/general-summary?q=W3siZiI6IlRTIiwidCI6IlwibG93IGNhcmJvbiBkZXZlbG9wbWVudFwiIE9SIFwiY2FyYm9uIG5ldXRyYWxcIiBPciBcInplcm8gY2FyYm9uXCIgT1IgXCJsb3cgZW1pc3Npb24gZGV2ZWxvcG1lbnQgc3RyYXRlZ2llc1wiIE9SIFwibG93LWNhcmJvbiBwYXRod2F5c1wiICBPUiBcImxvdyBjYXJib24gcGF0aHdheXMgXCJPUiBcImxvdyBjYXJib24gZ3Jvd3RoXCIgT1IgXCJsb3ctY2FyYm9uIGdyb3d0aFwiIn0seyJiIjoiQU5EIiwiZiI6IlBZIiwidCI6IjIwMDAtMjAyMSJ9LHsiYiI6IkFORCIsImYiOiJBVSIsInQiOiIifV0

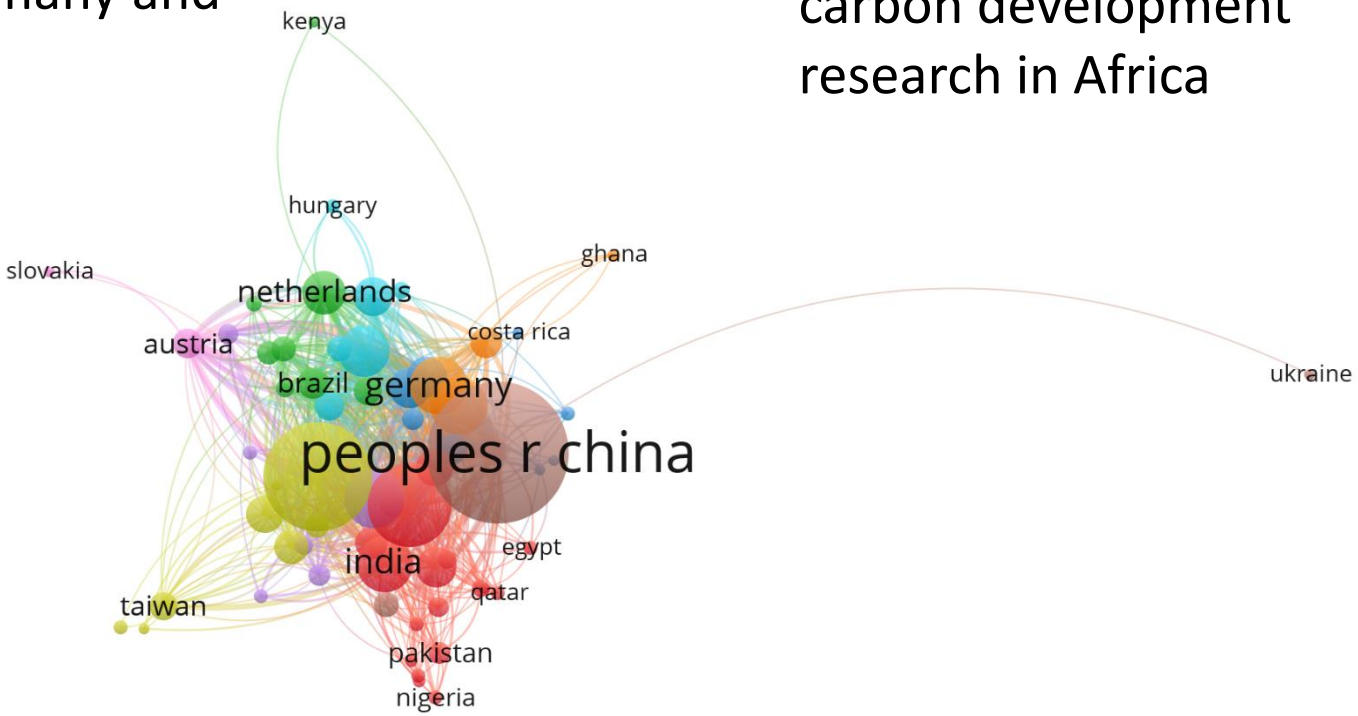
- Total of 3,939 publications extracted. 2, 496 included in the final analyses

- Some publications dropped based on title, content and relevance to the study

Results

Origin of studies

- Most of the studies are from China, Germany and Netherlands.

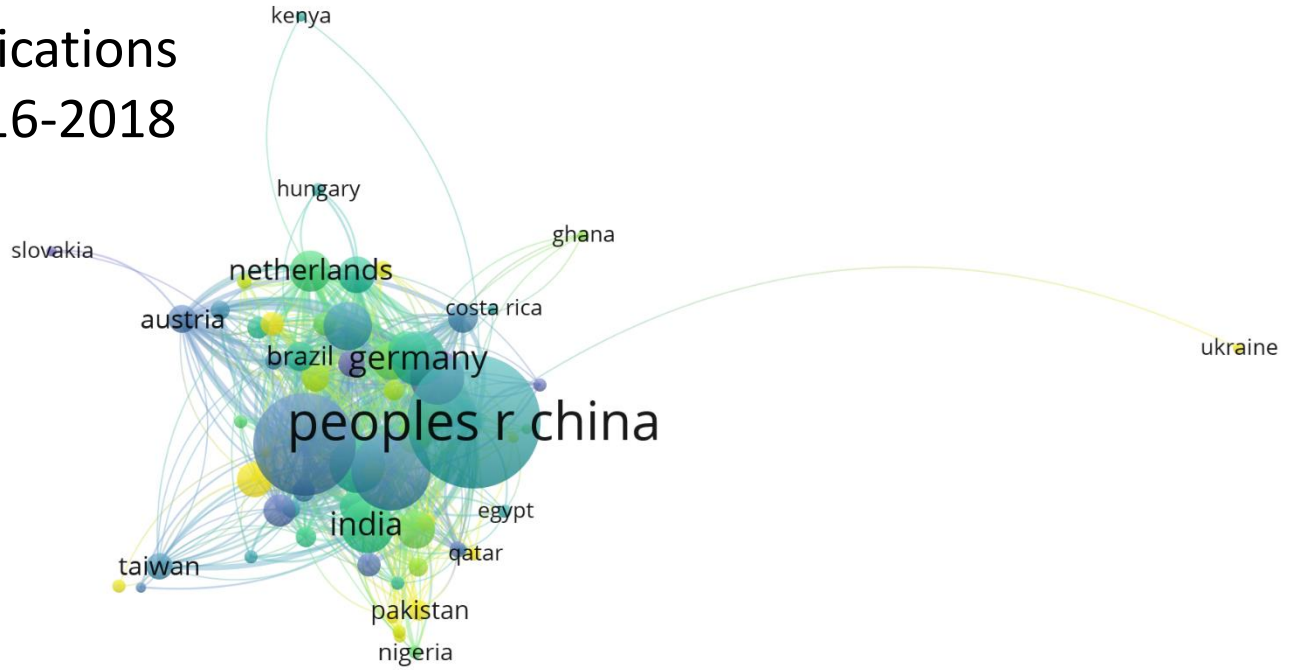


- Low impact of low carbon development research in Africa

VOSviewer

Density overlay of studies origin

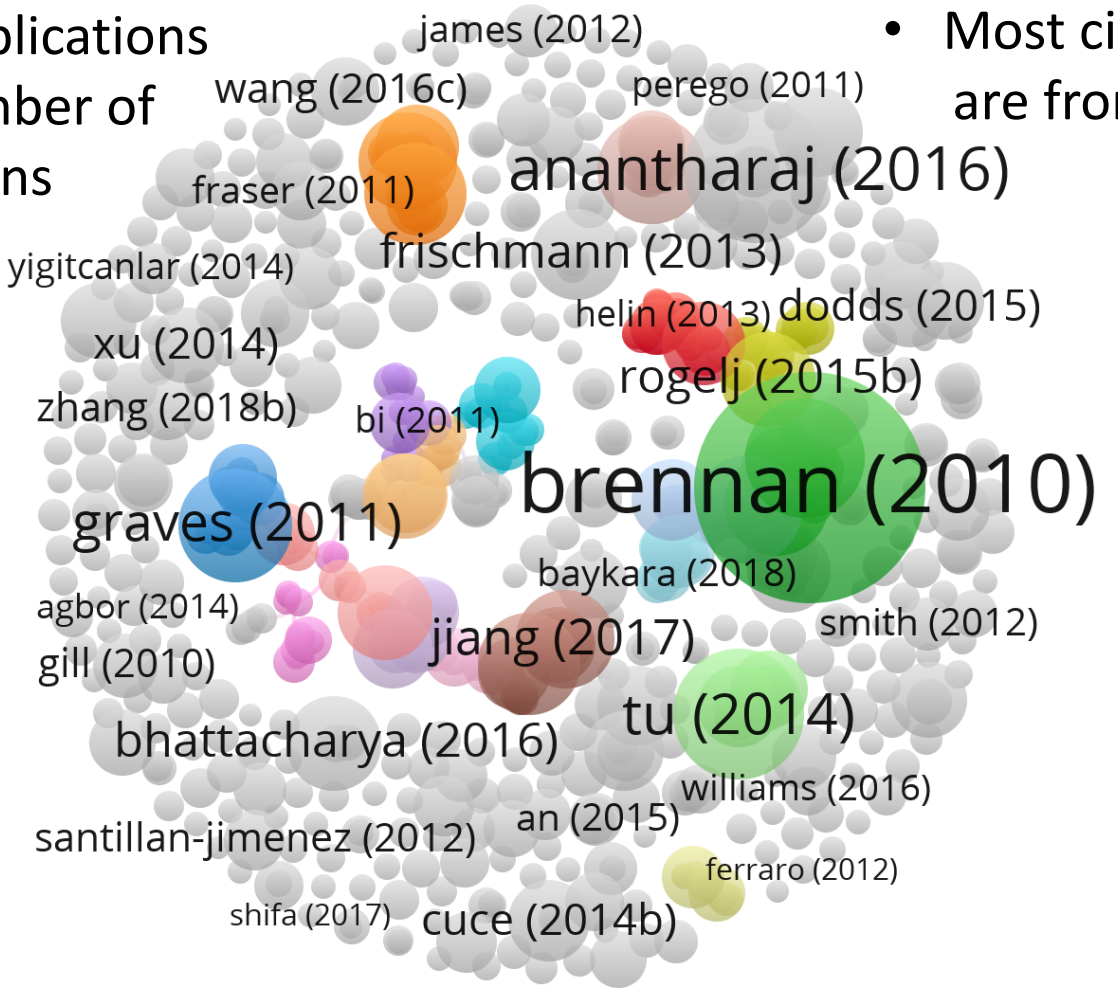
- Most of the publications conducted from 2016-2018



Citation analyses

- Impact of publications based on number of publications

- Most cited publications are from 2010-2017



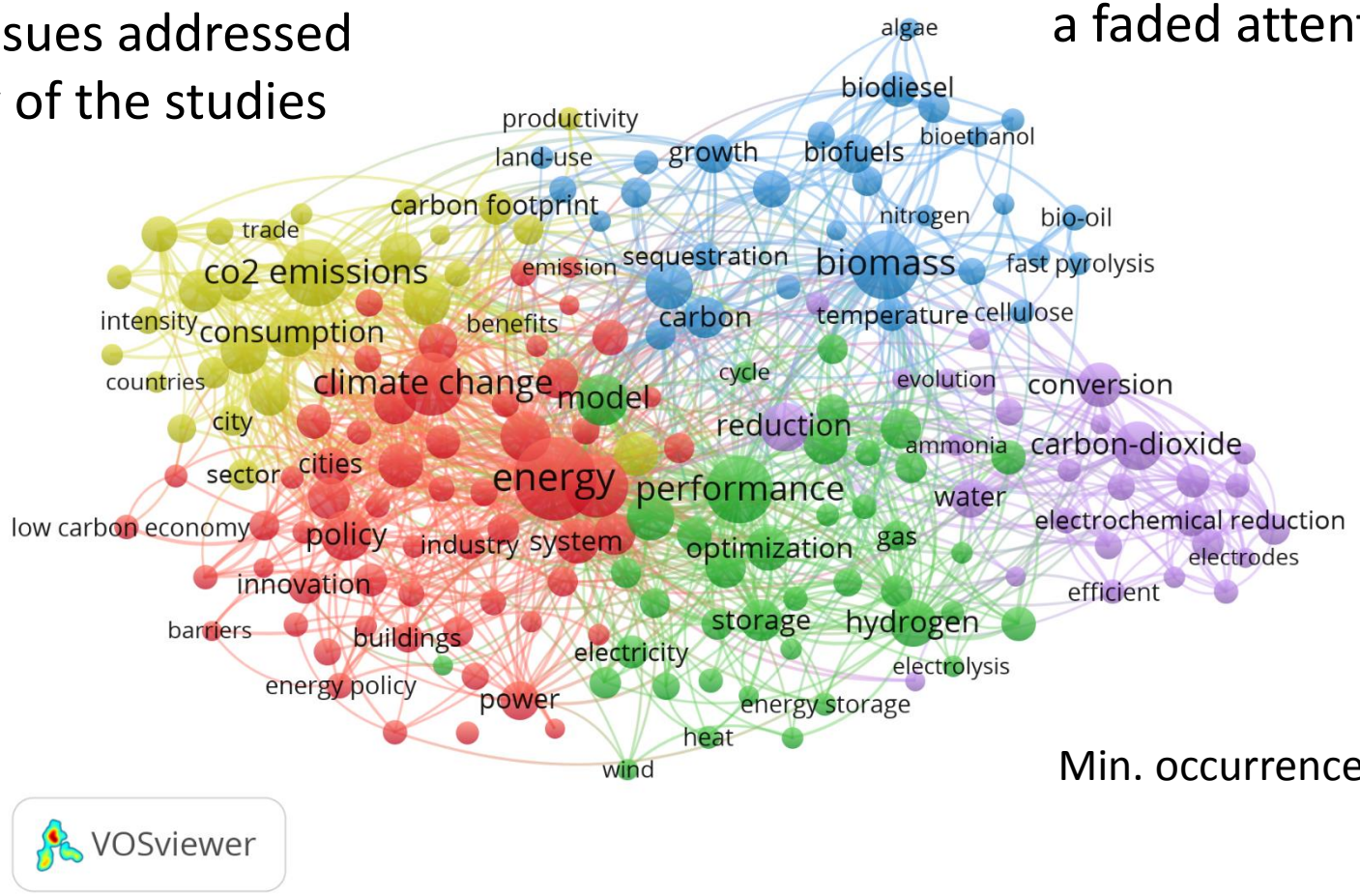
Min. Citation=25

VOSviewer

Keyword co-occurrence analyses

- Energy issues addressed in majority of the studies

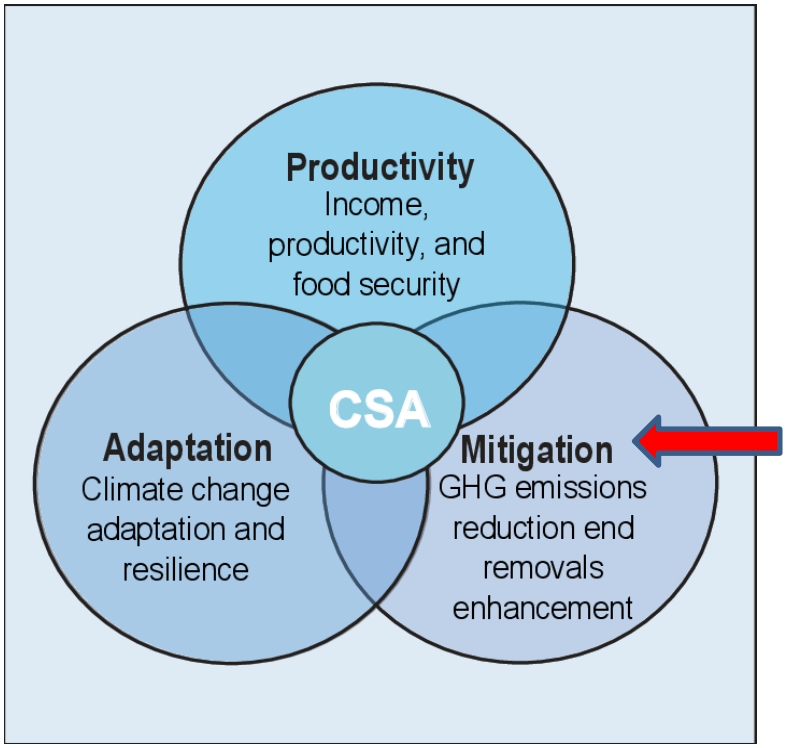
- Agriculture has a faded attention



Min. occurrence=25

Climate-Smart Agriculture (CSA) a low carbon Tool in Africa

- CSA incorporates sustainable practices to increase agriculture productivity vis-à-vis protecting the environment and coping with climate change (Tong *et al*., 2019; FAO, 2010).



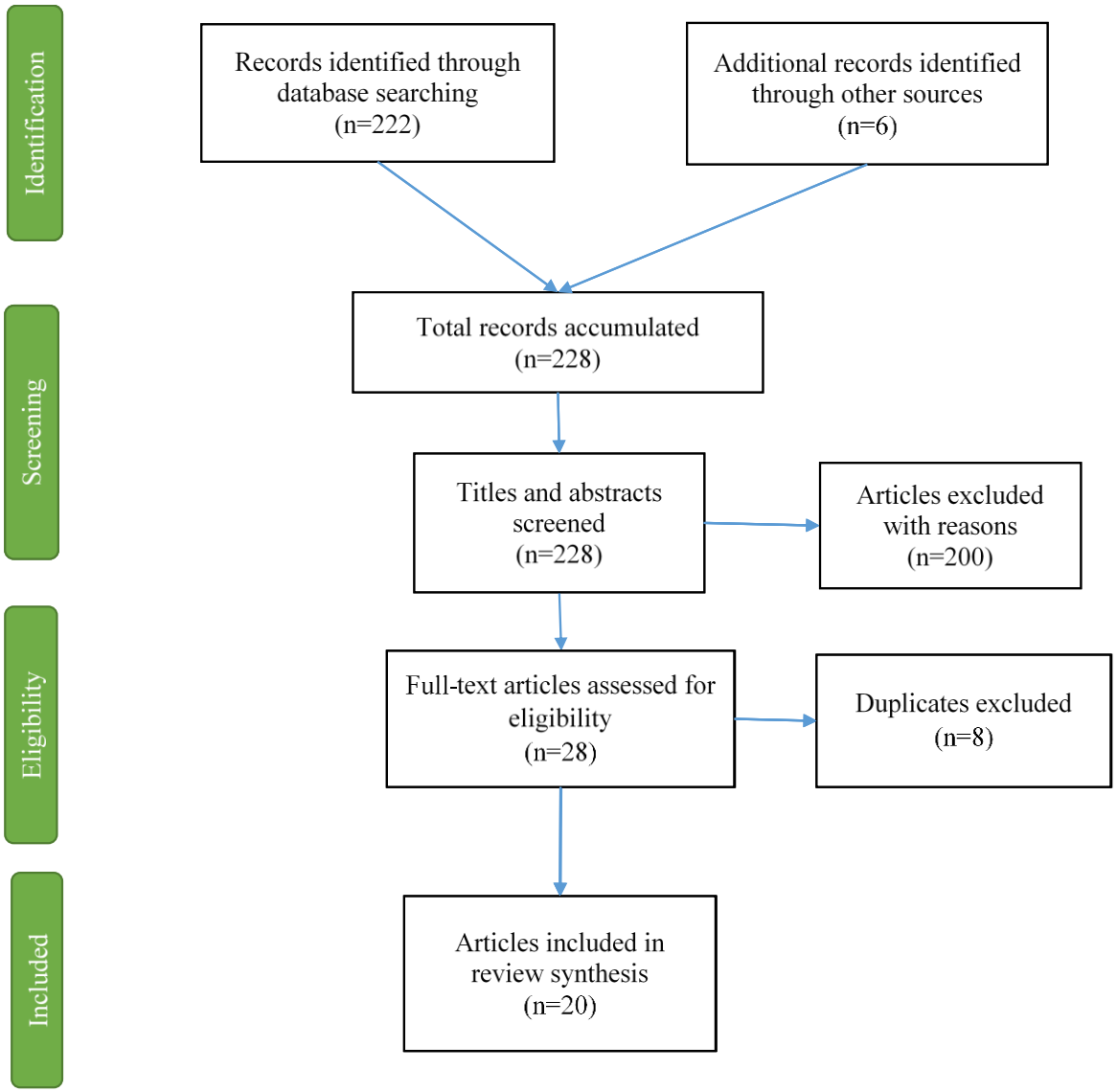
Current narratives on the efficacy and potential of CSA in agriculture transformation have majorly focused on the two pillars (1; adaptation and 2; productivity (Sparrevik & Utstøl, 2020; Dunnett *et al.*, 2018)

Common narratives/storylines of CSA

Mitigation narrative	Conventional Agriculture	Climate-Smart Agriculture
Soil Organic Carbon (SOC)	- Leads to erosion of soil organic carbon (C) stocks through burning of crop residues, use of fossil-fuel and chemical fertilizers.	+ Prevents soil erosion and maintains cover crops. When practiced with trees, increases C sequestration and storage.
Agroforestry (Carbon Stock Changes)	- Forests are cleared or degraded for new agricultural lands and farm expansions.	+ Reduces forest degradation through improved practices and higher productivity.
Livestock Enteric Emissions (LEM)	- Poor diet management including quantity and quality increases CH_4.	+ Fertilizing pastures and reducing grazing period reduces emissions.
Livestock Manure (LMM)	-A Low percentage of manure managed; illegal disposal, no surface crust and liquid manure flushed into the environment.	+ Composting, improve manure storage (covering manure heaps, biogas).
Fertilization	-Increase soil fertility through synthetic fertilizers.	+ Increase soil fertility through organic fertilizers.

Source: Literature compilation (2020)

Inclusion and Exclusion Criteria



Results

- Out of the 20 studies, nine were conducted in Southern Africa; Zimbabwe (6 studies), Malawi (3 studies), Zambia (2 studies) and Mozambique (2 studies).

- Three were from Eastern Africa and one a comparative study for Eastern and Western African countries.

- Two studies were collaborative, analysing issues from the global perspective with empirical evidence from Africa.

- Others included sectional studies; tropics (1 study), arid regions (1 study), Sub-Saharan Africa (2 studies).

Outcome of Studies

Author (s), country/region	CSA options evaluated	Key findings
Paul *et al.* (2018) Rwanda	Improved livestock breed and feed	Relatively small increase in GHG emissions (50 kg CO_2e hh^{-1} yr^{-1}), decreased emission intensity.
Bellarby *et al.* (2014) Kenya and Ethiopia	Organic Nitrogen (N) input	Residue addition contributed significant amounts of N to soil, lowering emissions than when N is supplied as synthetic fertilizer only
Ambaw *et al.* (2019) (Tanzania, Kanye & Uganda)	Agroforestry	Increased SOC stocks by 42–196% at the depth of 0-15 cm
Powlson *et al.* (2014) Global	No-till practice	Found an annual global rate of SOC accumulation of 0.17 Gt C
Thornton & Herrero (2010) Tropics	Livestock and pasture management	Improved pastures and intensification of ruminants diets reduced CH_4 and CO_2 emissions by 417 Mt CO_2-eq (12%)
Robroeck *et al.* (2015) Sub-Sahara África	Integrated soil fertility management	showed a change of C content from 12.2 g C soil kg^{-1} to 13.3 g C soil kg^{-1} when fertilizers and organic inputs are combined as compared to exclusively fertilizers

Outcome of Studies cont..

Author (s), country/region	CSA options evaluated	Key findings
Brandt *et al.* (2019) Kenya	Improved forage quality and concentrate supplementation	reduced GHG emission intensity from 2.4 ± 0.1 to 1.6 ± 0.1 kg CO_2eq per kg milk
Ngwira *et al.* (2012) Malawi	Intercropping	Observed a 76% increase in SOC when maize was intercropped with legumes.
Mujuru *et al.* (2013) Zimbabwe	Rotational farming	Carbon increased in a maize-soybean rotation
O'Dell *et al.* (2015) Zimbabwe	Cover cropping	Winter wheat cover crop produced 257 g of C addition compared to 197 g of no cover crop
Abdalla *et al.* (2016) Arid regions	No-tillage	Observed that conventionally tilled soils emitted 21% more CO_2 than untilled soils

Conclusions

- Limited experimental evidence exist on the GHG mitigation potential for some of the CSA alternatives including agroforestry, rotational farming, improved livestock breed and intensification of ruminants' diet.

- Progress on CSA pillar 3 in Africa is generally limited by a lack of the necessary analytical infrastructure to conduct the needed measurements.

- Low carbon development is fast growing and the agriculture sector in Africa presents ample opportunities to identify, up-scale and out-scale low carbon strategies.

Low Carbon Agriculture Paper

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Towards low carbon agriculture: Systematic-narratives of climate-smart agriculture mitigation potential in Africa

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References

- Wimbadi, R. W., & Djalante, R. (2020). From decarbonization to low carbon development and transition: A systematic literature review of the conceptualization of moving toward net-zero carbon dioxide emission (1995–2019). *Journal of Cleaner Production*, *256*, 120307.

- Zhao, Z. Y., Gao, L., & Zuo, J. (2019). How national policies facilitate low carbon city development: A China study. *Journal of Cleaner Production*, *234*, 743-754.

Call for collaboration

- Low carbon development: a bibliometric analyses

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Thank You!