Conference Guide & Book of Abstract

CAADP XP4 PROGRAMME

FARA Forum for Agricultural Research in Africa

SCIENCE AND PARTNERSHIPS for AGRICULTURE CONFERENCE

KM4AgD Knowledge Management for Agricultural Development Conference

Biennial Africa Climate Smart Agriculture Stakeholders Conference

LEAP4FNSSA Long-term EU-AU Research and Innovation Partnership for Food and Nutrition Security and Sustainable Agriculture

PANAP

African Union | AUDA-NEPAD African Union Development Agency | IFAD | CRS Catholic Relief Services | Global Center on Adaptation | DeSIRA LIFT

ACCRA, GHANA | 14 -16 SEPT 2022

WWW.EVENTS.FARAAFRICA.ORG

AFAAS | CORAF | ASARECA | CCARDESA | K4DP Knowledge for Development Partnership | ypard | GACSA Global Alliance for Climate-Smart Agriculture | Food and Agriculture Organization of the United Nations | IWMI International Water Management Institute | agrinatura | Global Research Alliance on Agricultural Greenhouse Gases | emerging | CGIAR | AICCRA Accelerating Impacts of CGIAR Climate Research for Africa | icipe | AGriDI | Soil Initiative for Africa

Science and Partnership for Agriculture Conference

14th -16th September 2022

Alisa Hotel, North Ridge, Accra Ghana

Forum for Agricultural Research in Africa (FARA)
12 Anmeda Street, Roman Ridge,
PMB CT 173, Accra Ghana
Tel: +233 302 772823 / 302 779421
Fax: +233 302 773676
Email: info@fara-africa.org
Website: www.fara-africa.org

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Conference Overview

Synopsis of THE Conferences

Science and Partnerships for Agriculture Conference

The Science and Partnerships for Agriculture Conference is crafted to encapsulate broad-based partnerships at different levels to address key issues in Africa's agricultural research and innovation space. The conference hosts four continental and bi-continental initiatives supported by different European Union funding portfolios, International Fund Agricultural Development, Catholic Relief Services, GCA, GRA, etc. The four key conferences will run simultaneously but independently. The 2022 *Biennial Africa CSA stakeholders conference; The LEAP4FNSSA final writeshop to develop the EU/AU International Research Consortium on Food and Nutrition Security and Sustainable Agriculture and closing General Assembly; the the2022 scientific meeting of the Pan-African Network for Economic Analysis of Policies (PANAP) and the Knowledge Management for Agriculture Conference (KM4AGD).* The joint conference will provide the opportunity to leverage the participation of high-level individuals in Africa and European agriculture to jointly address pertinent emerging issues affecting the continent. The four conferences and their constituents will provide important technical and policy information from different engagements.

Biennial Africa Climate Smart Agriculture Conference

The Biennial Africa CSA conference will give the opportunity to take stewardship of the CSA actions especially the spate of technology generation and a foresight analysis of the plausible futures. The conference will host the continental dialogue on the Africa Climate Smart Framework (ACSAF); ACSAF is developed to respond to and plan the implementation of the AU-developed Africa Climate Change Strategy. The ACSAF dialogue also provides the opportunity to prepare adequately for CoP27 in Egypt. The conference will also host a side event for stakeholders' consultation towards the development of the Soil Initiative for Africa (SIA). There will also be a side event that will host the meeting of the High-Level Technical Think-Tank set out to respond to emerging technological issues in African agriculture. The various side event will generate outputs that will flow into the conference outputs.

LEAP4FNSSA Final Writeshop and General Assembly

Decades of bi-continental collaboration have culminated in the Long-term Europe-Africa Research and Innovation Partnership for Food and Nutrition Security and Sustainable Agriculture (LEAP4FNSSA) project. The LEAP4FNSSA actors, coming from 23 countries across Africa and Europe, have taken on the task to help to establish a sustainable structure for the efficient and coherent implementation of the EU-AU Research and Innovation Partnership and the AU-EU Roadmap for Food and Nutrition Security and Sustainable Agriculture (FNSSA). The writeshop is aimed at creating consensus among founding partners on the design, strategy, and implementation plan of an AU-EU International Research Consortium (IRC) Platform. This IRC, as a framework for improved coordination and added value between the diversity of European and African supported research projects and initiatives on agriculture and food security.

KNM4AGD Conference

The Knowledge Management for Agricultural Development (KM4AgD) is an activity of the CAADP-XP4 organizations. The KM4AgD Challenge & Conference is an annual event that seeks to build appropriate capacities, establish communities of practice for Knowledge Management and strengthen the knowledge ecosystem to accelerate the achievement of the CAADP Malabo goals by 2025 and the SDGs by 2030. The Challenge is implemented through an integrated, strategic, educational, and transformational approach. It aims to strengthen the capacity of the knowledge management experts and run an investiture of new experts.

PANAP Stakeholders meeting

Pan-African Network for economic Analysis of Policies (PANAP) is established by the European Union commission and aims to foster the development of centers of excellence in Africa and to promote both the Europe-Africa and intra-Africa scientific collaboration as an element to vitalize synergies between the two continents on economic policies. PANAP was officially launched at the AU in November 2019 with the participation of 19 African partners. Its action also fosters scientific cooperation among the PANAP member .
The PANAP conference will create opportunities for synergies with other relevant scientific communities and networks operating at the Africa's continental level in agriculture.

Conference Overview

Program Dashboard

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Conference Program Dashboard
Day 1: 14th September 2022

<table>
<tr><th>Time</th><th colspan="10">Program Content</th></tr>
<tr><td></td><td colspan="10">Joint Plenary Session / Zoom Link https://faraafrica.zoom.us/j/87449603891?pwd=YnduRTAwN0YwNHdpZDRJQUpiT2krUT09 Meeting ID: 87449603891; Passcode: 266211</td></tr>
<tr><td rowspan="2">0900 to 1015</td><td>Opening Remark
Dr. Alioune Fall
Chair of FARA</td><td>Goodwill message
Dr. Hans Hoogeveen
GACSA co-chair</td><td>Goodwill message
ADG- FAO
Dr Abebe Haile-Gabriel</td><td>Video message
Stephen Quest DG
JRC European Union Commission</td><td>Mariya Gabriel,
European Commissioner for Innovation, Research, Culture, Education and Youth</td><td>Goodwill message
Massimo Mina, Head of Cooperation, Delegation of the European Union to Ghana</td><td>Goodwill Video message
HE Nardos Bekele-Thomas
CEO of AUDA-NEPAD</td><td>Video message
HE Josefa Sacko
Commissioner of DERBE, AUC</td><td>Video message
Dr. Akin Adesina President of Africa Development Bank</td><td>Welcome Address
Dr. Owusu Afriyie Akoto
Minister of Food and Agriculture, Ghana</td></tr>
<tr><td colspan="10">Keynote Address
HE. Jeanine Milly Cooper
Minister of Agriculture, Liberia</td></tr>
<tr><td>1015 to 1045</td><td colspan="10">Coffee Break / Group Photograph/Networking</td></tr>
<tr><td>1045 to 1130</td><td colspan="10">Lead Paper
“Introspection on CSA Action to Strengthen Accountability, Resource Use and Impact in Africa”
Dr. Bruce Campbell (ClimEAT)</td></tr>
<tr><td rowspan="2">1130 to 1330</td><td colspan="6">CSA Biennial Conference
Thematic Paper Presentation  </td><td rowspan="2">LEAP4FNSSA</td><td rowspan="2">PANAP</td><td rowspan="2">KM4AgD
Knowledge Management for</td></tr>
<tr><td>Theme 1</td><td>Theme 2</td><td>Theme 3</td><td>Theme 4</td><td>Theme 5</td><td>Theme 6</td></tr>
</table>

	The role of **digitalization** in advancing CSA in the smallholders' systems **Facilitator:** Dr. Vincent Aduramigba [GCA] **Venue:** Britannia	The nexus of CSA and the **mechanization of the smallholder system** in Africa. **Facilitator:** Dr. Dr Mkomwa [ACTN] **Venue:** Volta Hall	Bottom-up and system-wide **capacity development approaches;** to enhance CSA practices **Facilitator:** Prof. Babalola **Venue:** Afram Hall	Strengthening the support of **extension and advisory services to ensure CSA compliance among** smallholder farmers in Africa **Facilitator:** Max Olupot [AFAAS] **Venue:** Abban Lounge	Advances in **CSA technology generation and use** in the crop, **livestock, fisheries**, and aquaculture. **Facilitator:** Dr Alcade Segnon [AICCRA] **Venue:** Kaizer Hall	Compatibility assessment of agroecology and CSA practices **Facilitator:** Dr. Cliff Dlamini [DeSIRA-Lift] **Venue:** Botsio Hall	**General Assembly and Launch of International Research Consortium (IRC)** **Venue:** Ridge Arena [Main Hall]	**Pan African Network for Economic Analysis** **Partners Meeting and launch of Reports** **Venue:** Volta Hall	**Agricultural Development Conference 2022** **Venue:** Prince Hall
1330 to 1430	**Lunch**								
1430 to 1530	**Theme 1 [Cont.]**	**Theme 2 [Cont.]**	**Theme 3 [Cont.]**	**Theme 4 [Cont.]**	**Theme 5 [Cont.]**	**Theme 6 [Cont.]**			
1530 to 1700	**ACSAF Plenary 1:** Facilitator Dr. Manyewu Mutamba (AUDA-NEPAD) **Commissioned study** Foresight: Plausible futures of CSA in Africa Dr. Nasiru Taura **Commissioned study** Strategies for Continuous development of CSA technologies in Africa Prof. Tunde Ajayi								
1800	**ACSAF Cocktail**								

Day 2: 15th September 2022

<table>
<tr><td rowspan="4">Time

8:30 – 10:00 am

10:30 – 17:00</td><td colspan="4">Side Events</td><td rowspan="4">General Assembly Day II</td><td rowspan="4">Partners Meeting Day II</td><td rowspan="4">Conference Day II</td></tr>
<tr><td>“ Climate information services in climate-smart agriculture: enhancing resilient agrifood”

CGIAR

Venue: Abban Lounge</td><td>The contributions of agroecology to climate change

DeSIRA LIFT

Venue: Penthouse</td><td>Annual Meeting of the Continental Think-Tank for responding to Emerging issues in African agriculture

Venue: Affram Hall

CAADP XP4</td><td>Gaining Grounds…a workshop to strengthen collaborations to advance climate-smart agriculture in Africa

GLOBAL RESEARCH ALLIANCE

Venue: Kaizen</td><td>Soil Initiative for Africa (SIA)
Stakeholders Consultation

CRS

Venue: Britannia</td></tr>
<tr><td colspan="3">Field Visit</td></tr>
<tr><td>Take off @12:00</td><td colspan="3">Field Group 1
Blue Sky Company Limited.</td></tr>
</table>

Day 3: 16th September 2022

Time **0800 to 1030**	**ACSAF Plenary 2:** Session Chair: Dr. Alioune Fall **Commissioned study** **10 years analysis of Africa's progress on climate change / Decadal Plan for ACSAF** Dr. Ogiogio **Technical panel Discussion** [Wole Fatunbi] **Towards a common Africa position at CoP27 and COP28.** Dr. Vanlauwe [CGIAR]; Dr. Akinbamijo [FARA]; Dr. Chapoto [ReNAPRI]; Dr. Litha Magingxa [ARC-South Africa]; **Open Discussions**		**Partners meeting Day III** PANAP	**Conference Day III** KM4AgD
1030 to 1110	**Coffee break**			
1100 to 1330	**Joint Closing Plenary** **Project Pitch** **Science: Biennial CSA** **Policies: PANAP** **Knowledge Management** **Partnerships: IRC**			
	Closing Lunch			

Executive Organizers

Dr Alioune Fall

Is the Chairman of the FARA Board of Directors, and the former Director General of Senegal's National Institute for Agricultural Research (ISRA). He holds a Master of Science (MSc) degree in Agriculture from the Sam Houston State University, Texas, the United States, and a Doctorate degree (PhD) in Agricultural Engineering from Michigan State University, United States. Dr. Fall's career in research spans three and a half decades. He joined ISRA in 1984 as a researcher and rose quickly to become Regional Coordinator of Farm Mechanization and Post-harvest Technology projects. Dr. Fall served as the Scientific Director of ISRA from 2008 to 2013 when he was appointed the Director General. He served as the Chairperson of CORAF's Board of Directors from 2014 to 2018.

Dr Yemi Akinbamijo

Is the Executive Director of the Forum for Agricultural Research in Africa (FARA). Prior to his appointment in 2013, Yemi was the Head of the Agriculture and Food Security Division at the African Union Commission Headquarters in Addis Ababa, Ethiopia. He is a thought and process leader on the continent, Dr. Akinbamijo has considerable expertise in natural resource management including crop-livestock integrated systems. He is widely published in various agricultural disciplines. He is a former editor of the Bulletin of Animal Health and Production in Africa. He obtained his PhD in Agriculture and Environmental Sciences from the Wageningen Agricultural University, The Netherlands

Dr. Aggrey Agumya

is the Director of Research and Innovation at the Forum for Agricultural Research in Africa (FARA). He holds a BSc in Surveying and Photogrammetry, plus MSc (ITC, The Netherlands) and Ph.D. degrees in Geomatics specializing in GIS and Remote Sensing (University of Melbourne, Australia). Dr. Agumya has 25 years professional experience, His work at the World Agroforestry Centre and at the Forum for Agricultural Research in Africa spans the entire African continent. Over the past years, Dr. Agumya' s interest has been focused on the deployment of spatial tools in development work towards improving food security, incomes, and resilience to climate change-induced shocks.

Speakers Profile

Dr. Akinwunmi Adesina

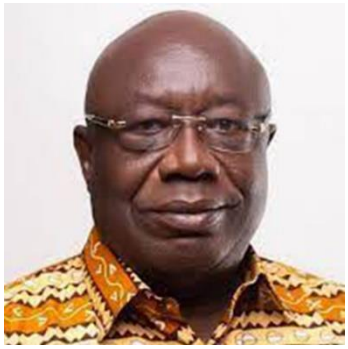
Dr. Akinwunmi Adesina is the President of the Africa Development Bank, he is often called "Africa's Optimist-in-Chief", Dr. Akinwumi A. Adesina is widely lauded for his visionary leadership and passion for Africa's transformation. Formerly the Nigerian Agriculture Minister, Dr. Adesina was first elected President of the African Development Bank Group on 28 May 2015. He was unanimously re-elected for a second five-year term on 27 August 2020. D.r Adesina graduated with a bachelor's degree in Agricultural Economics (First Class Honors) from the University of Ife (now Obafemi Awolowo University), Nigeria, in 1981. Dr. Adesina holds a master's degree (1985) and a PhD in Agricultural Economics (1988) from Purdue University, United States of America, where he won the Outstanding Ph.D. thesis award for that year. Dr. Adesina won the prestigious Rockefeller Foundation Social Science Fellowship in 1988, which launched him into his international career. A bold reformer, as Minister of Agriculture in Nigeria from 2011 to 2015 Dr. Adesina turned the agriculture sector of Nigeria around within four years. Under his tenure, Nigeria ended 40 years of corruption in the fertilizer sector by developing and implementing an innovative electronic wallet system, which directly provides farmers with subsidized farm inputs at scale using their mobile phones. Within the first four years of its launch, this electronic wallet system reached 15 million farmers, dramatically transforming their lives.

Dr. Owusu Afriyie Akoto

Honorable (Hon) Dr. Owusu Afriyie Akoto holds M.Sc. and PhD degrees in Agricultural Economics from the University of Cambridge, England. He worked as an Economist, Senior Economist, Principal Economist, and Chief Economic Advisor over a period of 18 years at the International Coffee Organization (ICO) in London, England. He has also worked as a consultant to the World Bank and the United Nations on Soft Commodities (Cocoa, Coffee, Sugar). Between 1995 and 2007, he was the CEO of two international commodity companies, Goldcrest Commodities Limited and Plantation Resources Limited both based in Ghana.

In 2008 he was elected to the Parliament of the Republic of Ghana. In 2017 he was appointed the Minister for Food and Agriculture. In this role he has spearheaded the design and implementation of the Government of Ghana's popular and transformational agricultural flagship program, Planting for Food and Jobs (PFJ).

Dr. Kwaku Afriyie



Honorable Dr. Kwaku Afriyie is currently the Minister for Environment, Science, Technology and Innovation and a Member of Parliament for the Sefwi Wiawso Constituency. He is a Medical Doctor by profession and a farmer. He previously served as Minister of the Ministries of Health, Lands and Natural Resources, Western Regional Minister, and Minister of State Interests and Governance Authority (SIGA). He holds a Master of Public Health from Tulane University, New Orleans, an MB CBH from the University of Ghana Medical School, and a Fellow of the Ghana College of Physicians and Surgeons.

Dr Kwaku Afriyie was the Managing Director of Afriyie Farms from 1990 to 2016 and the Managing Director of Green shield Hospital from 1994 to 2014. As Health Minister, Dr. Kwaku Afriyie introduced and implemented the well-known National Health Insurance Scheme, the National Post–Graduate Training program of Doctors and established the Ghana College of Physicians and Surgeons for a Postgraduate training of Doctors in Ghana. Dr. Afriyie, also served as a member of Cabinet Sub-committee on Cocoa Affairs (2001-2005); Member of National Development Planning Committee (2001-2004); Member of National AIDS Commission etc. In his role as Minister of Environment, Science and Technology,

Honorable Jeanine M. Cooper

The Honorable Jeanine M. Cooper is the Minister of Agriculture of Liberia. She graduated from Michigan State University in 1982 with a double B.A. in Business Administration and in French; and she has an MSc in Managing Rural Change from the University of London, Imperial College at Wye in 2003. Cooper has supported community-initiated agricultural projects and served on the board of directors of developmental bodies and educational institutions in Liberia and in Côte d'Ivoire. Following her time with VSF-S, Mde. Cooper served 13 years with the United Nations. Her, last posting was as the Permanent Observer to the African Union and the Economic Commission for Africa and, Head of the Liaison Office for the U.N. Office for Coordination of Humanitarian Affairs (UN-OCHA). Ms. Cooper also held postings with the UN-OCHA in Kenya and for the Eastern and Southern Africa region.

Honorable Jeanine Cooper founded FABRAR Liberia, currently Liberia's largest rice processor and producer, in 2009 and was managing the company from January 2017 to 2020.

The new minister has detailed a vision of the transformation of Liberian agriculture; a visio Madeenteredan on elevation of Liberian farmers from subsistence farming to commercial smallholders. A vision to ensure the supply of quality agricultural products produced in a sustainable and organic manner prized in today's market.

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HE Nardos Bekele-Thomas

HE Nardos Bekele-Thomas is the Chief Executive Officer (CEO) of the Africa Union Development Agency (AUDA-NEPAD). She is the first woman to lead the African Union's development agency. Prior to her appointment, M.s Bekele-Thomas was previously the Senior Director of the Office of the United Nations Secretary-General. She also served as Resident Coordinator for the United Nations in South Africa and as Resident Coordinator and UNDP Resident Representative in Kenya and Benin. Prior to that, she served for over four years in Kenya as Deputy Resident Representative. She is the author of several papers and monographs, and she is fully bilingual in French and English. She has excelled as a Private Sector Policy Adviser focusing on the promotion of trade and investment in several African countries through private/public sector partnerships in the United States. Ms. Bekele-Thomas has also served in a technical and advisory capacity in which she helped initiate and conceptualize a pro-poor program on the Social Dimensions of Development and has served in various other capacities in the international development space. [Adapted from: https://au.int/en/pressreleases/20220510/ms-nardos-bekele-thomas-takes-office-new-ceo-african-union-development-agency]

H.E. Josefa Leonel Correia Sacko

H.E. Josefa Leonel Correia Sacko is the Commissioner fo the Department of Agriculture, Rural Development, Blue Econobilingualtainable Development (**AUC**-**DARBE**)., an Angola national; Mrs. Sacko was previously the special adviser to the Minister of Agriculture, assigned with the responsibility of advising on issues related to international cooperation, Climate Change, food Security, Eradication of Hunger, and Poverty Reduction. She was also the former Secretary General of the Inter African Coffee Organization (IACO) for 13 years in Cote D'Ivoire where she oversaw the coffee economy of 25 African Coffee producing countries. During her tenure, she successfully advocated for the empowerment of small-scale coffee farmers across the continent by setting up Regional Centres of Excellence for Capacity Building of Member States, on Genetic Material Conservation, Coffee Quality Improvement, and Cup Tasting Liquor in Cote d'Ivoire, Uganda, Cameroon, and Zambia. adam Sacko has built up her international profile and reputation by either consulting or working with several Regional, and Global Institutional on Agriculture including the World Trade Organization (WTO), African Union (AU), International Coffee Organization (ICO), African Development Bank (AfDB), African Eexport-ImportBank (AFREXIMBANK), (FAO), UNECA, NEPAD ,etc

Dr. Abebe Haile-Gabriel

Abebe Haile-Gabriel is the Assistant Director General (ADG) of the Food and Agricultural Organization (FAO) Africa. The ADG holds a Doctorate and a Master of Arts degree in Agricultural and Rural Development from the International Institute of Social Studies (ISS) at The Hague, the Netherlands. He earned his Bachelor of Science degree in Agricultural Economics from the Alemaya (now Haramaya University) the University of Agriculture in Ethiopia where he taught between 1986 till 2005.

He worked as a senior manager at the African Union Commission (AUC), he engaged with crucial stakeholders and partners ranging from government

officials to civil society organizations, the private sector, farmers, etc. He served as Director of the Department of Rural Economy and Agriculture based at the AU Headquarters in Addis Ababa, Ethiopia. Haile-Gabriel joined FAO in 2015 as Deputy Regional Representative for Africa and Representative to Ghana. He was also the Regional Program Leader for Africa since 2017.

Dr. Hans Hoogeveen

Dr. Hans Hoogeveen is the Ambassador / Permanent Representative of the Kingdom of the Netherlands to the UN Organizations for Food and Agriculture. He doubles as the Co-Chair of the Global Alliance on Climate-Smart Agriculture. Before that he was the Director General (vice-Minister) for Agriculture and Nature Management at the Netherlands Ministry of Economic Affairs for 9 years responsible for national, European and international policies related to sustainable agriculture, agri-business natural resources and nature management. As such, Dr. Hoogeveen was the most senior civil servant to lead agriculture, agribusiness, food safety, food security, veterinary and plant health, international affairs, including the European Common Agricultural Policy and the Common Fisheries Policy, international food security, the FAO and other UN affairs, trade liberalization (WTO), market access and nature/biodiversity management agendas. Dr. Hoogeveen has written several scientific papers on sustainable development and natural resources, including seminal work on lessons learned from global forest governance. He is Commander in the Order of Gregorius (Holy See) and Commandeur de l'Orde Grand-Ducal de la Couronne de Chene.

Dr. Alioune Fall

Alioune Fall, Chairperson of the FARA Board of Directors, and the former Director General of Senegal's National Institute for Agricultural Research (ISRA). He holds a Master of Science (MSc) degree in Agriculture from the Sam Houston State University, Texas, the United States, and a Doctorate degree (PhD) in Agricultural Engineering from Michigan State University, United States. Dr. Fall's career in research spans three and a half decades. He joined ISRA in 1984 as a researcher and rose quickly to become Regional Coordinator of Farm Mechanization and Post-harvest Technology projects. Dr. Fall served as the Scientific Director of ISRA from 2008 to 2013 when he was appointed the Director General. He served as the Chairperson of CORAF's Board of Directors from 2014 to 2018.

Detailed Program

Joint Opening Plenary

14th September 2022

Venue: Ridge Arena [Main Conference Hall]

Time		Program Content
Joint Plenary Session [0900 to 1100]		
Zoom Link: https://faraafrica.zoom.us/j/87449603891?pwd=YnduRTAwN0YwNHdpZDRJQUpiT2krUT09 Meeting ID: 87449603891 Passcode: 266211		
Opening Courtesies **** Ghana National Anthem** **** Africa Union Anthem**		**MC: Julius Bizimungu (CNBC)** **Ghana Police Band**
	3 Minutes	***Curtain Raiser [Video]***
	5 minutes	**Welcome message** **Dr. Alioune Fall Chair of FARA**
	5 minutes	**Goodwill message [Virtual]** **Dr. Hans Hoogeveen GACSA co-chair**
	5 minutes	**Goodwill message** **Dr Abebe Haile-Gabriel ADG- FAO**
	5 minutes	**Video message** **Stephen Quest DG JRC European Union Commission**
	5 minutes	**Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth Goodwill message**
	5 minutes	**Massimo Mina, Head of Cooperation, Delegation of the European Union to Ghana**
	5 minutes	**Goodwill message [Video Message]** **HE Josefa Sacko** **Commissioner of DARBE, AUC**
	5 minutes	**Goodwill message** **Dr. Akin Adesina [Video Message]** **President of Africa Development Bank**
	10 minutes	**Opening Address** **Dr. Owusu Afriyie Akoto** **Minister of Food and Agriculture, Ghana**
20 minutes		**Keynote Address** **HE. Jeanine Milly Cooper** **Minister of Agriculture, Liberia**
1100 to 1130		**Coffee Break / Group Photograph/Networking**
30 minutes		**Lead Paper** **"Introspection on CSA Action to Strengthen Accountability, Resource Use and Impact in Africa" Dr. Bruce Campbell (ClimEAT)**
Close of Opening Plenary		

2nd Plenary

16th September 2022

Venue: Ridge Arena [Main Conference Hall]

Time: Plenary

MC: Julius Bizimungu (CNBC)

Zoom https://faraafrica.zoom.us/j/87449603891?pwd=YnduRTAwN0YwNHdpZDRJQUpiT2krUT09
Meeting ID: 87449603891
Passcode: 266211

Time	Conference	Time	Activity particulars
1100 to 1220	Partners Report & Pitch	5 min	**Traditional Dance / MC Introductions**
		5 min	**Reporting on side events [Dr. Wale Olayide]**
		20 min	**Partners organizations and projects pitch [MC]**
	Science **Biennial CSA**	10 min	Summary of Papers presentations **| Best Paper Award**
		10 min	Book Introduction: Strategies for continuous development of CSA technologies [**Launching: Dr. Alioune Fall**]
		10 min	Outcomes of ACSAF Discussions / Policy implications
	Knowledge management	10 min	**Conference Communique /Awards/ Certificates**
		10 min	**Induction of 2022 Fellows into the KM4AgD CoP and Center of Excellence**
		10 min	**Unveiling of the Good Practice Report on partnerships**
	Policies: **PANAP**	15 min	PANAP Meeting Report **Irchad Razaaly**, Head of Delegation of the European Union to Ghana /EU Ambassador to Ghana (present physically)

5 min	**Traditional Music and Dance**

PARTNERSHIPS **Launch of the IRC**	**Founding Launch of The International Research Consortium (IRC)** **Co-moderated by Dr Kwesi Attah-Krah and Dr Shadrack Moephuli**

Time (GMT)	Topic	Responsible
	Launch Context and Initial Remarks	
12.20- 12.25	Remarks (AU and EU)	Video message from Co-Chairs of the HLPD WG on FNSSA:

		Ms. Magdalena Gajdzinska, [Policy Officer, EC DG Research and Innovation] **Dr. Guillermo Cardon**, [Policy Officer EC DG Agriculture, and Rural Development] **Dr. Monica Ebele Idinoba**, [Co-Chair of the HLPD WG on FNSSA]
	Presentation of the International Research Consortium (IRC)	
12.30- 12.45	Presentation of the Summary of the IRC	**Dr. Irene Annor-Frempong** [Coordinator, LEAP4FNSSA, FARA]
	Goodwill Messages	
12.45-13.05	Goodwill messages from founding members	**Dr Christof Weissteiner**, [LEAP4FNSSA Project Officer, EC REA] **Member States** [Ghana, Senegal, South Africa, Kenya, Egypt, France] **Research institutions and Regional Bodies** [FARA, CAADP-XP4, CIRAD, WUR, RUFORUM, AGRINATURA, GFAR, CGIAR, YPARD, etc]
	Official Launch of the IRC	
13.05 – 13.15	Outlining the Principles of the FNSSA priority on which the IRC Communique / Declaration is based	**Nienke Buisman,** [EC DG RTD, International Cooperation Policy] **Dr Hans-Joerg Lutzeyer**, [EC DG RTD]
13.15- 13.20	Reading of the IRC Declaration	**Dr, Aggrey Agumya**, [Director of Research and Innovation, FARA]
13.20-13.30	Official Launch of the IRC	**Honorable Dr. Kwaku Afriyie** [Minister of Environment Science and Technology (MESTI), Ghana] **Honorable Jeanine M. Cooper** [Minister of Agriculture – Liberia]
		Photography

	Closing Remarks: ED of FARA
1330	**Lunch**

Detail Program

TIME	ACTIVITY	RESPONSIBLE
13th September	Arrival of Residential Participants	ALL
DAY 1 September 14	**Joint Opening Plenary Science and Partnerships for Agriculture Conference (SPAC)** MC: Mr Julius Bizimungu (Senior Producer & Presenter at CNBC Africa)	
08:00 – 08:30	Registration	Ms Merline Mensah
08:30 – 09:00	Introductions & Protocols	MC
09:00 – 10:15	Welcome address, Goodwill messages & Keynote Address	
10:15 – 10:45	**HEALTH BREAK & Group Photos**	**Hotel** Daniel Peprah (Comms Officer, FARA)
10:45 – 11:30	**Lead Paper Presentation:** "Introspection on CSA Action to Strengthen Accountability, Resource Use and Impact in Africa" by Dr. Bruce Campbell (ClimEAT)	
End of Joint Opening Plenary		
DAY 1 KM4AgD Opening	**14th September, 2022 Knowledge Management for Agriculrural Development (KM4AgD) Conference**	**MCs** **Mr Julius Bizimungu (Senior Producer & Presenter at CNBC Africa)**
Moderators: Mr Ben Illakut & Ms Sokhna Rokhaya GAYE		

11:30 – 12:00	Welcome & Opening Remarks Goodwill statements from reps of IFAD, AUC, One CGIAR, K4DP, AGriDI & YPARD	Dr Enock Warinda (ED ASARECA & Chair, CAADPXP4 Advisory Committee (**10 Minutes**) EDs/Reps of Institutions (**3 Minutes each**)
12:00– 12:05	Purpose of the Second KM4AgD Conference	Mr Benjamin Abugri (KMLC Lead Specialist, FARA)
12:05 – 12:25	Keynote Presentation ***Topic:*** How Knowledge influences economies and helps them achieve sustainable development	Prof. Albert Ahenkan Professor of SD & Head of Department, Public Admin & Health Services, University of Ghana Business School
12:25 – 13:00	Overview of KM Strategies in CAADPXP4 Institutions in Africa & the CGIAR	CAADP-XP4 ICKM Working Group (**20 minutes**) & One CGIAR (ILRI) (**10 minutes**)
13:00 – 14:00	**LUNCH BREAK**	**All**
14:00 – 15:00	Presentations of Individual KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	AFAAS Participants (Silvia, Sharon, Samuel & Godfrey) (**15 Minutes each**)
15:00 – 15:20	Discussion	Mr Andri Raso (ICKM Lead, AFAAS)
15:20 – 15: 50	Presentations of Individual KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	ASARECA Participants (Genevieve & Nestor) (**15 Minutes each**)
15:50 – 16:00	Discussion	Mr Ben Moses Illakut (Technical Communications Officer, ASARECA)
16:00 – 16:15	**HEALTH BREAK**	**Hotel**
16:15 – 17:15	Presentations of KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	CCARDESA Participants (Upile, Mirjam, Lloyd & Keneilwe) (**15 Minutes each**)
17:15 – 17:35	Discussion	Ms Bridget Kakuwa (KM Officer, CCARDESA)
17:35 – 17:40	End of Day Wrap-up Session and announcements	Moderators
DAY 2	**15th September, 2022**	
	Moderators: Mr Ben Illakut & Ms Sokhna Rokhaya GAYE	**MC**
08:00 – 08:15	Recap	Day 1 Rapporteurs

08:15 – 08:30	Presentation by KALRO "Institutionalization of KM Strategies in Agricultural Research Organizations in Africa"	Dr Boniface Akuku Director of Knowledge Management & ICT, KALRO, Kenya
08:30 – 08:55	Presentation on Advancing knowledge diversity and inclusion; promoting indigenous knowledge and decolonizing knowledge	Dr. Sarah Cummings (Director at K4DP and Lecturer, Waageningen University)
09:00 – 10:15	Presentations of KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	CORAF Participants (Ezekiel, Kossi, Kebbeh, Jacques & Julie)
10:15 – 10:40	Discussion	Mr Amadou Ngaido (CORAF) & Dr Steve Manteaw (Director, CSIR-INSTI)
10:40 – 11:00	**HEALTH BREAK**	**ALL**
11:00 – 11:40	Presentations of KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	YPARD (Sokhna, Bebel, Etienne & Selom)
11:40 – 11:50	Discussions	Mr Marc Bappa, Ms Zainab & Mr Kofi Acquaye
11:50 – 12:10	Presentations of KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	AUC (Ms Peace Mutuwa)
12:10 – 12:20	Discussions	Prof. Andreas Brandner & Dr Boniface Akuku
12:20 - 12:50	Presentations of KM Concepts and Challenges developed by participants through the 2022 KM4AgD Challenge	CGIAR Centers (Tsehay-ILRI, Patricia, Edith, Angela - CIAT, Soji, Olumide-II-TA & Murielle-AfricaRise)
12:50 – 13:00	Discussion	Mr Michael Victor (ILRI) & Ms Katherine Lopez (IITA)
13:00– 14:00	**LUNCH BREAK**	**ALL**
14:00– 16:00	**ICIPE Session: Accelerating Inclusive Green Growth through Agri-based Digital Innovation in West Africa (AGriDI)**	Dr Jonas Mugabe Programme Manager, AGriDI

	Presentation 1: Scaling AgroCenta Platform and Adoption for Effective Market Linkages in Ghana (SAPA) by AGROCENTA **Presentation 2**: Digital Tools to Drive Market Access and Manage Ag-Value Chains (DigiMakt) by ESOKO. **Presentation 3:** Enhancing farmers' uptake of digital technologies through empirical research, innovation, and policy intervention (EFUDTRIP) by STEPRI	
16:00 – 16:20	**HEALTH & NETWORKING BREAK**	**ALL**
16:20 – 16:40	Demonstration of Outreach and Extension equipment for promoting Indigenous Knowledge	Mr Kouadio Amavi Digisoft Africa
16:40 – 17:00	General Discussions / Knowledge Cafés	Prof Andreas Brandner & Ms Peace Mutuwa
17:00 – 17:10	Wrap-up of Day 2 and Announcements	Moderators
18:30 – 19:30	Dinner with Knowledge Art Wall	All
DAY 3	**16th September 2022**	
Moderators: Dr Andreas Brandner, Ms Gadzeni Mulenga & Mr Benjamin Abugri Rapporteurs: Marc, Nico & Zainab		
08:30 – 09:00	Recap	Day 2 Rapporteurs
09:00 – 09:10 09:10 – 09:30 09:30 – 09:50	Presentation on Communities of Practice and Km4AgD CoP Charter Presentation and the Induction of 2022 Challenge Participants as Fellows of KM4AgD CoP & Centre Presentation, discussion and validation of the CN for the KM4AgD Centre of Excellence with Linkage to the Academia, country partnerships, etc	Andri Raso (AFAAS) Dr Yemi Akinbamijo (ED, FARA) & Supported by Executive Directors of CAADPXP4 Prof Andreas Brandner, Prof Annet & Benjamin Abugri
09:50 – 10:10	Presentations and Discussion on the Recommended KM Framework for a CAADP-XP4 – One CGIAR Collaboration from the KM4AgD Challenge	Mr Micheal Victor & Ms Bridget Kakuwa
10:10 – 10:20	Presentations and discussion on the High-level Policy Recommendations from the KM4AgD2022 Challenge	Dr Godfrey Onagwa, Mr Ben Illakut & Ms Peace Mutuwa

10:20 – 10:55	Wrap up and Way Forward (Review and validation of Communique)	Benjamin Abugri, Andreas Brandner, Marc, Nico & Zainab
10:55 – 11:00	Closing of the KM4AgD Conference to join the closing plenary	Dr Yemi Akinbamijo (ED, FARA)
11:00 – 11:15	**HEALTH BREAK**	**ALL**
11:15 – 14:00	**Joint Closing Plenary Session: Science and Partnerships for Agriculture Conference (SPAC)**	
	1. Endorsement of Conference Communique 2. Presentation of Certificates of Completion of 2022 KM4AgD Challenge 3. Induction of 2022 Fellows into the KM4AgD CoP and Center of Excellence 4. Unveiling of the Good Practice Study Report on partnerships	
14:00 – 15:00	**LUNCH BREAK**	**ALL**
17:00 – 18:00	**Networking Snack**	
END OF CONFERENCE, POST CONFERENCE MEETINGS & DEPARTURE		

Detail Program

Writeshop to design/develop of the AU-EU an International Research Consortium on Food and Nutrition Security and Sustainable Agriculture, Ghana

Day 1 (September 14): setting the scene

TIME	SESSION	OUTPUTS
9:00-9:30	Introduction to the writeshop Roles & agenda (plenary)	Participants have common understanding of workshop objectives
9:30-9:45	Presentation of first and second manuscript: **Room 1: Functions and services,** **Room 2: Theory of change & impact pathway & strategic statements**	
9:45-10:30	Break out session to review draft results and components	Gather additional inputs and feedback
10:30-11:00	Presentation and discussion of participants inputs; Consolidation of agreements	Obtain agreement on next steps
11:00-11:30	**COFFEE BREAK**	
11:30-11:45	Presentation of third and fourth manuscript: **Room 1: Governance & coordination**	

	Room 2: Communication & Dissemination	
11:45-12:30	Break out session to review draft results and components	Gather additional inputs and feedback
12:30-13:00	Presentation and discussion of participants inputs; Consolidation of agreements	Obtain agreement on next steps
13:00-14:15	**LUNCH**	
14:15-14:30	Presentation of fifth and sixth manuscript: **Room 1: Membership criteria & growth strategy** **Room 2: Funding & sustainability strategy**	
14:30-15:15	Break out session to review draft results and components	Gather additional inputs and feedback
15:15-15:30	Presentation, discussion and consolidation of participants inputs	Obtain agreement on next steps
15:30-15:45	Consolidation of agreements	
15:45-16:15	**COFFEE BREAK**	
16:15-17:00	Wrap up day 1 (plenary)	
17:00-19:00	Editors revising the manuscripts	Prepare presentations day 2
19:00	DINNER	

Day 2 (15 September): Revisioning, consolidation, launch of IRC

TIME	SESSION	OUTPUTS
9:00-9:15	Presentation of revised manuscript **Room 1: Governance & coordination** **Room 2: Funding & sustainability strategy**	
9:15-10:00	Break out session to review draft results and components	Gather additional inputs and feedback
10:00-10:15	Consolidation of participants inputs	Obtain agreement
10.15-10:45	**COFFEE BREAK**	
10:45-11:00	Presentation of revised manuscript **Room 1. Communication & dissemination** **Room 2. Membership criteria & growth strategy**	
11:00-11:45	Break out session to review draft results and components	Gather additional inputs and feedback
11:45-12:00	Consolidation of participants inputs	Obtain agreement
12:00-14:00	**LUNCH**	

14:00-14:15	Presentation of revised manuscript **Room 1. Theory of change & impact pathway** **Room 2. Functions and services**	
14:15-15:00	Break out session to review draft results and components	Gather additional inputs and feedback
15:00-15:15	Consolidation of participants inputs	Obtain agreement on next steps
15:15-15:45	COFFEE BREAK	
15:45-16:00	Consolidation of participants inputs	Obtain agreement on next steps

Day 3 (16 September): Launch of IRC and LEAP4FBSSA General Assembly		
9:30 – 11:00	**GA Part 1**	
11:00 – 11:30	**COFFEE BREAK**	
11:30 – 14.00	**Launching of IRC**	Launch Opening, goodwill messages / statements Document, presentation to EU and AU HLPD representative, Founding members solidarity statements / messages
14:00 – 15:00	**LUNCH**	
15:00-17:00	**GA Part 2**	SUMMARY & CLOSING

WEDNESDAY SEPTEMBER 14

08:00 – 09:00 **Registration**

09:00 – 11:00 **Joint Plenary Session**

Biennial Africa Climate Smart Agriculture Conference
LEAP4FNSSA General Assembly
PANAP Annual Meeting
KM4AgD 2022 Conference

11:00 – 11:30 **Health Break**

11:30 – 12:00 **Introduction and review of PANAP main activities**

Dr. S. Nouala, African Union Commission - ARBE

G. Genovese, European Commission -JRC

12:00 – 13:30 **Panel discussion 1: A changing world: Implications and policy challenges for Africa**

Co-chaired by A. Agumya (FARA) and Genovese G. (EC-JRC)

Charles Peter Mgeni, Sokoine University of Agriculture (SUA)

Souleymane Diallo, Centre Ivoirien de Recherches Economiques et Sociales (CIRES)

Astou Camara Diao, Senegalese Institute of Agricultural Research (ISRA)

Endeshaw Habte, Ethiopian Institute of Agricultural Research (EIAR)

Dr. R. Ngugi, Kenya Institute for Public Policy Research and Analysis (KIPPRA)

Mamadou Adam, Institut National de la Recherche Agronomique du Niger (INRAN)

Dr. Fred Dzanku, Institute of Statistical, Social and Economic Research (ISSER)

13:30 - 14:30 Networking Lunch

14:30 - 16:00 Panel discussion 2: European Union policies and possible impacts on the African agricultural sector.

Co-Chaired by Dr. G. Bahiigwa (AUC-ARBE) and J. Clarke (EC - AGRI)

TBC, European Commission – INTPA

TBC, European Commission – AGRI

TBC, Representative from AUDA-NEPAD

TBC, Representative of RECs

TBC, Chair of 4th STC, ARDWE

16:00 - 16:30 Health Break

16:30 - 18:00 Panel discussion 3: Policy impact analysis and role of PANAP to promote the use of science-based policies.

Co-Chaired by TBC Dr. S. Nouala (AUC-ARBE) and TBC (EC-INTPA)

Dr. A. Agumya, Forum for Agricultural Research in Africa (FARA)

E. Ferrari, European Commission – JRC (EC - JRC)

TBC, Common Market for Eastern and Southern Africa (COMESA)

TBC, Economic Community of West African States (ECOWAS)

D.S.D. Amany, Banque ouest-africaine de développement (BOAD)

TBC, Akademya2063

THURSDAY SEPTEMBER 15

09:00 – 10:30 **PANAP governance meeting: Memberships of PANAP, Terms of Reference, Functioning and governance of PANAP**

Co-Chaired by B. Egulu (AUC-ARBE) and F. Micale (EC - JRC)

10:30 – 11:00 **Health Break**

11:00 – 13:00 **Impact of AfCFTA: a collaborative example of policy impact analysis**

Co-Chaired by E. Ferrari (EC - JRC) and TBC (AUC-ARBE)

TBC, African Continental Free Trade Area (AfCFTA) Secretariat

A. Simola (remote) **and V. Nechifor,** European Commission – JRC

J. Laichena, Kenya Institute for Public Policy Research and Analysis (KIPPRA)

A. Agyei-Holmes, Institute of Statistical, Social and Economic Research (ISSER)

TBC, Sokoine University of Agriculture (SUA)

O. E. Omoju, National Institute for Legislative and Democratic Studies (NILDS)

S.A. Sangaré, Cellule d'analyse des politiques publiques et évaluation de l'action gouvernementale (CAPEG)

13:00 - 14:30 **Networking Lunch**

14:30 - 16:00 **Parallel sessions 1**

1. DEMETRA developments and SAMs.
   Chaired by V. Nechifor (EC -JRC)
2. FSSIM-Dev: a farm-level model for policy impact analysis.
   Chaired by P. Tillie and S. Rege (remote) (EC -JRC)

16:00 - 16:30 **Health Break**

16:30 - 18:00 **Parallel sessions 2**

1. Demonstration of DEMETRA models: the analysis of Covid-19 impacts in Kenya/Ethiopia.
   Chaired by V. Nechifor and E. Ferrari (EC -JRC)
2. Using survey data to develop a multi-country farm-level model: the case of UEMOA-EHCVM.
   Chaired by P. Tillie and M. Rogna (remote) (EC -JRC)

FRIDAY SEPTEMBER 16

08:30 – 10:00 **Parallel sessions 3**

1. Linking MAGNET-DEMETRA (FSSIM-Dev?): modelling of the African Continental Free Trade Area (AfCFTA).
   Chaired by V. Nechifor and E. Ferrari (EC -JRC)
2. Using survey to inform on policy: The case of the irrigated perimeters in Niger.
   Chaired by A. Mamadou (INRAN, TBC) and L. Cockx (EC -JRC),

10:00 – 10:30 **Health Break**

11:00 – 13:30 **Joint Closing Plenary**

13:30 - 14:30 **Closing Lunch**

14:30 – 15:00 **Parallel sessions 4**

1. Modelling global food security issues: high prices and Ukraine war.
   Chaired by V. Nechifor (EC -JRC)
2. How do you know what works? Planning policy and programme evaluation from the beginning.
   Chaired by L. Cockx (EC -JRC)

15:00 – 18:00 **Bilateral discussions**

1. Bilateral discussions and hands-on session (DEMETRA).
   Chaired by V. Nechifor and E. Ferrari (EC -JRC)
2. Bilateral discussions and hands-on session (FSSIM-Dev).
   Chaired by L. Cockx and P. Tillie (EC -JRC)

Detail Program

Day 1: CSA Biennial CSA Conference

	Thematic Paper Presentation					
	Theme 1	**Theme 2**	**Theme 3**	**Theme 4**	**Theme 5**	**Theme 6**
1130 to 1330	The role of **digitalization** in advancing CSA in the smallholders' systems **Facilitator:** **Dr. Vincent Aduramigba** **[IAR&T]** **Venue: Britannia**	The nexus of CSA and the **mechanization of the smallholder system** in Africa. **Facilitator:** **Dr. Dr Mkomwa** **[ACTN]** **Venue:** **Volta Hall**	Bottom-up and system-wide **capacity development approaches;** to enhance CSA practices **Facilitator:** **Prof. Babalola** **Venue:** **Afram Hall**	Strengthening the support of **extension and advisory services to ensure CSA compliance among** smallholder farmers in Africa **Facilitator:** **Max Olupot** **[AFAAS]** **Venue:** **Abban Lounge**	Advances in **CSA technology generation and use** in the crop, **livestock, fisheries**, and aquaculture. **Facilitator:** **Dr Alcade Segnon** **[AICCRA]** **Venue:** **Kaizer Hall**	Compatibility assessment of agroecology and CSA practices **Facilitator:** **Isolina Boto** **[DeSIRA-Lift]** **Venue:** **Botsio Hall**
1330 to 1430	**Lunch**					
1430 to 1530	**Theme 1 [Cont.]**	**Theme 2 [Cont.]**	**Theme 3 [Cont.]**	**Theme 4 [Cont.]**	**Theme 5 [Cont.]**	**Theme 6 [Cont.]**
1530 to 1700	**ACSAF Plenary 1:** **Facilitator Dr. Manyewu Mutamba (AUDA-NEPAD)** **Commissioned study** **Foresight: Plausible futures of CSA in Africa** **Dr. Nasiru Taura** **Commissioned study** **Strategies for Continuous development of CSA technologies in Africa** **Prof. Tunde Ajayi**					
1800	**ACSAF Cocktail**					

Day 2: CSA Biennial CSA Conference

Day 2: 15th September 2022

<table>
<tr><td rowspan="4">Time

8:30 – 10:00 am

10:30 – 17:00</td><td colspan="5">Side Events</td><td rowspan="4">General Assembly Day II</td><td rowspan="4">Partners Meeting Day II</td><td rowspan="4">Conference Day II</td></tr>
<tr><td>“Linking climate information services to climate-smart agriculture practices: optimizing CSA across multiple scales”

Venue: Abban Lounge</td><td>The contributions of agroecology to climate change

Venue: Penthouse</td><td>Annual Meeting of the Continental Think-Tank for responding to Emerging issues in African agriculture

Venue: Affram Hall</td><td>Gaining Grounds…a workshop to strengthen collaborations to advance climate-smart agriculture in Africa

Venue: Kaizen</td><td>Soil Initiative for Africa (SIA) Stakeholders Consultation

Venue: Britannia</td></tr>
<tr><td colspan="3">Field Visit</td></tr>
<tr><td>Take off @12:00</td><td colspan="3">Field Group 1
Blue Sky Company Limited.</td></tr>
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Day 3: CSA Biennial CSA Conference

<table>
<tr><td>Time

0830 to 1030</td><td>ACSAF Plenary 2: Session Chair: Dr. Alioune Fall

Commissioned study
10 years analysis of Africa’s progress on climate change / Decadal Plan for ACSAF Dr. Ogiogio

Technical panel Discussion [Wole Fatunbi]
Towards a common Africa position at CoP27 and COP28.

Dr. Vanlauwe [CGIAR]; Dr. Akinbamijo [FARA]; Dr. Chapoto [ReNAPRI]; Dr. Litha Magingxa [ARC-South Africa];

Open Discussions</td></tr>
<tr><td>1030 to 1100</td><td>Coffee break</td></tr>
<tr><td>1100 to 1400</td><td>Joint Plenary & Closing Lunch</td></tr>
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Synopsis of Sessions

Keynote Paper: "Introspection on CSA Action to Strengthen Accountability, Resource Use and Impact in Africa"

This paper explicates the central theme of the Biennial Climate Smart Agriculture Conference **"Introspection on CSA Action to Strengthen Accountability, Resource Use and Impact in Africa"** This paper summarises the needs and relevant actions that should be taken by all actors and development partners toward the development of Africa agriculture. The problem of African agriculture is well known and has been reported by many scholars; same way, solution options have been proposed and some implemented. In truth, the sector is better positioned now than at any other time for progress than what obtains in the last two decades. Largely due to growing political will as well as different investments. Despite the foregoing, the pace of growth is still sub-optimal, and it is not consistent with the level of investment in the sector. The status may be due to the emergence of new challenges when the old one is still outstanding. It is apparent that concerted efforts built on effective partnership are the way to go to deliver the type of future we want for African agriculture. Africa Europe partnership for Food and Nutritional Security and Sustainable Agriculture (FNSSA) provides a tool for smart learning and exchanges for mutual benefit between the two continents. Its support through the LEAP4FNSSA project and the proposed transition into the International Research Consortium (IRC) is a smart way to ensure that the partnerships deliver. This is substantiated by the Pan-African Network for economic Analysis of Policies (PANAP) actions in Africa. The DeSIRA-supported Knowledge Management for Agricultural Development (KM4AGD) is playing a key role.

Apparently, all the partnerships is tailored towards the delivery of a sustainable Climate Smart Agriculture (CSA) across the continent. This is the way to go, but what is the state of action and stewardship. This paper will discuss these issues and make key recommendation for continental action.

Presenter

Dr. Bruce Campbell is part of the Clime-EAT team, He was the Director of the CGIAR Research Program on Climate change and Food Security (CCAFS), has a PhD in Ecology from Utrecht, but has carried out much inter- disciplinary work, championing new approaches to applied research on natural resource management. He has published over 120 peer-reviewed articles and more than a dozen books.

Prior to joining CCAFS, he focused on social-ecological systems in southern Africa, covering a spectrum of production systems (forestry, livestock, dryland and irrigated cropping), from small-scale (e.g. soil fertility management) to large-scale (e.g. deforestation analyses), and from biophysical and social science angles. He served as the inaugural Director of the Institute of Environmental Studies, University of Zimbabwe. For ten years, Bruce was the Director of the Forests and Livelihoods Program at the Centre for International Forestry Research (CIFOR) in Indonesia. Bruce serves on several editorial boards, and scientific committees.

ACSAF Plenary 1 / 14th September 2022 By 1530 to 1700 @ Brittinia

Link virtually: https://faraafrica.zoom.us/meeting/register/tZEpcuutpj8tGNV8-YilwKtAK0pGc7Ub8W0i

Commissioned Study 1: Foresight: Plausible futures of Climate Smart Agriculture in Africa

With growing interest on Climate Smart Agriculture (CSA) in Africa, numerous studies have examined its implication for African agriculture. However, we still lack a holistic understanding of plausible futures of CSA in Africa. Given the significance and relevance to the future we want for Africa, this study utilises a desk-based exploratory systematic review and analysis to identify research gaps from published literature and other available information in relevant public documents, to develop a summary of the current state of research on CSA futures in Africa. Using the best foresight techniques as a frame of reference, this study conducts a comprehensive systematic secondary search to identify and analyze the most relevant articles. Our analysis shows that prior studies utilized a range of foresight techniques, approaches, and methods to study CSA in Africa. These studies also adopted various definitions of CSA using multiple dimensions. Our analysis shows that visionary and scenaric frames are the most utilized foresight frames in African CSA studies. In our interpretation, while there are indications and an appetite for utilizing other foresight frames such as planning, predictive, critical, and transformative frames – they appeared to be underutilized in our continuous search for a plausible future explanation of CSA in Africa. We conclude with a conceptual model and sets of insightful propositions with clear implications for technical and public policy options for plausible futures of CSA in Africa.

Presenter

Dr. Nasiru Taura

Dr. Nasiru Daiyabu Taura is a Senior Lecturer in Entrepreneurship at Bournemouth University, UK. He is a visiting lecturer at Southampton University, UK, and an External Examiner at Bath Spa University, UK. He has examined and is now supervising doctoral students in the fields of entrepreneurship, knowledge management & innovation. He is an Associate Editor of the Journal of the International Council for Small Business (Washington DC). For further details about Dr. Taura - please refer to the Bournemouth University, UK expert directory. He is a seasoned academic, international consultant on innovation management, digital entrepreneur, and social innovator. With over 10 years' experience, his research and professional expertise cover interdisciplinary aspects of Futures, Entrepreneurship, innovation in hostile environments, and design management. Dr. Taura foresight work is linked to Agriculture and Climate in Africa. In collaboration with FARA, Dr. Taura provides technical support for the strengthening of capacity for foresight among more professionals in African AR4D institutions & private sector The outcome of the collaboration, has led to the creation of multiple digital assets for facilitating online sensitization (foresight awareness), networking, developing a Community of Practice among African foresight practitioners as well as capacity building.

Commissioned Study 2: Strategies for Continuous development of CSA Technologies in Africa

A literature study was carried out to answer some questions why there should be strategies for continuous development of climate smart agriculture (CSA) technologies in Africa. CSA was developed by FAO and its goal is food security and development while three objectives for achieving this goal are productivity, adaptation, and mitigation (FAO 2013a and Lipper et al. 2014). As a result of importance and attention given to CSA, several alliances have been formed and many institutions involved in CSA in Africa (Williams et al, 2015). Monitoring and evaluation framework has been found to be important for accountability framework for CSA research but needs to be backed up by a reporting system. Gender inequality is reported to hinder adaptation to climate change, including the adoption of CSA strategies and based on empirical study the average female share of labor input into crop production in Africa is 40%, which is substantially less than the previous quoted 60-80%. In agricultural production, CSA has proven to be sustainable and can uplift smallholder farmers' living standards. A policy incentive is important to CSA as a positive significant correlation was found between incentives provided to farmers and their willingness to adopt CSA technologies (Shittu et al, 2021). Many CSA strategies/technologies have been tested in Africa and are found to be promising and different from other technologies as they focus on climate change, have outcomes, synergies, and trade-offs, and create new funding opportunities (IFAD, 2011). However, despite the development of CSA technologies, wide-scale adoption remains problematic in Africa as there are hardware and software barriers (Barnard et al, 2015). The climate finance landscape in Africa features many different funding channels with different objectives and eligibility criteria but financing for CSA needs to be scaled up considerably. However, to meet the challenges of climate change, agricultural production and food systems need to undergo a profound transformation to continuously produce more sustainable CSA technologies.

Presenter

Prof. Micheal Tunde Ajayi holds a B. Sc. Degree in Crop Science, M.Sc. Degree in Agronomy and a Ph.D. Degree in Training and Human Resource Development all from the University of Ibadan, Nigeria. He also holds a certificate in Training of Trainers for Agricultural Extension and Rural Development Officers at USDA, Washington D.C., USA. He worked at IITA, Ibadan for 14 years and is currently a Professor of Agricultural Administration, Federal University of Agriculture, Abeokuta, Nigeria. He has over 25 years' experience in African Agricultural Research and Development contributing extensively to emerging issues in agriculture and agricultural innovation. He has served as a consultant to many international organizations such as FAO, AfDB, FARA, NRI, IITA, CORAF, ASARECA, RUFORUM, CCARDESA IDH etc. His areas of focus are agronomy, agricultural administration and extension, capacity development, monitoring and evaluation. Prof Ajayi has work experience in almost all sub-Saharan Africa countries.

ACSAF Plenary 2 / 16th September 2022 By 0800 to 1030 @ Ridge Arena

Link virtually: https://faraafrica.zoom.us/meeting/register/tZEpcuutpj8tGNV8-YilwKtAK0pGc7Ub8W0i

Commissioned study
10 years analysis of Africa's progress on climate change / Decadal Plan for ACSAF

This session presents reports of a synthesis study on the lesson learnt from Africa participation in different CoP from the 17th edition in Durna, South Africa. It is tagged Durban+10. The second attempt to study the dynamics of Africa to the issues of Climate Smart Agriculture (CSA) and the need for the Africa Climate Smart Agriculture Framework as an action-based instrument in consonance with the Africa Union Climate Change Strategy

This study represents a fundamental intervention in giving Africa a footprint at CoP27 on agriculture and food systems as a priority consideration and the main agenda item. Frustratingly, agriculture and food systems, despite being the second largest contributor to GHG emissions globally, is not receiving commensurate attention at the CoPs. At CoP23, the Fiji President gave prominence to this sector; CoP26 failed to take this forward decisively. CoP27 is therefore Africa's opportunity to reignite commitment and beat the drums very loudly on the need for support for CSA in Africa due to the disproportionate impact of climate change on its agriculture and food systems. The effort should be about putting sustainable agriculture and food systems, and thus climate-smart agriculture, in the core agenda for negotiations, plenary decisions, and financing of responses to challenges reflected in continuing losses and damage to African agriculture.

Agriculture in Africa is about lives and livelihoods, given the high level of dependence on the sector by a majority of the continent's population. To this end, the Synthesis Report on CoP17-26 Decisions and Policy Actions by African countries and the international community tells the story of weak intentions and inadequate commitment to agriculture and food systems as a global community and the need to address this imbalance in CoP meetings. CoP27 offers the AUC an opportunity to launch the AU Climate Change and Resilient Development Strategy and Action Plan 2022-2032 and the FARA Africa Climate Smart Agriculture Framework for the implementation of the CSA-related priorities of the climate change strategy.

Presenter

Dr. Genevesi Ogiogio is an experienced economist and institutional reform and development, expert. He is executive director of the African Centre for Institutional Development and has served as technical and institutional development advisor to numerous continental and international organizations including UN agencies, the World Bank, African Union organs and agencies such as the African Union Development Agency, the Pan African Parliament and the APRM, and the African Heads of State High-Level Advisory Council of the African Institute for Mathematical Sciences. Dr. Ogiogio was a Member of the UNDP-OECD Global Partnership Monitoring Advisory Group, OECD-DAC Task Team on Green Growth and Development, Operations Advisor for the World Bank Partnership for Capacity Building in Africa and Capacity Building Advisor to UNESCO, among numerous others. He is currently Green Economic Advisor to the African Union for the implementation of the AU Green Recovery Action Plan 2021-2027 and until recently he was National Climate Change Economic Advisor to the Government of the Kingdom of Eswatini. A rigorous researcher and a prolific writer, Dr. Ogiogio has produced more than 250 publications consisting of high-profile commissioned reports, books and articles in peer-reviewed journals. Dr. Ogiogio is the founder of two thriving institutions - the African Centre for Institutional Development (Africa-CiD) and Experts-Africa.com (www.experts-africa.com).

Synopsis of Side Events

Side Event 1

Climate information services in climate-smart agriculture: enhancing resilient agrifood systems through scaling of land and water innovations

Organizers: Lead-IWMI in collaboration with CGIAR and the Centre for Transformative Agricultural and Food Systems of the University of KwaZulu-Natal

Day 2: 15th September 2020 / 09:30 – 12:00 @ Abban Lounge

Register with this link to access the event

https://faraafrica.zoom.us/meeting/register/tZ0tf-uhrjoiHdduu1xIfx2j13MzEmoPM_MO

Background

Title Climate information services in climate-smart agriculture: enhancing resilient agrifood systems through scaling of land and water innovations

Lead CGIAR and the Centre for Transformative Agricultural and Food Systems of the University of KwaZulu-Natal**.**

Facilitator: Dr. Olufunke Cofie and Prof. Tafadzwa Mabhaudhi (IWMI)

Main concepts

It is well-established that Africa is a climate change hotspot and is highly vulnerable due to inherently low adaptive capacities. Most agriculture in Africa (~90%) is rainfed, done by smallholders residing in rural areas, often typified by marginal environments. Various factors, including lack of access to climate information services (CIS), poor agronomic and agricultural water management, limit productivity and ability to adapt to weather variability and extremes. Equal access to and proper use of land and water resources is a

prerequisite to building healthy, productive and OneHealth sensitive landscapes for resilient agrifood systems and livelihoods.

Climate-smart agriculture (CSA) is being promoted to sustainably increase productivity and incomes while adapting to or mitigating climate change. However, the heterogeneity of socio-ecological production landscapes within which smallholder farming systems exist means that CSA practices need to be regionally differentiated and integrated with water, energy and biodiversity from field to farm to landscape scale. Linking CIS to CSA can help identify, appraise, and prioritize best-fit practices that enhance resilient agrifood systems within integrated landscapes.

This side event is organized within the context of the One CGIAR Regional Integrated Initiative 'Transforming AgriFood Systems in West and Central Africa (TAFS-WCA).' The aim is to facilitate discussion on how linking CIS to CSA can enable sustainable scaling of bundled land, water, aquaculture, and climate-smart agronomic and digital innovations to strengthen agrifood systems and landscape resilience planning and investment.

(i) Discussion questions How do we link CSA to inclusive landscape management and developing pathways for scaling land and water innovations for resilient agrifood systems?

(ii) Are CIS effectively tailored and linked to CSA practices/technologies for smallholder farmers within socio-ecological production landscapes?

(iii) What are the key barriers to CIS and CSA access, adoption and linkage (socio-economic, socio-ecological, political economy, gender)?

(iv) Can CIS drive the adoption of CSA and support the development of appropriate Decision Support Systems? How and at what scale(s)?

(v) How can linking CIS and CSA help to identify, appraise, and prioritise best-fit practices that enhance resilient agrifood systems within integrated landscapes?

(vi) How can we effectively link CIS-CSA for a transformational adaptation landscape resilience?

Program Breakdown

Facilitator: Dr. Olufunke Cofie and Prof. Tafadzwa Mabhaudhi

Tentative Agenda, **CGIAR Side Event**

Climate information services in climate-smart agriculture: enhancing resilient agrifood systems through scaling of land and water innovations

09h30-12h00, 15 September 2022

No.	Item	Time
1	Introduction and welcome by Dr Olufunke Cofie, IWMI Country Representative, and One CGIAR Country Convenor, Ghana	5 min
2	Inclusive Landscape Management for scaling bundled innovations for resilient agrifood systems Dr Birhanu Zemadim (ICRISAT) and Dr. Olufunke Cofie (IWMI)	15 min
3	Generating landscape level information for CSA initiatives: Examples from the Offin sub-basin of Ghana (Dr. Gerald Atampugre, UCC)	15 min
	Q&A	10 min
4	How can CIS be effectively tailored and linked to CSA practices/technologies to benefit women and youth farmers within socio-ecological production landscapes?" Dr Aminou Arouna (AfricaRice)	15 min
5	Scaling and sustaining bundled CIS and CSA with other services to support the development of appropriate Decision Support Systems". Dr Desire Kagabo (Alliance Bioversity-CIAT).	15 min
	Q&A / Tea Coffee	15 min
6	Panel discussion - How can linking CIS and CSA help to identify, appraise, and prioritize best-fit practices that enhance resilient agrifood systems within integrated landscapes? Dr Robert Asiedu (IITA); Prof Maxwell Mudhara (UKZN), Dr Aidan Senzanje (UKZN), Dr Vimbayi Chimonyo (CIMMYT and UKZN), Dr. Abubakari Ahmed (UDS)	50 min
7	Wrap up and way forward Dr Olufunke Cofie (IWMI)	10 min

Side Event 2

The Contributions of Agroecology to Climate Change

Day 2: 15th September 2020 / 8:30 – 12:00 GMT @ PentHouse

Register using this link to link up with this event virtually:
https://faraafrica.zoom.us/meeting/register/tZAsdeisrTMuH90nm5q6roXMLxp5_WsR-S5W

Overview

- Today's agriculture has succeeded in supplying large volumes of foods to global markets but is generating negative outcomes on multiple fronts: widespread degradation of land, water, and ecosystems; high greenhouse gas (GHG) emissions; biodiversity losses; persistent hunger and micro-nutrient deficiencies alongside the rapid rise of obesity and diet related diseases; and livelihood stresses for farmers around the world.
- Already, more frequent, and extreme weather events, such as droughts, floods, and unpredictable rainfall, are having a severe impact on the ability of certain African regions to feed themselves. The COVID-19 pandemic and current food crisis highlighted the importance to foster transition to resilient and diversified sustainable agriculture and food.
- In this context, a growing number of voices are calling for a complete transformation of our agricultural and food systems and are pointing to a transition to agroecology as a key pathway to tackle the challenges we are currently facing.
- As a science, agroecology is multidisciplinary. It brings together agronomy, ecology, environmental science, sociology, economics, history and more, while prioritizing participatory and holistic approaches. Agroecological innovations are based on the co-creation of knowledge, combining science with the traditional, practical, and local knowledge of producers.
- An agroecological approach to sustainable food production is defined as one that favours the use of natural processes, limits the use of external inputs, promotes closed cycles with minimal negative externalities.
- In guiding countries to transform their food and agricultural systems, to mainstream sustainable agriculture on a large scale, and to achieve Zero Hunger and multiple other SDGs, FAO has identified ten interlinked and interdependent elements of agroecology[1] that include diversification; co-creation and sharing of knowledge; building synergies supporting multiple ecosystem services;

[1] FAO. The 10 elements of Agroecology guiding the transition to sustainable food and agricultural systems. 2018.

efficiency; recycling; resilience of communities and ecosystems; protecting human and social values; supporting culture and food traditions; responsible governance and circular and solidarity economy.

- Agroecological transformation of agricultural systems is an appropriate response to issues caused by climate change. Diversity in agroecological systems reduces vulnerabilities to climate variability. The reduction in the use of pesticides and synthetic fertilizers improve resilience to the climate change effects. Resilience of agroecological systems based on traditional knowledge of smallholders are effective in managing climate risks. Recycling, reduction of waste and use efficiency limits GHG and has benefits in terms of mitigation.
- Farmers' traditional knowledge combined with scientific knowledge to co-create innovation and the sustainable use of technologies is at the core of an agroecological farming system. Cultivation practices maintain high crop production and livestock diversity integrated in a farming ecosystem that facilitates recycling of biomass, nutrients, water, and energy and therefore contribute to climate resilient food systems.
- The ability of agroecology to diversify livelihoods and build resilience to climate change, support farmers to revive soils, promotes sustainable land management, and build resilient communities, while meeting the nutritional and cultural needs of people is recognized.
- Demonstrating the multiple benefits (economic, environmental, social, cultural, etc.) of agroecology to motivate wide-scale adoption is critical. Farmers will be able to sustain ecological approaches only if their business models properly reward them for the product and the value created. This should translate in higher income and higher returns to labor input.
- Innovative markets are emerging at local levels in synergy with diversified production systems and healthy diets as well as new opportunities for value chain actors, in the context of the implementation of the Africa continental Free Trade Agreement (AcFTA), including through origin-linked products and geographical indications (GIs). New business opportunities emerge on the provision of bio inputs, organic waste, recycling industries.
- Some challenges for the agroecological transition are holding back a wide-scale transition to agroecology, which include: lack of awareness of agroecology among policymakers; lack of enabling environment; insufficient support and incentives for producers during the farm transition period, which requires time; low support for innovative research and knowledge approaches, including refocusing on multidisciplinary research and education, and insufficient involvement of food producers in creating knowledge; low promotion of local diversified agroecological markets, which support more accessible, healthy diets and create connections between producers and consumers; lack of coordinated action among sectors and actors.
- To promote sustainable food systems, we will need to consolidate the evidence base to support agroecology through multi-dimensional analyses, to revisit our understanding of what is efficient and productive, and to promote policy changes supporting the transition to agroecology (i.e. participatory innovation systems, economic incentives for early adopters, payments for environmental services, and rewards for landscape conservation).

Objectives of the session:

- **To discuss agroecological approaches and practices which contribute to climate resilience and concrete ways in which agroecology can support adaptation and mitigation strategies**
- To make recommendations to mainstream agroecological principles into the Climate Change and Climate-Smart Agriculture debate and call for investments

Moderation: Isolina Boto, DeSIRA LIFT

Introductory remarks: EC
Short introduction of DeSIRA LIFT

Panel

The panel will provide different perspectives from policy to practice on how agroecology can contribute to climate change adaptation and mitigation. Drivers of agroecological transitions supporting economic, social, and environmental dimensions of sustainability will be discussed as well as incentives to MSMEs and smallholders to transition and accelerate the adoption and implementation of agroecological practices.

Successes in the field supporting climate change adaptation and mitigation

- **Karim Sawadogo**, Coordinator, West Africa Alliance for Agroecology (successful field cases)
- **Yohann Zaba**, Projet GCCA+AO (successful field cases)
- **Rosinah Mbenya**, PELUM, Kenya

Smart solutions and local-led technologies from farmers and entrepreneurs - Promoting waste reduction and circular economy

- **Noël N'Guessan LONO**, Côte d'Ivoire
- **Sandra Snowden**, CEO, Hendy Farms Ltd, Ghana

Public and private investments and policies needed to scale up successful agroecological practices

- Producers (ROPPA members)
- **Ibrahim TRAORÉ**, Chef de la Division Finance Climat, BOAD
- **Jacques Andre Ndione**, Regional Coordinator, AIC-BOAD, Regional Agency for Agriculture and Food (ARAA), ECOWAS
- INTPA, EC

Discussion

Way forward: key messages summarizing discussions and pointers for action

Side Event 3

Annual Meeting of the Continental Think-Tank for Responding to Emerging Issues in African Agriculture

Day 2: 15th September 2020 / 8:30 – 16:00 @ Affram Hall

A Closed Meeting: Invited Participants Only

Context

The Continental Think-Tank to respond to Technological Issues in Africa Agriculture was established to carry out discussions, networking, and hands-on studies on the various emerging around African agriculture to generate solutions. The Think-Tank will liaise widely and use infrastructure within universities and research institutes to create solutions and options for advocacy and action. The establishment of the continental Think-Tank by runs in alignment with the Sub-Regional Organizations (SROs) (ASARECA, CCARDESA, and CORAF), AFAAS, and all other willing international organizations, donor projects, and national and continental initiatives.

Vision : The vision of the Think-Tank is to constitute a consortium of experts from the continent to form a research response alliance that would rapidly attend to knowledge and technology generation on emerging issues.

Goal : To create a platform of a group of competent individuals who will engage in a dynamic context to the research and interact on how to generate solutions to emerging challenges in agriculture. It will be a platform to process ideas scientifically and analyze and develop strategies to combat biotic and abiotic factors affecting agricultural productivity on the African continent.

This side event is 2022 physical meeting of the think tank; it will review and discuss its study on the state of action in response to current technological issues confronting Africa Agriculture; as well as the readiness of the continent to respond appropriately to emerging issues.

Profile of Think-Tank Members

Dr. Robin Buruchara [Pioneer Chairman]

Trained as a plant pathologist, Dr Robin Buruchara has over 30 years of agricultural research and development (R&D) experience in Africa, derived from his work at the International Center for Tropical Agriculture (CIAT), and particularly, with the Pan Africa Bean Research Alliance (PABRA). PABRA, which is facilitated by the Alliance of Bioversity and CIAT, is research for development (R4D) multi-institutional and interdisciplinary partnerships in 31 countries in Africa. PABRA's goal is to transform the bean subsector to enhance smallholder farmers' incomes, natural resource base, food, nutrition and health of rural and urban poor consumers in Sub Saharan Africa (SSA) through demand led, climate resilient and nutritious bean research products. PABRA works in partnership with research institutions, government, non-government organizations, farmers, and a variety of private sector partners. As a researcher, Director of PABRA, and CIAT Africa, Dr Buruchara has accumulated extensive professional and managerial experience in developing, planning, implementation, coordination, monitoring, and evaluation of large multi-country, interdisciplinary R & D projects and networks. He has developed and facilitated R & D projects, programmes and partnerships that have enabled smallholder farmers, and value chain actors to exploit opportunities.

Prof . Appolinaire Djikeng

Prof Djikeng is a Senior Academic at the University of Edinburgh and a leader in African agricultural development and science capacity development. At the University of Edinburgh, Prof Djikeng's primary responsibilities are to lead and manage the Centre for Tropical Livestock Genetics and Health (CTLGH) as an R&D platform for the development for tropical livestock genetic improvement with operating nodes in the UK (Edinburgh) and in Africa (Nairobi and Addis Ababa). Prof Djikeng's research, capacity building and international development interests include i) livestock genetic improvement, and ii) development of human and technological resources to harness the genetic, socio-economic, and environmental gains to support sustainable tropical livestock development.

Prior to moving to the University of Edinburgh in 2017, Prof Djikeng completed an 8-years tenure at the International Livestock Research Institute (ILRI) where he contributed to the establishment of Biosciences eastern and central Africa (BecA) and subsequently assumed the program directorship to lead its evolution into a world-class, state of the art and well-funded biosciences research and capacity building initiative in support of African agricultural transformation and CGIAR programs.

Prof Djikeng has won many awards, he serves in a number of boards and science advisory committees.

Prof Djikeng completed undergraduate studies (BSc Hons and MSc) at the University of Yaoundé (Cameroon) and received a PhD from Brunel University (UK). He conducted a postdoctoral research

fellowship at Yale University School of Medicine (USA) and held faculty positions in the USA (Yale University & the J. Craig Venter Institute).

Professor Olubukola Babalola

Professor Olubukola Oluranti **Babalola** (Pr.Sci.Nat, MASSAF, FASLP, FTWAS, FAS), the Vice President of the Organization for Women in Science for the Developing World (OWSD), is an NRF-rated scientist with over 20 years of research experience focusing on rhizosphere metagenomics, coupled with an MBA in General Management. She is the incumbent Research Director of the Food Security & Safety Focus Area at North-West University (NWU), South Africa, without reservation leading, as the Head and Principal Investigator a Microbial Biotechnology Research laboratory. Olubukola is a member of the editorial board for Applied and Environmental Microbiology (American Society for Microbiology, USA), BMC Microbiology (Elsevier), and Biochemistry and Biophysics Reports (Elsevier). She is an International Advisor to F1000Research Plant Science Gateway and Nano-Horizon. Her team has received many awards, including being the finalist, GenderInSite 2020. Olubukola joined NWU in 2009; at NWU, Olubukola is passionate about capacity building and has graduated 27 doctoral fellows, 24 masters, and numerous Honors students. A number of her Ph.D. products are now in Italy, America, Canada, Australia, Sweden, and also scattered over Africa. Prof Babalola is a prolific author with over 300 publications. She is an AAAS-TWAS Science diplomacy alumnus, impacting the world after the eye-opening awareness of policymaking, diplomacy, and diplomatic engagement. She is now taking action using the gender lens and forging collaborations with diplomats. She is a fellow of The Nigerian Academy of Science (NAS), The World Academy of Sciences (TWAS), and the Academy of Science of South Africa (ASSAF). Her wealth of international experience spans the Americas, Asia, Europe, and Oceania, 36 countries to be precise. She enjoys international collaborations across the globe, research grants, and many awards. Olubukola has an H-index of 48, with over 11,300 citations Olubukola is #1 in Africa for Soil Science and Plant Nutrition (see https://www.adscientificindex.com/scientist.php?id=96341

Professor Adewale Adekunle

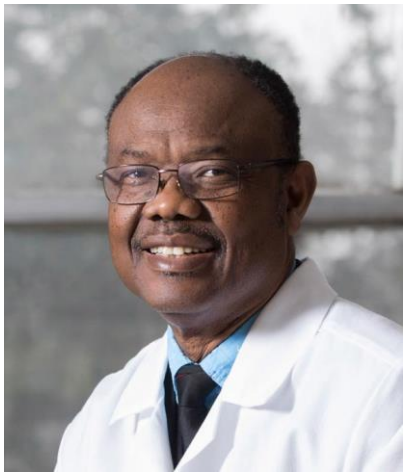
Wale Adekunle is an Agricultural Innovation and Rural Development Specialist. He has several years of experience in agriculture and rural livelihoods many of which he spent in different organizations across the world. Wale started his career in agricultural research and development on a World Bank project in Nigeria in 1985, and subsequently became Regional Program Coordinator. In 1988 he joined the International Institute of Tropical Agriculture (IITA). Wale worked on farming systems and agronomic research at IITA for about two decades. Initially his main focus was on maize/legume mixtures, cassava-based systems, and alley farming. The maize/legume and the maize/cassava/legume mixtures that he developed have been adopted by millions of farmers in the savannah and coastal regions of West Africa. Later,

his focus shifted to the innovation systems approach in research and development leading to the development of the 'innovation platform' approach which is now used across the world.
Through his work, Wale created innovation platforms to enhance information and communication technology (ICT)-modulated communication. He developed a model to sustain ICT, including internet, in rural communities. Some of the platforms he developed with other stakeholders integrated farmer commodity exchange for various commodities like maize, making them the first farmer-directed and managed commodity exchange platform in Africa. For this, Wale won the Stockholm Challenge Award in 2005. Wale later became the Director of the Sub-Saharan Africa Challenge Program (SSA CP), a CGIAR program and led the continent wide study to prove that the Integrated Agricultural Research for Development (IAR4D) gave better and quicker benefits than conventional approaches. In 2011, SSA CP won the Africa College First Prize for food security and poverty reduction.

Professor Nelson Ojijo

Nelson K. Olang'o Ojijo is an agricultural professional with about 30 years' experience in teaching, research, university management, and regional agricultural development practice. He has a PhD Degree in Agricultural Science from the University of Tsukuba, Japan.
He worked with the Forum for Agricultural Research in Africa (FARA) based in Accra, Ghana, for seven years between 2009 and 2016 - initially as Capacity Strengthening Program Officer and, later, as Lead Specialist for Capacity Development. In these roles, he – among other duties - coordinated the implementation of the SCARDA program in over 10 countries across Africa and represented FARA as a member of the FAO/TAP (Tropical Agriculture Platform) Capacity Development Expert Group that furnished the initial recommendations for the formulation of the Common Framework on Capacity Development for Agricultural Innovation Systems (CF-CDAIS). The CF-CDAIS seeks to promote better coherence and greater impact of capacity development in support of Agricultural Innovation Systems (AIS) in the tropics. Prof. Ojijo also worked closely with FAO, the Global Forum on Agricultural Research (GFAR), and the Committee on World Food Security (CFS) in the "Strengthening Capacity for Agricultural Innovation in Post-Conflict and Protracted Crises Countries" initiative, popularly known as the Kigali Movement. This eventually contributed in part to the elaboration of the CFS Framework for Action for Food Security and Nutrition in Protracted Crises (CFS-FFA), which was the first global consensus on how to mitigate the threat to food security and nutrition during protracted crises. Prof. Ojijo also served as the Regional Advocacy Coordinator for the Bill & Melinda Gates' funded project on Building Nutritious Food Baskets (BNFB) that as co-implemented by CIP, FARA, IITA, HarvestPlus, CIAT and CIMMYT in Nigeria and Tanzania. The BNFB project sought to take to scale selected biofortified crops in the target countries. He also served in various regional projects

Professor Sammy Aggrey



Samuel (Sammy) E. Aggrey is a Richard B. Russell Chair and Professor at the University of Georgia (UGA), USA. Professor Aggrey obtained his PhD in Population and Quantitative Genetics, at the University of British Columbia, Canada and was a Natural Science and Engineering Research Council of Canada's postdoctoral fellow in Molecular Genetics at McGill University. He has been on faculty at the Department of Poultry Science since 1999 and at the Institute of Bioinformatics-UGA from 2006 to date. He is an affiliate scientist at BeCA-ILRI. He is the AABNet Pillar leader for Capacity Building. His research includes developing models for genomic selection, nutrigenomics, molecular and cellular bases of stressors (heat and coccidia infections) and poultry breeding. Professor Aggrey is a co-editor of "Poultry Genetics, Breeding and Biotechnology" and the lead editor for "Advances in Poultry Genetics and Genomics". He teaches poultry breeding at the Undergraduate level, Population and Quantitative Genetics, and Breeding Strategies at the post-graduate level. He also co-teaches an international course on Quantitative Genetics and Genomics at BeCA and AABNet. He has authored or co-authored 9 book chapters and over 140 peer-reviewed research publications. His notable awards include Jaap Memorial Lectureship at the Ohio State University, the D.W. Brooks Award for Excellence in Research, and Career Development Recognition (the University of Georgia), The Broiler Research Award (Poultry Science Association), Changxin Chu Fund (China Agricultural University Educational Foundation, Carnegie Fellowship (Carnegie Institute) and the Paul B. Siegel Research Award from the World's Poultry Science Association. Prof. Aggrey has consulted for the poultry breeding industry, the government of Jamaica, The Bill and Melinda Gates Foundation, PROJ-X, Kuwait National Research Institute among others on animal improvement-related projects

Dr. Aliou Diagne

Aliou Diagne, Université de Thiès (UT), Sénégal

Research Fellow, Centre de Recherche en Economie et Finance Appliquées (CREFAT). Aliou Diagne is Senegalese researcher with over 25 years of experience across sub-Saharan Africa. His researches concentrate on agricultural development policies in sub-Saharan Africa, with a special on focus rice value chains, impact evaluation, technology adoption, microfinance and poverty analysis. Before joining the University of Thiès in 2020, he was Adjunct Professor in the University Gaston Berger, Saint Louis, Senegal (2014 to 2019). Prior to that, he served in numerous functions at The Africa Rice Center (AfricaRice) including as Impact Assessment Economist and as leader of its Policy and Innovation System program ((2000-2014). Before joining AfricaRice in 2000, Aliou was with the International Food Policy Research Institute (IFPRI) in Washington D.C (1994-2000). Aliou graduated in 1994 from Michigan State University (MSU),

with a dual PhD in Agricultural Economics and in Economics. He has Master degrees in Economics (1991) and Agricultural Economics (1990) from MSU and a B.A in Applied Mathematics (1985) from Cheikh Anta Diop University, Dakar, Senegal. Aliou has won numerous awards including AfricaRice Distinguished Service Award for Outstanding Service and Contribution to the Africa Rice Center (2014) and an Honorable Mention for the American Agricultural Economics Association Outstanding Dissertation Award (1995). Aliou also served as associate editor for the journals Food Security (2009 – 2015) and The African Journal of Agricultural and Resource Economics (2005 – 2012). He was also a member of the Core Research Support Team of the Sub-Saharan Africa Challenge Program (2008 to 2012) and a member of the Scientific Committee of the National Fund for Agricultural Research and Innovation for Development (FONRID) of Burkina Faso (2012 to 2018).

Dr Mweshi Mukanga

Dr. Mweshi Mukanga is the currently, Assistant Director - Technical Services, Zambia Agriculture Research Institute. With over 25 + years of working as a research scientist in various research activities in Zambia and Southern Africa as the lead, Co-Principal Investigator. Currently working on Sustainable countrywide Fall armyworm control. Graduate of the University of Zambia, BSc (1990-1994) and M.Sc. - Agronomy (1998-2001)., and University of KwaZulu-Natal, PhD -Plant Breeding (2004-2009). Author and reviewer of several scientific papers and reports. Former board member (2013-2019) of the National Science and Technology Council, Zambian Government. For the last 7 seven years as being member of the Natural and applied science ethics committee of the University of Zambia since 2015.

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Dr. Ade Freeman

Ade Freeman, Regional Programme Leader, FAO Regional Office for Africa
Ade provides management and leadership for strategic planning, formulation, execution, monitoring and reporting of FAO's program of work in Africa. He also supports the FAO Assistant Director General in formulating and implementing the Organization's work in response to FAO's Africa's regional priorities. Prior to joining FAO, he held several positions at the World Bank with responsibilities for investment operations, advisory activities, and policy dialogue. He also worked in four Centers within the Consultative Group for International Agricultural Research. He holds a PhD in Applied Economics from University of Minnesota

Professor Danquah Eric

Eric Yirenkyi Danquah is a Professor of Plant Genetics at the Department of Crop Science of the College of Basic and Applied Sciences, University of Ghana. He is a recipient of the University of Ghana Distinguished Award for Meritorious Service, 2013, a member of the IAEA's Standing Advisory Group on Nuclear Applications, the 2018 Laureate, Global Confederation of Higher Education Associations for Agriculture and Life Sciences (GCHERA) World Agriculture Prize and the President of the African Plant Breeders Association. He is an Adjunct Professor at the University of Western Australia and a Visiting Scientist at the College of Agriculture and Life Sciences, Cornell University. He was a Visiting Scientist at the BBSRC-Long Ashton Research Institute, UK from 2000 to 2001. Currently, he serves as the Director of the West Africa Centre for Crop Improvement, established in the University in 2007 because of his shared vision and leadership to train a new generation of plant breeders to develop improved varieties of the staple crops of West and Central Africa. He just won the Africa Fodd price at the just concluded Africa Green Revolution Forum (AGRF).

Dr. Ayodele Olusola

Dr. Ayodele Olushola is the Chief Economist and Head of the Strategy and Analysis Team for UNDP's Regional Bureau for Africa. Before his appointment as Chief Economist for UNDP Africa, Odusola served as the Millennium Development Goals (MDGs) Adviser for Sub-Saharan Africa, after his tenure as Economic Adviser in UNDP South Africa, where he played a key role in developing partnerships on the MDGs and in publishing the National and Provincial MDG and Human Development Reports. Before his time in South Africa, he was a Senior Economist in UNDP Nigeria, supporting the preparation of fiscal responsibility legislation; national and local economic empowerment and development strategies; local, regional an,d national MDGs; human development reports; and national development plans and visions. Odusola worked with the Presidency of Nigeria prior to joining the United Nations, where he served as Head of the Research and Macroeconomic Training Programme under Nigeria's National Centre for Economic Management and Administration. In December 2021, he published "Africa's Agricultural Renaissance

Dr Shadrack Moephuli

Dr. Moephuli was the immediate past president and chief executive officer of the Agricultural Research Council (ARC), South Africa, a position he held since 2006. He is a member of the Genetic Resource Policy Committee of the Consultative Group of International Agricultural Research (CGIAR), which is funded by the World Bank and member states. In the last 4 years, he chaired the National Agricultural Research Forum, a multi-stakeholder consultative initiative. Prior to joining the ARC, he served as acting deputy Director – General responsible for the production and natural resource management in the Department of Agriculture, South Africa. Since 2003 he served as the Chief Director for agricultural production in the same department. His responsibilities included developing and implementing policies and strategies for agricultural production, including agricultural research and development, as well as serving as a technical advisor to the Ministry of Agriculture. During the intervening period, he also served as the country's representative on various agricultural matters at the Convention for Biological

Diversity (CBD), Cartagena Protocol for Biosafety (CPB), Food and Agriculture Organization (FAO), International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA), Organization for Economic Cooperation and Development (OECD). Prior to joining the government, Dr. Moephuli was a biochemistry lecturer at the University of the, Johannesburg, South Africa. To his credit are a number of research publications, including invited Witwatersrand speaking events. He obtained his doctoral degree from the University of Connecticut, USA.

Professor Offie Samuel Kwame

Offei Samuel Kwame is a Professor of Biotechnology at the University of Ghana. He holds a BSc degree in Agriculture from the University of Ghana, a MPhil in Plant Virology and a PhD in Molecular Virology from the Imperial College of Science, Technology and Medicine, University of London. His research areas is focused on analysis of plant responses to biotic and abiotic stresses, the development of molecular diagnostic probes for plant microbes, and integration of biological and social science in the implementation of research. He has demonstrated a sustained high level of professional excellence and contribution to knowledge in his field of expertise through innovative research. Prof. Offei has held many leadership and administrative positions including its appointment as the Pro Chancellor. He has consulted extensively for a number of international organizations including the Food and Agriculture Organization (FAO), International Institute of Tropical Agriculture (IITA), United States Aid for International Development (USAID), Department for International Development (DFID), the United Nations University, Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA), and the West and Central African Council for Agricultural Research and Development.

Dr. Matabe Tapela

Dr Mataba Tapela – Executive Director for Natural Resources and Materials at the Botswana Institute for Technology Research and Innovation (BITRI). Graduated from Iowa State University, USA with a PhD in Agricultural Engineering (Power and Machinery. My career is driven by opportunity for professional growth and of propelling institutions to high performance levels. I spent 12 years as part of the Botswana University of Agriculture and Natural Resources (BUAN) Executive Management team starting as Deputy Dean of the Faculty of Agriculture and eventually becoming the acting Principal and Acting Vice Chancellor over a period of three years. I successfully lead the transformation of the institution from a college to a university,

resulting in a refocused and re-energized organization in just 4 years. My research philosophy is to conduct research that focus on Sustainable Agricultural Development, Beneficiation of Natural Resources, and Development of Decision Support Systems and Technologies for the benefit of humanity and the environment.

Side Event 4

Day 2: 15th September 2020 / 8:30 – 12:00 GMT @ Volta Hall

Register to join the meeting online with this link:
https://faraafrica.zoom.us/meeting/register/tZIpceqspjorHdcGzlJ69bbKltAAKk-G7jWg

Side Event Overview

Climate-smart agriculture (CSA) has emerged as a useful approach to enhance food/nutrition security, adaptation and resilience, and reducing agricultural greenhouse gas emissions. As such, many African countries have embraced CSA as a guiding framework in their policies for adaptation and mitigation action for the agricultural sector. At the same time, leading agricultural research institutions have been advancing several CSA innovations and policy ideas that could lead to the change that is needed. However, the current pace of change is insufficient and there are increasing calls to accelerate CSA actions beyond current levels for better outcomes on the ground. Missing components of this is better connections for the emerging scaling-up opportunities, and steps needed to translate CSA innovations and policy ideas into practice. Therefore, this side event, titled ***"Gaining ground: strengthening collaboration to advance climate-smart agriculture"*** will showcase science-based practices that illustrate pathways to climate-smart, low-emission agricultural development. The event will also offer an open platform to discuss how to connect the various scaling-up opportunities and different actors engaged in CSA to help advance long-term CSA change.

Objectives

1. Share examples of science-based practices that illustrate pathways to climate-smart, low-emission agricultural development
2. Showcase some of the ongoing work of the GRA and its partners that is focused on:

- Generating GHG emissions information on the continent in order to inform the design of efficient agricultural production systems; and
- Building capacity of African scientists on GHG emission estimations

3. Raise awareness of opportunities for research collaboration on agricultural GHG emissions research

Approach

The event will include a series of presentations and panel discussions by experts and students. The discussions shall be interactively moderated to enable expert exchange and ensure they are relevant and appropriate for the target audience. The event will be in hybrid mode, allowing physical participation and streaming transmission with global online participation.

Main organizer: Global Research Alliance on Agricultural Greenhouse Gases (GRA)

The Global Research Alliance on Agricultural Greenhouse Gases (GRA) is a network of governments who are interested in agricultural greenhouse gas emissions and their effect on climate change and food security. It aims to develop networks of researchers who work in this area, to collaborate and share information and technologies out to the farmers. The GRA was launched in December 2009 and now has 65 member countries from all regions of the world.

The GRA is focused on agricultural research, development and extension of technologies and practices that will help deliver ways to grow more food (and more climate-resilient food systems) without growing greenhouse gas emissions. The Alliance promotes an active exchange of data, people, and research to help improve the ways that agricultural GHG research is conducted and to enhance participating countries' scientific capability.

Contact

Dr. Ackim Mwape [Ackim.Mwape@nzagrc.org.nz] and Dr. Sega Ndao [Sega.Ndao@nzagrc.org.nz]

Speakers

Dr. Claudia Arndt

Dr Claudia Arndt joined the Sustainable Livestock Systems Program as Senior Scientist and Co-leader of the Mazingira Centre in March 2021. In May 2022, she became the Team Leader of the Mazingira Centre. Previously, she has been working as Associate Scientist on sustainable livestock systems at the National Agrarian University La Molina in Peru. Prior to that she worked at the Tropical Agricultural Research and Higher Education Center (Spanish acronym CATIE) in Costa Rica. She was the on-the-ground coordinator of an international project called "Sustainable futures for the Costa Rica dairy sector: Optimizing environmental and economic outcomes" (SusCoRiDa) led by Bangor University in collaboration with Rothamsted Research. Before that she worked at the Environmental Defense Fund, a non-profit environmental advocacy group in the US. Her research focuses on optimizing

nutrient utilization efficiency to reduce the use of natural resources and environmental impact from livestock systems.

She holds a PhD in Dairy Science from the University of Wisconsin - Madison (USA) and a MSc in Livestock Sciences as well as a BSc in Agricultural Sciences and Environmental Management from the Justus Liebig University of Giessen (Germany).

Dr. Ackim Mwape

Dr Ackim Mwape is an Environmental Scientist with over 20 years of experience, working on agro-environmental issues spanning food production, biodiversity, and climate change. He currently serves as Africa Program Coordinator at the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) and supports New Zealand's engagement with the Global Research Alliance on Agricultural Greenhouse Gases (GRA). He is responsible for supporting research and capacity development activities and liaising with national government representatives, regional institutions and GRA Partners in Africa. Prior to joining NZAGRC, he served as Natural Resource Management Officer in the Ministry of Lands, Natural Resources and Environmental Protection in his native Zambia, worked in a technical role in the Ministry of Agriculture and Livestock, and lectured at the Zambia College of Agriculture.

Dr Mwape has consistently advocated for enhanced collaboration and information sharing, strong science-policy linkages, and ambitious action for low emissions development strategies to effect change in Africa. He holds a PhD in Natural Resource Management and a MSc in Environmental Management (with distinction) from Massey University (New Zealand) and has achieved other academic successes in Zambia, Germany, and China.

Dr Kofi Konadu Boateng

Kofi Konadu Boateng holds a PhD in Agro-environmental Engineering from the Kwame Nkrumah University of Science and Technology, Kumasi-Ghana. His doctoral work focused on the quantification of GHG emissions from inland valley smallholder rice cultivation systems in southern Ghana. Dr Boateng is a GRA CLIFF-GRADS alumnus from the second cohort where he collaborated with the USDA-ARS Columbia Basin Soil Conservation Research Centre in Pendleton, Oregon on various emissions mitigation research on different management systems. Currently, he is transitioning from the CSIR-SRI of Ghana to the Global Methane Hub (GMH) as Program Associate for Agriculture. At the GMH, he hopes to utilize his skills to develop new partnerships and strengthen existing ones while leveraging on them to build consensus on unified and innovative approaches to scaling Climate Smart Agricultural practices across the world to especially reduce the sectors methane footprint. Dr Boateng credits a significant part of his training and career progression to the networks he has built in science over the years especially the GRA networks. He is of

the strongest conviction that CSA innovations are as good as the scientific networks from which they are honed and it's only through collaborative efforts that scaling can be possible to achieve impact.

Side Event 6

Soil Initiative for Africa (SIA) Stakeholders Consultation

Day 2: 15th September 2020 / 8:30 – 17:00 @ Britannia Hall

Register with this link to join this meeting online:
https://faraafrica.zoom.us/meeting/register/tZcsc-mprTwrH91NQgt72BZyIku3wz5Nb1bE

Background

The Soil Initiative for Africa (SIA) is an initiative of the Africa Union Commission (AUC) to respond to the need for sustainable use of African soil. Anecdotal data on arable soil in the world suggest that 60% of the world's available arable land is in Africa. This suggests huge potential for increased production and economic benefit for Africa. This production asset is threatened by rapid soil and land degradation; recent statistics indicated that African soil is eroded at the rate of 5.8 tons/ha/year, leading to land loss, and about 9% - 47% reduction in soil nutrients and potential income loss of about 68 billion US dollars. Soil fertility loss is on the increase largely due to unproductive farming practices without recourse for nutrient replacement either from mineral fertilizer or organic nutrient sources. Continuous cropping with the current average rate of fertilizer use of 8kg/ha, while the nutrient uptake per ha of maize is 120kg N, is tantamount to soil nutrient mining - an unsustainable practice.

The SIA aims to restore the health of African soils and integrate an efficient soil management system to ensure sustainable soil/land use for improved agrarian livelihood and economic prosperity. This broad objective requires a holistic approach that gives cognizance to the soil as a system with many sub-systems that must function in a coherent manner to achieve a balance. The notion of soil health is a composite label that is made popular in recent literature; it refers to "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. It covers the issues of soil to function within the ecosystem and land-use boundaries, to sustain plant and animals". Taking a soil health approach suggests a consideration of physical, chemical, and biological properties of the soil to achieve a balance between soil ecosystem function and provision of food and fiber.

The SIA is currently being developed by a broad stakeholder group in African agriculture under the leadership of FARA. The initial task team comprised representatives of the Sub-regional Organizations (SROs) (CORAF, CCADERSA, ASARECA) and AFAAS. Further key stakeholders include the African Soil Partnership (AfSP) (African chapter of the FAO Global Soil Partnership [GSP]) and enthusiasts in soil development that are also drawn from other African organizations. The current technical and

programmatic content of the SIA has been developed by this team, with key capacity support from Catholic Relief Services (CRS), the European Commission through CAADP-XP4 program, USAID, and Bill and Melinda Gates Foundation (BMGF). Technical and strategic work to underpin the development of an overall strategy and action plan is ongoing in the following areas: (1) Soil information systems, (2) Landscape/plot level soil (and water) management; (3) Human and institutional capital for soil science; (4) Scaling of the African system for soil management (5) Economics of soil degradation and soil management; (6) Policy and regulatory frameworks; (7) Fertilizer manufacture and use for sustainable soil management; (8) Dashboard, metrics, and results framework; and (9) Organizational architecture and management framework for the African system for soil management.

Having organized a successful first layer of technical consultation between 20th to 22nd June 2022 in Nairobi supported by BMGF to shape the initiative, FARA and its partners aim to organize the 2nd layer consultation as a side event of the 2022 Biennial Africa CSA stakeholders conference to review and provide inputs into the initiative, as well to increase understanding and support for the initiative. This concept note explicates the content and process for the 2nd consultation.

A. Purpose and objectives

The central objective of the consultation meeting is to:

1. Seek stakeholders' opinions on the vision, purpose, and content of the SIA – as part of formal consultation process for AU adoption later on (need to be able to demonstrate engagement and consultation)
2. Demonstrate unique value proposition to the SIA for the stakeholders (Framing the intent of the SIA around a systemic approach to scaling sustainable soil management and restoration in Africa – demonstrate the uniqueness and value of what SIA is trying to achieve and how)
3. Actively engage with member states for co-development of the initiative to ensure a shared sense of ownership.
4. Foster discussion on the state of soils and ongoing initiatives at the country level as a contribution to the SIA.
5. Provide input and feedback on the draft framework and foundational area of work of the SIA.
6. Identify opportunities for continued input

A. Expected outputs/outcomes

The following outputs are expected from the workshop (outcomes):

- Shared understanding of the SIA (WHY, WHAT, WHO, HOW - vision, purpose, and content of the SIA) and of its Unique Value Proposition: the system approach to scaling sustainable soil management
- Buy-in from stakeholders in the SIA intent and process: General collective confirmation of member states to support the SIA and to engage in co-development of the initiative
- Initial shared sense of ownership
- Collated initial feedback and buy-in from stakeholders on the SIA's intent, approach, objectives, foundational areas of work, and scaling approach.
- Feedback from members states on their national efforts in terms of soil management

Deliverables:

- Collated initial feedback from stakeholders on the SIA's intent approach, objectives, foundational areas of work, and scaling approach.
- Feedbacks from members states on their national efforts in terms of soil management
- Final Workshop Report to be shared with stakeholders.

- Accra communique on SIA engagement process and the reaction of participants to it and next steps

B. Beneficiaries

All partners in African agriculture including the FARA stakeholders, Africa Union Commission (AUC), CGIAR, AFAAS, SROs, NARS, CSOs, RECs, and Ministries of agriculture in AU member countries etc.

C. Partners

FARA, CRS, USAID, BMGF, AGRA, SROs [CORAF, ASARECA, CCARDESA, NASRO], AFAAS, One-CGIAR, etc.

Field Visit

Blue Sky Products (Ghana) Ltd
Dobro, Nsawam
Eastern Region
Ghana

The field visit is planned for Blue Skies Limited, an agroindustry dedicated to fresh fruit production, processing, and export.
Blue Skies was founded in 1997 with the mission to build together a profitable enterprise where people respect each other, care for the environment, and inspire a legacy for the future.
Blue Skies concentrates on 'Adding Value at Source'. it aims to make the finished product where the fruit is grown. By doing this it return more value to the communities that produce the fruit, and can deliver products that are Fresh from Harvest.

What to Expect from the field visit

1. **Best practice is eco-friendly production and handling of agricultural commodity at industrial level**
2. **Good partnership with farmers and the production community for livelihood enhancement.**
3. **Techniques in health food management from farm to shop.**
4. **Smart youth engagement through school program.**
5. **Agroecology compliant fruit production at scale.**

Field visit process

1. **Registration for field visit on day 1, following announcement in the open plenary.**
2. **Take off from Alisa Hotel at 12 Noon on 15th September.**
3. **Arrival at Blue Skies factory at 12.30 pm.**
4. **Short travel to the Blue sky farm (40 minutes ride).**

Personal Preparation

1. **Smart casual dressing for field visit.**
2. **Footwear that is compatible for the field; high heel shoe may not be suitable.**
3. **Conference organizers will arrange packed launch for field visit participants.**

Blue skies web page : https://global.blueskies.com/

Paper Presentation Tracker

Sub-theme 1: The Role of Digitalization in Advancing CSA in the Smallholders' Systems

Digitalization plays a critical role the advancement of climate-smart agriculture in the smallholders' systems. In Africa, digitalization application in climate-smart agriculture is emerging. Available studies show that d*igital* technology is transforming the agricultural sector through the application of innovative tools and new business models. Enhancing the capacity of smallholder farms to tap into digital climate service technologies opportunities for improved agricultural and food systems is germane for agricultural transformation in Africa. In the near future, the classification of agriculture may not necessarily be defined by volume or scale of production but by *digital* transformation in agricultural practices which may lead to a "*digital* divide" between small and large farms as a result of the characteristics and availability of digital technology.

Significant policy implications of the papers scheduled for presentation in the sub-theme are that inclusive digital application in climate-smart agriculture relies on would advance agricultural transformation from land scale operations to service scale operations and ensure the sustainable transition from inclusive technological progress to food system-wide innovation.

Overall, the collection of papers in this sub-thematic area represents broad areas of current, emerging, and future digitalization in the smallholders' systems. The papers focus on the following areas for advancing digitalization in smallholders' agriculture systems:

i. Information and communication technologies, including the internet of things and metadata
ii. Digital climate service use, up-scaling, and sustainability
iii. Deployment of mobile telecommunications and social media platforms
iv. Spatial and temporal mapping of agricultural systems
v. Agro-technologies for climate change adaptation and weather-based index

Facilitator: Dr. Aduramigba Vincent // Venue: Britannia

Abstract No.	Time	NAME	Paper Title	Mode
1	**11:30-11:35**	**BASHIR M. AHMED**	Digital technologies for increased and sustainable agricultural production in Sudan	Physical
2	**11:37-11:42**	**ALIYU YAMUSA**	Adoption of Crop-weather Calendar as a tool for Climate Smart Agricultural Practices in Semi-Arid Nigeria: A Case Study Samaru, Northern Nigeria	Physical
3	**11:44-11:49**	**ANGELINE MUJEYI**	Digitalization options for scaling Climate Smart Agriculture in smallholder farming systems: Lessons and opportunities	Physical
4	**11:51-11:56**	**BENJAMIN FIAFOR**	The Role of Interactive Radio and Mobile platform in Climate Smart Agricultural Communication: The case of CLIMA project	Physical

5	**11:58-12:03**	**JOSEPH MANZVERA**	Digital Climate Service Use and Uptake of Climate-Smart Agriculture Practices Among Smallholder Farmers in Africa: A Review	Physical
6	**12:05-12:10**	**MOSES ODEKE**	Role of digital moisture and nutrient monitoring tools in enhancing resilience against climate change effects in semi-arid rural communities practicing smallholder irrigation in Malawi and Tanzania	Physical
7	**12:12-12:17**	**RALPH ADEWOYE**	Big data and artificial intelligence deployment for climate-smart agricultural modelling of the Lake Chad Basin.	Physical
8	**12:19-12:24**	**AWONIYI SAMUEL OLUGBEMIGA**	Digitalization of Agriculture: what relevance and challenges in enhancing Climate Smart Agriculture in Nigeria?	Virtual
9	**12:26-12:31**	**DOMINIC UCHI**	Utilization of Rice advice Smartphone Technology in Enhancing Climate Smart Agricultural Practices Among Small-Scale Farmers in Benue State, Nigeria	virtual
10	**12:33-12:38**	**EKUNDAYO AFOLABI**	Implications of Digital Divide in Digitalization of Farming Activities in the NAERLS Adopted Villages	virtual
11	**12:40-12:45**	**JUSTIN AMANI**	Modeling and spatial distribution of Peste des Petits Ruminants in South Kivu, DR Congo	virtual
12	**12:47-12:52**	**MORUF ABIOLA OLAIDE AKINTUNDE**	Assessment of Use of Selected Information Communication Technologies (ICTs) by Extension Workers to disseminate Climate Smart Agriculture (CSA) Information to Farmers in Lesotho	virtual
13	**12:54-12:59**	**OYAKHILOMEN OYINBO**	Digital innovations, agricultural productivity growth and environmental sustainability: A randomized evaluation in Nigeria	virtual

Sub-theme 2: The nexus of CSA and the mechanization of smallholder system in Africa

Climate smart agriculture can benefit immensely from appropriate farm mechanization. Smallholders' agricultural systems in Africa therefore need to respond to the twin challenges of inadequate climate smart agriculture practice and low level of mechanization.

Farm power and mechanization are agricultural production inputs that will be essential to raise the agricultural productivity which is a necessarily condition for agricultural transformation in Africa. Further, there are going concerns for raising smallholder farm sector demand for to stimulate the agricultural value chains (inputs, production, processing, storage, and marketing).

The key areas of engagement of mechanization for climate smart agriculture are appropriateness, sourcing, and sustainability. Appropriate use of mechanization tools for the smallholder sector covers the range of possible power sources human, draft animal, and motorized, including application of renewable energy sources and mobile devices. The sourcing of mechanization may include public, private or a

combination of public and private. Sustainability of mechanization includes technical, financial, social, and environmental factors.
The papers scheduled for presentation in this sub-theme on nexus of CSA and the mechanization of smallholder system in Africa can be classified into the following areas:
i. Tractorization and agricultural systems
ii. Precision agriculture and sustainable land management practices
iii. Mechanization and renewal resources management
iv. Mechanization, risk management, and climate smart business models
v. Climate smart agriculture, indigenous knowledge, innovations and sustainability

Facilitator: Dr. Mkomwa [ACTN] // Venue: Volta Hall

Abstract No.	Time	NAME	Paper Title	Mode
14	**11:30-11:35**	**FRANCK NGOYI TSHITE**	Temporal climate variability in the Luki Biosphere Reserve Mayombe, Democratic Republic of Congo	Physical
15	**11:37-11:42**	**KAREEM LONGWE**	Effects of soil amendments on the incidence of bacterial wilt and tuber of potato in different environments in Malawi	Physical
16	**11:44-11:49**	**RICHARD NJUE**	Technical And Economic Evaluation of a Mechanical Cassava Harvester in Busia County of Kenya	Physical
17	**11:51-11:56**	**VINCENT ADURAMIGBA-MODUPE**	Scaling Precision Agriculture in West Africa Smallholder Irrigation and Water Management Systems	Physical
18	**11:58-12:03**	**RAHETLAH VOLATSARA BAHOLY**	Effects Of Mulching/Green Manuring and Intercropping with Crotalaria Grahamiana on Growth and Yield Parameters Of Potato In The Vakinankaratra Region, Madagascar	Physical
19	**12:40-12:45**	**PORTIA ADADE WILLIAMS**	Advancing local vulnerability assessment framing to enhance climate adaptation planning and actions: Insights from smallholder production system of Ghana	physical
20	**12:05-12:10**	**ABEGUNDE VICTOR**	Rethinking Climate Change: Opportunity to Mechanize Smallholder System in Africa Through Climate-Smart Agriculture	Virtual
21	**12:12-12:17**	**ADEGBITE SIROJDEEN**	Development of a Pilot Scale Energy Efficient Flash Dryer for Cassava Starch/Flour	virtual
22	**12:19-12:24**	**PONTIOUS MUBIRU MUKASA**	Drivers of holistic Agricultural risk management training transfer.	virtual
23	**12:26-12:31**	**DORAH MWENYE**	Renewable Energy and Mechanization in The Smallholder Sector: Experiences from Wedza E-Mobility Pilot Study	Virtual

24	**12:33-12:38**	**PETER KATHULI**	Effect of nitrogen fertilizer on water use efficiency of 11 selected sorghum genotypes grown in semi-arid regions in Kenya.	Virtual

Sub-theme 3: Bottom-up and system-wide capacity development approaches to enhance CSA practices

Climate-smart agriculture has the potential bottom-up and system-wide capacity to deliver "triple wins" by contributing to sustainably increasing productivity and food security; enhancing farmers' adaptive capacity, and reducing greenhouse gas emissions. Despite the potential of climate-smart agriculture in promoting bottom-up and system-wide capacity development, there is the earth of workable approaches for enhancing climate-smart agriculture practices.

The decision on whether or not to adopt a particular climate-smart agriculture practice is influenced by many idiosyncratic and covariate factors. These factors include the farmer's awareness of the CSA practice, the amount and quality of information at the farmer's disposal, the financial (dis)incentives to adopt, the farmer's time preference, and the level of risk averseness.

Overall, the desired scaling-up of climate-smart agriculture includes identifying specific practices, knowledge, and technologies within conducive enabling environments (social and economic) and with institutional and policy arrangements. The scaling-up process for CSA may occur horizontally by replicating promising/proven practices and technologies in new geographic areas or target groups or vertically by catalyzing institutional and policy change or diagonally by adaptive management within project implementation to reflect emerging reality.

The papers scheduled for presentation in this sub-theme on bottom-up and system-wide capacity development approaches to enhance climate-smart agriculture practices are classified into the following areas:

i. Biofortification, yields, and food systems
ii. Climate-smart agriculture practices by smallholders' systems
iii. Agricultural values chains and financial services
iv. multi-stakeholder platforms for promoting climate-smart agriculture
v. Empowerment, entrepreneurship, and emerging markets

Facilitator: Prof. Babalola // Venue: Afram Hall

Abstract No.	Time	NAME	Paper Title	Mode
25	**11:30-11:35**	**ANTHONY AGBONGIARHUOYI**	Evaluating Climate-Smart Adaptation Practices on Cocoa Insect Pests and Diseases Incidences Among Farmers in Cross River State, Nigeria	Physical
26	**11:37-11:42**	**EMILY NGUYEN-PERPERIDIS**	Advancing a Gender-Responsive Delivery Model for Mitigating Climate Impacts in Ghana's Cocoa Landscape	Physical

27	**11:44-11:49**	**JOSHUA SIKHU OKONYA**	The role of CSA Multistakeholder platforms in advancing the CSA agenda in Eastern and Southern Africa	Physical
28	**11:51-11:56**	**LYDIAH C MIRITI**	Factors Influencing Access to Rural Finance Market by Different Actors in Climate-Smart Agriculture in Kenya.	Physical
29	**11:58-12:03**	**MICHAEL OMODARA**	Deployment of monitoring devices to address quality degradation in bagged grain in storage	Physical
30	**12:05-12:10**	**MOSES ODEKE**	Scaling CSA initiatives in Eastern and Central Africa: Successes and lessons learned	Physical
31	**12:12-12:17**	**MTISUNGE MNGOLI**	A Comparative Analysis of The Soyabean Value Chain in Malawi and Zambia	Physical
32	**12:19-12:24**	**MUNOKO M. KAREN**	Capacity Assessment within Multi-Stakeholder Partnerships Towards Resilient Food Systems: Imperatives for Climate Smart Agriculture	Physical
33	**12:26-12:31**	**NELSON C.K. SELLO**	Climate-Smart Agriculture Practices: Interrogating the CSA Stakeholder engagement in Botswana	Physical
34	**12:33-12:38**	**OLABISI DAMILOLA OMODARA**	Factors influencing choice of climate change adaption practices among cassava farmers and its effect on cassava productivity in Osun State, Nigeria	Physical
35	**12:40-12:45**	**OLADELE IDOWU**	Mainstreaming Climate-Smart Agriculture into Agricultural Extension Curricula in West Africa: The Roles of Sasakawa Africa Association	Physical
36	**12:47-12:52**	**OLGA MAPANJE**	Financing sustainable agriculture in Sub-Saharan Africa: the role of FinTech	Physical
37	**12:54-12:59**	**OSUMBA, JOAB**	Towards a replicable innovative community-based ethnographic tool for adaptive local weather forecasting using indigenous or traditional indicators to strengthen local agro-weather resilience at scale	Physical
38	**13:01-13:06**	**TEMITOPE OLUWASEUN OJO**	Financing adoption of climate smart agriculture among smallholder rice farmers in Osun State, Nigeria	Physical
39	**13:08-13:13**	**AKYALA ABRAHAM**	Using Gender-Land Rights to Increase Climate Resilience Among Smallholder Farmers in the least Developed Countries (LCDS)	virtual
40	**13:15-13:20**	**ALIKU OREVAOGHENE**	Yield Response of Sorghum to Micronutrient-Fortified Fertilizer in the Savanna Agroecological Zone of Nigeria	virtual
41	**13:22-13:27**	**DIRIBA TULU**	Adaptation Capacity of Indigenous Sheep Breed to Saline Lake Drinking Water in Dry Area of Ethiopia Under Climate Change Scenarios	virtual

13:30 – 14:30		Lunch Break		
42	**14:30-14:35**	**ERMIAS KEBREAB**	Empowering African Scientists in development of livestock nutrient requirements and greenhouse gas emissions tracking system	virtual
43	**14:36-14:41**	**SUNITA FACKNATH**	Climate-Smart Agriculture as an innovative socioeconomic sector for the national economy	virtual
44	**14:43-14:48**	**ZAKARIA FOUAD FAWZY**	Applied of Climate Smart Agriculture Approach for Agricultural Development to African Food Security and Sustainability of Agriculture as well as Adaptation Future Climate Changes	virtual
45	**14:49-14:54**	**PHILIPPA OJIMELUKWE**	Climate adaptation strategy for cassava processing and storage by a Niger Delta Community in Nigeria	Virtual

Sub-theme 4: Strengthening the support of extension and advisory services to ensure CSA compliance among smallholder farmers in Africa

There is a going concern to strengthen agricultural extension advisory services due to its multiplier effects on climate-smart agriculture compliance among smallholder farmers in Africa. Agricultural extension advisory services usually refer to any organization in the public or private sectors that provide information and advice to farmers and other rural actors. Agricultural extension services are rendered to strengthen farmers' capacity for improved agricultural outcomes. Further, successful climate-smart agriculture implementation involves effective and efficient extension providers and systems, which will often require major organization and institutional reforms in order to strengthen capacity at organization and individual levels.

In most African countries and regions, limited spending on agriculture impedes the availability of agricultural extension services programs. Therefore, inadequate agricultural extension services place enormous demands on the few extension workers who have a crucial role to play in promoting climate-smart agriculture. Little wonder, the papers in this section explore, among other things, reflect the extent to which agricultural extension services are used to improve the implementation of climate-smart agriculture practices in the following areas:
i. Public and private extension advisory services
ii. Information management systems and metadata
iii. Professional networks, social capital, and resilience
iv. Gender, regenerative agriculture, and generational agriculture
v. Research-output-outcome-impact nexus

Facilitator: Max Olupot [AFAAS] // Venue: Abban Lounge

Abstract No.	Time	NAME	Paper Title	Mode
46	**11:30-11:35**	**ANGELINE MUJEYI**	Scaling up Climate-Smart Agriculture adoption through action research: Lessons from the Agriculture Centre of Excellence Methodology	Physical
47	**11:37-11:42**	**BLAISE AMONY**	Strategies for extension and advisory services to promote Climate Smart Agriculture among smallholder farmers in Eastern and Central Africa	Physical
48	**11:44-11:49**	**BRIAN OGENRWOTH**	Impact Of Climate Change on Food Security in Uganda: A Panel Regression Analysis	Physical
49	**11:51-11:56**	**JOSHUA SIKHU OKONYA**	Practical CSA Strategies That Farmers in Eastern & Southern Africa Can Use to Cope or Adapt to Changes in Seasonal Rainfall	Physical
50	**11:58-12:03**	**OLASHINDE OLADEJI**	Factors influencing the Adoption Intensity of Climate-Smart Maize Varieties among Rural Farming Households in Southern Guinea Savannah of Nigeria	Physical
51	**12:05-12:10**	**VIMBAYI G.P. CHIMONYO**	Elite drought-tolerant varieties can reduce maize yield penalties in intercrop systems	Physical
52	**12:12-12:17**	**VIMBAYI G.P. CHIMONYO**	Assessing cereal nitrogen use efficiency in Eastern and Southern Africa	Physical
53	**12:19-12:24**	**AMINA AHMED**	Implications of climate data application for the enhancement of extension services delivery to smallholders' farmers in Tanzania	virtual
54	**12:26-12:31**	**ADESOLA OLALEYE**	Comparative Analysis of Factors Affecting Fertilizer Supply and Use by Smallholder Farmers in Ethiopia, Nigeria, and Uganda	virtual
55	**12:33-12:38**	**AFFONFERE MARIUS**	Assessing Indigenous Knowledge, Uses and Nutritional Value of Adansonia digitata, Cochlospermum spp. and Moringa oleifera in the Era of Climate Change	virtual
56	**12:40-12:45**	**DIGNA MLENGULE**	Experience Of Smallholder Farmers on Climate Smart Agriculture on Soil Fertility and Moisture Conservation in Ludewa District, Tanzania	virtual
57	**12:47-12:52**	**FRANK WESONGA**	Fencing Lands to Enhanced Climate Change Resilience, Promoting Biodiversity Regeneration, and Improved Livelihoods of Climate Change in Makueni County	virtual
58	**12:54-12:59**	**GILBERT K. KORIR**	Can climate smart forages replace concentrates in dairy milk production?	virtual
59	**13:01-13:06**	**CLARA IFEANYI-OBI**	How Are Rural Women Crop Farmers in Southern Nigeria Coping with Climate Change?	virtual

60	**13:08-13:13**	**KOLAWOLE OLAJIDE ALAKA**	Assessing Household Socio-Economic Factors Affecting Smallholder Farmer's Investments in Climate Smart Agriculture Practices in Eastern Cape Province, South Africa.	virtual
61	**13:15-13:20**	**MARTIN PAUL TABE-OJONG**	Public-private extension and advisory systems and climate-smart agriculture: Evidence from West Africa	virtual
62	**13:22-13:27**	**MARTIN PAUL TABE- OJONG**	Resilience and yields under climate-smart agriculture: Panel Evidence from Ethiopia	virtual
63	**13:29-13:34**	**MESERET DAWIT**	Assessing the impact of climate change on the farming system	virtual
64	**13:36-13:41**	**MKUHLANI SIYABUSA**	Optimum Planting Dates and Season Length for Climate Change Adaptation in Maize for Kano, Nigeria	virtual

Sub-theme 5: Advances in CSA technology generation and use in the crop, livestock, fisheries, and aquaculture

Advances in climate-smart agriculture (crops, livestock, forestry, fisheries) are boosting efforts to reduce food insecurity through the building of resilience of rural communities to shocks and strengthening of their adaptive capacity to cope with increased variability and slow onset weather changes.
Climate-smart agriculture practices are also positioned to transform the agriculture sector through appropriate technological generation and deployment by ensuring economic growth and poverty reduction. This transformation must be accomplished without hindering the natural resource base of production. In this regard, more productive and resilient agriculture requires a paradigm shift in the way land, water, soil nutrients, and genetic resources are managed efficiently and sustainably. Again, making this shift requires considerable changes in technological progress and innovation.
Therefore, the papers in this section explore the following areas:
i. Technical and economic efficiencies in climate-smart agricultural practices
ii. Climate resistant and high-yielding varieties
iii. Agricultural resource mapping and climate-smart agriculture technological modeling frameworks
iv. Modeling Climate Change Adaptation Practices in agricultural and food systems
v. Agro-technologies for climate-smart agricultural value chains

Facilitator: Dr Alcade Segnon [AICCRA] // Venue: Kaizer Hall

Abstract No.	Time	NAME	Paper Title	Mode
65	**11:30-11:35**	**ABA-TOUMNOU LUCIE**	**Using Radiation-Induced Novel Genetic Diversity to develop pest-resistant Maize in Central African Republic**	**physical**

66	11:37-11:42	ADEOLA LYDIA ADEJUMO	Dissemination and adoption of Sustainable Soil Management technologies among farmers; advances in Climate Smart Agricultural practices in Nigeria	Physical
67	11:44-11:49	CHRISTINE A. A. OWADE	Structural and functional composition of macroinvertebrate communities as indicators of livestock disturbance of streams and rivers in Agropastoral rangelands	Physical
68	11:51-11:56	CYAMWESHI RUSANGANWA ATHANASE	Unraveling The Effect of Secondary and Micronutrients on Potato Yields and Profitability Under Variable Climatic Conditions in Rwanda	virtual
69	11:58-12:03	DESALEGN YAYEH AYAL	Smallholder Farmer's Adoption of Climate-Smart Livestock Production: Practices, Status, and Determinants in Hidebu Abote Woreda, Central Ethiopia	Physical
70	12:05-12:10	GADDAFI SANI	Physiological And Behavioural Adjustment of Livestock to Climate Change: Coping Mechanisms	Physical
71	12:12-12:17	EVANS SICHARANI	Spatio-Temporal Dynamics of Greenhouse Gases (GHGs) Emissions from Watering Points along Livestock Production Systems in Taita-Taveta, County, Kenya	Virtual
72	12:19-12:24	GADDAFI SANI	Towards Exploring Development Intervention of Three Key Pillars of Climate-Smart (CSA) Agriculture as Options for Livestock Farmers	Physical
73	12:26-12:31	HAMDINO M. I. AHMED	Heat Stress Management in Bean (Phaseolus vulgaris) through Nitric Oxide and Trehalose Interventions	Physical
74	12:33-12:38	ISAAC AMEGBOR	Yield performance and estimates of genetic analysis of drought-tolerant provitamin A maize under drought stress and rainfed conditions	Physical
75	12:40-12:45	KIMWEMWE KITENGE PAUL	Genetic variation in germplasm for a rice (Oryza sativa L.) improvement program for the Eastern Democratic Republic of Congo based on yield and yield components	Virtual
76	12:47-12:52	OLAWALE E. OLAYIDE	Assessing Climate Smart Agriculture Practices on Livelihoods, Farm Income, Food Security and Food Safety in Ghana	Physical
77	12:54-12:59	OLAWALE SELESI	Influence of Enriched Rice-Husk Biochar on Soil Quality, Growth and Yield of Cucumber (Cucumis sativus) on an Utilsol in Epe, South-West Nigeria.	Physical
78	13:01-13:06	OSINNOWO ADEGBOYEGA	Optimizing Climate-Smart Aquaculture for Sustainable Catfish Production in Nigeria	Physical

79	**13:08-13:13**	**PETER CHUKWU EZE**	**Soil Physical and Chemical Properties as Affected by Land Configuration and Cow Dung Manure at Minna, Niger State, Nigeria**	**Physical**
80	**13:15-13:20**	**PETER CHUKWU EZE**	**Soil Properties as Affected by Crop Residue Management Practice at Minna, Niger State, Nigeria**	**Physical**
81	**13:22-13:27**	**VINCENT ADURAMIGBA-MODUPE**	**Climate-Smart Agriculture and Soil Fertility Mapping: Nigeria Soil Information Service (NiSIS) Pilot Project**	**Physical**
13:30 – 14:30			**Lunch Break**	
82	**14:29-14:34**	**ADEWALE ADETAYO**	Adaptation Strategy to Climate Change and Variability for Sorghum (Sorghum Bicolor L. Moench) Production in Forest-Savannah Agro-Ecological Zone of Nigeria	virtual
83	**14:36-14:41**	**ANYAIT RITAH**	Characterization of chemical composition and availability of pastures in pastoral and agro-pastoral production systems of Uganda: tackling barriers to enteric methane inventorying using the Tier-2 approach	virtual
84	**14:43-14:48**	**BRENDA KORIR**	Crop Residue Utilization Practices in Peri-Urban Dairy Cattle Systems in Kisumu County, Kenya	virtual
85	**14:50-14:55**	**CONFIDENCE KALU**	Factors Influencing the Adoption of Climate Smart Agricultural Technologies Among Root Crop Farming Households in Nigeria	virtual
86	**14:57-15:02**	**ESHETU ZEWDU**	Modeling Climate Change Adaptation Practices for Sorghum (Sorghum bicolor (L.) and Wheat (Triticum aestivum L.) Production in Ethiopia	Physical
87	**15:04-15:09**	**EUNICE BAMISHAIYE**	Agrobacterium- Mediated Transformation of Tomato CV ARKA VIKAS with CRY2AX1Gene for Insect Resistance	virtual
88	**15:11-15:16**	**FUNMILOLA OLUWAFEMI**	Climate Change Mitigation: A Case Study of Soil Biochar Influence on Morpho-physiology of Crop Species and Genotypes	virtual
89	**15:18-15:23**	**GODFREY BARASA OWUOR**	Drivers of Greenhouse Gas Fluxes from Zones of Afrotropical Rivers as Influenced by Different Livestock Production Systems	virtual
90	**14:30-14:35**	**HAROUNA OUEDRAOGO**	Soil properties and tomato productivity improvement by use of polyter and turbo-bio in Sudanese zone of Burkina Faso	virtual
91	**14:37-14:42**	**KAREEM LONGWE**	Effects Of Intercropping Sweet potato (IPOMEA. BATATAS) With Pigeon pea on Productivity and Major Pests of Sweet potato In Malawi	virtual

92	**14:43-14:48**	**KEDIR KEBERO**	Bio-fortification of cereal-based Sorghum using Orange Fleshed Sweet Potato for alleviating of Vitamin A Deficiency	virtual
93	**14:49-14:54**	**KIROS WELAY**	Growth performance and carcass characteristics of Sasso T44 and Koekoek chicks exposed to temperature variation with supplementary Coriander seed powder	virtual
94	**14:56-15:01**	**KUSIIMA NASURU**	Comparison of acid insoluble ash and acid detergent lignin as makers for estimating digestibility by open grazing goats: tackling barriers to enteric methane inventorying using the Tier-2 methodology	virtual
95	**15:02-15:07**	**MOSHOOD POPOOLA**	Physiological response of Hyla weaner rabbits fed Wheat Offal-Carried Watermelon Rind	virtual
96	**15:08-15:13**	**MUHAMMAD LAWAL**	Mitigation of Enteric Methane Emission in Africa as A Climate-Smart Livestock Strategy	virtual
97	**15:15-15:20**	**SCOLASTICA WAMBUA**	Technical Efficiency of Improved Indigenous Chicken Producers in Kenya: A Stochastic Frontier Approach	virtual
98	**15:22-15:27**	**TSEGAY TEKLEBRHAN**	Dietary sulfur mitigated enteric methane emission and modulated gut microbiome in goats	virtual

Sub-theme 6: The contribution of agroecology to climate smart agriculture

Agroecology is widely accepted as an approach to land management that applies ecological and social concepts to the design and management of food and agricultural systems. The basic principle guiding agroecology is seeking to optimize the interactions between plants, animals, humans, and the environment while considering crucial social aspects for a sustainable and just food system.

On the other hand, climate-smart agriculture is an approach to agriculture that addresses interlinked challenges of food security and climate change. In this regard, climate-smart agriculture seeks three core outcomes which are to: sustainably increase agricultural productivity, support equitable increases in farm incomes, food security, and development; adapt and build the resilience of agricultural and food security systems to climate change at multiple levels; and reduce greenhouse gas emissions from agriculture.

The linkage between agroecology and climate-smart agriculture is sustained by the fact that there is value in using multiple frameworks to inform improved and purposeful actions.

Therefore, the paper presentations in this section focus on the following areas:

i. Carbon auditing and soil-health
ii. Nature-based solutions to climate change
iii. Ecological organic agriculture
iv. Biodiversity conservation of neglected and underutilized species
v. Land-landscape-livelihood nexus

Facilitator: Dr. Cliff Dlamini [DeSIRA-Lift] // Venue: Botsio Hall				
Abstract No.	**Time**	**NAME**	**Paper Title**	**Mode**
99	**11:30-11:35**	**ADEBOLA ADEDUGBE**	Smallholder Farmers and The Need for Climate-Smart Agriculture in Nigeria	Physical
100	**11:37-11:42**	**BERNARD VANLAUWE**	Agronomy-driven climate-smart agriculture: Agronomy and climate adaptation and mitigation as conceptualized by the Excellence in Agronomy Initiative of the CGIAR.	Physical
101	**11:44-11:49**	**IREDELE OGUNBAYO**	Climate-Smart Agricultural Practices for the sustainable food system in Nigeria: An Agroecology-specific Analysis	Virtual
102	**11:51-11:56**	**OLUYINKA ADEWOYIN**	Ecological Organic Agriculture: A mitigating alternative for climate change	Physical
103	**11:58-12:03**	**SUWILANJI SINYANGWE**	The contribution of agroecology to CSA	Physical
104	**12:05-12:10**	**VICTOR OLOWE**	Agronomic Evaluation of Soybeans (Glycine Max (L.) Merrill) Under Crop Rotation System in The Forest-Savanna Transitory Location in The Humid Tropics	Physical
105	**12:12-12:17**	**ADEOLA OLOYEDE**	Analysis of Agroforestry Practices Among Small-Scale Farmers in Southern Guinea Savannah Zone of Nigeria	virtual
106	**12:19-12:24**	**ANTHONY IMOUDU OYEOGBE**	Stimulating ecological intensification of cropping systems in Nigeria – Short-term impact of ecological cropping systems on maize productivity, weed management, soil health and nitrogen fertilizer economy	virtual
107	**12:26-12:31**	**FUNMILAYO MARY OLOYEDE**	Biodiversity Conservation of Neglected and Underutilized Nigerian Horticultural Crops	virtual
108	**12:33-12:38**	**NEVER MUJERE**	Examining the strengths, weaknesses, opportunities and treats of agroecology in ensuring food security and environmental sustainability	virtual
109	**12:40-12:45**	**OGUNNAIKE GBEMISOLA**	Mangrove Forest Restoration Nature-Based Solution to Climate Change: An Agro-ecological Contribution to Climate Sensitive Agriculture in Coastal Communities	virtual
110	**12:47-12:52**	**TAOFEEQ YEKINNI**	Assessment of stakeholders' satisfaction for Sustainable ecological agricultural practices that promote climate smart agriculture in Nclimate-smartigeria	virtual

111	**12:54-12:59**	**TEMITAYO ADEYEMO**	Agroecological Differentials in Crop Production: Evidence from Smallholder Rice Producers in Nigeria	virtual
112	**13:02-13:07**	**GENETU FEKADU**	Heterotrophic and autotrophic soil respiration in contrasting agro-ecologies: the case of the Upper Blue Nile basin, Ethiopia.	virtual
113	**13:09-13:14**	**ALINE MWINTOME NAAWA**	Locality and Originality: Enhancing Agroecology as an Effective Climate Smart Agriculture Approach to Reduce Wildfires Vulnerability in the Savannah Ecological Zone of Ghana	virtual

Scientific Papers

Theme 1

Paper 1

Digital Technologies for Increased and Sustainable Agricultural Production in Sudan

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Abstract

Increasing production per unit area or expanding the existing agricultural land are important to meet the food demand of the rapidly growing population. To address the challenge, digital agricultural technologies have been used to increase access to agriculture information such as weather forecasts, provide agricultural extension services and reduce the cost of project implementation as well as shorten the time-of-service delivery. The purpose of this paper is to highlight the available and easily accessible modern digital technologies that contribute to at least two pillars of Climate-Smart Agriculture (CSA) of increased food productivity and adaptation.

Yield prediction was based on NASA's multi-temporal MODIS images with limited ground information, while for ICT was based on selected farmers fields' corners using GPS and linked with farmers' mobile phone. For the digital farm machinery, two major irrigation technology toolkits were deployed among farmers. The land preparation was conducted using laser guided Engineered land levelling.

Results showed that satellite-based (MODIS data) measurements can be used to predict crop yield (e.g., sorghum yield was predicted 30 days before harvesting). Results also indicated that Information & Communication Technologies (ICT) are can effectively improve crop production (increase in wheat yield was range between 40 and 80%). The interviews showed that ICT shorter irrigation interval and increased yield of wheat through SMS messages. On the other hand, the results of the digital farm machinery (e.g., laser land levelling) ensured that wheat yield and water productivity can be increased up to 5.0 t/ha and 1.28 kg/m3, respectively over the wheat national average yield of 1.7 t/ha.

Keywords: Climate information, ICT, crop modelling, Triticum aestivum L.

Paper 2

Adoption of Crop-weather Calendar as a tool for Climate Smart Agricultural Practices in Semi-Arid Nigeria: A Case Study Samaru, Northern Nigeria

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Abstract

Agriculture in semi-arid Nigeria is highly vulnerable and sensitive due to dependence on rainfall indices especially those parameters that quantify the water available for activities to be carried out from crop pre - establishment to harvest. The most critical environmental threat in this region would appear to climate change and is a major limitation to increased national food security The current work employs the use of Crop-Weather Calendar in mitigating the impacts of climate change on some selected crops in Samaru the Northern Guinea Savannah of Nigeria. Crop-Weather Calendar is a tool that supports farmers in taking appropriate decision on crops. It contains information on best practices from land preparation, planting dates, crop development to harvest, storage and marketing. The historical data analysis involved characterizing long-term mean values, and calculation of indices of variability and trends at monthly, seasonal and annual time steps. Coefficient of variation (CV) was used as statistical descriptor of rainfall variability. Determination of maize and sorghum yield anomalies, CV (%) in association with rainfall variables were used for this study. The result showed mean annual rainfall of Samaru as 1015.9 mm (CV = 15.2%) with number of rain days recorded as 81while the mean onset, cessation and length of season are 21st May 7th October and 157 days respectively. This study also indicates serious rainfall intensity due to increasing rainfall amount and decreasing rain days in the study area. The implication of this trend to agricultural production is the risk of soil fertility depletion due to leaching losses, soil erosion and farmland destruction. The analysis also discovered that some of the crops like maize that were largely grown in the area are shifting southward with shift in planting date while new sorghum varieties are taking over the area in order to adapt to the new climate.

Keywords: Climate change, crop production, crop-weather calendar, rainfall amount, rain days.

Paper 3

Digitalization Options for Scaling Climate Smart Agriculture in Smallholder Farming Systems: Lessons and Opportunities.

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Abstract

Agriculture is a pillar of livelihoods in smallholder farming systems but faces many challenges and chief among them is climate change and vulnerability. Climate-smart agriculture (CSA) has been promoted by research and governments as a panacea to these challenges. Digitalization can play a critical role in spearheading the adoption of CSA. Drawing from a systematic literature review and key informant interview consultation, this study contributes to Digitalization work by reviewing the status of digitalization in the smallholder farming systems, its role in out scaling CSA, constraints, and discusses enablers and opportunities for improvement. The findings show that Digitalization is still low in smallholder farming systems with digital technologies for monitoring CSA with evidence of soil moisture and solute monitoring tools, market apps on smartphones and some predictive (smart weather stations) being there while digital technologies such as decision support systems such as real-time monitoring systems for livestock, crops need to be promoted as they have potential to enhance CSA efficiency. Barriers to Digitalization in out scaling CSA include the high costs (installation and maintenance), lack of technical know-how on how they work, and wrong perceptions. As such governments might need to consider initial subsidies and capacity building on how these digital technologies work until the smallholder farmers appreciate how these technologies solve the challenges that they face. Results, however, show that Digitalization can strengthen market linkages along with input and produce value chains and have great potential to increase productivity through precision and cost-saving practices which can translate to improved food security, incomes, and livelihoods.

Keywords: Climate-Smart Agriculture, smallholder farming system, digitalization

Paper 4

The Role of Interactive Radio and Mobile platform in Climate Smart Agricultural Communication: The case of the CLIMA project

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Abstract

Radio is a one-way medium that reaches farmers in their homes and fields and an excellent platform for reaching farmers with Climate Smart Agriculture (CSA). However, it has several limitations including limited means of interacting with listeners or including them in program delivery. FRI recently completed a 12-months project entitled Climate Information Made Available to Farmers, (CLIMA). The project supported three radio stations and their key stakeholders in northern Ghana to design and broadcast a CSA radio program infused with seasonal, weekly and daily weather information. FRI incorporate the ULIZA suite of services into the program to enable listeners in target communities interact and provide feedback. Endline evaluation showed that in farming communities which were fully engaged in the program, people listened more, and had better knowledge of the topic as long as there is more opportunity for feedback. It also showed a strong correlation between listening to more episodes of a radio campaign and adopting a new practice as more farmers started practicing the CSA improvement recommended in the broadcasts.

A combination of radio and ICT (mobile platform) increases interaction, listenership, and knowledge and adoption of climate smart agricultural practices by farmers. The use of uliza suite of services allowed for a combination of broadcast and narrow casting, leading to the flow of information and the feedback loop to amplify their voice. Increased ability of rural radio to help farmers improve their learning and practice of CSA for improved productivity.

Keywords*:* climate-smart agriculture, communication, radio, agriculture

Paper 5

Digital Climate Service Use and Uptake of Climate Smart Agriculture Practices Among Smallholder Farmers in Africa: A Review

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Abstract

Climate smart agriculture (CSA) practices (such as adoption of drought tolerant maize varieties and weather index insurance) are being touted as sustainable responses to strengthen farmers' resilience against climate change whilst boosting agricultural productivity. In fact, a number of countries developed CSA investment plans as a way of placing CSA practices at the centre of national development agenda. Nevertheless, the uptake of CSA practices among smallholder farmers remains low. As such, profiling innovations which can sustainably scale-up adoption of CSA practices cannot be overemphasized. Use of digital climate services is regarded as one of the key innovations with significant potential to boost the uptake of CSA practices especially among smallholder farmers. However, there is limited evidence on the impact of digital climate services use and uptake of CSA practices. To bridge this knowledge gap, this study explored the nexus between use of digital climate services and uptake of CSA in Africa based on extensive review of literature. In this case, the digital climate services refer to mobile phone-based weather forecast services such as Esoko's mobile based weather forecast services in Ghana. A synthesis of more than 30 articles reviewed underscored that; digital climate services significantly influence farmers' decision to adopt CSA practices. It is therefore important to promote the use of digital climate services among smallholder farmers to incentivize uptake of CSA practices in Africa.

Keywords: climate change, climate smart agriculture, digital climate services, resilience & productivity

Paper 6

Role of Digital Moisture and Nutrient Monitoring Tools in Enhancing Resilience Against Climate Change Effects in Semi-Arid Rural Communities Practicing Smallholder Irrigation in Malawi and Tanzania

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Abstract

Agriculture accounts for 32% of the GDPs in most countries in Sub Saharan Africa and employs close to 65% of the population in these countries (World Bank 2015). However, there is growing evidence that credible data is critical for agricultural investment and transformation in Sub Saharan Africa. Improved food security and nutrition are among the potential impacts on the livelihoods of the smallholder farmers. Data access by small holder farmers to make meaningful investment decisions still remains a major challenge. For these farmers, data and information services available through less high-tech digital tools, are the only best bet option (World Bank, 2011). The paper looks at the role of digital moisture monitoring tools ('chameleon') in building farmer resilience against extreme weather events such as drought. The tools developed by CSIRO are user friendly as they display output in terms of color. When a digital reader is connected to the wires it shows either blue, green or red color. When it's red, the soil is dry and the farmer needs to irrigate immediately. When its green, there is still some moisture, the farmer should prepare to irrigate in the 3-5 days. When its blue, the soil is too moist and hence framer should plan to irrigate after 1 week. This paper explores the potential role of the irrigation tools to improve water utilization and on-farm productivity and deliver multiple outcomes at community/scheme level especially in terms of saving water resources, reducing water-use conflicts, improving food production, availability and security, empowering women and youth as well as improving gender relations at household level. The paper also looks at the potential models for scaling up these innovative tools within the Eastern and Central Africa (ECA) sub region. The promising models could involve a public/private entity providing farmers with the tools and then farmers take readings from their plots and uploads the information into central database using their mobile phones.

Key words: Digital moisture monitoring tools, chameleon, resilience, climate change; smallholder phones, information access.

Paper 7

Big Data and Artificial Intelligence Deployment for Climate-Smart Agricultural Modelling of the Lake Chad Basin

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Abstract

Lake Chad and its river basins are sources of water and sustainable lively hood of the growing population of the area. climate change has been attributed to the dwindling water resources of the once thriving Lake Chad which has contributed to the conflict in North-Eastern Nigeria and the neighbouring countries. In this paper, we use Google Earth Engine, a big data application platform with artificial intelligence to model potential rice-growing land areas within the basin and also characterize the land use and climate change dynamics of the area. Landsat optical Satellite Remote Sensing from the United State Geological Service and Synthetic Aperture Radar data from the European Copernicus data sets were used to derive a climate-smart agricultural model for rice production in the study area. Accuracy assessment with field data for both land use, and land cover characterization and the modelled potential land for rice cultivation was 72% and 75% respectively. Modelled potential land for rice cultivation was 194.93 square Kilometre while the calculated yield for rice is 48532.5 tons.

Keywords:

Paper 8

Digitalization of Agriculture: What Relevance and Challenges in Enhancing Climate Smart Agriculture in Nigeria?

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Abstract

The digitalization of agriculture is critical in solving Nigeria's agriculture faced by myriads of challenges. Climate change is unfavourable to agriculture, yet Nigeria's population will add 63 million more people by 2030 and increase to 400 million in 2050. The distortion of the environment and biodiversity is inevitable with aggravated climate change disasters in the absence of climate smart agriculture powered by digitalization. The study examines the critical barriers to involvement in digital agriculture for climate smart agriculture and the uptake of digital technologies by farmers in Nigeria. Two Focus Group Discussions were done virtually involving 48 stakeholders in farming, climate change and digitalization fields from public and private sectors across the geopolitical zones to elicit information about strengths, challenges, and opportunities in the country's digital space. Discussed issues include agricultural digitalization enhancement, rural farmers' involvement, and greater efficiency and output. However, a low level of skill in the agriculture sector and a high level of internet poverty, energy poverty, poor technological infrastructure, high technology costs, poor e-literacy and digital skills, weak regulatory framework, and limited access to services make the digitalization process a problem. Nevertheless, over 80% of the discussant believe digitalization would enhance information sharing and speedy dissemination of innovations. Benefits of Nature financialization projects, Geoengineering efforts and other Nature-Based Solutions would be enhanced by digitalization. The study recommends that digitalization efforts in the agriculture sector should avoid widening the digital divide between sectors and urban and rural locations that differ in adopting new technologies.

Keywords: Digitalisation of Agriculture, Nature-based Solutions, Financialisation of nature, Geoengineering.

Paper 9

Utilization of Rice advice Smartphone-Technology in Enhancing Climate Smart Agricultural Practices Among Small-Scale Farmers In Benue State, Nigeria

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Abstract

Traditionally, farmers have relied solely on their own knowledge and expertise for decisions making. The current transformation in information and communications technologies has made it possible to create decision-support tools that can help farmers increase productivity, minimize risks and improve livelihood. Climate Smart Agriculture (CSA) is aimed at; income sustainability, resilience to extreme weather and elimination of greenhouse gases. The study examined utilization of Riceadvice Smartphone-Technology in enhancing climate smart agricultural practices among small-holder farmers in Benue State, Nigeria. A Purposive sampling and simple randomization was used in selecting 120 respondents. The socio-economic characteristics, utilization, attitude and perception, knowledge and constraints were the specific objectives analyzed using descriptive statistical tools. The mean age of the respondents is 36 years, majority were Males (77.5%), married (66.7%), Christians (72.5%) with 0- 0.5 hectares of land (77.5%). Mean household size of 7 persons, farming experience of 10 years, monthly income of N32, 500.80k. Source of labor is from family (75.0%) and cooperative movement complaints (90.0%). Main sources of knowledge on Rice advice technology are Cofarmers/farmers group (92.5%), Radio programs (77.3%) and family/friends/neighbors (75.0%). They have positive attitude and perception towards Rice advice technology (=0.992-2.000 and =0.958-2.000). Major constraints to utilization of technology are inadequate network coverage (92.5%), fewer clienteles with android phones (88.3%) and poor extension contact (75.8%) amongst others. It was recommended that extension services should be proactive, network should be made available and accessible, provision of lending institution at the community level as well as other infrastructural development of the study area.

Keywords: Climate, Smart-Agriculture, Rice advice, Smartphone-Technology, Practices

Paper 10

Implications of Digital Divide in Digitalization of Farming Activities in the NAERLS Adopted Villages

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Abstract

Agricultural practice in Nigeria is predominantly in the rural area where the traditional cultivation system is the dominant practice with fewer new media tools (NMTs) drives. Thereby, creating strategic setbacks to integrate agricultural stakeholders, particularly the adopted village farmers of the National Agricultural Extension and Research Liaison Services (NAERLS) into the new media hub for the participatory Agricultural Extension System. As a result, the full participation of some agricultural stakeholders is not guaranteed due to the digital divide. This implies that the agriculturalist has limited access to requisite information on Climate-Smart Agriculture (CSA) in the global space that is tech-driven. Hence, the need for the new media tools has implications for mitigating the digital divide in advancing the NAERLS adopted villages farmers, agricultural activities, and systems in Nigeria. Thus, the study reflected on the NMTs' technological revolutionary in the agricultural sector, the concept of CSA, and agricultural extension systems in Nigeria. More so, looked at the digital divide in agricultural extension, the role of NMTs4AE in creating participatory agricultural extension system, and the creation of synergy among agricultural stakeholders based on knowledge, and practices for increasing productivity via climate-smart agriculture as purported to improve the economic status of Nigerian.

Keywords: Mitigation, Digital Divide, Climate-Smart Agriculture, Adopted Villages

Paper 11

Modelling and Spatial Distribution of Peste des Petits Ruminants in South Kivu, DR Congo

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Abstract

Despite its nutritional and economic advantages, small ruminant livestock farming is still faced with numerous constraints, especially of a sanitary nature, due to the infection of herds by several pathogens and more particularly by a virus of the Morbillivirus genus responsible for peste des petits ruminants (PPR). In order to better deal with this disease in the Democratic Republic of Congo and in the province of South Kivu in particular, it is essential to determine its spatial distribution and it's mapping according to the risk areas in order to be able to generate a model for the control, surveillance and eradication of the disease. To this end, a survey was conducted among 210 randomly selected farms in the territories of Mwenga, Uvira and Kalehe, with 70 farms per study site.

The study showed that water source, watering method, husbandry system, types of livestock, gender, age and cleaning frequency were the farm and pasture characteristics that correlated significantly with seroprevalence. Furthermore, the risk factors determining infection with the disease were: the sex of the animal (OR=91.73; CI=21.15-39.60); the agro-ecological zone (OR=8.28; CI=4.75-14.42) with a higher prevalence in Mwenga (31.11%); and the rearing system (OR=0.42; CI=0.19-0.905), which showed that animals reared in the agropastoral system were the most exposed to infection (31.85%) The mapping of the different sites studied revealed the existence of three types of pastures according to the risk of infection of the disease and the territories of Uvira and Kalehe present a large proportion of high-risk pastures than that of Mwenga given the prediction maps established. Finally, the MaxEnt model generated in the present study considering as explanatory factors the Euclidean space and the livestock system can be applied for the control and eradication of PPRV in South Kivu and in other regions with the same farm and pasture characteristics as this study area.

Keywords: Mapping, Epidemiology, Infection, Peste des Petits Ruminants Virus, South Kivu

Paper 12

Assessment of Use of Selected Information Communication Technologies (ICTs) by Extension Workers to disseminate Climate Smart Agriculture (CSA) Information to Farmers in Lesotho

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Abstract

Agriculture remains a key sector in the economy of Lesotho. Majority of smallholder farmers are struggling to improve their agricultural production due to dire effects of Climate Change (CC). Agriculture extension workers can positively influence farmers' adoption of Climate Smart Agricultural (CSA) technologies for improved agricultural productivity. It is therefore necessary to explore how extension workers in Lesotho are making use of ICTs to sensitize farmers on best practices to enhance agricultural production despite CC phenomenon. The study will assess how selected Information Communication Technologies (ICTs) are exploited to transmit agricultural information that mitigate against devastating effects of CC on agriculture, especially among smallholder farmers. A simple random technique will be used to select at least 50% of the total public extension workers (68) in Maseru, Lesotho. Data will be collected using structured questionnaires and analyzed descriptively using frequency counts, percentages, mean and standard deviation. Inferential statistical tools such as Pearson Products Moment Correlation (PPMC) will be used to test the statistical relationship between respondents' socio-economic characteristics and their attitude towards the use of ICTs. Findings from this study will assist in making appropriate recommendations to policymakers and stakeholders on the best practices in using digital tools to alleviate the negative effects of CC on agricultural production.

Keywords: ICT, climate-smart agriculture, information, farmers

Paper 13

Digital Innovations, Agricultural Productivity Growth and Environmental Sustainability: A Randomized Evaluation in Nigeria

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Abstract

In the face of climate change, the emphasis on increased use of external inputs, such as inorganic fertilizer in Africa will likely be associated with increased greenhouse gas (GHG) emissions, especially nitrous oxide, as with the Asian Green Revolution. Yet, traditional agricultural extension systems in Sub-Saharan Africa typically provide generalized or 'blanket' fertilizer recommendations that are not tailored to the plot-specific growing conditions of individual farmers, which could lead to more negative environmental externalities. In light of the rapid advancement in digital technologies, digital decision support tools are increasingly considered to allow better tailored extension services. Within this context, a digital nutrient management tool 'Nutrient Expert' has been co-developed in Nigeria to enable the extension system to transition from provision of generalized to site-specific nutrient management-based fertilizer recommendations towards improving productivity while reducing negative environmental footprints of fertilizer use. Using a three-year randomized controlled trial in northern Nigeria, this paper analyzes the impact of farmers' access to site-specific nutrient management recommendations, provided through the Nutrient Expert tool on yield and environmental sustainability of maize intensification. The primary outcomes of interest are maize yield (ton per hectare), and GHG emission intensity (kilogram carbon dioxide equivalent emissions per ton of maize), measured using the Intergovernmental Panel on Climate Change Tier one method. The results show that the use of a digital tool to provide site-specific nutrient management recommendations to the treatment group led to an increase in maize yield, and a reduction in GHG emissions intensity compared with the control group, who were exposed to blanket fertilizer recommendations. Overall, the findings of this paper suggest that the use of digital decision support tools can drive agricultural productivity growth with limited negative environmental footprints through more efficient fertilizer use and technical efficiency gains.

Keywords: Digital tool, fertilizer, GHG emissions, maize, yield.

Scientific Papers

Theme 2

Paper 14

Temporal Climate Variability in the Luki Biosphere Reserve Mayombe, Democratic Republic of Congo

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Abstract

The aim of this study is the evaluation of temporal climate variability in Biosphere Reserve of Luki (BRL) from 1959 to 2018. Daily sum of rainfall, daily average temperature and daily average relative humidity collected at Luki meteorology station were study data. Standardized precipitation index (SPI), Stern et al., (1981) method, and Bagnouls F., Gaussen H., (1957) were analyze methods. Significant warming trend in temperature, not significant increase in precipitation and relative humidity which contrast with trend decrease of number of rainfall days and the standardized precipitation index (SPI) revealed the instability of climate in biosphere of luki. All data series are homogeneous. Rainfall onset is observed in October with a drift on beginning of November. Rainfall retreat is observed in May. Overall, dry season recorded 5 months. Obtained results prove that Central Africa is not protected against climate disturbances. In these conditions, development of short-cycle varieties seeds and agroecological methods is essential to small farmers

Paper 15

Effects of Soil Amendments on Incidence of Bacterial Wilt and Tuber of Potato at Different Environments in Malawi

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Abstract

Potato bacterial wilt caused by Ralstonia solanacearum is a major threat to potato production in Malawi and sub-Saharan Africa region. The incidence of the disease has been reported to be exacerbated under conditions of moisture stress, low soil fertility and low pH. Effects of soil amendment on bacteria wilt incidence and potato tuber yield was assessed in Malawi at Bvumbwe, Bembeke, Kandiyani and Lunyangwa research station during 2020/21 and 2021/22 growing season. Five treatments including agricultural lime (3t/ha) and 4 rates of a Granulated Calcium Carbonate called CALCIPRIL; CALC25%, CALC50%, CALC100% and CALC150% were laid out in Randomized complete block design (RCBD) replicated three times. Data collected included disease incidence data collected at 70 days after planting (DAP) and weight of tubers were graded to market size and non-market size. Data was subjected to analysis of variance in R programming and means were separated by the least significant difference (LSD0.05). Disease incidence showed an interaction between amendments and season at bembeke (P=0.007). Soil amendment with lime and CALCIPRIL had reduced incidence in all sites ranging 4 – 20%, the highest reduction was achieved by lime at Bembeke at 70 DAP. Marketable tubers yield showed interaction between treatment and season at Bvumbwe (P=0.004), highest being 10.02 tha-1 obtained in CALC150% in 2020/21 while non-marketable tubers showed interaction at lunyangwa (P=0.02) highest being 3.9 tha-1 recorded in CALC150% in 2021/22. Soil amendments reduced incidence and increased tuber yield at different sites leading to reduced pesticides and increase smallholders' income sustainably.

Keywords: Amendment, Potato, Soil, Disease, incidence.

Paper 16

Technical and Economic Evaluation of a Mechanical Cassava harvester in Busia County of Kenya

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Abstract

Cassava harvesting is the most challenging operation across the entire value chain. It is done manually, making it tedious, costly, and time-consuming especially if the plantation is medium to large scale where manual work may take some time. Currently, there is no known harvester in Kenya to address this gap. Hence, the Kenya Agricultural and Livestock Research Organization (KALRO) collaborated with Agricultural Technology Development Centre (ATDC) in Siaya County to design and fabricate a mechanical cassava harvester. To validate the harvester its performance was assessed in comparison with the manual methods, in Busia County. Data on the area harvested, time taken, working depth and broken tubers were collected from the demo plots to achieve the parameters for the two harvesting methods and comparisons were made drawn from the averages. Comparatively, the mechanical harvester took 1.28 minutes while manual harvesting took 9.53 minutes to harvest an area of 62.4m². The working depth of the harvester was almost uniform (22cm) signifying that the soil type in the three plots was identical. In terms of post-harvest losses, the manual method was inferior with the 13.6% broken roots against the harvester's 7.07%. The harvester performed better in cassava planted in ridged rows. A comparative cost-benefit analysis for the mechanical harvester showed that its gross margin was (Ksh 31,490) per acre and was relatively higher than manual harvesting (Ksh. 21,000 per acre). Thus, if the mechanical harvester is adopted it could save farmers time, and cost of labour, reduce drudgery and increase income.

Keywords:

Paper 17

Scaling Precision Agriculture in West Africa Smallholder Irrigation and Water Management Systems

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Abstract

The advent of precision agriculture (PA) is changing global agricultural productivity; through underlining principles that ensure inputs required for the management of soil, water and crop agronomy are supplied precisely across the field landscape resulting in optimum yield. Smallholder irrigated crop production across West Africa accounts for significantly more areas in Burkina Faso, Ghana, Mali, Nigeria and Senegal than the conventional large irrigation schemes. Scaling the practice of PA specifically in large scale commercial and smallholder irrigation systems faces different challenges thus requiring different approaches. Distinction is made between large scale and smallholder irrigation with farm holdings between 0.1 to 1.0ha., with farmers' technical and financial capabilities being major critical factors limiting the scaling of irrigation technology in West Africa (WA). Scaling PA in WA smallholding system using basic tools like TDR moisture meter, wetting front detector, Chameleon sensor and simple soil test kits are required to guide irrigation scheduling in smallholder irrigation system; enabling efficient water use and improved crop yield. The use of these tools is still very low across WA with only few farmers in Ghana trained in the use of wetting front detector and Chameleon sensor. There is need to scale down and digitalize soil information from regional project like AfSIS and make it available to smallholder farmers to improve on fertilizer usage. Scaling these tools for efficient deployment of PA in irrigation systems at smallholder scale will involve awareness, capacity building, and a business model that make such tools affordable for small holder farmers.

Keywords: Precision agriculture, West Africa, irrigation, small holder, AfSIS

Paper 18

Effects of Mulching/Green Manuring and Intercropping with Crotalaria Grahamiana on Growth and Yield Parameters of Potato in the Vakinankaratra Region, Madagascar

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Abstract:

Potato (*Solanum tuberosum*) is an important food crop and income source for rural households in the Highlands of Madagascar, especially in the Vakinankaratra region, the main production area. The present field study aimed to evaluate, under two growing seasons, the effects of mulching or green manuring and intercropping of a legume cover crops (*Crotalaria grahamiana*) as source of organic fertilizer supplement on potato growth and yield parameters. The experimental design was a randomized complete block design with 4 replicates and 3 treatments (T1: control, T2: intercropping + mulching with *Crotalaria grahamiana* T3: intercropping + green manuring with *Crotalaria grahamiana*). Results showed significant ($p<0,05$) positive effects of soil treatment with *Crotalaria grahamiana* on potato variety Bandy akama total tuber yields and on potato variety Meva height, stem fresh weight, total tubers number and yield, large-sized tubers number and yield as compared to control. Total tubers yield advantage was 92 to 115% on potato variety Bandy akama and 79 to 86% on potato variety Meva. Large-sized potato tubers yield advantage on variety Meva was 116 to 124%. Therefore, integration of *Crotalaria grahamiana* in farming systems has potential to sustainably enhance rural farm household income, food security and resilience to climate change.

Keywords: cover crops, *Crotalaria grahamiana*, green manure, potato, Vakinankaratra

Paper 19

Advancing local vulnerability assessment framing to enhance climate adaptation planning and actions: Insights from smallholder production system of Ghana

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Abstract

Studies on vulnerability have widely contributed to building understanding of the nature of vulnerability through the development of methods and frameworks for its analysis. Vulnerability science has however been criticized in recent years for its limited use in decision-making and consequent poor adoption of adaptation strategies. To ensure preparedness for the increasingly extreme and uncertain climate, ther ea is need to strengthen vulnerability assessment practice and enhance its relevance for decision support to improve adaption planning and actions. Certain improvements can result from a wider awareness of changing climate, and an explicit assessment of adaptation options under such changes. An improved vulnerability assessment then is to integrate identification and evaluation of adaptation strategies as routine components. This study described the operationalization of a localized vulnerability assessment, explicitly integrating adaptation alternatives, as demonstrated by three studies conducted with smallholder farmers in Ghana, West Africa. Lessons and insights from the studies are used to offer a design for this integration, as well as demonstrate its value added in terms of vulnerability assessment information. The adaptable design is built upon the utility of existing frameworks and methods, to guide adaptation planning and actions. Further exploration of a systems' adaptive capacity is however essential for ensuring continuous identification and evaluation of adapted alternatives and ensuring successful adaptation in practice.

Keywords: Vulnerability assessment, climate adaptation, vulnerability framework, smallholders, Ghana, local studies

Paper 20

Rethinking Climate Change: Opportunity to Mechanize Smallholder System in Africa Through Climate-Smart Agriculture

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Abstract

Smallholder farmers are the cornerstone of the agricultural sector in Africa. The smallholder system contributes not less than 70 per cent of the food production in Africa. However, with the reality of the ever-growing population in the continent, there is the need for increased capacity for food supply, thereby spelling out the urgent need for rapid transformation of the smallholder farming system. With increase in food production needed to be achieved in the context of preservation of natural resources, sustainable agricultural mechanization becomes fundamental to the process. This paper analyses climate change as a possible drive for mechanization of smallholder agriculture and climate-smart agriculture (CSA) as a viable tool to drive the sustainable mechanization of smallholder farming system in Africa. The paper synthesizes a subset of literature between 2010 and 2022. The key findings are that mechanization must be efficient and effective in attending to farmers' needs. Mechanization should enhance farm productivity and competitiveness of food supply chain. To ensure the sustainability of mechanization, economic, social, environmental and institutional factors must be taken into consideration. Sustainable mechanization can be made available to the smallholder system in diverse ways, while mechanization can be climate-smart and environmentally friendly. Given their significant position in food production, it is crucial for smallholder farmers to be involved in climate-related actions. This paper argues that CSA is an approach to be explored for agricultural mechanization in the smallholder faming system for a paradigm shift in the agricultural sector in African countries.

Keywords: Africa, climate change, climate-smart agriculture, mechanization, smallholder

Paper 21

Development of a Pilot Scale Energy Efficient Flash Dryer for Cassava Starch/Flour

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Abstract

Cassava's transformation into an industrial raw material necessitates new processing techniques that improve product quality while lowering processing costs. This has resulted in the development of an energy-efficient flash dryer for the production of cassava flour/starch on a smaller scale. The flash dryer is a scaled-up version of the prototype installed at the International Center for Tropical Agriculture (CIAT) in Cali, Colombia. The flash dryer components were designed using the excel tools developed by the CGIAR RTB flash dryer project. The flash dryer was built using locally sourced materials based on the specifications in the excel tool. The flash dryer is a fully automated system that allows for operational flexibility. The dryer was evaluated by drying cassava mash into High Quality Cassava Flour with the drying air temperature of 180 ℃ and air velocity of 13 m/s. The initial moisture content of cassava mash was 47.06% wb, which was reduced to 9.60% of dried product. Using a drying capacity of 298 kg of wet cake per hour, an output of 186.34 kg of dried product was achieved, resulting in an energy efficiency of 80.8% and specific energy consumption 2.65 MJ/kg. The dryer's drying performance and capacity indicate that the dryer is highly efficient and best suited for small-scale enterprises. When this innovative technology is adopted, the production costs can be reduced, the standardization of cassava products may be facilitated, and the global market opportunity will expand.

Keywords: Flash Dryer, Energy Efficiency, Specific Energy Consumption, High Quality Cassava Flour

Paper 22

Drivers of holistic Agricultural risk management training transfer.

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Abstract

Assessing the level of transfer in both public and private organizations is increasingly becoming necessary as a means of determining employee productivity and efficiency. In 2000 Holton and others came up with training transfer system inventory as a tool to predict transfer. He asserted that the success or failure of training transfer in an organization depends on the learning transfer system which are: trainee characteristics, training design and work environment (Burke & Baldwin, 2016). However, it is important to note that these factors are viewed differently according demographic characteristics, context and time span taken after the training. (Kim, Park, & Kang, 2019). The purpose of this study was to analyze the drivers that lead to the transfer of agricultural risk management practices among agricultural extension staff in Uganda who were trained by the Ugandan ministry of Agriculture Animal Industry and Fisheries (MAAIF) so as to build their capacity to train smallholder farmers to manage the agricultural risks that have for long affected productivity. There was need to determine the extent to which the trainees were able to transfer the skill gained in agriculture risk management (ARM) training back to their work environment. A total number of 281 were interviewed on their last day of training.

Results; showed that perceived content validity, opportunity to use, readiness to learn, transfer effort performance expectation, and training design, had a significant impact on agricultural risk management transfer. Extension worker trainers, decision-makers/facilitators, and other actors in the extension system should pay particular attention to the factors reported here as important to agricultural risk management training transfer. Furthermore, the LTSI has been proved to be effective in evaluating agricultural risk management training.

Keyword: Agriculture, risk management, extension services, training transfer, LTSI

Paper 23

Renewable Energy and Mechanization in the Smallholder Sector: Experiences from Wedza E- Mobility Pilot Study

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Abstract

Transport as a challenge to agriculture and along agricultural value chains is often muted in developmental projects, despite the fact that one of the identified factors that has a potential to accelerate mechanization in the smallholder sector is provision of efficient and affordable transport. The burden of manual work and reduced rural mobility is borne disproportionately by women farmers. They have some of the most diverse transit needs, given that they spend a higher proportion of their time on both productive and reproductive work, thus compromising on the expected outputs when engaged in agricultural activities related to CSA. A pilot project providing transport in a bid to mechanise agricultural activities was initiated in Wedza district of Zimbabwe, by purposefully targeting 90 women in groups of three. The objective was to evaluate the use of the three wheeler (hamba) that uses renewable energy, by smallholder farmers in livelihoods options. A mixed method research approach was used and both qualitative and quantitative data were collected through surveys and case studies. Besides provision of reliable and affordable first and last mile solutions, the three wheeler, contributed to adaptation to climate change by providing alternate sources of non- farm based livelihood options. 52% of women farmers used the three wheeler for agricultural mechanization; 23% for buying and selling of various goods; 16% provided taxi transport services and 9% were not very specific on their use. The initiative improves agricultural productivity by reducing drudgery, and it contributes to reduction of greenhouse gas emissions.

Key words: Mechanisation; Women farmers; Renewable energy; Rural mobility; E- mobility

Paper 24

Effect of Nitrogen Fertilizer on Water Use Efficiency of 11 selected Sorghum Genotypes Grown in Semi-arid Regions in Kenya.

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Abstract

Sorghum production in semi-arid lands is constrained by soil fertility and inadequate moisture which is acerbated by climate change. A study was carried out in SR 2018 and 2020 at Katumani, Machakos to evaluate effect of nitrogen fertilizer on water use efficiency and determine water efficient sorghum from 11 selected genotypes using gadam as a check. First season was used to shortlist genotypes based on high grain yield, large nitrogen use efficiency and nitrogen uptake from the soil. The experimental design was a RCBD with split-plot arrangement. Sorghum genotypes plus check were planted in the main plot and nitrogen fertilizer at three levels (0, 6.5, 32.5 kg ha^{-1}) with 10 kg P ha^{-1} as basal fertilizer was applied in the split plots. Potential evapotranspiration (ETo) was used to determine WUE. The experiment was replicated three times. The results showed that, use of nitrogen fertilizer at (6.5 kg N) ha^{-1} and (32.5 kg N) ha^{-1} significantly increased WUE by 12-25% and 17-35% on biomass and grain productivity mm^{-1} of rainwater. The sorghum grain yields were significantly correlated (r^2=0.8) to mean WUE. Five genotypes had significantly large WUE. It was concluded that use of fertilizer nitrogen significantly increased WUE of sorghum genotypes in semi-arid Machakos and there are five genotypes with significantly large WUE than Gadam and are recommended for farmer cultivation and incorporation in breeding Programme for development of drought resistant sorghum.

Key words: Nitrogen fertilizer, sorghum genotypes, WUE, semi-arid lands, potential evapotranspiration.

Scientific Papers

Theme 3

Paper 25

Evaluating Climate Smart Adaptation Practices on Cocoa Insect pests and Diseases Incidences among Farmers in Cross River State, Nigeria

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Abstract

Climate change impact during dry season and prolong rainfall poses great risk to cocoa and farmers' livelihood. This scenario creates ideal conditions for the spread of diseases in cocoa plantations. The study accessed Climate Smart Adaptation (CSA) practices used by farmers to mitigate insect pests and diseases challenges of cocoa in Cross River State. A systematic random sampling was used to select farmers across Boki, Etung and Ikom Local Government Areas to obtain a total of 132. Field data were collected with interview schedule and analysed with descriptive statistics and Pearson Product Moment Correlation. The results showed that majority of the farmers were a little above 45 years and had more of secondary education. Prolong rainfall and rainfall (50.7%),) were ranked by the respondents as the main observed weather variables promoting the occurrence of insect pests and diseases in cocoa production. Removal of diseased and dried up cocoa pods from the tree regularly (66.7%), fungicides and insecticides application to cocoa trees during raining season (60.6%) and pruning (59.1%) proved to be effective (CSA) strategies used by farmers. Significant relationship existed between constraints farmers encountered and their (CSA) practices in coping with insect pests and diseases problems of cocoa ($r=0.172$, $p=0.050$ at $p\leq0.05$). The study concludes that irrespective of limiting constraints, farmers were able to adapt to the effects of changing climate associated with insect pests and diseases situation in cocoa farms. It is recommended that farmers should ensure the use of approved pesticides to enhance adaptation.

Key words: Climate smart agriculture, adaptation, cocoa insect pests and diseases.

Paper 26

Advancing a Gender-Responsive Delivery Model for Mitigating Climate Impacts in Ghana's Cocoa Landscape.

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Abstract

In the Ashanti region of Ghana, climate change impacts are expected to reduce cocoa yields by 30-50%. These changes are felt in the daily lives of cocoa-dependent households who struggle with reduced yields and increasingly strenuous farming conditions. While private sector investments into climate smart agriculture (CSA) are increasing, these investments are gender-blind at best and may often exacerbate gender inequalities by imposing additional labor and financial burdens on women. This study focused on understanding a gender-responsive delivery model that can be used by cocoa-purchasing companies to improve the reach of CSA services and resources for all relevant categories of household members involved in cocoa production, specifically women. Qualitative research was used to assess the barriers and enablers of CSA adoption for women engaged in cocoa production and determine the most feasible delivery model for supporting women with services and resources that would allow them to uptake CSA practices. Fieldwork findings led to the design of a "VSLA-plus-Cooperative" delivery model that would reach all relevant categories of men and women cocoa farmers to target them with specialized trainings as well as subsidized inputs and labor. This model stands out as a non-traditional vehicle for delivering services and resources in the cocoa supply chain and would require a transformation of current operational contexts of Licensed Buying Companies (LBC); however, it is envisioned to empower all categories of male and female farmers with the ability to improve the resiliency of their farms on their own terms—without overreliance on external support.

Paper 27

The Role of CSA Multistakeholder Platforms in Advancing the CSA Agenda in Eastern and Southern Africa.

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Abstract

Climate change is one of the most critical challenges facing the global community today. It threatens to undo decades of development efforts in all sectors, particularly agriculture, health, environment, roads, education, and fisheries, especially in developing countries. From a food security perspective, sub-Saharan Africa (SSA) is arguably the most vulnerable region to many adverse effects of climate change due to a very high reliance on rainfed agriculture for basic food security and economic growth, and entrenched poverty. It is increasingly becoming clear that no single organization or entity can single headedly promote Climate Smart Agriculture (CSA) practices in the Eastern and Central Africa. This has led to establishment of several CSA MSPs at local, national, and sub-regional levels. Among the most prominent CSA platforms are the ASARECA CSA Alliance, the Kenya CSA MSP, the Tanzania National and District CSA Alliances, the Global CSA Alliance. All these platforms are geared towards convening stakeholders to generate or scale up CSA, breaking down silos by connecting like-minded stakeholders and sharing of knowledge and experiences on the review, design, and implementation of NAIP highlighting how inclusion and resilience have been and can be integrated in food security programming. The participation of CSA Alliances in government-led dialogues and learning platforms, such as the CAADP Partnership Platform and the Malabo Policy Learning helps to create transformational partnerships to encourage action and CSA policy formulation and implementation. CSA Alliances also serve as tools for collectively identifying challenges and CSA needs which informs government and development partner interventions and policy decisions.

Keywords: ASARECA CSA Alliance, Climate Change, Partnerships, CSA Policy

Paper 28

Factors Influencing Access to Rural Finance Market by Different Actors in Climate Smart Agriculture in Kenya.

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Abstract

In Kenya, small holder farmers face climate change related challenges. It is therefore imperative to enhance adaptive capacity through climate smart agriculture (CSA) technologies. Access to finance is a significant enabler for adoption of CSA technologies yet small holder farmers, especially women, have an acute financing gap for agriculture. The purpose of this study was to carry out an in-depth analysis of rural finance markets that support agriculture and identify factors that influence access by different actors. The study was conducted in eight (8) Kenya Climate Agricultural Project (KCSAP) counties in Kenya. Both qualitative and quantitative approach was used for data collection. A probit binary regression model was used to examine factors perceived to influence farming household access to rural finance market. Results showed a significant effect ($P<0.001$) of gender, education level, marital status, household size, membership in farmers association, number of months household head resided on-farm in previous year, and household total asset value. Conversely, findings for rural finance actors showed a significant effect ($P<0.001$) on gender, education level, years of business experience, distance to financial institution and operation of business under partnership. The study recommended that in order to increase utilization of rural finance market services by various actors, following factors are key; Capacity building on both financial literacy and digital banking, locality of financial services should be closer to clients especially those in remote areas, a gender-transformative approach in order to increase women access to rural financial services while also alleviating the gender inequalities in socio-cultural norms.

Keywords: Kenya climate smart agriculture, rural finance markets, probit regression.

Paper 29

Deployment of monitoring devices to address quality degradation in bagged grain in storage.

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Abstract

Efforts are being made to address the challenges of food security and climate change especially among smallholder farmers in Africa through the application of innovations in agriculture. However, many of the efforts have focused on improving agricultural productivity with little attention being paid to reducing postharvest food losses which is a major contributor to climate change. High postharvest food losses being experienced in Sub-Saharan African have been attributed to inadequate storage infrastructures. Arduino based data logging system with eight onboard temperature and relative humidity sensors was developed and used to monitor the micro-climate of bagged grain in storage. The system was deployed in warehouses containing bagged maize and paddy rice respectively in Ilorin, Kwara state and Saki, Oyo state of Nigeria. Temperature and relative humidity in the bags and the warehouses were recorded in real time from May 3 to September 9, 2019, by the system with low errors. Data obtained by the system can provide useful information on the onset of spoilage during grain storage. Deployment of low-cost data loggers has the potential of improving grain storage management which will consequently reduce postharvest grain losses and improve farmers' resilience under climate change.

Keywords: climate change, data, food losses, monitoring, quality.

Paper 30

Scaling CSA initiatives in Eastern and Central Africa: Successes and lessons learned.

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Abstract

Various development partners working in the area of climate change are implementing strategic interventions aimed at mitigating the adverse effects of climate change. It's anticipated that, these efforts will deliver more impact if they build on previous interventions. However, this will only be possible if we know the status of implementation and scaling of CSA initiatives across the different countries as well as lessons learned. This would provide the required evidence on opportunities and critical success factors to inform the design of future interventions. Yet, information on past CSA initiatives at regional level is scanty and where available it's not comprehensive enough to make meaningful deductions. The main objective of this paper is to highlight the status of scaling CSA initiatives in ECA region. Specific objectives include: (i) highlight successful CSA initiatives scaled up in the ECA region; (ii) share successes, lessons learnt, gaps and challenges on implementation of CSA; (iii) share critical success factors for scaling of CSA initiatives; and (iv) provide recommendations to inform design of future CSA initiatives in the region. Evidence gathered shows that are various successful CSA initiatives in the Eastern and Central Africa that are ready for scaling within and across national boundaries. The findings also reveal that there are various challenges currently constraining wider adoption and scaling of the CSA technologies. Key among this were: lack of an IPR policy to support transfer of germ plasm across national boundaries; (ii) lack of coordination in implementation of CSA initiatives; (iii) inadequate sharing of knowledge and information among others. These findings suggest a need to put in a place a framework for sharing CSA technologies as part of a broader strategy for scaling the CSA technologies across the ECA sub region.

Paper 31

A Comparative Analysis of the Soyabean Value Chain in Malawi and Zambia.

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Abstract

Africa is one of the fastest growing continents in the world, highly vulnerable to Climate Change, 65% of Africa's population relies on subsistence farming. Agricultural value chains are one of the priority areas for Africa's agricultural transformation, effective agriculture value chains create opportunities, and enhance living standards. Globally, soyabeans area has expanded rapidly over the last decade. Soyabeans is one of the alternative cash crops being promoted in Malawi and Zambia, it improves soil fertility and is less vulnerable to climate change impacts. The African Continental Free Trade Area (AfCFTA) presents a major opportunity for African countries to bring 30 million people out of extreme poverty. A comparative analysis determines the strategies of indirect and direct competitors, the emerging opportunities in different sectors. Secondary data was used in this study derived from government departments, publications, and international agencies. Soyabean production in Malawi and Zambia has increased by 13% and 20% respectively from 2011 to 2021. The export markets continue to increase. Challenges faced in the soyabean value chain are lack of improved varieties, there are opportunities for growing soyabeans as it can be stored for longer periods due to its low vulnerability to pests. There is need for capacity building on growing the crop as most smallholder farmers lack production knowledge.

Keywords: Soyabeans, Malawi, Zambia, value chain, African Continental Free trade Area (AfCFTA).

Paper 32

Capacity Assessment for Multi-Stakeholder Partnerships Towards Resilient Food System; Imperatives for Climate Smart Agriculture.

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Abstract

Multi-stakeholder platforms (MSPs) have proven to be efficient to align research, extension, business, policy, farmers, and other stakeholders in dealing with complex sustainability challenges in the agri-food sector. However, members may not fully understand what capacities and skillsets they may require to form strong MSPs; and funders may not fully understand the best approaches to allocate scarce resources to achieve targeted long-term goals and shorter-term objectives. This paper highlights the findings of a recent study assessing individual, organizational and systemic capacities necessary for achieving expected outcomes and impacts of agricultural research and extension systems. The study used mixed methods and an integrative literature review. Open Data Kit and Ona.io were used for data collection, whereby qualitative data was processed by grouping similar responses into thematic categories to explain varying perspectives and observations. The assessment observed the importance to facilitate climate-smart agriculture technology transfer and uptake through learning routes and multi-stakeholder engagement. However, some critical gap areas were identified including commercialization of technologies, gender mainstreaming, and interpersonal skills. The study suggests that future capacity strengthening efforts should broaden the traditional focus on technical and knowledge acquisition to include soft skills that facilitate more effective stakeholder engagement for more resilient food systems and associated greater outcomes and impact.

Keywords: Soft Skills, Capacities, Resilient Food Systems, Multi-Stakeholder Partnerships, CSA Technologies.

Paper 33

Climate Smart Agriculture Practices: Interrogating the CSA Stakeholder engagement in Botswana.

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Abstract

Climate change has become one of the dominant challenges in modern history. Climate change has brought of economic, social and environmental hardships. Examples of climate change include hurricane Katrina in the USA, Dineo in Botswana and cyclone Idai which ravaged Mozambique and Zimbabwe leaving behind a trail of destruction. Agriculture has not been sparred by climate. The frequent droughts and floods in different parts of the world has increased incident of hunger necessitating swift action to mitigate against impacts of magnitude seen in the past. This paper explores the strategies and way that Botswana has devised to fight the climate change and promote climate smart agriculture. To achieve this the paper adopts desktop research where secondary data is used. The data sources include scholarly articles, government reports, international organizations, reports newspaper articles. The data will be obtained through internet search where key words or phrase such as "climate smart agriculture" Climate change and agriculture" etc. will be used. Relevant articles will then be selected for analysis. This research will find that Botswana has taken steps to mitigate against the negative impact of climate change. The research finds that the government has taken steps to implement climate smart agriculture. The challenges include the poor institutional collaboration and the lack of genuine and meaningful engagement with farmers which frustrate the framers hence poor results of climate smart agriculture. This problem being a result of top-down approach which often leaves communities with unclear choices of where they can get support.

Keywords: Climate change, Agriculture, farmers, institutions. Climate smart agriculture

Paper 34

Factors Influencing Choice of Climate Change Adaption Practices Among Cassava Farmers and Its Effect on Cassava Productivity in Osun State, Nigeria.

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Abstract

This study examined the effects of climate change adaptation practices on cassava productivity in Osun State with a view to determining socio-economic factors influencing choice of climate change adaptation practices and check if these practices affect cassava productivity in the study area. Using a two-stage sampling technique, a primary data was employed to select one hundred cassava farmers. The result was analyzed with a multivariate probit regression and a generalized linear regression model. The result showed that cassava farming was dominated by male (82%), with average age of 45.84±9.42 years where there were about 64% that belonged to cooperative associations and 67% that had access to credit facilities. Multivariate model revealed that age of farmers, sex, education qualification, primary occupation, total income, membership of cooperative associations, farming objectives, farming experience, access to extension visit, access to credit, type of land ownership, farm size, and climatic conditions significantly influence choice of climate change adaptation practices among cassava farmers in the study area. The generalized linear model identified farming system, crop types used in inter-cropping, crop diversification, organic manuring, multiple planting dates and use of alternative fallow to significantly affect cassava productivity. The study then concluded that environmentally friendly climate change adaptation practices boost cassava productivity. Thus, cassava farmers should be trained on the use of best climate change adaptation practices that aid cassava productivity. The use of organic manure and alternate fallow in particle should be emphasized in climate smart farming.

Keywords: climate change adaptation, multivariate regression, generalized linear model, cassava farming, climate-friendly farm practices.

Paper 35

Mainstreaming Climate Smart Agriculture into Agricultural Extension Curricula in West Africa: The roles of Sasakawa Africa Association

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Abstract

This paper describes the roles of Sasakawa Africa Association in mainstreaming climate smart agriculture into agricultural extension curricula. This is predicted on the fact that Sasakawa Africa Association introduced demand- driven curriculum in agricultural extension in thirty universities in 11 countries in Africa for experiential and competence-based training that are responsive to needs of farming communities. A thematic and content analysis of the curricula were carried out to ascertain the mainstreaming of CSA. The mainstreaming was an off shoot of the strategic plan of Sasakawa Africa Association through the decentralised workshop with faculty members in ten universities in Nigeria and Sierra Leone. In each university, lecturers in the faculty of agriculture, alumni of Sasakawa Africa Fund for Extension Education, staff of Agricultural extension agencies and representatives of farmers' organisations were interviewed for the inclusion of perceived concepts into the curricula. In most universities, course/module titles were changed, and concepts and keywords were introduced into the synopsis of curricula. Interdisciplinary expertise was designed to deliver the curricula. Another prominent feature of the mainstreaming was the introduction of sskill-basedand hands- on activities located within farming communities for training and interventions on value chain actors'needs. The mainstreaming covered all stages of the value chain, from input to consumption with emphasis on climate-smart ponses in the areas of weather, water, crop, nutrient, energy a nd knowledge/ institutions.

The mainstreaming of climate smart agriculture into agricultural extension curricula guarantees improved the knowledge and dissemination of CSA since agricultural extension services remaclimate-smartins the most used source of information to value chain actors despite the pluralistic extension landscape. This will also harness the potential if youths and women as the food future food systems respond to climate-change.

Keywords: climate-smart agriculture, thematic analysis, Sasakawa Africa Association, curricula, agricultural extension

Paper 36

Financing Sustainable Agriculture in Sub-Saharan Africa: The Role of Fintech.

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Abstract

Scaling up climate-smart agriculture solutions in Africa not only requires knowledge about their costs but also knowledge about their financing options. Better and more inclusive options to leapfrog Africa's sustainable agricultural development lie in financial technologies- FinTech. FinTech is an industry that makes use of digital technology innovations to facilitate the provision of financial services to clients. It has disrupted many business processes almost in every sector, and this has been accelerated by the Covid-19 pandemic. Its importance comes not only from the fact that it enables traditional financial institutions to function more efficiently but also from its ability to modify traditional financial services/ products and create new ones. Under traditional business mechanisms, smallholder farmers in developing countries suffer funding deficiencies, capital issues, and limited access to financial institutions, resulting in their exclusion from formal financial markets. They have generally been considered to be un-bankable by the traditional financial institutions, due to market failures such as poorly defined property rights, and information asymmetry, among other factors. FinTech has the potential to meet the demands of farmers thus, addressing financial inclusion. This study examines the role of FinTech in driving new services/ products in credit, payments, and risk markets, for sustainable agriculture among smallholder farmers in Africa by reviewing the literature on FinTech-enhanced agricultural enterprises. The results confirm that FinTech has the opportunity to become the much-needed 'support system' for sustainable agriculture in Africa, and it can help the agricultural sector of African countries to compete in global markets.

Keywords: sustainable agriculture, FinTech, financial inclusion, smallholder farmers.

Paper 37

Towards a Replicable Innovative Community-Based Ethnographic Tool for Adaptive Local Weather Forecasting Using Indigenous or Traditional Indicators to Strengthen Local Agro-Weather Resilience at Scale.

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Abstract

This paper presents lessons of a replicable innovative community-based adaptation (CbA) decision support tool for strengthening emerging traditional knowledgebase and participatory scenario planning for community-oriented resilience to climate shocks. The tool was conceptualized under two training-of-trainers (ToT) initiatives on Climate-Smart Agriculture (CSA) in East Africa from March 2016 to December 2021. The objective was to strengthen local capacity of smallholder farmer leaders, agribusiness value chain partners, and field extension agents on the practical applications of indigenous climatology. The aim was to build local momentum for consensus-based ethnographic weather monitoring, local weather forecasting and agro-weather advisory development for adoption by local stakeholders to improve agro-climatic extension service delivery. Most of this indigenous technical or traditional knowledge (ITK) is now getting lost due to climate change and loss of institutional memory but little effort is being made to identify and document emerging ITK. It is therefore important to develop innovative approaches to bridge the gaps by retrieving what is left of weather prediction ITK that are still useful. This local level climate and weather information generation addresses the challenges of salience, access, legitimacy, equity and integration of climate information to meet users' felt needs. The study adopted a transdisciplinary, participatory learning and action research model to identify and confirm emerging local weather indicators and what they mean for local rainfall forecasting, and to drive self-organization processes to bring indigenous climate knowledge into practical use in each community. The tool emphasizes transdisciplinary production of local weather forecasts and agro-weather advisories using consensus-based ethnographic weather indicators to improve climate information services and extension service delivery. Testing and validation were conducted with 1,184 participants among various communities across Kenya, Tanzania and Uganda. Results comprise identified ethnographic weather prediction indicators per locality, both celestial and environmental or biophysical, and their implications for local weather forecasting, which for the first time is presented in probabilistic terms which the locals associate with, and which compares with conventional weather forecast language. Lessons from the process underscore the importance of community-based climate and weather forecasting using ITK, and to provide actionable agro-climate/ agro-weather advisories with appropriate lead times for local response. The description of the emerging state of local community ethnographic, indigenous and traditional rainfall prediction indicators provides a basis for strategic local seasonal planning and operational farm management decision-making based on the agro-ecological potential and socioeconomic circumstances. Evidence from this work is currently being packaged for sensitization to influence policy reforms and decision-making at various levels among relevant stakeholders in the region.

Keywords: Rainfed, climate risk, folklore ITK, community-based, early warning, lead time, planting window.

Paper 38

Financing Adoption of Climate Smart Agriculture Among Smallholder Rice Farmers in Osun State, Nigeria.

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Abstract

Application of climate smart agriculture (CSA) technologies being context-specific is premised on integrating agroclimatic and socio-economic conditions, institutional structures, and most importantly, financing mechanisms vis-à-vis the adoption capacities of the farmers. This study examined financing adoption intensity of CSA technologies among sampled smallholder rice farmers in Osun State, Nigeria. The results of this study point to the fact that gender of household head, marital status, access to climate information, access to off-farm income, access to cooperative and access to credit were the determinants of level of adoption of CSA technology amongst the smallholder rice farmers in the study area. In view of the nexus between CSA adoption level and access to credit as revealed in this study, increasing awareness about how the credit market works and information on the provision of climate change can help farmers to better adapt to climate change. This significant impact of the credit accessibility on level of CSA adoption confirms the critical role that credit availability has in climate financing. Thus, agricultural policies to improve institutional support, such as involvement in farm-based cooperative, credit facility, and off-farm income activities, are crucial to upscale CSA adoption in the study area. The income from non-farm activities can be reinvested into farm operations to improve farmers' adaptive capacity and subsequently increase productivity. It could also be recommended that policies enhancing and strengthening institutional support may also be valuable in augmenting the adaptation strategies of smallholder farmers.

Paper 39

Using Gender-Land Rights to Increase Climate-Resilience Among Smallholder Farmers in Least Developed Countries (LCDS).

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Abstract

Studies have shown that gender inequalities exist in land rights globally. However, the extents to which equal gender-land rights increase climate-resilience has not received adequate attention. Hence, this paper investigates the underlying trajectories of power-relations in land use, control and transfer of ownerships between men and women smallholders in the LCDs. The study adopted a mixed-sequential design and used mainly secondary data retrieved from the Food and Agricultural Organisation (FAO). The study used descriptive statistics and content analysis and presented results on graphs and in quotes. The study found that Africa and the Middle East had a higher gender discrepancy than Asia and Latin America because of low enforcement of gender-land rights and climate change advocacy. The study concluded that gendered land right is the future of climate-smart agriculture (CSA) in the LCDs. The study recommends a bottom-top approach to the enforcement of gender-land rights and climate change advocacy to increase climate-resilience among smallholders in the LCDs..

Keywords: climate adaptation strategy, cassava processing and storage, Orashi river, Ogwuaniocha community, microbial flora, flavour compounds.

Paper 40

Yield Response of Sorghum to Micronutrient-Fortified Fertilizer in the Savanna Agroecological Zone of Nigeria.

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Abstract

Sorghum is an important staple food crop in many sub-Saharan African countries, with Nigeria being a leading producer. However, its productivity is being hampered by soil fertility constraints and inappropriate fertilizer use in the producing states in the savanna agroecological zone of Nigeria. Matching nutrient supply with crop nutrient requirements through site-specific and crop-specific fertilizers could optimize crop yield while reducing nutrient losses to the environment. Thus, a two-year field study was conducted to assess the yield response of sorghum to two Sorghum Specialty Fertilizer Formulations [SFF1 (NPK11:22:21+5%S+0.7%Zn+0.5%B) and SFF2 (NPK14:31:0+9%S+1%Zn+1%B)] produced from soil test recommendations. Both formulations were compared against the widely used NPK 20:10:10 in a randomized complete block design across three savanna agro-ecologies. Data were collected on stover yield and grain yield using standard procedures and subjected to analysis of variance using the General Linear Model Procedure in SAS. Across two years of study, both specialty fertilizers significantly ($p < 0.05$) increased stover yield by 32% (SFF1) and 18% (SSF2) relative to NPK 20:10:10. Similarly, grain yield was consistently higher in SFF1 and SFF2 by 16% and 12% than NPK 20:10:10, even in low soil moisture conditions, with agronomic efficiency being in the order of SFF1 > SFF2 > NPK 20:10:10. Our results show both specialty fertilizers, with low amounts of nitrogen and an adequate supply of potassium and micronutrients via soil test recommendation, could help farmers increase sorghum productivity while minimizing nitrogen losses under varying agro-ecological zones.

Keywords: Soil fertility, blanket fertilizer application, sorghum, specialty fertilizers, agronomic efficiency

Paper 41

Adaptation Capacity of Indigenous Sheep Breed to Saline Lake Drinking Water in Dry Area of Ethiopia Under Climate Change Scenarios.

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Abstract

Climate change-induced salinization and scarcity of water is a growing global phenomenon that poses new threats to farm animal production and productivity, particularly in dry regions. However, the adaptation capacity of livestock to water stress depends on species, breeds, and environmental situation. Therefore, the current study aimed to evaluate the adaptation capacity of local sheep breed to drinking lake water salinity levels based on their growth performance, behavior, physiology, and blood constituents under an intensive management system in Haramaya University, eastern Ethiopia. A total of 28 lambs were categorized into four groups based on their initial body weight with eight replicates and allocated into levels of water salinity, namely freshwater (510mg/l TDS (Total Dissolved Solids), 2600mg/l TDS, 5200mg/l TDS) and 7900mg/l TDS). The current results revealed that increasing TDS levels in lake Basaka water varies water intake watering frequency, time spent on drinking, inactive behavior, and, increased rectal temperature and respiration rate. Additionally, the concentration of blood hemoglobin, glucose, albumin, urea, triglycerides, sodium, triiodothyronine, enzymes of alanine, and aspartate aminotransferases were changed with slightly decreased thyroxine hormone. No significant difference was observed in dry matter intake, digestibility, body weight, packed cell volume, red and white blood cell, total protein, cholesterol, creatinine, chlorides, potassium, magnesium, and calcium. Generally, the Hararghe-highland sheep breed was adapted to water with a high salt level (7952mg/L TDS) with some notable physiological changes, indicating that increased salinity beyond the level in the present study may affect animal welfare and productivity.

Keywords: blood, performance, physiology, water quality.

Paper 42

Empowering African Scientists in development of livestock nutrient requirement and greenhouse gas emissions tracking system.

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Abstract

One of the main opportunities for improving livestock productivity and developing low emissions production system is better matching diets with nutrient requirements of animals and ration formulation tools. In recent years significant progress has been made through the Global Research Alliance on Agricultural Greenhouse Gases (GRA) to develop global databases of diet information and associated greenhouse gas emissions. In Africa, there is still a shortage of information on available feeds as well as their nutrient composition and associated greenhouse gas emissions, making ration formulation and assessment of emissions a challenge. Additionally, most ration formulation software are written in English and mostly appropriate for livestock in temperate climates. Therefore, there is a need for a region-specific decision support tool based on available feed resources and in the language of the end-user in Africa.

A committee of Africa based researchers will work together with University of California, Davis (UC Davis) and other collaborators in the GRA in development of ration formulation and emissions tracking system. The UC Davis team developed such a system for cattle in Amharic (Ethiopia) and small ruminants (Burkina Faso) However, the software and mobile app needs to be extended to various regions of Africa that includes building a feed database.

Building a regional decision support and emissions tracking system will enhance productivity and reduce methane intensity associated with livestock production. African scientists will take ownership and continue its development in successive generations of researchers from the continent.

Paper 43

Climate-Smart Agriculture as an Innovative Socioeconomic Sector for The National Economy.

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Abstract

Since its inception and definition in 2010, Climate Smart Agriculture (CSA) has grown speedily and been accepted throughout the world as being the only solution to the challenges posed by a rapidly changing climate for local agriculture and food production. On one hand, transforming agri-food systems to achieve sustainable food security while also contributing to global climate goals is a pressing need throughout the world, and on the other hand, countries are in quest of finding innovative sectors that can contribute to the national economy.

Mauritius has embarked on a transformative project to transform an entire farming community into a CSA one, with financial support from the European Union and the Government of Australia. This farmer participatory project has several axes: implementing CSA practices at field level, building an empirical evidence base for CSA, contributing to the creation of CSA policy frameworks, strengthening national and local capacity in CSA, creating options for climate financing and safety nets for farmers, and creating an innovative socioeconomic platform that has CSA at the center.

Each of these axes has been formulated into a Work Package that ensures the desired output and outcome. The innovative CSA socioeconomic platform is the first of its kind in the world, and groups (i) farmers that grow vegetables and fruits using CSA practices, (ii) a national certifying body that certifies the vegetables as being CSA-grown, (iii) upmarket hotels that uses the CSA- certified value-added vegetables and fruits in their sustainability branding, (iv) extension staff that provide the necessary backstopping to the CSA farmers, and (v) researchers that provide the tested CSA technologies to the farmers. It represents a multiple win for all concerned.

Keywords: Climate Smart Agriculture, socioeconomic sector, innovative platform.

Paper 44

Applied Climate Smart Agriculture Approach for Agricultural Development to African Food Security and Sustainability of Agriculture as well as Adaptation Future Climate Changes.

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Abstract

Climate Smart Agriculture is a production system which or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent feasible, Climate Smart Agriculture systems rely on crop rotations, crop residues, animal manures, and good agriculture practices.

Climate Smart Agriculture is a highly knowledge-based technique for manipulating complex agro-ecosystems, for breeding locally adjusted seeds and livestock, and for producing on-farm fertilizers and inexpensive nature-derived pesticides. Such knowledge is a crucial 'reservoir of adaptations. In particular: "Within agriculture, Climate Smart Agriculture holds an especially favorable position, since it realizes mitigation and sequestration of carbon dioxide in an efficient way. Climate Smart Agriculture production has great mitigation and adaptation potential, particularly with regard to soil organic matter fixation, soil fertility and water-holding capacity, increasing yields in areas with medium to low-input agriculture and in agro-forestry, and by enhancing farmers' adaptive capacity. Paying farmers for carbon sequestration may be considered a win-win-win situation as (a) carbon dioxide is removed from the atmosphere (mitigation); (b) higher organic matter levels in soil enhance their resilience (adaptation), and (c) improved soil organic matter levels lead to better crop yield (production). Agriculture is both affected by climate change but also contributes to it. As a sector, agriculture must therefore both adapt to changes and offer options for mitigation, i.e., reducing greenhouse gas emissions and storing carbon.

Climate-smart agriculture is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. Widespread changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor. Climate change disrupts food markets, posing population-wide risks to food supply. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. CSA promotes coordinated actions by farmers, researchers, private sector, civil society and policymakers towards climate-resilient pathways through four main action areas: (A) building evidence; (B) increasing local institutional effectiveness; (C) fostering coherence between climate and agricultural policies; and (D) linking climate and agricultural financing. Climate Smart Agriculture differs from 'business-as-usual' approaches by emphasizing the capacity to implement flexible, context-specific solutions, supported by innovative policy and financing actions.

To conclude, Climate Smart Agriculture is a productive agro-ecosystem which might be very resilient and adaptive to climate change scenarios.

Key Words: Climate Smart Agriculture – Sustainable of Agriculture – African Countries - Climate changes

Paper 45

Climate adaptation Strategy for Cassava Processing and Storage by a Niger Delta Community in Nigeria.

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Abstract:

Ogwuaniocha is a Niger Delta community in Nigeria facing climate challenges (notably periodic flooding of crop farms), environmental pollution and resource conflicts due to oil exploration activities. The Orashi (Olasi) river serves all purposes for this community (drinking, waste disposal, washing and storage of cassava mash). Preliminary research was conducted to investigate the adaptation of cassava farmers to periodic over flooding of their farms. Climate smart adaptation measures for cassava farming and processing involved: harvesting of cassava before the flooding period; processing the cassava and storing it at the river bank. Cassava fufu was the most commonly consumed in households (63%). Over 60% of the farmers fermented their cassava tubers in the river for 3-4 days and up to 20% stored their fermented cassava mash at the river banks for 6-12 months from where they periodically collect portions for consumption and for commerce. About 2% of the farmers use alum or salt additives for storage. Microbial flora of freshly prepared cassava mash were Enterobacter, Bacillus, Fusarium, Lactobacillus and Trichoderma spp. The major volatile compounds associated with the cassava flour processed from the mash were: hexadecanoic acid methyl ester; 11, Octadecenoic acid, methyl ester; 14-Octadecenoic acid methyl ester; Trans-3-Octadecenoic acid methyl ester.

Key words: cassava processing and storage, climate smart adaptation strategy, esters, flavour volatiles in cassava flour, microbial flora of cassava mash, Orashi River, over flooding, over flooding.

Scientific Papers

Theme 4

Paper 46

Scaling up Climate-Smart Agriculture adoption through action research: Lessons from the Agriculture Centre of Excellence Methodology

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Abstract

The empirical literature on the adoption and impact of Climate-Smart Agriculture (CSA) technologies in smallholder farming communities shows that there is a gap in possible scaling up models for such productivity-enhancing innovations. To address this, the Zimbabwe Agriculture Knowledge and Innovation Project (ZAKIS) established Agricultural Centres of Excellence (ACEs) to coordinate market-oriented, demand-driven research, education, and extension as replicable proof-of-concept models. This study examines the role of the Agriculture Center of Excellence (ACE) methodology in strengthening action-oriented research and diffusion of CSA technologies by extension and advisory services. The study further identifies priority challenges and capacity-strengthening needs of the ACES for them to sufficiently deliver market-oriented and demand-driven action-oriented research. A cross-sectional survey of 402 households, 16 community focus group discussions, and over 20 key informant interviews in four districts of Zimbabwe was done to gather evidence. Findings show that over 60% of the farmers are aware of the ACES and over 40% have visited the ACEs for services such as training or exchange visits and field days. More than 70% highlighted that the ACE showcased CSA technologies and indicated that they had high satisfaction levels with the training provided and had the opportunity for hands-on practice and feedback from researchers and extensionists. Challenges noted however included limited availability of regular training, longer distances for some farmers, and limited market linkages for produce. In order to strengthen market-oriented and demand-driven action-oriented research, ACEs need to involve farmers, extensions, and researchers in problem analysis, proposing solutions, implementation, and evaluation of the interventions. An action-oriented research guideline is proposed for the ACEs.

Paper 47

Strategies for Extension and Advisory Services to Promote Climate Smart Agriculture Among smallholder Farmers in Eastern and Central Africa

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Abstract

Africa is one of the most vulnerable and least adapted countries to climate change. The increasing climate variability as well as extreme weather events such as droughts or floods hit the economy hard, reduce food production, increase food prices, and contribute to an already vulnerable food security situation. This scenario is specifically extensive among small holder farmers in East and Central Africa who typically work at a subsistence level with inadequate financial resources, access to infrastructure, information, and knowledge, further exposing them to climate and market-related risks. Even though a range of CSA technologies including Sustainable Land Management have been promoted, the rate of adoption is less than 30 percent. This is attributed to limited capacity in extension and advisory services to enhance CSA compliance. The objective of this paper is to share strategies for strengthening extension and advisory services to promote CSA among small holder farmers. These strategies were generated through undertaking a bench marking exercise with ASARECA member NARIs to promote peer to peer learning and exchange of knowledge and information. Findings from the outcome assessments of these interventions (benchmarking exercises) show increased skills and knowledge of participants in different innovation areas, promoted knowledge sharing and exchange of innovations and technologies. The envisaged strategies to improve adoption include; (i) invest in strengthening institutions to promote mindset change among policy makers and communities regarding the benefits of promoting CSA innovations in value chains, (ii) provide appropriate incentives or instruments to enhance adoption of CSA (iii) improve and strengthen knowledge management and; (iv) invest in early warning systems, surveillance and forecasting. Development of CSA innovations alone is not enough but using strategies to strengthen capacity to ensure wide spread adoption among small holder farmers is pertinent to enhance community resilience to climatic shocks.

Keywords: Climate Change, extension and advisory services, knowledge management.

Paper 48

Impact of Climate Change on Food Security in Uganda: A Panel Regression Analysis

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Abstract

Globally, food security remains a pertinent issue that requires urgent attention. The predicament is enormous in sub-Saharan Africa that has been registering the highest increase in population of people facing hunger. Climate change affects food security through constraining on-farm production. This results into reduced production capacity and hence low incomes for farming communities. This study used two food security proxy indicators: number of meals taken per day and self-reported food shortages. Many previous studies used cross-sectional data, many of which had a regional feel, and few studies investigated the relationship between climate change and food security using panel data econometric procedures. We use 3 waves of Uganda National Panel Survey data. The fixed effects, random effects and panel fixed effects logit models were employed to study the impact of climate change on food security. The empirical analysis revealed that climate shocks reduced the number of meals taken per day by 0.11 although the effect was not significant (P=0.109). Residing in the Eastern region increased the number of meals taken per day by 0.19 and the effect is significant (P=0.011). In contrast, residing in the Northern regions reduced the number of meals taken per day by 0.06 as compared to living in the central region although the effect is not significant (P = 0.521). In addition, residing in urban areas increased the number of meals taken per day by 0.21 and the increase is significant (P=0.013). Household size increased the number of meals taken per day by 0.03 and the effect is significant (P=0.012). Therefore, climate change is causing food insecurity among farming households in Uganda and the most affected households live in the Northern region. Implying, the government of Uganda and development practitioners should deliberately design more climate change adaptation interventions to ameliorate the status quo. Most importantly, development practitioners undertaking climate change adaptation extension projects should explore other indicators, beyond number of meals taken per day to capture robust impact outcomes.

Keywords: Climate change, Food security, Fixed effects, Random effects, Panel logit, Uganda.

Paper 49

Practical CSA Strategies That Farmers in Eastern & Southern Africa Can Use to Cope or Adapt to Changes in Seasonal Rainfall

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Abstract

Climate change threatens to undo decades of agricultural development efforts especially in Eastern and Central Africa (ECA). From a food security perspective, sub-Saharan Africa is arguably the most vulnerable region to many adverse effects of climate change such as droughts, floods, and extreme temperatures due to a very high reliance on rainfed agriculture for basic food security and economic growth, and entrenched poverty. A shift in rainy seasons negatively affects water availability for agricultural production leading to reduced crop and pasture yields but also distorts the cropping calendar.

In response to changes in the frequency, timing and intensity of seasonal rainfall, smallholder farmers are using a combination of these Climate smart agriculture (CSA) technologies, and management practices (TIMPs): (i) Agroforestry (ii) Rain Water harvesting and storage (iii) Soil and water conservation practices, (iv) Switching crops and crop varieties, (v) Integrated pest and disease management (vi) Crop and farm intensification (vii) Fodder making & storage (viii) Use of ICT for mapping prone areas (ix) Seed priming and fertilizer micro-dosing. Since CSA contributes to increased household food security, climate mitigation and adaptation. And bearing in mind that some CSA practices are already practiced by smallholder farmers in the ECA region at small scale scales, there is need to scale-up CSA practices where evidence of impact is plenty. Continuous documentation of evidence and impact of CSA practices on household food security needs to be enhanced.

Keywords: ASARECA, Climate Change, Agro-forestry, Crop intensification.

Paper 50

Factors Influencing the Adoption Intensity of Climate-Smart Maize Varieties Among Rural Farming Households in Southern Guinea Savannah of Nigeria

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Abstract

Farming techniques in sub-Saharan Africa are not improving at the same stride with the advancement of modern agriculture practice. The resultant effects are obscene and foulest recital in agricultural productivity which culminate in food insecurity, impoverishment and a deprived national economy. This paper examines the determinants of intensity of adoption of Climate-Smart Maize Varieties (CSMVs) in the Federal capital territory of Nigeria, using secondary data (IITA SRMV's data). The study used descriptive statistics to analyse the socio-economic characteristics of respondents and a double hurdle model was used to analyse the intensity of adoption of CSMVs. The results indicate that the level of awareness was 47 percent, while the adoption rate was 53 percent. The results further indicate that age, contact with the extension agent, and marital status significantly influenced the intensity of (CSMV) adoption.

The study recommended that adequate policies and development programs for promoting the use of climate-smart maize varieties in Nigeria should be directed towards input and output delivery, land under climate-smart maize varieties, extension service provision, affordable credit, education, and mechanism that are more effective as well as youth-oriented initiatives. Furthermore, farmers should be encouraged to join groups (farmer groups, cooperatives) in order to build their social capital, which could expose them to better practices, obtain informal training from those who have adopted them, and obtain help for implementation.

Keywords: Adoption, Climate-smart maize varieties, intensity, extension access, Double hurdle.

Paper 51

Elite Drought-Tolerant Varieties Can Reduce Maize Yield Penalties in Intercrop Systems

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Abstract

Intercropping maize with legumes can improve net productivity; however, significant yield penalties for maize have been observed, especially under drought conditions. We hypothesise that these yield penalties could be reduced by growing elite drought-tolerant maize cultivars. We evaluated the productivity of three maize cultivars [CZH131011 and CZH131014, elite drought-tolerant and SC634, a local check] intercropped with cowpea across three contrasting environments [High potential – Domboshava (DB), Mid potential – University of Zimbabwe (UZ), Low potential – Chibhero (CH)] in Zimbabwe and across five growing seasons [2014/15 to 2018/19]. Seasonal rainfall variability and drought were analysed across the environments, examining the inter-seasonal rainfall distribution using the 3-monthly standardized precipitation index (SPI) and standardized precipitation and evapotranspiration index (SPEI). Maize yield stability within the intercrop and across the site and season interactions with cowpea yield and plant population; the relationships between the drought indices were then assessed. Rainfall analysis showed that the 2015/16 and 2018/19 seasons experienced severe drought (SPI < -1.5 and SPEI < -1.3) conditions during growing months. High yields (6.6 t ha -1) were observed for CZH131014 at UZ for most seasons except when there was a severe drought, in which case CZH131011 performed better. Intercropping did not affect the productivity of the elite maize cultivars. However, the cowpea plant population had a negative (-0.56) and significantly ($P<0.05$) relationship with maize grain yield. Under severe drought, the cowpea-maize yield ratio was significantly ($P<0.05$) higher than when seasonal rainfall was at or above average. It is recommended to reduce plant populations of cowpea in such systems to improve overall productivity under severe drought conditions.

Paper 52

Assessing Cereal Nitrogen Use Efficiency in Eastern and Southern Africa

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Abstract

In eastern and southern Africa (ESA), significant variations in cereal production from smallholder farms have been attributed to high inter and intra-seasonal rainfall variability, a lack of fertilizer inputs and nutrient-poor soils. Using an ensemble of three models (DSSAT, STICS and Celsius), the study assessed the spatial and temporal variations in maize, millet, sorghum and rice yield and nitrogen use efficiency (AEN) in response to different management options. Models for each crop were calibrated with measured grain yield, plant biomass, leaf area index, and in-season soil water content (SWC) from field experiments established across the ESA region. The models were then applied to simulate cereal yield responses across ten contrasting agro-ecologies in response to management scenarios of mulching, planting dates and N input (0, 100, 200 kg ha-1) levels. Calibrated models for the four cereals simulated grain yield variations within reason (average relative root mean square error of 34%, respectively). We showed that the ensemble had higher accuracy than the individual models' results. Planting early improved yield and increased AEN in low rainfall environments. More significant variations in simulated yield and lower AEN were observed for environments in the southern than the eastern region of Africa. Yields of maize and sorghum were more responsive to mulching than millet and rice, especially in the southern environments. Improving water availability can improve AEN; however, too much water may cause leaching of N and result in AEN reduction. The modelling approach can be used as an advisory tool for farmers and extension in the region.

Paper 53

Implications of Climate Data application for the Enhancement of Extension Services delivery to Smallholders Farmers in Tanzania

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Abstract

Like other developing countries, Tanzanian's economy is highly dependent on agriculture, with a high percentage attributed to smallholder farmers. About 68% of Tanzania's workforce engages in agriculture, and 83% is attributed to smallholder farmers. The agricultural sector contributes about 28% of the country's GDP and 24% of the total exports. However, the current climate change trends affect the agricultural sector in several ways. For example, these changes include changes in rainfall and temperature patterns that greatly affect smallholder farmers' livelihood in terms of productivity, food security and incomes. On the other hand, climate-smart agriculture is an approach that helps people who manage agricultural systems to respond effectively to climate changes. Therefore, this study will present the institutional setup and integration of information asymmetry of climate data among extension service providers and smallholder farmers in Tanzania. First, we have examined the mode of flow of climate information from the Tanzania Meteorological Authority to the key stakeholders, including the agricultural sector. Second, we analyzed the awareness and integration of the climate information on the extension services delivery system. Lastly, we assessed the knowledge, attitude and practical use of climate data by the smallholder farmers in Tanzania.

Moreover, we have identified the effect of the climate change information breakdown on the productivity, incomes of the farmers and food security. Furthermore, we have recommended policies to strengthen national and local institutions toward sustainable agriculture by linking climate change data with institutions and human resources engaged in extension service delivery to the smallholder farmers in Tanzania.

Keywords: Climate-smart agriculture, climate data, extension services delivery, smallholders' farmers.

Paper 54

Comparative Analysis of Factors Affecting Fertilizer Supply and Use by Smallholder Farmers in Ethiopia, Nigeria and Uganda

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Abstract

The problem of inorganic fertilizer demand and supply in SSA is multifaceted as multiple factors impact it. This study attempts to identify factors that may explain differences in the supplies of fertilizers to smallholder farmers across different countries in three other countries – Ethiopia, Nigeria and Uganda. Panel data were collected from these countries between October and December 2019 from consumers (i.e. smallholder farmers) and fertilizer suppliers using structured questionnaires. Data collected were subjected to summary statistics and multivariate ordinary least stage regression analysis. Factors influencing fertilizers supplied to smallholder farmers varied across countries. Across the three countries, the size of farms (ha) was one of the determinants of fertilizer supplied to these farmers. In Ethiopia, factors that determined supplies of fertilizers to farmers were farm size, access to credit and total farm income, and in Nigeria, years of farming experience, size of the farm, and access to credit facilities, while in Uganda, these factors were a number of years in school, farm size, total income/season. Pooled results showed that these factors would influence fertilizer supplied to these smallholder farmers – household size, number of years in school, source of income, access to subsidy, ability to hire transport to move products and total income/season. The study concludes that increasing attention to supply-side factors in the use of inorganic fertilizer is an essential element that the three countries must continue to pay attention to help smallholder farmers gain access to inorganic fertilizers at the lowest cost, at the right time, and in the correct quantity to increase crop production, and reduce poverty.

Key words: Ethiopia, Inorganic fertilizer, supply chains, Nigeria, Uganda.

Paper 55

Assessing Indigenous Knowledge, Uses and Nutritional Value of Adansonia digitata, Cochlospermum spp. and Moringa oleifera in the Era of Climate Change

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Abstract

Climate change is impacting the dietary needs of Africans through changing agricultural resources and adoptions of technologies in farming systems. Besides, local food resources are known to play an important role in rural community livelihoods. This review aims to document empirical data on the indigenous knowledge, food and nutritional value of Adansonia digitata, Moringa oleifera and Cochlospermum spp. Data on these review aspects are collected using a numerical approach. The results show that the different parts of these plants are widely used for food and medicinal purposes. Moringa oleifera leaf powder, Adansonia digitata fruit pulp and Cochlopsermum spp. root powder are the most commonly used organs of these plants due to their nutritional value and cultural acceptability. They are used especially for food fortification and as natural food colorants (case of Cochlopsermum spp. root powder). Moringa oleifera leaf powder, Adansonia digitata fruit pulp and Cochlopsermum spp. root powder were also found to be rich in micronutrients, and their combination could be an alternative to alleviate mineral deficiencies among children aged 6-59 months. Only a few food and nutritional data are available on Cochlopsermum spp. root powder. The reported nutrient contents of different parts of these plant foods show a large variation according to the authors, which may be due to various factors. Food combination of Moringa oleifera leaf powder, Adansonia digitata fruit pulp and Cochlopsermum spp. root powder could be envisaged as a pathway to alleviate mineral deficiencies among children, and a good strategy for building resilience to climate change.

Keywords: Plant food, Nutrients, Moringa oleifera leaf powder, Adansonia digitata fruit pulp, Cochlopsermum spp. root powder, Climate resilience.

Paper 56

Experience of Smallholder Farmers on Climate Smart Agriculture on Soil Fertility and Moisture Conservation in Ludewa District, Tanzania

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Abstract

The agriculture sector is vital for economic growth, poverty alleviation, and food security in developing countries. However, the economic losses from climate change impacts on agriculture are estimated to be higher yearly. Climate-smart agriculture offers opportunities to reduce climate change losses, build resilience, improve productivity and incomes, and mitigate climate change. This paper discusses the climate-smart agriculture on soil fertility and moisture conservation practiced in Ludewa district. Methods used in data collection were semi-structured interviews, key informant interviews, and observation. A total of 355 respondents were randomly selected for this study. The collected data were analysed using IBM Statistical Product and Service Solution, and content analysis. The study revealed that smallholder farmers have diverse climate-smart agriculture practices in soil fertility and moisture conservation. These include using organic manure, mulching, crop rotation, planting, and conserving plants that store water. However, they are practiced by few farmers. This is due to lack of the requisite education, awareness, information and training to adapt to climate-smart agriculture. It is concluded that climate-smart agriculture practices are essential for smallholder farmers to reduce their vulnerability to climate change and variability. This calls for strengthening the sustainability of smart climate agriculture through ongoing capacity building, provision of extension services, and incentives to smallholder farmers for practicing them.

Keywords: Smallholder farmers, climate-smart agriculture, climate vulnerability, soil fertility and moisture conservation.

Paper 57

Fencing Lands to Enhanced Climate change Resilience, Promoting Biodiversity Regeneration and Improved Livelihoods of Climate Change in Makueni County

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Abstract
Kenya is a food insecure country, weather patterns are drastically changing, and people are losing livelihoods and earnings when their lands dry, water for domestic supply lacks and livestock die further frustrating livelihoods of the poor. This paper briefly discusses Fencing of lands as prerequisite to biodiversity protection and faster water retention mechanism, through tree planting, enhancing CO2 sequestration as trees, shrubs and vegetation's find suitable environment to grow. Baringo and Makueni County are characterized by unsustainable agriculture, environmental degradation resulting from soil erosion, high poverty levels and food insecurity due to unpredictable dry spells and climate change. The present paper illustrates that Fencing of lands improves agricultural land management practices, biodiversity growth increased soil carbon sequestration.

Keywords, food security, soil carbon sequestration, climate change, soil erosion

Paper 58

Can Climate Smart Forages Replace Concentrates in Dairy milk Production?

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Abstract

The contribution of the dairy sector to the GDP and household nutrition cannot be overemphasised. However, competitiveness and growth of the sector has largely been impeded by issues relating to access to quality feed in sufficient quantities due to the effects of climate change. Consequently, the use of concentrates has been rampant, but their availability and quality are highly variable, and costs are prohibitive for most resource constrained farmers. Therefore, use of high-quality nutritive forages such as Lucerne, Pearl millet, Sugar graze sorghum and forage maize to mitigate against supply and quality as a pliable pathway that would reduce the need for concentrates. This study aimed to analyse the technical efficiency of using these forages. Cross-sectional data on farm and farmer characteristics and factors of production collected from 410 small-scale dairy farmers sampled from Kericho, Nakuru and Uasin Gishu counties were used to estimate Stochastic Production Frontier simultaneously with a technical inefficiency model, while Tobit regression model was used to assess the factors associated with technical inefficiency. The empirical results indicated that the dairy farmers had a mean of 63.27 % technical efficiency, in addition the frontier exhibited increasing returns to scale and that farm technical inefficiencies are positively related to the quantities of concentrates, dairy production system, and farming experience. Improving farmers access to key agricultural resources would increase the local availability of reliable climate-resilient forage for dairy cattle. Ensuring all year-round quality feed supply will reduce the need of concentrates thus improving dairy productivity while reducing the costs of production.

Paper 59

How are Rural Women Crop farmers in Southern Nigeria Coping with Climate Change?

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Abstract

Women constitute 75% of agricultural workforce in Nigeria yet suffer marginalisation in accessing information and resources. Despite the fact that they are more exposed and vulnerable to climate change, they are less represented in climate change initiatives in the country hence their needs scarcely addressed. The need to understand their strategies to adaptation and challenges faced hence proffer relevant advisory services that better address their felt needs prompted this study.

The study assessed adaptive strategies and constraints to climate change adaptation among rural women crop farmers in Southern Nigeria. Four hundred and twenty rural women crop farmers were selected for the study using multi-stage sampling procedure. The study employed a mixed method approach of data collection to ensure holistic data comprising both qualitative and quantitative was collected for the study. Descriptive statistics and Varimax rotated factor analysis was employed to describe the data collected. Majority (91%) of the rural women interviewed were married with mean age of 48years. Average household size and farming experience was 5persons and 13years respectively. Five major climate change adaptation strategies used by the rural women crop farmers as shown by the Varimax rotated factor analysis were soil and crop management practices (Factor 1), use of indigenous knowledge and socio-economic practices (Factor 2), Land-based and water management practices (Factor 3), financial management practices (Factor 4) and use of herbicides and pesticides (Factor 5). The major challenges experienced by the rural women in adaptation to climate change were found to be poor state feeder roads for easy access to markets ($\bar{X}$ = 3.84), financial incapacitation ($\bar{X}$ = 3.76), non-functional government climate change adaptation frameworks ($\bar{X}$ = 3.57), unavailability of needed resources and inputs($\bar{X}$ = 3.52), low knowledge and capacity to adapt ($\bar{X}$ = 3.51), barriers and limitations placed on women by traditional beliefs ($\bar{X}$ = 3.37), inadequate government support ($\bar{X}$ = 3.32), relegation of women needs in community development projects and programmes ($\bar{X}$ = 3.22), crude/traditional storage methods and facilities ($\bar{X}$ = 3.19) and unfavourable land tenure system ($\bar{X}$ = 3.11). Understanding and recognizing the key role of women in adaptation initiatives by government agencies, non-governmental agencies and private sector could inspire more programmes that could help build the rural women adaptive capacity to climate change impacts as well as their ability to overcome adaptation challenges.

Keywords: gender-responsiveness, adaptation responses, soil and crop management, gender barriers

Paper 60

Assessing Household Socio - Economic Factors Affecting Smallholder Farmer's Investments in Climate Smart Agriculture Practices in Eastern Cape Province, South Africa

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Abstract

Climate change would likely pose significant challenges to agricultural productivity. Such adverse climate change effects may result in a greater incidence of crop pests, loss of soil moisture content, rapid soil nutrient depletion, substantial decrease in crop productivity and yields. Climate-Smart Agriculture (CSA) is one of the solutions that simultaneously address the issues of climate change and agricultural productivity. Inadequate attention has been paid at socio-economic factors affecting smallholder farmer's investments in climate smart agriculture in rural communities and the adaptive capacity of the smallholder farmers. The present study aimed to assess the socio-economic factors affecting smallholder farmer's investments in climate smart agriculture in Eastern Cape Province of South Africa. The study made use of a mixed method design combining qualitative and quantitative approaches. A sample of two hundred farmers were selected for the study. Findings revealed overwhelming awareness of CSA practices with low level of investments in CSA technologies among smallholder farmers. The results from Ordinary Least Square Regression indicate that Number of years in school, farming experience, access to credit, climate change information, and access to extension services were significantly affects smallholder farmers investments in CSA. The study concludes that for successful transition to CSA in rural communities' governments need to consider indigenous knowledge system-based climate change support and interventions to empower farmers with capacity to withstand climate change challenges. The study recommends scaling up of CSA finance in rural communities through provision of low-cost inputs, extending credit to farmers through direct loans or establishment of community financing operation.

Keywords: Climate smart agriculture, Smallholder farmers, Climate smart agricultural finance, Productivity, Eastern Cape.

Paper 61

Public-Private Extension and Advisory Systems and Climate-Smart Agriculture: Evidence from West Africa.

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Abstract

The population of sub-Saharan Africa is growing at an alarming rate, which has put a strain on the region's farmland, water, and infrastructure. This is even exacerbated by changing climates and the vagaries of weather and climate. Small farms that use resource-intensive technology produce a significant portion of the region's food. As agriculture becomes more difficult to sustain, smallholders cannot feed an expanding population while still conserving and preserving the environment. Climate-smart agriculture can achieve these objectives more efficiently than conventional agriculture. Surprisingly, the continent's adoption of new technologies and farming methods is slow. Numerous government and non-government organization programs have been created to bridge the information gap and educate farmers on new technologies and farm management practices that can boost productivity and yield.

This paper examines the relationship between climate-smart agriculture and access to public and private extension services in West Africa. Longitudinal data from Ghana, Mali, and Nigeria are used to study how smallholder farmers' use of climate-smart agricultural practices differs based on their access to extension services. Here, we differentiate between private and public extension services and see which one matters more for climate-smart agriculture. Exploring the nature of the dataset, we use the Mundlak Chamberlain device (correlated random effect model) and other panel data econometric methods. We find that farmers with access to extension services are more likely to use climate-smart agricultural practices such as crop rotation, intercropping (alternating groundnuts with cereals), and using high-yielding and disease-resistant varieties. These relationships hold true across both public and private advisory systems. In addition, agricultural training can account for the positive relationship between farmer advisory systems and climate-smart agricultural practices. In this regard, smallholder farmers and the environment may both benefit from a combination of public and private advisory systems.

Paper 62

Resilience and Yields Under Climate-Smart Agriculture: Panel Evidence from Ethiopia

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Abstract

Extreme weather events continue to have huge impacts on agriculture in many parts of the world. While a burgeoning literature has examined and established that agriculture could have immense impacts on climate change through the release of greenhouse gases, little empirical work investigates the impact of climate change on agriculture which forms the basis of most livelihoods in developing nations. In this paper, we investigate the relationship between adaptation to climate change, and its impact on land productivity and yields. We begin by estimating the impact of rainfall anomalies (shortfalls and surpluses) on land productivity and yields. Given the extended dry seasons in many arid and semi-arid regions of Africa especially in some of the study countries, climate-smart agricultural practices such as improved crop varieties have been developed that are tolerant to these droughts and heat stresses and could survive and lead to higher yields in these production systems. Besides these improved crop varieties, conservation agriculture has been proposed as a crucial climate adaptation strategy for climate change. In the next step, we examine whether households adopt these improved varieties and conservation agriculture practices based on previous rainfall shocks and anomalies. We also examine if the adoption of these improved varieties and conservation practices delivers on their intended mission (of building resilience to climate change) and leads to productivity and yield increases.

Adoption of these drought-tolerant improved varieties and conservation agriculture has been shown to be generally low in many rural settings despite the benefits they offer to farmers. One reason that has been attributed to this dismal outcome is the lack of information. Digital tools and innovations have the power of relaxing this information constraint faced by smallholder households. In the final step, we consider the impact of the role of the provision of climate information on the adoption of drought resistance improved varieties and yields. In the study countries, farmers belong to cooperative groups where they can update their information base and acquire different sorts of information that could stir them to adopt improved varieties that have the potential to build their resilience to climate change. Moreover, some weather-oriented digital tools have been developed in these countries that provide farmers with weather information as a way of nurturing and guiding their behaviors and outcomes.

This paper uses a three-wave panel from Ethiopia for which we observe the cultivation of maize, barley, and wheat, important staple crops, and priority crops under the cluster-based development initiative of the government. We use different panel and pseudo panel estimators like the household fixed effect estimator, random effect estimator, and the correlated random effect estimator to control for unobserved heterogeneity associated with establishing the relationship between our variables of interest. Beyond associations at the mean, we also perform some quantile regressions to understand the association between adoption and different quantiles of the conditional distribution of yields. We find that climate-smart agriculture matters for productivity and yield increases especially under rainfall shocks. Moreover, digitalization and climate information matter for driving the adoption of these climate-smart agricultural practices

Paper 63

Assessing the Impact of Climate Change on the Farming System

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Abstract

Frequent drought induced by climate change, deforestation of natural vegetation, land degradation due to intensive cultivation of farmlands and conversion of marginal lands into crop cultivation, soil erosion, and shortage of water for domestic and irrigation purposes are major natural resource-related constraints of the communities in the Watershed. These constraints have, in turn, caused chronic, very low production and productivity of crops, malnutrition and human health problems leading to loss of biodiversity and food/water insecurity for the livelihood of the community. Climate change impacts and the suitability of potential land resources are crucial for sustainable irrigated agricultural systems.

The topography, rainfall, soils and vegetation coupled with the archive farming systems combine to accelerate the rates of both, reflecting the magnitudes of land degradation and deterioration of the environment. Therefore, this research study applied a multi-criteria analysis supported by the GIS application and aimed to identify the vulnerable agricultural areas to droughts to a different extent and to understand the present situation in the area in terms of coping capability, the physical condition of the measures, operational regulation, and institutional management policy.

Keywords: Drought, Climate change, deforestation, and productivity.

Paper 64

Optimum Planting Dates and Season Length for Climate Change Adaptation in Maize for Kano, Nigeria

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Abstract

Maize is a staple crop in Nigeria and most of the cropping is under rainfed farming. Climate variability affects rainfall variability affecting yields. Research on climate change adaptation in maize through use of low-cost strategies such as optimum planting dates is therefore important. The study was based in Kano, a maize belt in Northern Nigeria. Historical climate data (1980-2020) from NASA was inputted into the DSSAT crop model. A series of plantings and simulations were undertaken at scale (10km2) every 10 days (1 May to 31 August), each year. The date with the highest yields each season was the optimum planting date. The season length at scale was computed through the difference in commencement and termination of rainfall. The optimal planting dates ranged from 20-May to 29-June. This was more notable in 1985, 1990, 1995, 2010, 2015 and 2020. In 2000 and 2005, optimal planting dates were delayed and ranged from 29-June to 8-August. The season length was shorter in Northern compared to Southern Kano. The season length in Northern Kano ranged from 80-110 days, making it suitable for short to medium season varieties. In contrast the season length was 110-130 days in southern Kano, which is suitable for medium to long seasoned varieties. In conclusion there is need to use of different varieties to ensure considerable yields across the state. Similarly, use of optimum planting dates will lead to high yields. There is need to include seasonal forecasts in determination of the optimum date and season length.

Keywords: planting date, crop model, at scale, season length, variety.

Scientific Papers

Theme 5

Paper 65

Using Radiation-Induced Novel Genetic Diversity to develop pest-resistant Maize in Central African Republic

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Abstract
Maize is a major crop feeding 80% of the population of the Central African Republic (CAF). However, the country is not yet self-sufficient in its maize need and continues to rely partially on imports. Exacerbating this situation is the recent invasive spread of the fall armyworm attributed to change in weather patterns since 2016 which has been decimating the crop leading to drastic yield losses. Various control measures continue to be tested globally for the control of FAW, including chemical control, biological control using microbial organisms and predatory insects that attack FAW, use of genetically modified crops with Bt genes, and integrated pest management. However, the use of developing genetic resistance in maize against the pest remains under-explored. We focused research on initiating a mutation breeding effort in maize in CAF.

2000 seeds on four varieties (CMS 87 04, CMS 20 19, CMS 85 01, ECOTYPES LOCAUX) sending for irradiation to Vienna. 200 seeds are bulk to irradiation with different doses (100 Gy, 200 Gy, 300 Gy, 400 Gy and 500 Gy). The test of germination is carried out on 200 seeds four varieties. The treated seeds are sown at equal depths in a tray filled with soil/compost or can as well sow in natural condition on the field just to assure that the soil surface is flat, and the treated seeds are sown at equal depth containing the five treatments in rows of 200s seed each for one control and each treatment. Per assay three replicates are performed, one tray per replicate. Fourteen days after sowing, the seedling height and survival is measured to determine the Growth Reduction Value 50 or GR50.

All seeds from different doses (CMS-20 19, CMS87 04 and the Local ecotype) were germinated from different doses (100Gy, 200Gy and 300Gy) and did be presented the symptom of FAW. However for the CMS85 01, all seeds from different doses (100Gy, 200Gy, 300Gy; 400Gy and 500Gy) were germinated as the control, but the major of plants are attacked by the FAW (Fall Armyworm).

Keywords: Host resistance, Zea mays, Fall Army Worm (FAW).

Paper 66

Dissemination and Adoption of Sustainable Soil Management Technologies Among Farmers; Advances in Climate Smart Agricultural Practices in Nigeria

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Abstract

The study identified the Sustainable Soil Management (SSM) technologies disseminated by Extension agents and adopted among farmers through Research-Extension-Farmer-Input Linkage System (REFILS) activities. This was with a view to determining the appropriateness of these SSM technologies for the advancement of Climate Smart Agriculture in the region.

A total of 380 respondents comprised of 44 extension agents and 336 farmers were purposively sampled across the four Agricultural Development Programme (ADP) zones in Oyo state for this study. Findings identified a total of 24 SSM technologies categorized as Soil Erosion Control, Soil Nutrient Management, Minimum Soil Disturbance, Water Management Techniques, Vegetation Management and Agroforestry System to have been disseminated and adopted among the farmers. Some of the technologies were perceived to be appropriate by the farmers based on the ease of application, ecological, economic and socio-cultural benefits.

It is concluded that the farmers' perceived appropriateness of the technologies disseminated influenced their efforts towards involvement in activities that would promote the widespread adoption. These technologies should therefore be prioritized by SSM implementers to achieve the targeted advances in Climate Smart Agriculture (CSA). Adoption of the identified and appropriate SSM technologies should be promoted among the farmers as a necessity for the transition to CSA.

Keywords: Climate-Smart Agriculture, Sustainable Soil Management, Appropriateness, REFILS, Dissemination, Adoption

Paper 67

Structural and Functional Composition of Macroinvertebrate Communities as Indicators of Livestock Disturbance of Streams and Rivers in Agropastoral Rangelands

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Abstract

Although the structural and functional macroinvertebrate community's composition have been utilized as indicators of ecological integrity and ecosystem functioning in streams and rivers, the trait-based method is less studied, especially in the seasonal Afrotropical streams. Both humans and livestock rely on riverine ecosystems in arid and semi-arid areas as primary water sources. Studies on impacts, monitoring and management of livestock influences on ecological health of these seasonal systems are thus necessary. The use of macroinvertebrate traits as indicators of water quality and ecological integrity of streams in different livestock production systems (LPS) was studied in Bura and Wundanyi rivers of Taita Taveta, Kenya. Macroinvertebrates were sampled from 18 sites: Free Range (high livestock density), Mixed Farming (medium livestock density), and Zero Grazing (low livestock density). Five FFGs (collector-gatherers, collector-filterers, scrapers/grazers, predators, and shredders) were used to categorize the sampled macroinvertebrates. The results show that macroinvertebrate traits such as having body armor (shells), climbing and crawling abilities, and large body sizes (>20 mm), were associated with mixed farming and zero-grazing. Characteristics like having tegument/cutaneous respiration, soft bodies (no armoring), burrowing ability, spherical body shape and a detritus preference, small body sizes (>5-10 mm), and preference for the filter-feeding mechanism were linked to free-range systems. This study shows that the trait-based approach can be used to biomonitor riverine systems that have been disturbed by livestock. Further trait classification and a more robust trait-based biomonitoring study would improve the sensitivity of the indicators to other forms of disturbance in these streams.

Paper 68

Unraveling the Effect of Secondary and Micronutrients on Potato Yields and Profitability Under Variable Climatic Conditions in Rwanda

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Abstract

Soil deficiency in secondary and micronutrients is one of the major causes of low potato yield in Rwanda. This has consequently resulted in low agronomic efficiency of NPK fertilizers and unsatisfactory economic returns from fertilizer investments by smallholder farmers in the country. Field experiments were conducted during the cropping seasons 2018A, 2018B, 2019A and 2020B in 13 districts representing the diverse agro-ecological and variable climatic/weather conditions for potato production in Rwanda. The experiments were set up in three provinces including: northern province (Musanze, Burera, Gakenke, Rulindo, Gicumbu) with moderate rainfall; and western (Rubavu Ngororero, Rustiro, Nyamasheke, Karongi, Nyabihu, Nyamagabe) and southern provinces (Nyaruguru) with high rainfall regimes. The experiments comprised of six treatments consisting of recommended dose of NPK fertilizer and its combination with secondary (Ca, Mg, S) and micronutrients (Zn, B, Cu). Results revealed that application of secondary and micronutrients increased potato yields and significantly surpassed the current recommendation. In Rubavu and Musanze districts where the soils are volcanic with moderate rainfall, the best treatment was made of the blend of 12.8N+26.2P+17.5K+2.9S+0.3Zn+ 0.1B+0.1Cu, which recorded a yield increase of 13.2% and a value-cost ratio (VCR) of 8.9. In the acid soils which cover the remaining district sites, the best treatment was 12.8N+26.2P+17.5K+ 2.9S+0.3Zn+0.1B+0.1Cu with application of dolomite (110kg ha-1 Ca and Mg 55kg ha-1) applied one week before planting. The later recorded a yield increase of 20.8% and a VCR of 9.7. The results of this study highlight the need for policy support for the research on secondary and micronutrients and for blending them in currently used fertilizers.

Keywords: Variable weather conditions, balanced crop nutrition, potato yield, economic return.

Paper 69

Smallholder Farmers Adoption of Climate Smart Livestock Production: Practices, Status and Determinants in Hidebu Abote Woreda, Centeral Ethiopia

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Abstract

Livestock production plays an important role in Ethiopian economy. However, climate change presents a range of challenges for animal in the country. Livestock production is affected by human population pressure and menace of climate variability. The adoption of climate smart livestock production practices is considered to be an innovative solution to the challenges. This study is aimed to identify the status of adoption and analyze the determining factors and challenges in adopting Climate Smart livestock production practices in HidabuAbote Woreda, NorthShewaof Oromia National Regional State, Ethiopia. Three-staged sampling techniques were used to select the targeted area and sample household respondents. A total of 233sampledhouseholds were selected using simple random sampling method and household survey was conduct with pre-tested structured questionnaire. Key Informant Interviews and Focus Group Discussions were also conducted to complement the study. Various descriptive and inferential statistic techniques were applied to analyze the collected survey data. Ordered logistic regression model wasalso used to analyze the determinant factors which affect the adoption status of the sampled household.Descriptive result shows that the mostly adopted practices are composting (85.41%) and manure management (70.39%) while the least adopted technologies were bio-gas generation (3.86%) and rotational grazing (22.32%).Theadoption status of the sampled household were also categorized into low (19.74%), medium (67.81%) and high adopter(12.45%).High cost of improved breed, use of manure for fuel, free grazing and lack of information and awareness are the major constraints to adopt technology. The result of ordered logistic regression revealed that education, grazing land,total livestock holding and extension contact contributed significantly and positively to adoption status, while distance from water source weed had a significant and negative effect adoption status of climate smart livestock production practices. From the result,it could be concluded that livestock farmers having more grazing land, higher educational level, more livestock holding and good extension contact are more likely to adopt climate smart livestock production practice whose water source are far from their home are less likely to adopt climate smart livestock production practices in the study area. The policy measures derived from the results include livestock raring should get more attention, increasing the frequency of extension contact, improving grazing land practices, expanding education, and providing sufficient water supply for the farmers to improve the adoption status of climate smart livestock production practices.

Keyword: Adoption, Climate Smart, Constraints, Hidabu Abote,Livestock, Ordered Logit

Paper 70

Physiological and Behavioural Adjustment of Livestock to Climate Change: Coping Mechanisms

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Abstract

Livestock species have varied greatly in the degree to which they demonstrated coping mechanisms through adjustment of various physiological and behavioural activities. Therefore this paper focused to highlight various physiological and behavioural adjustments upon which animal is used as a coping mechanism to excessive change of climate condition. Physiologically, ruminants have demonstrated high adaption to heat load through enhanced respiratory, sweating rates, shift in body temperature, vasodilation of skin capillary bed to enhance blood flow to the skin periphery for facilitating heat transfer to the surrounding, secretion of corticotropin-releasing hormone (CRH) from hypothalamo-pituitary-adrenal axis (HPA axis), adjustment of haemoglobin levels, shifting of some antioxidant enzymes and formation of heat shock proteins to protect enzyme systems for the animals retain their original thermal set points. Among the most profound behavioural changes seen in heat stressed animals in an attempt to ameliorate thermal stressed animal is shade seeking, reduced feed intake, increasing water intake, increasing standing and decreasing lying time, pattern and orientation of lying or standing. It could be concluded that animals employed different coping mechanism through physiological and behavioural changes to adapt heat load to some degree without caretaker assistance.

Keywords: Behavioural, Physiological, Adjustment, Livestock, and Climate Change

Paper 71

Spatio-Temporal Dynamics of Greenhouse Gases (GHGs) Emissions from Watering Points along Livestock Production Systems in Taita-Taveta, County, Kenya

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Abstract:

Livestock access and use of rivers and their riparian areas during watering, feeding and crossing have significant influence on greenhouse gases (CO_2, CH_4, and N_2O) emission. Through stamped, defecation and urination, they contribute to change in stream morphology and nutrients loading which drives GHG emissions in Agropastoral streams. Sampling was done in Bura and Wundanyi catchments three times from December 2021 (wet), February 2022 (dry) and May 2022 (dry). Eighteen sampling sites categorized into low livestock density (sites, n = 6), medium density sites (n = 4) and high-density sites (n=8) selected. At each sampling site, triplicate water samples were collected for nutrients analysis and instream sediments for carbon stock while CO_2, CH_4, and N_2O samples were collected by headspace equilibrium method. Based on livestock densities, CH_4 and CO_2 fluxes varied significantly with the livestock production system while N_2O was significant in dry river bed. There was significant difference FBOM, DOC, Nitrates TSS, POM, SRP and Temperature. DOC, temperature and FBOM found to be associated with CH_4 and CO_2 emission while nitrates and ammonium fuel N_2O emission. Livestock access to streams and rivers increases GHGs emission from aquatic ecosystem hence need to adopt technology to handle livestock related GHGs emission.

Keywords: Greenhouse gases (CO_2, CH_4, and N_2O), Livestock, Afromontane (low livestock, high human density, mid-livestock high human density, high livestock low human density)

Paper 72

Towards Exploring Development Intervention of Three Key Pillars of Climate-Smart (CSA) Agriculture as Options for Livestock Farmers

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Abstract

This paper explore negative impact of climate change in livestock, provides insights and novel approaches of development intervention through increases livestock productivity, modern ways of mitigation of greenhouse gases emissions and developing strategic approaches to livestock with tolerance and adaptation mechanisms to climate change as a three key pillars component of climate-smart agriculture. This review extensively highlighted the recommendations of animal scientist from various disciplines in ameliorating the climate change impact in livestock production such as animal nutritionist (feeding pattern, nutritional alternative to depress methanogenesis without affecting ruminal parameters and modification of rumen physico-chemical conditions with the aid of various strategies, use of ionophores, organic acids, plant extracts and use of probiotics), Animal breeders (through selection and breeding of animals with tolerance ability to harsh climate condition, use of molecular genetic alteration of animal to speedily cope with climatic condition), Animal environmental physiologists (Monitoring pen environmental temperature and humidity with designing modern housing that will provides animals with ventilation, automated control of animal manure/litter, artificial cooling and use of other novel approaches to ameliorate thermal stress), Pasture agronomists (through changing farmers attitude of grazing, reduce GHG emissions, introducing grass and legumes species into grazing land that enhance carbon storage in soil), and better waste management through the use of covered storage facilities, recovery of re-usable and recyclable materials from animal waste. It is therefore, concluded that there is urgent need for animal scientist to further intensified their effort with robust ideas of mitigating climate change, need for policy framework programme for breeding and developing animals that are better not only in adaption to climate change but provides maximum productivity.

Paper 73

Heat Stress Management in Bean (Phaseolus vulgaris) through Nitric Oxide and Trehalose Interventions

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Abstract

Ambient temperatures are predicted to rise in the future owing to several reasons associated with global climate changes. These temperature increases can result in heat stress-a severe threat to crop production in most countries. High temperatures during the reproductive growth stage result in a reduction in pod and seed set in bean due to enhanced abscission of flower buds, flowers, and pods.

Two filed experiments were carried out to study the effects of Trehalose and Nitric oxide (NO) via leaf sprays to investigate how to reduce the heat stress on bean plants and to improve growth and yield of bean under late sowing conditions.

The obtained results indicated that vegetative growth, chemical composition of leaves, setting, yield and its components as well as seed quality parameters responded positively to different of trehalose and nitric oxide treatments. Foliar application with either nitric oxide or trehalose proved superiority as compared with the control in most studied parameters. The best values of vegetative growth, chemical composition, setting, seed yield and germination were achieved when plants sprayed with nitric oxide at 80 ppm in both growing seasons. Thus, this treatment could be recommended to improve common bean plants performance under similar conditions of this study.

For obtaining high seed yield and quality of bean plants under late cultivation condition (high temperature) it could be recommended that, plants should be sprayed with nitric oxide at 80 ppm three times during the growing season at 3, 5 and 7 weeks after sowing

Keywords: bean; high temperature; heat stress; nitric oxide; trehalose.

Paper 74

Yield Performance and Estimates of Genetic Analysis of Drought Tolerant Provitamin a Maize Under drought Stress and Rainfed Conditions

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Abstract

Breeding for climate smart and nutritionally enhanced maize hybrids are crucial in mitigating the threat posed by recurrent drought on maize production as well as tackling malnutrition with plant-based food products. This study was conducted to elucidate the mechanisms of inheritance of drought tolerance of provitamin A maize under drought stress and also assess the yield performance maize hybrids under drought and rainfed conditions. A total of 24 inbred lines from CSIR-Savanna Agricultural Research Institute Maize Improvement Programme gene pool were selected and intermated using North Carolina II mating design to generate 96 single cross hybrids. The 96 hybrids together with four hybrids checks were evaluated under drought and rainfed conditions for two years at Wenchi and Agortime Kpetoe using a 10 x 10 lattice design with two replications. The results indicated that, the hybrids as well as general combining ability (GCA) and specific combining ability (SCA) for grain yield and its related traits were significant. Even though additive and non-additive gene actions controlled the inheritance of the traits, additive gene action was found to be important than non-additive genetic effects. Hybrids 68, 91 and 26; and 89, 18, and 26 were identified as the outstanding genotypes under drought and rainfed conditions, respectively. Yield reduction up to 65% was recorded due to drought stress. These superior hybrids identified under drought from the present study should be extensively evaluated at multiple locations and consequently commercialised to combat the effects of drought stress on maize production in Ghana and sub-Saharan Africa at large.

Keywords: Hybrid, drought tolerance, combining ability.

Paper 75

Genetic variation in Germplasm for a Rice (Oryza sativa L.) Improvement Program for the Eastern Democratic Republic of Congo based on Yield and Yield Components

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Abstract

Genetic variability between yield with its components are critical for a yield crop improvement program. Forty-nine rice (Oryza sativa L.) genotypes were evaluated for genetic variability in the germplasm for yield and yield contributing traits and drought tolerance in Eastern DRC. The field experiment was conducted following a 7x7 partially balanced lattice design in two locations, each with three replicates. Data were collected on fourteen traits, yield, and its components. The analysis of variance revealed significant differences among the genotypes for all the traits indicating the existence of wide genetic variation within the germplasm used and giving the possibility of yield and water use improvement to breeders. The variation was explained by four PCs accounting for 78.7 % of the total variation. High GCV than ECV was observed for traits such as days to flowering, days to maturity, plant height, panicle length, number of spikelet, number of filled grains/panicle, panicle weight, 1000 grains weight, grain width, and grain length to grain width ratio showing the dominance of genetic expression over environmental effects. Moderate to high heritability and genetic advance exhibited by grain width, number of spikelet number of filled panicles, plant height, panicle length, 1000 grains weight, days to flowering, panicle weight, number of productive tillers, number of primary branches. This indicates that these characters can be improved through selection. Grain yield reflected a highly significant and positive correlation with the number of productive tillers per hill, panicle weight, number of primary branches per panicle, number of filled grains per panicle, and number of spikelets per panicle. Breeders should consider this information when selecting parents for grain yield improvement using this germplasm and come up with high yield and climate smart varieties.

Keywords: Climate Smart, Drought tolerance, Rice, Genetic variation, Yield components.

Paper 76

Assessing Climate Smart Agriculture Practices on Livelihoods, Farm Income, Food Security and Food Safety in Ghana

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Abstract

The growing rate of food shortages due to climate change and climate variability has exacerbated the food security and food safety concerns for significant peri-urban and urban population. Worse still, the adoption of some climate smart agriculture practices are perceived as part of the problem rather than sustainable solutions. This study, therefore, assessed climate smart agriculture practices on livelihoods, farm income, food security and food safety in Ghana.

The study employed cross-sectional design, and mixed research methods. The survey instrument contained sub-sections on experience of climate change and climate variability; adaptation and mitigation practices; crop losses and productivity; resilience strategies adopted as well as food security and food safety indicators. The study sample is made up of 474 crop farmers from four urban and peri-urban centers in Ghana (Accra, Kumasi, Tamale, and Wa). The quantitative data were analysed using descriptive statistics (frequencies and percentages) and inferential statistics (multiple regression analysis). The qualitative data were content analyzed.

The result showed that climate change and climate variability have impacted on the livelihoods, income, and food security statuses of farmers. Climate smart agriculture practices (adaptation, mitigation, and resilience) have significant and positive effect on the income and food security statuses of farmers. However, there are growing concerns on sources of irrigation water used in dry season farming as vegetables produced using water from drainages or contaminated water sources is perceived as unsafe. Hence, this situation has implications for dietary balance, dietary diversity, and health status of consumers. Therefore, climate smart agriculture practices (especially dry season vegetable farming) in urban and peri-urban centers of Ghana should consider ecological and social sustainability issues of the agricultural and food production systems.

Keywords: Climate smart agriculture, Food security, social sustainability, Urban and peri-urban, Ghana.

Paper 77

Influence of Enriched Rice-Husk Biochar on Soil Quality, Growth and Yield of Cucumber (Cucumis sativus) on an Utilsol in Epe, South-West Nigeria.

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Abstract

Biochar is an organic matter that has undergone combustion under low to no oxygen conditions,

has gained global attention as a soil amendment due to its carbon sequestration, soil quality enhancement, crop productivity and climate change mitigation potentials.

The experiment was carried out at the Teaching and Research Farm of the Department of Agricultural Technology, Yaba College of Technology, Epe Campus, Lagos, Nigeria. The objective was to study the influence of biochar made from rice husk and its potential as a soil amendment in acid soils. Rice-Husk Biochar (RHB) was produced by pyrolysis at the University of Ibadan; after which it was enriched with decomposed poultry manure and applied as a soil amendment at 0 t/ha, 20 t/ha, 30 t/ha, 35 t/ha and 40 t/ha. Data collected were pre and post planting soil analysis, plant height, stem girth, number of leaves, flowers and fruits, fruit weight, water holding capacity amongst others.

While 20 t/ha of enriched RHB produced significantly higher yield than control (0 t/ha), results ranks plots treated with 30 t/ha enriched RHB superior to other treatments and not significantly different from 35 t/ha. Post-harvest soil pH and water holding capacity were considerably increased in all plots except control.

It was concluded from the study that Rice Husk Biochar, when used as a soil amendment has the potentials to conserve soil moisture and raise the pH of soil. When enriched with poultry manure at 30 t/ha, it can significantly improve the yield of cucumber planted on acidic soils.

Paper 78

Optimizing Climate-Smart Aquaculture for Sustainable Catfish Production in Nigeria

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Abstract

Food security is a major developmental issue in Africa; it has a huge social and economic effect on people. In Nigeria, the population explosion has contributed to food and nutritional insecurity; protein consumption is grossly insufficient in the diet of a larger percentage of the population. The availability and heightened cost of protein-rich food has been attributed to the incidence of climate change. Climate change is fast affecting the aquaculture industry in Nigeria, especially catfish production which accounts for over 70% of cultured fish. This study used a mixed-method technique comprising of a review of published literature in the last 10 years as well as an analysis of secondary data from the public repository to identify plausible adaptation practices to ensure sustainable production of catfish in Nigeria. The study indicated that changing weather pattern tends to affect the biology of the catfish leading to reduced growth, poor feed conversion, and incidence of new diseases. The adaptation measures include the use of Best Management Practices (BMPs) in fish farming; the adjustment of pond stocking time; the use of PVC materials for rearing fish; planting of trees around pond areas for shade and increasing the fish stocking rate during the rainy season among others. Increased capacity-building efforts for fish farmers on climate change adaptation practices would play a key role. Research efforts to develop catfish breed with tolerant traits to adverse pond water conditions is also important.

Keywords: Optimising, climate Smart Aquaculture, African catfish, Nigeria.

Paper 79

Soil Physical and Chemical Properties as Affected by Land Configuration and Cow Dung Manure at Minna, Niger State, Nigeria

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Abstract

A 3 x 3 factorial experiment was carried out under rain-fed condition at the Federal University of Technology Teaching and Research Farm, Minna to determine the effect of land configuration (ridge, flat-bed and mound) and cow dung manure application rate (0, 5 and 10 t/ha) on soil physical and chemical properties. Treatments were laid out in a randomized complete block design and replicated four times. The land was ploughed and grown to Oba super 1 maize variety. Soil moisture content was determined at 3, 6, 9 and 12 weeks after planting. Following crop harvest, other soil physical (bulk density, total porosity, and moisture content) and chemical (organic carbon, available phosphorus, exchangeable calcium, magnesium, potassium and sodium) properties were determined. Data generated were subjected to statistical analysis at 0.05 level of significance. Flat-bed configuration resulted in higher soil moisture content than ridge by 12 %. Also, 5 and 10 t/ha of cow dung manure gave rise to significantly ($P \leq 0.05$) higher moisture content than 0 t/ha by 30 and 23 %, respectively. Flat-bed treatment resulted in significantly highest soil organic carbon, available phosphorus, exchangeable magnesium, and potassium content. Also, planting on flat-beds and mounds gave rise to higher exchangeable sodium content than planting on ridges. Application of 10 t/ha cow dung manure produced highest soil available phosphorus, exchangeable magnesium, and potassium content. Interaction between land configuration and cow dung manure application rate had significant influence on soil organic carbon, exchangeable magnesium, potassium, and sodium content.

Keywords: Land configuration, cow dung manure, soil physical and chemical properties.

Paper 80

Soil Properties as Affected by Crop Residue Management Practice at Minna, Niger State, Nigeria

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Abstract

A field experiment was conducted at the Teaching and Research Farm, Federal University of Technology, Minna, in the Southern guinea savanna agro-ecological zone of Nigeria. The treatments consisted of method of crop residue application (surface application and incorporation) and rate of application (0, 10 and 15 t/ha), laid out in a randomized complete block design and replicated four times. Maize (Oba Super 1 variety) was used as the test crop. Soil samples were randomly collected at 0 – 15 and 15 – 30 cm depths after crop harvest. Soil physical and chemical properties were determined. Data collected were subjected to analysis of variance at 0.05 level of significance. Results obtained from this study indicated that incorporation of crop residue resulted in significantly ($P \leq 0.05$) higher soil total porosity, organic carbon, available phosphorus, exchangeable calcium, magnesium, potassium and sodium content than surface application. Also, soil chemical parameters increased significantly with rate of application of crop residue. Fifteen t/ha application rate gave rise to the highest soil organic carbon, available phosphorus, exchangeable calcium, magnesium, potassium and sodium contents, while zero residue treatment produced the lowest amount of the soil chemical parameters determined in this study. Combination of incorporation of crop residue and 15 t/ha application rate gave rise to highest soil exchangeable potassium and sodium content. Thus, it could be concluded that returning crop residues back to the soil, especially by incorporation, increases soil nutrient status, and has potential to increase crop growth and yield for sustainable food security.

Keywords: Crop residue management, method and rate of application, soil chemical properties.

Paper 81

Climate Smart Agriculture and Soil Fertility Mapping: Nigeria Soil Information Service (NiSIS) Pilot Project

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Abstract

Inherently low soil fertility constitutes threats to agricultural productivity and ecosystem in Nigeria, with the changing climatic conditions disrupting current land use systems; with sustainability depending on interactions between climate, land management and policies that enable or undermine them. The rapidly growing population (projected to ~262.6 M by 2030) will require substantial increases in either productivity per unit cultivated land area and/or expansion to meet food demands. There is an urgent need for accurate, and spatially geo-referenced soil fertility mapping using recent techniques to support agricultural development. The NiSIS pilot project assessment aims to provide spatially explicit measurements and predictions of nutrient levels, for main crops grown in the cropland areas of Ebonyi and Kebbi states, Nigeria. The main geographical region of interest (ROI) for this assessment (1590 sampling locations) were identified based on the geosurvey (https://geosurvey.qed.ai) of Nigeria. Using the AfSIS field protocol, geographically matched (using R-script and grid layers) composite topsoil (0-20cm) and subsoil (20-50cm) were collected in circular 100m2 plots. All the field observations were recorded in Open Data Kit forms, using preprinted QR code labels for uniquely identifying individual soil samples; and samples were analyzed with mid-infrared (MIR) spectroscopy. The assessment provided a key reference point for evaluating changes and impact on the current distribution of essential macronutrients and micronutrients in soils; and established a statistical baseline for comparing yields before-and-after nutrient interventions. The approach can be readily expanded to include CSA validation trials, thereby enhancing interpretation of largely disconnected case studies.

Keywords: NiSIS, nutrient mapping, croplands, climate smart agriculture, Nigeria.

Paper 82

Adaptation Strategy to Climate Change and Variability for Sorghum (Sorghum bicolor L. Moench) Production in Forest-Savannah Agro-Ecological Zone of Nigeria.

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Abstract

Climate change and variability have far reached consequences on smallholder farmers in developing countries. Timely planting is critical for maximizing yield of sorghum (Sorghum bicolor L. Moench). In order to determine the optimum planting date for good growth and yield of sorghum, three planting dates were selected at two weeks interval. This research was conducted during the growing season of 2021 at the Laboratory for Geoecology and sustainable food systems (GeoLab), Federal University of Technology Akure (7□15'N, 5□15'E) and Institute of Agricultural Research and Training (I.A.R&T.) Ibadan (7□22'N; 3□.30'E), both within the forest-Savannah eco-climatic zone, Nigeria. The varieties of sorghum used are, Samsorg-44, Deko and Zauna-Inuwa. Planting spacing used was 75cm by 30cm. Variables measured include plant height, number of leaves, leaf area, number of grains/head, grain weight/head and grain yield. The three planting dates selected for are 28th June (d1), 12th of July (d2) and 26th of July (d3). The experiment was laid out with spilt plot design with variety of the crop as main plot and days of planting as sub-plot treatment. Generally, the plant growth and yield parameters decreased with delayed planting irrespective of location and variety of sorghum planted. Yield obtained for Samsorg-44, Improved Deco and Zauna-Inuwa planted in Akure are 2.23 tons/ha, 2.74 tons/ha and 3.8 ton/ha respectively, while 1.96 tons/ha, 2.36 tons/ha and 3.12 tons/ha respectively were recorded in Ibadan. While recommending planting is best done at the onset of rains in forest-savannah agro-ecology of Nigeria, planting should not be delayed beyond mid-July.

Keywords: Climate change, Adaptation strategies, planting dates, agronomic characteristics, sorghum, sustainable crop production.

Paper 83

Characterization of Chemical Composition and Availability of Pastures in Pastoral and Agro-pastoral Production Systems of Uganda: Tackling Barriers to Enteric Methane Inventorying Using the Tier-2 Approach

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Abstract

Pasture quality is an important factor that influences enteric methane (CH_4) emissions, and hence among the key requirements for using the IPCC Tier-2 approach to estimate enteric CH_4. In Uganda, enteric CH_4 accounts for over 68% of CH_4 emissions (MWE, 2019), with the bulk coming from pastoral and agro-pastoral livestock. The IPCC (2006) recommends a Tier-2 approach for source categories that make a significant contribution to a country's GHG emissions. However, there is a lack of data on feed characteristics (i.e. chemical composition, intake and digestibility), which is a key requirement for using the Tier-2 approach. This study, therefore, characterized the chemical composition and availability of pastures in pastoral and agro-pastoral systems of Uganda.. Data on pasture chemical composition and availability were collected from pastoral and agro-pastoral areas of Uganda (Nakasongola, Moroto, Gulu, and Mbarara to represent the Central, Karamoja, Northern, and Western regions). The pastures were analysed for dry matter (DM), crude protein (CP), and fiber contents. The data were analysed using the PROC MIXED procedure of SAS (2003) with the production system and season as fixed factors, and study farms as a random factor. Chemical composition was similar ($P>0.05$) across regions (Table 1). Agro-pastoral pastures tended ($P=0.058$) to have higher CP content, while NDF content was similar ($P>0.05$). For ADL, pastoral pastures exhibited a higher ($P<0.05$) content only in northern Uganda, but similar across the other regions. The season-production system interaction effect on DM yield was non-significant ($P>0.05$). DM content was higher ($P<0.05$) in the dry season for all the production systems (Table 2). There was a tendency for higher (agro-pastoral; $P=0.090$) and higher (pastoral; $P< 0.05$) fresh herbage yield for the wet season. However, DM yield was similar between the seasons for all the systems. Pasture availability score by farmers (Fig. 1) matched the bimodal rainfall pattern of the study areas (March-May and September-November, being the rainy months). Although there was no difference in DM yield, there was a trend for higher CP content for agro-pastoral than pastoral pastures, which points to better agro-pastoral pastures, and hence higher likelihood for lower contribution to the national enteric CH_4 inventory.

Paper 84

Crop Residue Utilization Practices in Peri-Urban Dairy Cattle Systems in Kisumu County, Kenya

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Abstract

Crop residues are common means for improving soil fertility and crop production but can also have negative impacts to the environment. Effective utilization of crop residue is key to reducing greenhouse gas (GHG) emissions in peri-urban dairy cattle systems where a lot of waste is generated. In Kenya, there is limited research on the utilization of crop residue thus making assessment of GHG mitigation strategies a challenge. Therefore, there is a need for site-specific information on available crop residue and their uses. This would contribute to the development of nationally appropriate mitigation action in Kenya. The study assesses the effects of crop residues utilization practices on GHG emissions in peri-urban dairy cattle systems. The study was conducted in Kisumu County where 380 households practicing mixed crop-livestock farming selected using multi-stage sampling technique were interviewed using structured questionnaires. The study results indicate that the main type of crop residues available in the study area are green maize stovers (41.0%), dry maize stovers. (16.8%), and banana residue (7.2%) that are commonly used as livestock feed. The use of crop residues as feed for livestock is good because it promotes nutrient cycling and also converts non-useful material into dairy products.

Paper 85

Factors Influencing the Adoption of Climate Smart Agricultural Technologies Among Root Crop Farming Households in Nigeria

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Abstract

The variability and change in climatic factors have impacted greatly on food production in Nigeria. The adoption of climate smart agricultural (CSA) approach by root crop farmers is critical to sustainable food production in the face of climate change impacts. The study identified CSA technologies adopted by root crop farmers as well as examined socio economic factors that influence the adoption these technologies among smallholder root crop farmers in Nigeria. The data obtained were analyzed using descriptive statistic and Tobit regression analysis. The CSA technologies adopted by the root crop farmers in the study area include use of irrigation (12.62%), having diversity of production streams through livestock ownership (51.54%), crop rotation (87.03%) and use of improved crop variety (19.45%). Agricultural climate smart adaptation decisions were influenced by farm size, age, access to credit, level of education and ownership of means of transport. Based on the result, it was recommended that financing institutions should enhance access to credit to rural households for those who need them most and minimize financial exclusiveness. Also, educational campaign and awareness on climate smart agricultural activities should be embarked on so as to uplift the consciousness of root crop farmers on CSA technologies. More so improved root crop varieties are required for sustainable food production and food security in Nigeria.

Keywords: Root crop, climate smart, Production, and Smallholder.

Paper 86

Modeling Climate Change Adaptation Practices for Sorghum (Sorghum bicolor (L.) and Wheat (Triticum aestivum L.) Production in Ethiopia

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Abstract

Agriculture, in Ethiopia, is well-known by its high reliance of rainfall system, poor technology adoption and high exposure of climate change impacts. Because of this, the impact is more serious and devastating which needs more attention to reverse the impact. Recently, advanced tools and approaches have been used widely to precise farming practices to reduce climate-induced risks. In this case, Decision Support System for Agro-technology Transfer, and global climate models were used to investigate impacts and to evaluate adaptation practices for sorghum and wheat production in northern Ethiopia. CERES-Sorghum and CERES-Wheat cropping system models were calibrated and validated using field data sets obtained from Enderta and Kobo districts. Two early maturing sorghum varieties (Teshale and Melkam) and one wheat (Mekele-1) cultivars were considered. According to the result, yield is expected to be varied spatially and temporally for the two sorghum varieties. The projected mean yield of sorghum is expected to decline in a range of 1.2-23%. Teshale variety is highly sensitive to environmental change from the baseline climate at Kobo and Sirinka. On the other hand, regardless of rainfall variation, a rise in temperature up to 3oC would result an increase in yield by 2.3-13.8% for melkam variety. In addition, the rise of atmospheric CO2 by 540 and 750 ppm from the current level would result an increase of yield from 4.5 to 6.9% for sorghum and up to 25.7% for wheat. Mid-June planting is expected to increase a slight increase in yield for sorghum, while mid-June and mid-July planting would cause to declined wheat yield at Enderta area. In general, change in planting date would not reward wheat production under the changing climate. The expected reduction in yield is decreasing from lowland to midland and highland areas. In general, future sorghum production is expected to be negatively affected, whereas wheat production would expect a slight positive advantage according to the results. Despite model uncertainties, the adverse impacts of climate, for both crops, is estimated to be maximum by the end of the 21st century when the maximum insolation is reached to 8.5 W/m2. The results further revealed that, the ongoing food production risk will be continued to be intensified, unless appropriate adaptation plans designed. Indeed, the findings of this assessment would give an insight for policy makers, researchers, and agricultural experts how the future sorghum and Wheat production that enable them to prepare for the adverse impacts.

Keywords: Adaptation, Climate change, Impact, Sensitivity, Sorghum, Wheat.

Paper 87

Agrobacterium- Mediated Transformation of Tomato CV Arka Vikas with Cry2ax1 Gene for Insect Resistance

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Abstract

Tomato (Solanum lycopersicum) is one of the world's most preferred vegetable crops which is extensively damaged by lepidopteran insect pest, Helicoverpa armigera Hubner (tomato fruit borer). Insect pest causes serious damage in crop production, and various attempts have been

made to produce insect-resistant crops, including the expression of genes for proteins with

anti-herbivory activity, such as Bt (Bacillus thuringiensis) toxins. In order to mitigate this problem, an attempt was made to generate transgenic tomato plants resistant to fruit borer. Cotyledonary explants of tomato cv. Arka vikas were co-cultivated with Agrobacterium tumefaciens strain, LBA4404 harbouring a codon-optimised chimeric cry2AX1 gene driven by enhanced CaMV35S promoter in pCAMBIA2300 vector backbone. Seventy-six putative transgenic plants were regenerated, and the presence of the cry2AX1 gene in twenty eight plants was demonstrated by PCR analysis. ELISA showed that nine out of the fifty-eight plants had detectable level of Cry2AX1 protein expression, which ranged from 0.311 to 0.312 µg/g of fresh tissue. Insect bioassay of transgenic T0 tomato plants using H. armigera neonates recorded a mortality of 36.67 to 90 per cent and showed significant reduction in leaf feeding and inhibition of growth in surviving larvae. The results demonstrated the potential of the chimeric cry2AX1 gene in developing H. armigera resistant transgenic tomato varieties which can minimize the effect of climate change and decrease in beneficial soil flora through the use of synthetic chemicals.

Keyword: Bacillus thuringiensis, Cry2AX1, ELISA, Helicoverpa armigera, Insect bioassay

Paper 88

Climate Change Mitigation: A Case Study of Soil Biochar Influence on Morpho-physiology of Crop Species and Genotypes

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Abstract

Agriculture is estimated to contribute 40% to climate change, hence the agricultural sector has to reduce the climate change impacts intentionally. The impact evaluation or assessment can be done through the cultivation of soil, production of crops or breeding of animals. Plants account for the majority of human food and improving their nutritional status, enhances food security. Hence, making the soil more competent through the factors that influence soil organic carbon-sequestration and carbon dioxide emissions by partaking in climate smart agriculture is important e.g. adding biochar and microbial-biomass to the soil sequesters carbon to the soil, makes soil more competent, reduces to minimum carbon escape to atmosphere; and still makes crops have nutritional benefits, improving food security (yield response, cost benefits), health, poverty reduction and welfare. Also, rearing of animals (cows) contributes to global warming through the release of methane and deforestation. Therefore, contributing to climate smart agriculture through climate change mitigation; and the adoption of this practice and policy by the agriculture policy makers is crucial. In this case study, biochar was added to the soil to sequester carbon and the morpho-physiological effects on crop species and genotype were determined. At the end, the soil's improved efficiency had varying effects on barley, wheat, sorghum, common bean, and pea species; and Awash melka, Hirna and Chercher common bean genotypes; that were all determined against their physical growth, physiological and anatomical parameters and characterization.

Keywords: Climate Smart Agriculture, Soil, Biochar, Morpho-Physiology, Crop Species, Crop Genotype.

Paper 89

Drivers of Greenhouse Gas Fluxes from Zones of Afrotropical Rivers as Influenced by Different Livestock Production Systems

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Abstract

The global estimation of greenhouse gas emissions is limited by inadequate data availability especially from the Sub-Saharan Africa (SSA). The role of livestock production on the global carbon cycle has not been extensively documented in the afro-tropical savanna biomes where agro-pastoralism dominate. In the agricultural sector, however, global data estimates that 62% of CO2, 28% of CH4 and 65% of N2O is emitted from livestock production systems. Therefore, this study seeks to contribute the much-needed data on fluxes of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) from riparian zones in the agro-pastoral rangelands of Taita Taveta in Kenya. Daytime greenhouse gas emissions were studied from 18 watering points with (i) no livestock (zero) density (NLD), (ii) low livestock density (LLD) and (iii) high livestock density (HLD) using the manual chamber method during the dry and wet seasons of 2021-2022. In the wet season, HLD areas recorded the highest CH4 and N2O fluxes. This zone, additionally, recorded the lowest CO2 emissions while the NLD areas recorded the highest CO2. CH4 emissions were least in the LLD zones. In the dry season, the HLD zone recorded the highest fluxes in all cases. Negative CH4 fluxes were recorded in the NLD and LLD areas. The NLD areas recorded the lowest CO2 and N2O. In all cases, the HLD areas recorded the highest GHG fluxes while the NLD areas recorded the least GHG fluxes.

Paper 90

Soil Properties and Tomato Productivity Improvement by Use of Polyter and Turbo-Bio in Sudanese zone of Burkina Faso

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Abstract

A trial was carried out in under greenhouse at Institute of Research for the Development (IRD) in Ouagadougou to apprehend the influence of polyter and turbo-bio on one tropical ferruginous and a browned soils properties and the production of tomato. The trial was set up according to a fully randomized complete block design with 4 repetitions. Ten treatments resulting from combination of factors fertilization at five level and water stress at two level were compared. Observations focused on height growth and biomass production assessment. Soil samples were collected and some following parameters were analyzed in the laboratory: pH, moisture content, organic carbon, total nitrogen and available phosphorus.

Results showed that polyter and turbo-bio improved pH, organic carbon, total nitrogen and assimilable phosphorus of soil. Also, they induced an increase the moisture content from 2.57 to 113.41% and biomass production from 4 to 75.78% compared to the controls. In the context of global changes, polyter and turbo-bio could be an alternative for improving soil fertility and the productivity of vegetable crops in the Sudanese zone of Burkina Faso.

Keywords: soil fertility, polyter, turbo-bio, water stress, plant biomass.

Paper 91

Effects of Intercropping Sweetpotato (Ipomea. Batatas) With Pigeonpea on Productivity and Major Pests of Sweetpotato in Malawi

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Abstract

Effects of sweetpotato- pigeonpea intercrop on yield and major pest of sweetpotato was evaluated on-station at Chitala, Baka and Chitedze during 2020/21 and 2021/22 growing season. Sweetpotato was strip-cropped with pigeonpea in 1:1 and 2:1 ridge arrangement. Treatments including sole sweetpotato (Sole SP), sweetpotato+pigeonpea, 1:1 (SP+PP-1:1); sweetpotato+pigeonpea, 2:1 (SP+PP-2:1) and within-row intercrop (SP+PP-within-row) were laid out in Randomized Complete Block Design (RCBD) replicated three times. Yield data and pest's incidence were collected. Harvesting was done at two intervals: 5 and 6 months allowing more exposure to sweetpotato weevil. Data was subjected to analysis of variance using R Programming. Partial land Equivalent Ratio (pLER) was calculated to determine sweetpotato productivity. Root yield loss due to weevil damage showed significant interaction between treatments and time of harvesting at all the sites; Baka (P=0.03), Chitala (P=0.03) and Chitedze (P=0.005). At Baka, no weevil damage was recorded in SP+PP-row during both harvesting times and recorded minimal weevil damage, only 2.8% at Chitala during second harvesting. While SP+PP-2:1 interestingly reduced weevil incidence by 5% at second harvesting compared to the first. pLER for sweetpotato was > 0.5 in all treatments at Chitala and Chitedze except at Baka. Sweetpotato was highest in sole at Baka, 14.3 t/ha ($P < 0.001$) while at Chitedze, sole SP (22 t/ha) and SP+PP-2:1 (17 t/ha) did not differ. Sweetpotato intercrop with pigeonpea in some sites indicate yield advantage above monoculture and reduction of weevil incidence suggest pigeonpea intercrop as a suitable climate smart agricultural practice for sustainable sweetpotato production.

Keywords: Intercrop, Sweetpotato, Yield, Sweetpotato weevil, incidence.

Paper 92

Bio-fortification of cereal-based Sorghum using Orange Fleshed Sweet Potato for alleviating of Vitamin A Deficiency

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Abstract

Ethiopia is one of the developing countries with a high prevalence of micronutrient deficiencies and protein-energy malnutrition. Fortifying cereals through processing and conventional breeding can tackle micronutrient deficiency. Sorghum is a rich source of fiber, protein, minerals, and bioactive phenolic compounds. Substitution of sorghum flour in bread reduces the level of gluten content in bread. Wheat is a vital industrial grain for food that ranks second in the world next to rice and is traded internationally. Orange Fleshed Sweet Potato (OFSP) is a source of food that contains useful β-carotene, starch, mineral, dietary fiber, and vitamins. The inclusion of OFSP enhances the beta-carotene content of bread. This research aims to develop nutritionally rich and sensorial acceptable sorghum and wheat-based bread enhanced with orange-fleshed sweet potato. The straight dough baking method was used to develop bread. Major unit operations employed during bread baking were formulating flour, mixing with yeast containing water, kneading, proofing, knocking back, proofing, filling in greased pan, proofing, baking, cooling, and packing. All treatments were not significantly different from each other in their crude protein content. Bread developed with a maximum ratio of Sorghum flour has high ash and fiber content. The total carotenoid content of bread products ranged from 0.154mg/100g to 3.998mg/100g. As the ratio of OFSP in composite flour increased, the total carotenoid and beta-carotene content increased. Bread developed with a high ratio of OFSP has high sensory acceptance. Generally, formulated flour might be advantageous as a means of enhancing nutritional composition and sensory acceptance of food products.

Keywords: Bread, Formulations, Sensory, Wheat, Sorghum, Orange Flashed Sweet Potato.

Paper 93

Growth Performance and Carcass Characteristics of Sasso T44 and Koekoek Chicks Exposed to Temperature Variation with Supplementary Coriander Seed Powder

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Abstract

The aim of the present study was to evaluate the effects of ambient temperature and coriander seed supplementations in SassoT44 and Koekoek on their growth performance, and carcass characteristics. In the experiment, both breeds were exposed to two temperatures rooms (heated rooms 32±1.20c from 11:00 to 16:00 and the normal room temperature of average maximum and minimum of 23.8±30c and 16.6±1.60c, respectively) with relative humidity between 34.5 ±4 to 44.8±3%. Both breeds were received 0g/kg, 5g/kg and 10g/kg of coriander seed supplementations. The results indicated that the breed effect was rather influenced more on growth performance, carcass characteristics and water intake. Accordingly, SassoT44 had higher feed intake, body weight, and consequently higher water intake, weight gains, carcass characteristics and internal organs. Water intake was 2.5% higher in the groups exposed to a heated room than those exposed to a normal (unheated) room. Similarly, the interaction of temperature, breed and age in weeks showed slightly lower ($P<0.05$) feed intake in Koekoek placed in a heated room at the age of week16. Moreover, temperature had an effect on body weight gain, and breed groups reared in heated room had slightly lower weight gain (by1.4%) than those placed in normal room. It can be concluded that, breeds subjected to heated room impaired some of the growth and carcass performance parameters, while coriander supplementation enhances performances and the 10g/kg coriander seed powder supplementations had a positive effects potential on body weight of Koekoek exposed to heated room.

Keywords: body weight, dual purpose, feed intake, heated room, water intake.

Paper 94

Comparison of Acid insoluble Ash and Acid Detergent Lignin as Makers for Estimating Digestibility by Open Grazing Goats: Tackling Barriers to Enteric Methane Inventorying Using the Tier-2 Methodology

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Abstract

Natural digestion makers do not have the same effectiveness at determining feed digestibility and hence the derived intake. Feed intake and digestibility are key parameters that influence enteric methane emissions, and hence they are also among the requirements for using the IPCC Tier-2 methodology (IPCC, 2006). Conventionally, digestibility is determined by measuring feed intake and faecal output (i.e., total collection method), but in practice, measurement of feed intake and total collection of faeces by grazing animals is impossible. An alternative method is to measure the concentration of a reference substance (digestion maker) in the feed and in faeces, and then use the digestibility to derive feed intake (Sales & Janssens, 2003). Acid insoluble ash (AIA) and acid detergent lignin (ADL) are among the most widely used natural digestion markers. However, there use has been reported to lead to unrealistic digestibility values owing to a number of factors such as low contents in feeds (which decreases analytical precision), as well as soil ingestion by animals and soil/dust contamination (which increase AIA content). This study therefore compared AIA and ADL with respect to digestibility and the derived dry matter intake by open grazing goat. Sixty-four goats (4 farms x 2 Growing females x 2 Growing males/castrates x 2 Suckling/dry does x 2 bucks) under open grazing were used. Each goat was dosed with 28 g of Cr-mordanted straw (for faecal output estimation). Pasture samples were collected from each farm and faecal grab samples collected from each goat at 60 hours (after dosing). The samples were then analysed for Cr, ADL and AIA contents. Faecal output was used to calculate digestibility and intake derived from the digestibility values. Data were analysed using the PROC MIXED procedure of SAS according to the model: $Y_{ij} = \mu + Marker_i + goat_{j(i)} + e_{ij}$.

Overall, digestibility determined using AIA was lower ($P<0.05$) than that determined using ADL. The same observation was made with the growing goats category. However, for the adult goats, the digestibility was not different ($P>0.05$) between the two digestion makers. The DM intake derived was not different ($P>0.05$). However, for growing goats, the DM intake derived using AIA tended ($P=0.07$) to be lower. The digestibility determined using AIA was significantly lower than with ADL for the case of growing goats. The intake derived was similar between the two markers, but with a tendency for lower intake with AIA for the case of growing goats.

Paper 95

Physiological Response of Hyla Weaner Rabbits Fed Wheat Offal-Carried Watermelon Rind

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Abstract

Rabbit production in tropical and subtropical areas of the world like Nigeria are faced with many problems related to hot climate, particularly heat stress. Climatic conditions in these regions are such that the warm hot season is relatively long, with intense radiant energy for an extended period of time, accompanied with high relative humidity. Rabbits are homoeothermic animals and are more sensitive to high air temperature conditions thereby limiting their ability to dispense excess body heat. Factors such as species of animal, the physiological status of the animals, the relative humidity, velocity of ambient air and the degree of solar radiation determine animal's zones of thermal comfort of animal. This study was conducted to assess physiological response of Hyla weaner rabbits fed Wheat Offal-Carried Watermelon Rind (WCWR). Five experimental diets comprising of 0, 10, 20, 30 and 40% were compounded with levels of inclusion of WCWR. Data on thermo-physiological traits (rectal temperature, respiratory rate, pulse rate, ear temperature, eye temperature and skin temperature) were collected from forty- five (45) Hyla weaner rabbit. Data were also collected on ambient temperature, wind velocity and relative humidity to estimate the Temperature Humidity Index of the environment. Result revealed significant effects of the diets on the thermo-physiological traits of the rabbits; values of rectal temperature, respiratory rate, pulse rate, ear temperature, eye temperature, skin temperature was significantly ($p<0.05$) lowest in rabbits fed 30% inclusion level of WCWR. Based on the results of this study, it could be concluded that inclusion of WCWR in diet up to 30% has potential of ameliorating adverse effects of thermal stress on physiological traits the rabbits.

Keywords: Climatic conditions, heat stress, Hyla rabbit physiology, traits

Paper 96

Mitigation of Enteric Methane Emission in Africa as A Climate-Smart Livestock Strategy

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Abstract

The paper aims to elucidate how ruminants contribute to climate change through the process of enteric methane emission and how its mitigation is a viable climate-smart strategy for livestock production in Africa. The paper describes the importance of ruminants as food and means of livelihood globally. It goes on to explain the effects of global warming on the environment and how greenhouse gases are responsible for it particularly methane. The process of rumen fermentation is explained in good details and how this natural process leads to the production of methane through the activities of numerous rumen microbes. The various strategies developed for mitigating enteric methane emission are discussed. The paper called for the need for research to develop strategies for mitigating enteric methane emission appropriate for smallholder livestock farmers in sub–Saharan Africa. The need for equipment necessary for measuring methane emissions in developing any effective strategy was raised. The paper proposes the utilization of forages containing plant secondary metabolites (PSM) as a viable methane mitigation strategy for smallholder farmers in sub–Saharan Africa. Some forages containing PSM with anti-methanogenic properties are reviewed. The paper identified the need to conduct more research to identify forages with methane mitigation properties and to develop protocols on how they can be used to mitigate enteric methane emission in ruminants for a better climate. The paper concluded by identifying governments' role in providing policy framework towards achieving enteric methane emission in Africa.

Paper 97

Technical Efficiency of Improved Indigenous Chicken Producers in Kenya: A Stochastic Frontier Approach.

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Abstract

Indigenous chicken (IC) is kept by 80% of the rural population for both meat and egg production in Kenya. However, IC has been dogged by numerous challenges leading to low productivity. These challenges include; low growth rate, low egg production and high incidences of pests and diseases. In order to overcome these problems KARI (Kenya Agricultural Research Institute) now KALRO (Kenya Agricultural and Livestock Research organization) improved the local indigenous chicken and called it the KARI improved indigenous chicken which matures at four and half months (starts laying and ready for meat), lays 180 to 250 eggs per year compared to 60 to 100 of the IC in the same period. It is one of the climate smart agriculture technologies being promoted under the Kenya Climate Smart Agriculture Project (KCSAP) to enhance food, nutrition and income security in rural areas. Results from the study indicated that efficiency level was low (58%) though there was room for improvement. All input variables considered were positive and significant had a direct effect on the output (eggs produced per month). Some of the socio-economic factors that influenced a farmer's technical efficiency included; household size, access to extension services, distance to input and output markets and the tarmac. The result indicate that farmers are not utilizing available resources effectively and therefore there is need for capacity building on management practices.

Keywords: Stochastic frontier, improved indigenous, efficiency, variables, resources, Kenya

Paper 98

Dietary Sulfur Mitigated Enteric Methane Emission and Modulated Gut Microbiome in Goats

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Abstract

The study investigated that using corn gluten (CG) in instead of corn meal (CM) increased dietary sulfur shifted H2 metabolism from methanogenesis to alternative sink and modulated microbiome in the rumen as well as hind gut segments of goats. The experiment was performed using randomized block design with 2 dietary treatments (CM and CG with 400 g/kg DM each). Goats in CG increased sulfur, NDF and CP intake and decreased starch intake as compared with those in CM. Goats that received CG diet had decreased dissolved hydrogen (dH2), (P = 0.01) and dissolved methane yield and emission (dCH4) (P = 0.001), while increased dH2S both in the rumen and hindgut segments than those fed CM. The study suggested that goats fed corn gluten improved the gene copies of microbiota and fibrolytic bacterial species while, reduced starch urilizing species in the rumen and hindgut segments as compared with those fed corn meal. Goats consuming corn gluten had enriched methanogenic diversity and reduced Methanobrevibacter, a contributor to CH4 emissions, as compared with goats fed CM. Corn gluten could be used as an alternative feed to decrease the enteric CH4 emission in ruminant production.

Keywords: dissolved gasses, methanogenesis, microbial community, metagenomics

Scientific Papers

Theme 6

Paper 99

Smallholder Farmers and The Need for Climate Smart Agriculture in Nigeria

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Abstract

Adaptation strategies that can be implemented during droughts serve as a foundation for planning response to future climate change. Climate change is already affecting the livelihoods of smallholder farmers in northern Nigeria who rely on rain-fed agricultural techniques, and it is expected to make food shortages more acute as the region is facing challenge from insurgents-Boko Haram and herdsmen. Farmers in the region are trying to cope with irregular rainfall, flooding, farm destruction by militant groups and degraded soil. Farming households are changing agricultural practices as a result of global observation of climatic and environmental changes. With the shift towards Sustainable Development Goals (SDGs) approaches that severe multiple purpose and provide cross-cutting benefits are highly needed in Nigeria and elsewhere. For example, achieving food security is unmanageable without adaptation and resilience to climate smart agricultural practices that not only support smallholder farmers in producing enough food to meet people's nutritional needs, but that also preserve ecosystems from degradation. The objective of this paper is to determine the effects of climate change on smallholder farmers in northern Nigeria and to explore possible ways to promote uptake and integration of climate smart agriculture practices and innovations into policy and practice in Nigeria and Africa as a whole through the development of actionable roadmaps to facilitate the process.

Keywords: Adaptation, Climate Change, Climate Smart Agriculture, Smallholder Farmers, Nigeria.

Paper 100

Agronomy-driven climate-smart agriculture: Agronomy and climate adaptation and mitigation as conceptualized by the Excellence in Agronomy Initiative of the CGIAR.

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Abstract

Climate change is already affecting smallholder farming systems in sub-Saharan Africa and other parts of the global south and its impact is predicted to result in substantial yield losses across the continent, with sever impacts on rural livelihoods.

Locally relevant agronomy provides entry points for smallholder farmers to adapt to climate change with often observed mitigation co-benefits. In this paper, we describe howe the Excellence in Agronomy Initiative of the CGIAR will work with farmers to boost their farming systems' defenses against climate change. First, we describe smallholder farmers' exposure and vulnerability to climate change, weather variability, and extreme events. Second, we outline the ways to which agronomy-focused interventions reduce climate risks (robustness), help farming systems rebound from a variety of climate and weather events (adaptability and transformability), and support accumulation of physical, financial, and information assets that allow farmers to respond to changing and variable production conditions (adaptive capacity). Third, we define a typology of the agronomic adaptation actions, with respect to risks, innovations, and implementation modalities. Fourth, we identify regional priorities and visions of success for agronomic adaptation. These four components lay out the conceptual and operation models underlying how.

Paper 101

Climate-Smart Agricultural Practices for sustainable food system in Nigeria: an Agroecology-specific Analysis

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Abstract

Climate change (CC) has been a threat to achieving zero hunger and a sustainable food system globally. While this problem is expected to persist for years to come, climate-smart agriculture (CSA) is being promoted as a measure to guarantee its end. Although, CSA has three pillars – mitigation, adaptation and food security; adaptation is most advocated in developing countries like Nigeria given the most devastating effects of CC in this region of the world. To comprehend the trends and eco-specific narratives around CSA in Nigeria, the study reviewed literature on climatic scenarios and adaptation strategies by food crop farmers across the six major agroecological zones, with insight from the last two waves (2015/16 and 2018/19) of the LSMS-ISA datasets for triangulation. Review was done using Google Scholar, ScienceDirect, Web of Science and Scopus core collection databases to find scientific publications between 2016 and 2021 on CSA in Nigeria, while frequency, percentages were used to present quantitative results. Although CC manifests in the form of consistent dry spells, unpredictable weather patterns and increased erosions across the agroecological zones, they differ in intensity and frequency. Farmers had adopted different CC adaptation options as a strategy for improving agricultural productivity of food crops and enhancing crop resilience. However, many of these practices fall short of expected standard, given established climatic patterns over the past five years. An institutional framework that sufficiently addresses the needs of different ecological situations is required for an effective, and a sustainable food system.

Paper 102

Ecological Organic Agriculture: A Mitigating Alternative for Climate Change

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Abstract

Climate change is a natural process that occurs through human activities like industrialisation, auto mobile activities, land degradation, petroleum exploration and misuse of ecological diversity. Although there is increased awareness on climate change, yet minimal attention has been given to climate change and Ecological Organic Agriculture (EOA). The international food standard defines EOA as holistic production systems, which promotes and enhances agro-ecosystem health, biodiversity, and soil biological activity. EOA production system plays vital societal role, enhances public health, and protects the environment and animal welfare. The concentration on climate change in isolation prevents consideration of a bigger encompassing mitigation and adaptation alternatives. EOA systems provide new opportunities to explore feedback loops with multiplier effects and to identify opportunities for systems transformation. Approaching climate adaptation and mitigation through EOA broadens the range of opportunities to achieve mitigation and adaptation goals and facilitates the consideration of systems level effects and interactions. A food systems perspective also enables engagement of the full range of stakeholders that should be involved in food systems transformation. EOA facilitates building immune system of animals for rapid adaption to climate change. It reduces greenhouse effect by 20% while compensation potential by carbon sequestration is about 40–72% of the world's current annual agricultural greenhouse gas (GHG) emissions, reduces global warming by promoting biodiversity, and promotes soil biological activities that balance oxygen, carbon and nitrogen circles, Welfare of animals is considered by prohibiting systems that afflicts animal. It has a strong potential for building resilient food systems in the face of uncertainties, through farm diversification and building soil fertility. This review paper investigated the prospects of EOA as a mitigation strategy in climate smart agriculture. It also compared other possible mitigation methods in relation to Ecological Organic Agriculture system.

Keywords: Climate change, Mitigation Strategies, Ecological Organic Agriculture.

Paper 103

The Contribution of Agroecology to CSA

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Abstract

Climate Smart agriculture involves farming practices that improve farm productivity and profitability, help farmers adapt to the adverse effects of climate change, and mitigate climate change effects. CSA contributors, such as agroecology, provide guidelines to develop diversified agroecosystems that take advantage of the effects of the integration of plant and animal biodiversity, such integration enhances complex interactions and synergisms and optimizes ecosystem functions and processes, such as biotic regulation of harmful organisms, nutrient recycling, and biomass production and accumulation, thus allowing agroecosystems to sponsor their functioning. Agroecological practices aiming for a permanent soil cover, either with trees or crops, are among the most common CSA practices. The principles of agroecology are not only relevant but are necessary to achieve the goals of adaptation and mitigation. Mainly, from a technical perspective, the diversity principle is fundamental to improving the resilience of farming systems and livelihoods by ensuring food security and nutrition while conserving, protecting, and enhancing natural resources.

Using FAO's ten elements of Agroecology as a framework I will investigate what Agroecology has contributed to CSA and methods being used for scaling up CSA practices using the science of agroecology. Case studies of soil health practices by small-scale farmers in Southern Africa will be given. These farmers use farm yard manure, biochar, ash, compost, and vermicompost to improve the depleted soil nutrients. Other practices include the use of fish wastewater. The analysis presented in this paper demonstrates that agroecology has indeed evolved to enact many of the principles of Climate-Smart Agriculture.

Paper 104

Agronomic Evaluation of Soybeans (Glycine max (L.) Merrill) Under Crop Rotation System in the Forest-Savanna Transitory Location in the Humid Tropic

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Abstract

Crop rotation is a major climate smart agriculture strategy (CSAs) being used to mitigate climate change effects. Consequently, the agronomic performance of soybean was evaluated under five cropping systems {continuous cropping (without organic fertilizer), continuous cropping (with Organic fertilizer), rotation (with organic fertilizer), rotation (without organic fertilizer) and conventional system} in a randomized complete block design replicated three times in 2020 and 2021. The experiment was carried out on the Organic Research plot of the Research Farm of Institute of Food Security, Environmental Resources and Agricultural Research of the Federal University of Agriculture, Abeokuta, Nigeria. Soybean was sown after sunflower and cotton in 2020 and 2021 in the rotation scheme, respectively. Data were collected on phenology, growth, grain yield and yield component parameters. Cropping system significantly ($P<0.05$) affected number of days to full bloom (R2), plant height at R2 and physiological maturity (R7), number and weight of seeds per plant, and grain yield in both years. Soybean plants grown under rotation plus organic fertilizer cropping system were significantly ($P<0.05$) taller at R7, recorded higher number and weight of seeds per plant and grain yield than those plants on control and conventional plots in 2020 and 2021. Soybean grain yield under rotation plus organic fertilizer in both years ranged between 1,612.00 and 1,746.67 kg/ha and was superior to Nigerian (926.90 kg/ha) and African (1,348.00 kg/ha) average values though lower than the world (2,784.20 kg/ha) average. We concluded that crop rotation system should be adopted as a CSAs in Africa.

Keywords: climate smart agriculture, conventional system, crop rotation, cropping system, organic system, yield components

Paper 105

Analysis of Agroforestry Practices Among Small-Scale Farmers in Southern Guinea Savannah Zone of Nigeria

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Abstract

In Nigeria, efforts were made by the government to enhance the use of agroforestry practices by small-scale farmers through agroforestry projects implemented by the Agricultural Development Projects (ADPs). The ADPs and the Forestry Research Institute were saddled with the extension service responsibility to effectively disseminate the practice to the farmers at the grass-root level in order to boost the use of the practices. Having completed some of the projects for some years, it has become pertinent to assess the effect of the practices on the farming activities of the small-scale farmers. This study, therefore, analyzed adoption of agroforestry practices among small-scale farmers in Southern Guinea Savannah zone of Nigeria. The data used were collected from randomly selected 315 households in three states (Kwara, Niger, Kogi) and analyzed using descriptive and inferential statistics. The findings of the study were that about 35% of the farmers did not use any of the agroforestry practices. The commonest agroforestry practice undertaken by the farmers was the scattered trees on farm. The factors that influenced the choice of agroforestry practices by the farmers were their age, farm size, land tenure, membership in agricultural related group, labour availability and access to planting materials. The result also showed that adoption of agroforestry practice significantly increased the average gross margin, mean returns on investment and land productivity of arable crop farmers. The study therefore recommended that policies facilitating increased dissemination/outreach programmes and access to improved planting materials could encourage increased adoption of the practices among the farmers.

Paper 106

Stimulating Ecological Intensification of Cropping Systems in Nigeria – Short-Term Impact of Ecological Cropping Systems on Maize Productivity, Weed Management, Soil Health, and Nitrogen Fertilizer Economy

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Abstract

Conventional cropping practices (CP) have adversely impacted soil health. A shift to ecological intensification practices can sustain the soil ecosystem services. Conservation agri-culture (CA), organic agriculture (OA), and regenerative agriculture (RA) are paradigms of eco-logical intensification. This study examined the impacts of CP, CA, OA, and RA on maize yields, weed management, soil health, and nitrogen (N) fertilizer economy. In the first year of crop-ping, maize yields under CP and CA increased significantly by 24 – 31 % compared to OA and RA. Weed growth reduced significantly in CP and CA in the early stage (21 days after maize sowing) compared to OA and RA but increased in CP than CA at the late stage of maize growth (49 days after maize sowing). OA and RA marginally increased the soil organic matter (SOM), but total N and phosphorus (P) concentrations in soil were slightly higher in the CA and CP systems. Also, CA used 25 % less N fertilizer dose in providing similar yields with CP. Transitioning to CA contributes to maize yield increase, soil fertility, and weed management. Nurturing ecological cropping systems in the long-term can reduce mineral N fertilizer input in CA while sustaining yields and enhancing ecosystem services.

Keywords: African smallholder cropping, agroecology, ecosystem services, nature-based crop-ping

Paper 107

Biodiversity Conservation of Neglected and Underutilized Nigerian Horticultural Crops

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Abstract

Biodiversity is fundamental for ecosystem functioning, sustainable crop production, soil health and the attainment of food and nutritional security. It is vital for current and future human well-being. Loss of biodiversity in Africa and across the globe and its negative impacts on food security, wealth, climate, nutrition and health must be curbed. African indigenous and underutilized crops are not likely to cause diet-related diseases. In addition, some of them cannot be adversely affected by climate change and they also require minimum agronomic input to yield optimally. Besides supplying appropriate proportions of essential minerals, underutilized horticultural crops can also reduce hunger and alleviate poverty. While abiotic stresses like low/high temperature, drought, light intensity, and sub-optimal relative humidity will have negative impacts on exotic plants growth and development, indigenous crops are seldom affected. It is of great importance that neglected and underutilized plant species (NUS) also serve a dual purpose as food for man as well as animal feed. Despite these crucial roles that NUS occupy, some are still threatened with neglect and potentials not maximized. This paper discusses strategies that can be adopted to conserve NUS for their optimal utilization, with the Nigerian rain forest species as prototypes. Deliberate identification and cultivation of the NUS, Establishment of gene- and field- banks, Recognition, and promotion of NUS through national and special research and development programmes, use of media, including social, Extension Agents and agencies, linking NUS to relevant industries including foods, feeds and pharmaceuticals, biodiversity conservation through diversified farming systems etc. are major key strategies for Climate smart and sustainable agriculture.

Keywords: Biodiversity, Climate-smart agriculture, food security, value chain.

Paper 108

Examining the strengths, weaknesses, opportunities and treats of agroecology in ensuring food security and environmental sustainability

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Abstract

Concerns of food security and environmental sustainability have increased enormously in recent years due to rising populations, changing food tastes, climate change and other stresses. Climate smart agriculture principles that restore natural ecosystems, improve the resilience of farming systems and enhancing food security comprise a number of locally devised and applied practices that work simultaneously through contextualized crop-soil-water-nutrient-pest-ecosystem management at a variety of scales. However, not all principles are agroecological. For example, minimum tillage combined with herbicides rather than mechanized methods to remove weeds may be considered climate smart but not agroecological. This paper discusses the contribution of agroecology towards enhance household food and environmental security. The uses on qualitative data were collected online interviews from a sample of 100 agroecology practitioners and stakeholders in and outside Zimbabwe. A SWOT analysis framework was used in identifying opportunities and constraints of using agroecology as a panacea for environmental sustainability and food and nutrition security. Preliminary research findings show the strengths of agroecology include enhancing biodiversity, soil health, use organic biodegradable fertilizers and integrated pest management. Its weaknesses comprise the long period smallholder farmers take to attain agroecology status and certification. Rising food insecurity, food related diseases and national, regional and global food policy shifts towards natural products were some of the opportunities highlighted by respondents. However, agroecology is under attack from large cooperates who are promoting industrial farming under their agenda of green revolution in Africa. Overall, agroecology is a springboard by which farming systems are environmentally sound, socially acceptable, and economically viable.

Paper 109

Mangrove Forest Restoration Nature-Based Solution to Climate Change: An Agro-ecological Contribution to Climate Sensitive Agriculture in Coastal Communities

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Abstract

Climate change affects livelihoods among rural coastal communities, albeit disproportionately, especially with considerable gender and socioeconomic biases. Whereas, small-scale fisheries provide employment and contribute to food security alike, climate change has altered fish productivity and distribution, which negatively affects the livelihoods of fishery-dependent communities. This study of coastal communities in Ogun State Nigeria shows that, plausibly, climate impacts may already be actively diversifying livelihood activities as several coastal communities are resorting to various response options imposing untold effects on food production. Frequent storm surges and rapid coastal erosion are driving decline in coastal resources such as aquaculture and loss of crucial biophysical environment, along with deteriorations in associated cultural, ecological and economic subsistence values. Furthermore, coastal societies are neglected due to rural-urban migration of the youth, leaving older men and women, thus exacerbating the gender dimension of the crises. In most communities where fishing is primary livelihood, fishing revenue is declining, owing to decreasing fish catches and unpredictable weather. These imposes the need for strategies that specifically target fishing communities whose livelihoods rely on natural ecosystems. We therefore recommend mangrove forest restoration as a nature-based solution to encourage climate sensitive agriculture which also contributes to climate change mitigation and adaptation efforts. This is imperative as coastal ecosystems are protected against flooding, erosion, and sea-level rise, serving as the first line of defense as well as engine for economic growth. This goes beyond mere coastal protection to augment coastal livelihoods and build resilient coastal communities with greater adaptive capacities.

Keywords: Mangrove; Nature; Coastal; Climate; Fishing.

Paper 110

Assessment of stakeholders' satisfaction for Sustainable ecological agricultural practices that promote climate smart agriculture in Northeastern Nigeria.

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Abstract

Sustainable ecological agricultural practices are essential to fulfilment of environment concerns with which climate concerns are pursued. Promotion of value chain activities of organic fruits, vegetables and spices are expected to raise the opportunities and remove barriers in the processes to ensure the satisfaction of the stakeholders. A study was conducted in Northeastern Nigeria to analyse the stakeholders' satisfaction with value chain of organic fruits, vegetables and spices. Multi-stage sampling procedure was used to select 120 respondents. Data were collected on respondents' socioeconomic characteristics, needs and priorities, level of knowledge, benefits derived and their satisfaction with issues related to the value chain. Data were analysed using both frequency counts, percentages, weighted score, analysis of variance and linear regression at α 0.05.

Results showed that more (58.2%) of the respondents were between 21- 35 years of age, female (59.2%), had less than 5 hectares farm size (57.5%) and had 1 – 10 years farming experience (95.8%). They dealt in organic cucumber (0.76), okro (0.72), onion (0.74) and derived benefits from zero expense on inorganic pesticides (95.0%) and they were satisfied with the organic land tenure system (53.3%). Also, 55.5% had high level of organic agriculture knowledge, 68.3% derived more benefits and 58.3% of them had more satisfaction. Felt needs and priorities of most of the respondents were fertile land (294.4) and increased market (283.3). Whereas level of knowledge (β=0.19; p=0.04) and benefits derived (β=0.30; p=0.00) determined their satisfaction with value chain of organic fruits, vegetables and spices, significant difference (F=4.35, p=0.02) existed among respondents' satisfaction across the states. Frequent interactions for knowledge dissemination (workshop and training) are recommended to keep the stakeholders updated about issues related to value chain of organic fruits, vegetables and spices.

Keywords: Sustainable ecological agricultural practices, climate concern, organic fruits and spices, stakeholders' satisfaction.

Paper 111

Agroecological Differentials in Crop Production: Evidence from Smallholder Rice Producers in Nigeria.

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Abstract

In the quest to sustain the current level of rice self-sufficiency and achieve export potential amidst challenges of climate change in Nigeria, irrigation farming has been encouraged. However, empirical information on the agroecological differential effects between irrigated and non-irrigated systems is required. This study adopted National Bureau of Statistics data on Integrated Survey on Agriculture (2018) to estimate these differential effects in rice production systems in Nigeria. Descriptive analysis revealed that the practice of rainfed production still predominate with only about 2% practicing some forms of irrigation. Majority of the irrigated farmers relied on water from rivers/streams (41%) while others sourced from well (21%), boreholes (20%) and lakes/ponds (6%). As a result, only 26% of the rice farmers were able to perform year-round irrigation, which is mainly self-managed (95%) by the resource-poor farmers. Notwithstanding, irrigation was found to have positive and significant effects on output production of rice. Average output stood at 800.5kg and 664.7kg for irrigated and rainfed systems respectively. Meanwhile, the significance of other underlying factors accounting for output differential effects of the two agroecological practices requires further econometric investigation. It is obvious however, that Nigeria cannot achieve sustainable increase in rice production under rainfed or self-managed irrigated practices; and thus, a call for a deliberate policy to promote the development of such improved agroecological practices that fit local context fir sustainability.

Keywords: Agroecology, irrigation, rainfed, rice, output.

Paper 112

Heterotrophic and autotrophic soil respiration in contrasting agro-ecologies: the case of the Upper Blue Nile basin, Ethiopia.

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Abstract

The contributions of heterotrophic and autotrophic soil respiration to the atmosphere have been poorly documented. This study examined the effect of land use on heterotrophic and autotrophic soil respiration in different agroecological systems in drought-prone areas of the Upper Blue Nile Basin in Ethiopia. We collected data monthly from November 2019 to March 2020. The results showed that there were seasonal variations in heterotrophic and autotrophic soil respiration in the different agroecological systems with different land uses. Friedman's ANOVA showed that there was a significant mean rank difference at $p < 0.05$ for heterotrophic soil respiration in the Guder and Aba Gerima watersheds. In addition, autotrophic soil respiration was significantly different between land use in the Guder and Dibatie watersheds. However, in the Aba Gerima watershed, no significant difference was observed in between land uses. Soil properties and environmental factors, especially soil temperature and moisture, contribute to the variations in the components of soil respiration.

Keywords: drought-prone, groundnut; khat plantation; land use; teff cropland.

Paper 113

Locality and Originality: Enhancing Agroecology as an Effective Climate Smart Agriculture Approach to Reduce Wildfires Vulnerability in the Savannah Ecological Zone of Ghana.

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Abstract

The incidences of disasters such as wildfires, droughts, and floods induced by climate change are causing major ecological disturbances across the globe. Climate change is expected to increase the frequency and intensity of some natural hazards including wildfires which can lead to higher exposure of people and assets in the savannahs. The savannah zone is mostly agrarian and relies consistently on the environment for its livelihoods. However, high incidences of wildfires, deforestation, intensive cultivation, and overgrazing have exposed most forested areas within the savannah to various land degradation problems thereby threatening the sustainability of the ecosystem. With the depletion of soil nutrients and compacting of the soil caused by erosion, it is expected that there would be serious changes in vegetation types and composition which will likely affect crops, farmlands, wildlife, and other ecosystem services. This phenomenon coupled with wildfires means we have to "Sankofa" which means going back to our roots. Farmers have been practicing climate adaptation strategies such as crop rotation, mixed cropping, agroforestry, and soil and water conservation such as half-moon and stone lines. Nevertheless, something seems not to be going on well, and looking at future climate projections, these strategies may not necessarily be efficient. This paper analyzed and reviewed the effectiveness of various agroecological processes carried out within the savannah zone and also identified the most effective strategy to be farmer-managed natural regeneration as a long-term solution to climate change.

Partners

FARA

The Forum for Agricultural Research in Africa (FARA) is the apex continental organization responsible for coordinating and advocating for agricultural research for development (AR4D). FARA serves as the technical arm of the Africa Union Commission on matters concerning agriculture science, technology, and innovation. As a coordinating body, FARA works through collaboration with its partners, an approach driven by the principle of Subsidiarity, which devolves the implementation of programmes to the Sub-regional organizations and the National Agricultural Research Institutes NARIs.

GACSA

GACSA is an inclusive, voluntary, and action-oriented multi-stakeholder platform on Climate-Smart Agriculture (CSA). Its vision is to improve food security, nutrition, and resilience in the face of climate change. GACSA aims to catalyze and help create transformational partnerships to encourage actions that reflect an integrated approach to the three pillars of CSA.

IWMI

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. It is headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa. IWMI works in partnership with governments, civil society, and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. IWMI works through collaborative research with many partners in the North and South, and targets policymakers, development agencies, individual farmers, and private sector organizations. IWMI leads the CGIAR Research Program on Water, Land and Ecosystems and is a member of the CGIAR System Organization, a global research partnership for a food-secure future.

CGIAR

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector

DeSIRA-LIFT

DeSIRA-LIFT (Leveraging the DeSIRA Initiative for agri-food systems transformation) is a service facility supporting the DeSIRA Initiative (Development Smart Innovation through Research in Agriculture, in short DeSIRA) funded by the European Commission. DeSIRA aims to bridge the gap between research and policy making towards resilient, sustainable, and equitable agri-food systems in the Global South.

GLOBAL RESEARCH ALLIANCE

The GRA is focused on research, development and extension of technologies and practices that will help deliver ways to grow more food (and more climate-resilient food systems) without growing greenhouse gas emissions. The GRA is involved in the Coalition's Agriculture initiative. The CCAC also participates in the GRA Council meeting annually, to share information and build on progress in shared areas of interest, including livestock and paddy rice methane emissions.

AICCRA

Accelerating the Impact of CGIAR Climate Research for Africa (AICCRA) is a new initiative that will enhance access to climate information services and validated climate-smart agriculture technologies in Africa. With the support of AICCRA projects, farmers and livestock keepers will be able to better anticipate climate-related events and take preventative actions, with better access to climate advisories linked to information about effective response measures. This will help communities better safeguard

their livelihoods and the environment. It is supported by a grant from the International Development Association (IDA) of the World Bank and will enhance research and capacity-building activities by the CGIAR and its partners.

CRS

Catholic Relief Services aims to improve food security and the quality of life of poor families in rural and semi-urban areas in Ghana. To accomplish this, CRS/Ghana supports programs that promote the involvement of local communities and organizations in the design and execution of activities. CRS/Ghana focuses on the country's three northern regions (Northern, Upper West, and Upper East). Working through local church and government counterparts, CRS/Ghana supports development and relief activities in several sectors including: Education, health, safety net, agriculture, peace building, micro finance, emergency response. Currently, CRS/Ghana has two country program offices with over 180 national staff and three international staff. The head office, where all programming activities are coordinated and managed, is based in Tamale, in the Northern Region while the administrative support office is in the nation's capital of Accra.

AUDA-NEPAD

AUDA-NEPAD is the development agency of the African Union, coordinating and executing priority regional and continental development projects to promote regional integration towards the accelerated realization of Agenda 2063 – Africa's vision and action plan. They are mandated to strengthen capacity of Member States and regional bodies.

FAO

The Food and Agriculture Organization (FAO) is a specialized agency of the United Nations that leads international efforts to defeat hunger. Its goal is to achieve food security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives. With over 194 member states, FAO works in over 130 countries worldwide.

CORAF

CORAF is an international non-profit association of national agricultural research systems (NARS) of 23 West and Central Africa countries. It is the largest Sub-Regional Organization (SRO) on the continent. It was created in 1987 and assigned the responsibility to coordinate and facilitate ground-breaking and cutting-edge research outputs needed to unlock the agricultural potential of West and Central Africa. The primary objective of CORAF is to improve livelihoods through sustainable increases in agricultural production and productivity, promoting competitiveness and markets.

ASARECA

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a sub-regional not-for-profit association. It was established in 1994 by ten member States represented by their National Agricultural Research Institutes (NARIs) following the approval of the Framework for Action (FFA) for agricultural research in Eastern and Central Africa. Currently it has 14 member states. ASARECA's vision is a transformed Eastern and Central Africa agricultural sector supporting improved livelihoods, sustained economic growth and inclusive development.

CCARDESA

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) was founded by SADC member states to harmonies the implementation of agricultural research and development (R&D) in the SADC region. CCARDESA through promoting innovative research, technology generation and adoption for sustainable agricultural development through affective partnership and capacity building, seeks to achieve a food secure and prosperous Southern African region with vibrant rural livelihoods.

AFAAS

The African Forum for Agricultural Advisory Services (AFAAS) is the continental umbrella organization that aims at strengthening national Agricultural Extension and Advisory Services (AEAS). Its mission is to promote lesson learning and add value to initiatives in AEAS through policy advocacy and lobbying,

sharing of knowledge and information through increased professional interaction among AEAS providers.

Emerging Ag Inc

Emerging Ag is a boutique international consulting firm providing communications and public affairs services to clients in the agriculture, food, and health sectors. We are a dynamic group of multicultural individuals with a passion for making a positive impact. We provide expert services to our clients, with a strong focus on global policy issues, sustainability strategies and engagement with international organizations. We provide public affairs and communications services, including coalition creation, sustainability plans, communications strategy and campaigns, digital outreach, stakeholder engagement, crisis/reputation management, coalition creation and consensus building.

IFAD

The International Fund for Agricultural Development (IFAD) is an international financial institution and a specialized agency of the United Nations dedicated to eradicating poverty and hunger in rural areas of developing countries.

European commission

The European Commission is the executive of the European Union. This means that it is responsible for initiating laws, enforcing the laws of the EU, and managing the EU's policies. It is made up of 27 commissioners (one from each member state) and is based in Brussels. Each member state nominates a commissioner, but the nominated candidates must be approved by the European Parliament. The Parliament must also approve the President of the European Commission.