UNIVERSITY of RWANDA

IBMA

International Conference on Business Models in Agriculture

2023

AOTA
African Organization Of Technology In Agriculture

International Conference on Business Models in Agriculture IBMA 2023: Collection of Abstracts and panel discussions

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INTERNATIONAL CONFERENCE ON BUSINESS MODELS IN AGRICULTURE IBMA 2023: COLLECTION OF ABSTRACTS AND PANEL DISCUSSIONS

by

University of Rwanda, College of Agriculture, Animal Sciences and Veterinary Medicine
(UR-CAVM)

This Book of Abstracts and Panel Discussions has been prepared by Dr. Judith Uwihirwe (j.uwihirw@ur.ac.rw or uwihirwejudith@yahoo.fr) and reviewed by the Scientific Committee.

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Thank you

FOREWARD

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The 20^{th} century was the best for farmers from advanced economies and the worst for 95% of the world's farmers living in the 175 so-called non-developed economies. Despite the fact that the number of farmers living in poverty is still increasing today, agro-technologies have never been better than now in history, and total investments in the agro-sector of non-developed economies have never been greater. Yet, in many of such economies, over 40% of the population depends on agriculture for their livelihood and often needs to survive on less than 2US Dollars per day. This resembles the situation in Europe in 1900, except that today less than 4% of the European workforce is involved in agriculture and European farmers are no longer poor; they belong to the middle class. It shows that to advance the agricultural sector in the said 175 countries, we must redefine the essence and root problem they face. After decades of failures, it is evident that the reason for their poverty and undeveloped agro sectors is not a result of the lack of technologies, funds, water, land, light or workforce. Rather, it is something that we have overlooked and neglected for far too long – dedicated business models for over 500 million smallholders and non-professional farmers. Born to a family of farmers and raised as a farmer, I know firsthand that transferring from poverty to prosperity is not only possible, but also a must for over two billion people depending on agriculture for their livelihood. IBMA is unlike any other conference in the agro sector you have ever been a part of. It is a milestone in the history of agriculture and that of non-developed economies and their farmers. It is about presenting, discussing and learning about dedicated business models lacking in the agro industry in Africa, Asia, and many Latin American countries. Taking part in the Conference on Business Models in Agriculture (IBMA) ensures you meet leading experts in the agro industry, hear from their experiences, and get a chance to meet and cooperate with national, international and business leaders. In turn, you

will alleviate your country's agro sector from poverty to prosperity based purely on business models, not exploitation or charity. IBMA gives you the chance to be remembered, to create a legacy and leave a landmark in the history of your country, organization or company. IBMA 2023 is in many ways the Woodstock of agro conferences, the one that no one will ever forget, and those who are part of it will tell its story. Cynicism aside, taking the business attitude, it is possible to do great agro-business and see happy and prosperous farmers. You will never regret it and never be more proud of being part of such a historical transformation.

Dr. Nimrod Israely

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BRAIN RE-ENGINEERING CONCEPT AND REIMAGINATION: STRATEGY FOR ENTREPRENEURSHIP DEVELOPMENT AND YOUTH ENGAGEMENT IN AGRICULTURE

Introduction

Agriculture has never been left out in the various technological and scientific advances of man. How far the agriculture sector has come in development and production is a proof to the excellent progress and breakthrough recorded in our modern world realised in these evolving times of industrial revolution (IR). Industrial and agrarian revolution always go hand-in-hand, and that is the reason why economies in which agriculture is more or less static does not show industrial progress or development. History has always been in favour of earth moving changes and one of such transformations in the globe came in the guise of IR. Truly, it left a lasting footprint in the socio-economic and developmental strides of the modern world. IR can be described as the period of time during which work began to be done more by machines in factories than by hand. Over the past 2 centuries, IR transformed the world most profoundly in human history since the neolithic revolution. The neolithic revolution about 12, 000 years ago (i.e. the first agricultural revolution when people began to farm and used polished stone tools, which was succeeded by the Bronze Age.) is the period from a lifestyle of hunting and gathering to one of agriculture and settlement, thereby making an increasingly larger population possible.

United Nations Report and Youth Engagement in Agriculture: The Perception Problem?

By 2050, the demand for food will surge by 70%, which aligns with rapid population

growth. Research findings from a UN study indicates that about 9.9% of global population still goes hungry, so the thought of feeding almost 10 billion persons is still anticipated as daunting. With environmental changes hard to predict, we must turn to innovation in agriculture technology. The role of youths and youngsters of Africa is really a concern as their perception towards farming and agribusiness is outdated and regarded as wrong. Their importance in tackling this issue cannot be over emphasized. Hence, the concept of brain re-engineering and reimagination which forebears on changing the wrong perception problem youths have about agriculture thereby underscoring it as a prospective strategy for enhancing youth engagement in agriculture to build their entrepreneurship capacity. I reckon, from the findings of previous high level panel of experts (HLPE) studies about youths in driving transformation outlines as follows:

1. That youth are on the front lines to build the food systems of the future, while also bearing significant risks from climate change, social and economic inequities, and political marginalization.

2. That food systems provide a wide spectrum of opportunities for the engagement and employment of young people across diverse global contexts, but these jobs do not always provide decent and meaningful work or adequate livelihoods.

3. In response, policies and initiatives to protect and strengthen youth engagement and employment in food systems need to be based on the pillars of rights, equity, agency and recognition. The redistribution of resources, knowledge, and opportunities for youth innovation and engagement in the development of context-specific employment and labour policies can not only contribute to creating jobs for youth but can also directly support transitions to sustainable food systems.

Brain Re-Engineering and Reimagination Conceptualised

The core focus of brain re-engineering and reimagination is conceptualized and hinges on changing this perception problem as it stands to provide a veritable strategy in transforming sunken economies through the agriculture or agribusiness sector in an age where environmental concerns and climate change issues are at an all-time high; and sadly, sustainable farming is a hotbed subject. Our population is growing, and increasing shortages of land and water pose a noteworthy threat to the longevity of humans as we know it. But while many politicians stall at a glance, agriculture technology start-ups are busy taking action. We must establish that advances in machinery have increased the scale, speed and productivity of farm equipment. Hence, this leads to a more efficient cultivation of more inputs and variables in productive lands with seeds, fertilizers and irrigation also have greatly improved thereby ultimately helping farmers in increasing their yields in either crops, livestock, agroforestry or fisheries.

Pillars to Brain Re-Engineering Concept and Reimagination

The pillars of the brain re-engineering concept and reimagination hinges on awareness creation or education of youngsters and youths. This is a paradigm shift that entails building of ideas and knowledge levels of youths in order to volunteer their willingness to change the negative or wrong ideologies and mindset creativity to appropriate a correct or right perceptive and engaging in agriculture or agro related ventures entrepreneurially to employ technology solutions to drive a sustainable change. The institutions that can

actualise this are institutions or platforms such as educational institutions (formalised and non-formalised), and the social media.

1. Perception Change: This involves identifying the wrong ideologies and mindset about agriculture and willingness to drop them. This thought process must be frank, sincere and intentionally approached in interchanging the wrong mindset or way they perceive agriculture.

2. Ideation and Enterprising: This can be addressed on a dual basis and entails formation of new ideas or concepts, as well as building or developing their entrepreneurship capacity. Having or showing initiative and resourcefulness is intended to be accompanied by expressing some good degree in being innovative which is all about being original, creative and introducing some new business ideas.

3. Technology: This must be followed after Ideation and enterprising. This involves application of the knowledge of science to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment. In addition, training on different technology solutions are not left out. Today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems allow businesses to be more profitable, efficient, safer, and more environmentally friendly

4. Sustainability: This revolves around being intentional, constant and productive in an agro enterprise or agro business over time. Every activity and practise between production, manufacturing, processing or value-addition, marketing or distribution from time to time and from season to season must factor in training and education; research and innovation; cross-sector collaboration; regenerative practices and nature-based solution; and also, transparency and traceability.

   Truly, agriculture is often high tech and today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology.Farmers and others use science and technology to collect data, analyse efficiency, monitor growth and quality, and more to save money and get better yields. In essence, advanced devices, precision agriculture and robotic systems allow agribusinesses to be more profitable, efficient, safer, and more environmentally friendly.

Fourth Industrial Revolution (4IR) and Precision Farming: Bridging the Gap

The fourth industrial revolution (4IR) is characterised by the blurring of boundaries between the physical, digital and biological worlds. It is a fusion of the advances in agricultural innovation systems (AIS) which explains about people, their knowledge, technology, infrastructure and cultures they have created or learned, who they work with, what new ideas they are experimenting with. Examples of AIS are: agricultural drones, artificial intelligence, blockchain technology, Internet of things (IoTs) and automation; Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and genetic editing (Biotechnology and Nanotechnology). Precision agriculture is an approach to farm

management that uses IT to ensure that the crops and soil receive exactly what they need for optimum health and productivity. The goal of PA is to ensure profitability, sustainability and protection of the environment. Conclusively, new technology solutions, including chemicals and larger tractors, allowed farmers to work larger areas of land with less labour. Government policies encouraged farmers to scale up their operations. Farmers were also motivated by economies of scale—the economic advantage of producing larger numbers of products. Identifying the latest teeming productive and prolific technology options in agriculture for youths are drones which are mainly employed in following ways: to monitor crops, spray fertilizers and pesticides. They are referred to as unmanned aerial vehicles. This latest trend in agriculture and agricultural technology is revolutionalising the agriculture space by lessening the amount of labour required to propagate a crop.

Brain Re-Engineering Concept and the Fourth Industrial Revolution (4IR): Focus on Agricultural Production

Truly, the potential level of agricultural production is generally considered to be determined by physical factors such as quality of the soil, quality and availability of water and the prevailing climate. In so doing, the need of the hour is to drive transformation in an economy through these recent new dimensions of technology since the whole idea of brain re-engineering seizes the opportunity and leverages on the advent of technology and fourth industrial revolution (4IR) which operates on Cyberspace systems such as Artificial Intelligence (AI), Blockchain technology, Internet of Things (IOTs), Agricultural Drones, among other technology solutions. Technological innovations have, to a great extent shaped the agriculture sector throughout time. Examples of technological solutions in the 4IR era are: Bee vectoring technologies; precision agriculture; indoor vertical farming; livestock farming technology; laser scarecrows; farm automation; real-time kinematic (RTK) technology; mini-chromosome technology; farm management software; and water management technology. From the creation of the plough to global positioning system (GPS) driven precision farming equipment, humans have developed new ways of making farming more efficient and productive.

Brain Re-Engineering Concept and Reimagination: Are youths the key target?

Of course, youths are the rationale behind the brain re-engineering concept and reimagination. However, this concept can also work in empowering women through the process of re-engineering of their mindset, ideologies and perception especially for communities where their traditional values are antithetical to women empowerment. Similarly, women play a significant role in agricultural production and household food security. Despite the central role that the evolving agriculture sector has earmarked for the youth, the younger generations are reluctant to take up vocations in the sector due to various misconceptions associated with the industry, and a lack of information and awareness of opportunities. Deficiency associated with linkages between amplification created around the fourth industrial revolution and the agriculture sector has led to youths searching for professional career opportunities focusing on sectors that are non-agricultural. No doubts, the younger generation are regarded as society's future. When the youth contributes his/her ideas and energy to resolve social issues, he/she becomes a capable leader and can also make a difference in people's lives of others. Truly, the younger generation simply needs to renew, refresh and maintain the current status of so-

ciety. They are expected to advance the current technology, education, politics, peace of the country. On the other hand, youths are vested with the energy and drive to maintain society's culture and values thereby contributing to advancing developmental projects of nations. For instance, the role of youths in elevating the agriculture sector as touching on higher crop productivity, decreased water, fertilizer and pesticides usage cannot be over emphasized. Youths' role will definitely collapse food prices, as well as reduce its impact on natural ecosystems, less runoff of chemicals into rivers and groundwater. That youth are on the front lines to build the food systems of the future in developing and developed nations of the world, while also bearing significant risks from climate change, social and economic inequities, and political marginalization cannot be over emphasized. Interestingly, the role of youths in agriculture can be felt in the usage of automated harvesters, drones, autonomous tractors, seeding and weeding implements to transform their culture of cultivating food crops (permanent or perennial or plantation crops; field crops and horticulture crops). Technology controls the menial and recurring tasks, allowing them to focus on more critical tasks.

Brain Re-Engineering Concept and Reimagination: Impacting the Younger Generation

Whether youngsters or youths will engage in farming depends on how productive and profitable farming is now and in the future. This depends on agricultural policies and programmes that will help youths in adopting new technology innovations and access productive resources including land, credits and markets. These opportunities would really drive young persons in seeking viable and attractive career options in the sector. Most importantly, youngsters are persons who may fall within the age category of 15 and 24 years between 35 and 40 percent. Youngster is a very flexible word as it does not have a specific meaning as teenager or toddler. The word youth is a little more complex, as it can refer to a young person, and also to the period of life when you are young. All the same. the question of governments of developed and developing nations attracting youths to agriculture will go a longer to tackle the unemployment problem of creating jobs within the supply chains and value chains thereby leading to economic growth and development. Firstly, agriculture needed to be appealing to youths which can be done by sharing the benefits of agriculture as a business and to enable them understand or change their ideologies that agriculture is no longer in the old economy when our parents and fore-parents practiced agriculture in the field under the sun with drudgery using crude implements. Truly, social media is a vehicle or tool that can rebrand agriculture factoring the blessings of the fourth industrial revolution such as Artificial Intelligence, Blockchain, Internet of things (IOTs), augmented realities, metaverse, among other technology solutions. Since agriculture is currently perceived by many youngsters and youths as unattractive probably due to an obvious outcome of decades of insufficient support from government and other stakeholders of economic growth and development. We must reckon that there are many trajectories to economic engagement for youths in agriculture, and not all of them means getting their hands dirty. Youths should be encouraged to engage in activities that support agricultural production, capacity building, goods and services, logistics and value addition as service providers and entrepreneurs in the agriculture or agribusiness space. To a great extent, I am convinced that youths can be enlisted in driving impact through the agriculture sector in the fol-

lowing ways:

1. Rebranding and repackaging of farming activities and agriculture operations in driving the required influence. No doubts, youngsters and youths are increasingly becoming image conscious in this age and era of social media and instant gratification. Self-image has a strong currency and they are attracted to latest slangs and phrases, innovations and have a unique outlook that is all their own. Persistent images associated with agriculture ranging from low wages, and also boring and heavy manual work could grossly repel youths. As agriculture is being rebranded to fit this younger generation, we need to improve on the dialect around farming and agriculture, and replacing them with new ideologies and innovations in agriculture using images in editorials thereby leveraging on the existing role models who have proven testimonials of excellence in the agriculture space as that would potentially influence the youth.

2. In this era of fourth industrial revolution (4IR), engaging and embracing technology solutions can drive impact and scale. A good number of tools for digital operations in the agriculture sector can assist for weather information, crop production and market access thereby providing farmers with tools and information to create informed decisions and improve productivity.

3. Promoting farming as a business can attract youngsters to increase their participation in agribusiness. Business of agriculture is not only central to job creation and food security, but cumulatively impacts economic and social development outcomes. While the formal economy can only absorb less than 10 per cent of labour-market entrants, young entrepreneurs have a far less saturated market to venture into, through agribusiness. Now is the perfect time to attract the youth as attitudes and practices towards agribusiness are experience a paradigm shift due to job losses from the pandemic.

4. Tackling major issues that revolves around productivity and efficiency gaps in young people's participation in value chains is a priority. Key bottlenecks such as inadequate access to information on production, inaccessibility to finance and market intelligence have to be addressed bearing youngsters in mind.

5. Value addition in food supply chains must be fostered as that would increase entrepreneur's capacity on emerging agribusiness models such as circular economy principles and value addition opportunities, through the adoption of productive use of energy technologies.

6. Government should ensure that farm implements are made available to youngsters at subsidized rates. Farm machineries such as: ploughs, ridgers, tractors and cultivators should be sold at very affordable rates to encourage youth participation in agriculture.

Brain Re-Engineering Concept and Reimagination as Veritable Strategy for Youth Engagement

Generally, the youths and youngsters are fascinated by automation, and yearn to see a

more-scientific and technologically-driven agriculture and that specifically factors in the use of robots, drones, and autonomous tractors to make farming more efficient. Precision agriculture is not left out in the brain re-engineering concept and reimagination which involves applying irrigation, fertilizers and pesticides at variable rates, depending on crop needs, rather than uniformly applying them at set times, quantities and frequencies. Conversely, major technologies that are most commonly being utilized by farms are harvest automation, autonomous tractors, seeding and weeding, and drones. Farm automation technology addresses major issues like a rising global population, farm labor shortages, and changing consumer preferences. Youth engagement in agriculture is essential and critical for growth and to strengthen local food systems, feeding communities and providing gainful employment opportunities for the world's booming youth population. The role of youths in digital agriculture is streamlined in such a way that automated workflows have become invaluable for teams in the agriculture industry. The more youths and youngsters are in the agriculture space in the 4IR era, the more its potential to increase efficiency, improve quality, and lower costs is assure. However, some of the demerits to the use of technology in agriculture are negligible as that would create more work for the agripreneur or young farmer and can reduce the personal contact farmers have to their farmlands. Indeed, the brain re-engineering concept and reimagining of what the agriculture sector and its enterprise activities stands to offer which hinges on unveiling the technology new dimensions can allow farmers to better engage in effective monitoring of the health of their livestock and crops, better documentation, more informed decisions, as well as in saving time and money.

Brain Re-Engineering and Unlocking Transformation: Changing the Narrative with Entrepreneurship and Technology in Agriculture

Findings from studies carried-out have indicated that one of the brilliant strategies for economic progress whether in developed or less developed economies as it helps in employment generation, and the most important mechanism and tool for it is entrepreneurship. The whole concept of innovation, imagination, creativity, risk-taking, inventiveness and creation of new jobs have subsisted in the past, as well as in recent times when entrepreneurship underscores the processes of speeding up the pace at which new businesses and ventures are generated. With the new technological findings, agriculture and agribusiness are undergoing radical changes, innovation being the core around which farmers seek solutions to streamline their activities, increase their production by maximizing resources. The business process consists of any group of activities performed in order to produce a specific customer-oriented or market-specific result. The business environment is constantly changing and new techniques and methods for developing this process are required. In Romania, through the funds attracted by agricultural entrepreneurs, higher productivity and access to modern solutions for agriculture can be obtained, with a major role in increasing efficiency. An information system created in support of agribusiness companies offers farmers the opportunity to reduce raw material costs, to optimize their production flow, this being possible by applying better technologies, based on information taken directly from the field, or the production area. Each IT solution is based on microservices, on the breakdown of agricultural processes into activities and sub-activities. In this way, we are talking about the overall efficiency of production.

Conclusion

Brain re-engineering concept and reimagination is a strategy enhancing youth engagement especially in the agriculture space as that would enhance their entrepreneurial capacity. Entrepreneurship in agriculture is a transformative option to unlock income generation through the agriculture sector since it will create jobs and multiple sources of income. Truly, youth agripreneurship creates decent work for young people, strengthens communities and drives inclusive economic growth, but for too many young people, entrepreneurship is out of reach. One of the biggest advantages of getting started with entrepreneurship at a young age is the opportunity to learn important skills such as teamwork, networking, problem-solving, critical thinking, innovation, self-discipline, etc. All these skills can help in school performance and later in life. We must not forget that entrepreneurs in the agriculture industry are important to market economies, because they can act as the wheels of the economic growth of the country. By creating new products and services, they stimulate new employment, which ultimately results in the acceleration of economic development.

Prof. Ikechi Agbugba

KEYNOTE ADRESS

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DRIVING INNOVATION IN SUB-SAHARAN AFRICA: ROLE OF WOMEN IN AGRICULTURE

I feel greatly honoured to be given this opportunity to present a keynote address on the crucial issue of "Driving Innovation in sub-Saharan Africa: The Role of Women in Agriculture". It is my very great pleasure to be here today to share with you some critical views on the role women are playing in the process of agriculture innovation in sub-Saharan Africa (SSA). Women have been identified to dominate the agriculture sector in SSA stricken by food insecurity. This suggests that women have so much to bring to the table in building a robust and efficient agricultural research and innovation ecosystem which are imperative for sustainable growth and development of the agriculture sector. It is fundamental to leverage the talents of women to unlock the agricultural potential in the SSA as they represent 52 per cent of the total population in the sector and account for about 50 per cent of the agricultural labour. The development and implementation of gender-sensitive policies that allow for increased women's participation in agriculture are imperative in disrupting the agriculture value chain in the SSA. It is worthy of note that, in recent times, women are leading research in the agriculture value chain to provide solutions to some of the most intractable agricultural problems and shape the process of innovation. Women researchers work in a variety of fields related to agriculture,

such as breeding, pathology, entomology, and soil science, and they are vital sources of fresh ideas that help solve the particular and pressing problems faced by female farmers and the entire agriculture sector. Recognizing the critical role of innovation at every step of the agriculture value chain, countries in the SSA need to optimise the potential of women in delivering workable solutions that are relevant to the growing needs of farmers in the region. This will promote an inclusive agriculture-driven prosperity capable of responding to the environment-specific needs and priorities across the agriculture value chain in the SSA. In addition to breaking new ground in water resource management and climate change adaptation, women are at the forefront of a number of creative research programmes in livestock, forestry, fisheries, and environmentally friendly indigenous crops. It is interesting to note that various women's agriculture organizations such as African Women in Agricultural Research Development (AWARD), African Women in Agribusiness Network (AWAB), and African Women in Agriculture and Arts (AWAA), among others, have continued to empower women agricultural scientists across SSA by strengthening their science and leadership skills to deliver innovative and sustainable agricultural research for the region and African continent in general. The efforts of these organizations have been instrumental in fostering gender-responsive agricultural innovation for inclusive growth and shared prosperity in accordance with Sustainable Development Goal 2 (SDG 2) of ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture. To create more opportunities for agricultural innovations, we need to prioritize gender responsiveness by closing the gender gap in agriculture participation and empowering women to do more in the areas of research, entrepreneurship, and technological advancement to transform the agriculture sector for innovative and sustainable development in SSA. We need to expand the options for agriculture innovations by putting in place requisite technologies and infrastructure while allowing for the existence of strong institutions and environment-specific policies that empower women to play a critical role in the process of transformation and technology disruption in the agriculture sector. Innovative business women from across ACP are forming international agriculture markets as they strive to overcome gender inequities and achieve sustainable success in the sector. Let me conclude by reminding us of the need for policymakers to incorporate agricultural innovation into the broad poverty reduction and food security initiatives and allows for gender equality and empower women and girls as outlined in the fifth Sustainable Development Goal.

Prof. Data Irene Ekine

CONTENTS

SUMMARY

The University of Rwanda (UR) and the African Organisation for Technology in Agriculture (AOTA) agreed to co-organise an annual International Conference on Business Models in Agriculture (IBMA). The UR and AOTA share some core components of their missions, including:

1. Supporting to the development of Rwanda by generating and advancing knowledge aiming at the highest standards of academic excellence that prepare students for lives of service and leadership

2. offering excellent and large scale opportunities for creation of job in the agricultural sector

The University of Rwanda (UR) and African Organisation for Technology in Agriculture (AOTA) have therefore agreed to co-organise an International Conference on Business Models in Agriculture (IBMA). The IBMA 2023 was organised from 27^{th} March - 29^{th} March 2023 at Kigali Convention Center, Kigali, Rwanda. IBMA 2023 had insightful presentations and discussions from leading industry experts, and other exciting activities. The scientific presentation covered 12 themes:

1. Theme 1: Reimagining the Agriculture sector in the Fourth Industrial Revolution (4IR) Era to enhance research development in Africa: Focus on Technological Solutions and land use planning

2. Theme 2: SWOT analysis of the agriculture sectors' resources (institutions, researchers, farmers, lands, water, industry, finance, markets, policies) and development of guidelines

3. Theme 3: Development of successful farming business models that focus on marketing of agricultural inputs and produce by encouraging export of high value produce/products

4. Theme 4: Transformation of the agricultural value chain, African Nutritious Food Systems, and the African Continental Free Trade Area (AfCFTA)

5. Theme 5: Impact of climate change/variability on agriculture production and development of mitigation and adaptation measures

6. Theme 6: Updating soil information database for environmentally friendly, specific land suitability, as well as fertilizer recommendation for soils

7. Theme 7: Development of indigenous and improved seeds and livestock for sustainable agricultural development

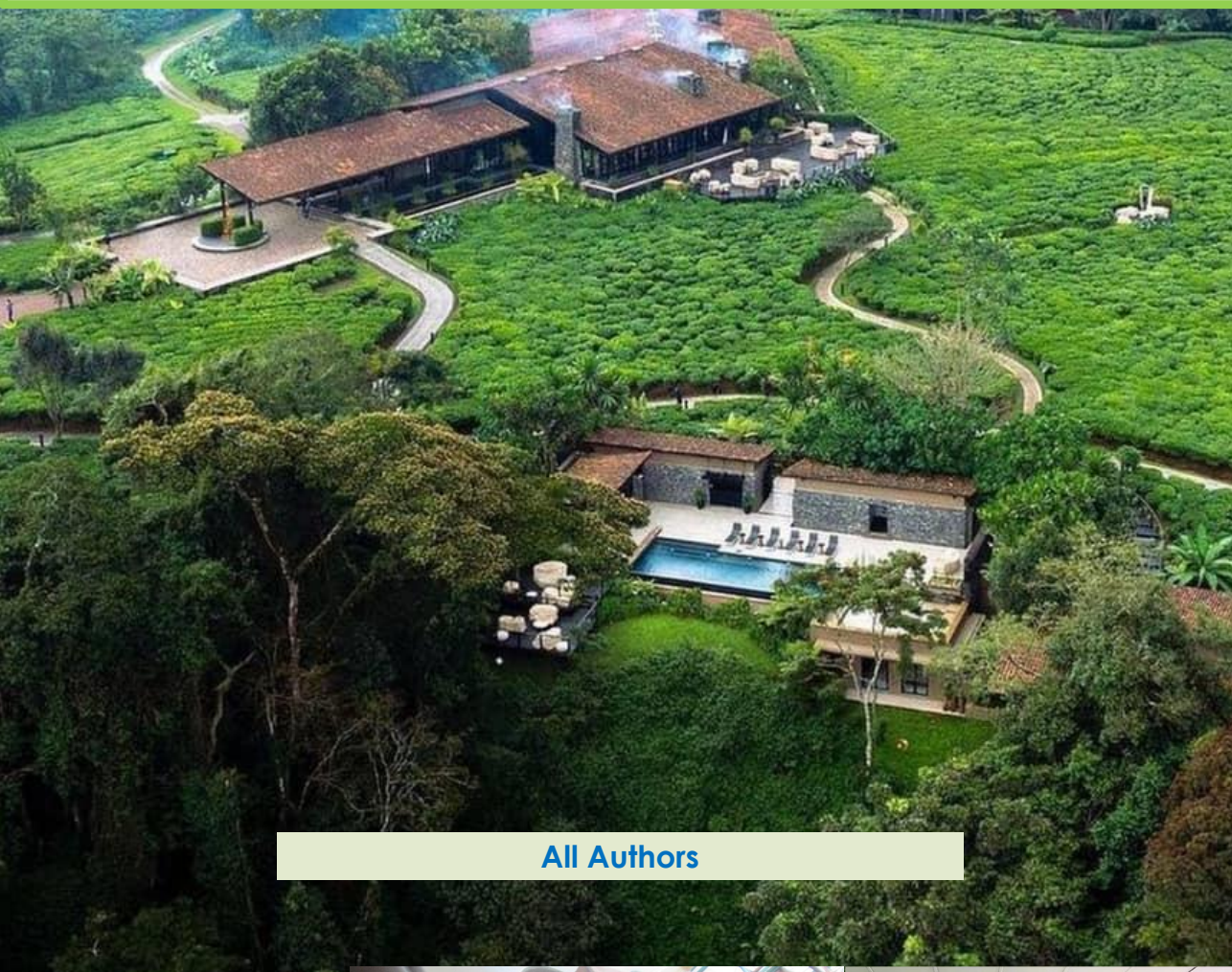
8. Theme 8: Production of nutritious food for better health based on consumer demographics and dietary needs
9. Theme 9: Agroforestry and Fisheries subsector and their contributions in transforming Africa's economy
10. Theme 10: Women in agriculture and young agro-entrepreneur
11. Theme 11: Ways to secure the 5 freedoms for Livestock and Farmers
12. Theme 12: Farmer based programs in line with ag extension and advisory services

The panel discussions between various speakers covered a range of topics:

1. Panel 1: Soil Health and Regenerative Agriculture Paradigm
2. Panel 2: Business Models and Approaches to Increase Smallholder Farmers' Income per Hectare
3. Panel 3: Models to Address Hunger Malnutrition on the African Continent. International Local Policies; The Ecosystem of Farming, the Value Chain
4. Panel 4: Women in Agriculture Models Designed to Support Smallholder Farmers
5. Panel 5: Investment in Agriculture. Models designed to attract and increase investment in agriculture. A case for Rwanda and Senegal
6. Panel 6: Youth-led and University models promoting entrepreneurship and agro-industry
7. Panel 7: The role of Academia and research Science in promoting Agriculture for smallholders. Model approaches used
8. Panel 8: Sustainable Farming Issues on Climate Change and Variability

PART 1: ABSTRACTS UNDER ORAL AND POSTER PRESENTATION IN IBMA 2023

Part 1: Abstracts under Oral and Poster Presentation in IBMA 2023



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THEME 1: REIMAGINING THE AGRICULTURE SECTOR IN THE FOURTH INDUSTRIAL REVOLUTION (4IR) ERA TO ENHANCE AFRICAN RESEARCH DEVELOPMENT: FOCUS ON TECHNOLOGICAL SOLUTIONS AND LAND USE PLANNING

1.1. CONSTRAINTS AND CHALLENGES OF SERICULTURE PRODUCTION IN RWANDA (CASE STUDY: HUYE, NYANZA, AND MUHANGA DISTRICTS) BY *Muhinyuza J.B. et al.*

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The study was carried out in 2019 at Huye, Nyanza and Muhanga districts, with a general objective to assess the major constraints and challenges of sericulture production in Rwanda and propose the way forward for the development of sericulture industry in Rwanda based on case studies of Huye, Nyanza and Muhanga districts. The study used a random sampling which involved three districts, three villages per district- and six respondents per village. This resulted in a total of three districts, 9 villages, and 54 respondents to get characteristics of the farms, production systems and gender balance. The result showed that women were more involved in sericulture industry than men. Farmers involved in Sericulture were mainly of primary level of education (47%), followed by illiterate (19%) and University level (8%). This study revealed that sericulture production constraints and challenges in Rwanda especially in Muhanga, Huye and Nyanza districts were mulberry and silkworm diseases, lack knowledge about sericulture farm and industry, lack of good quality silkworm eggs and mulberry seeds, lack of liable and efficient market and poor private investment in sericulture.

Keywords: challenges, constraints, Rwanda, sericulture

1.2. A REVIEW ON OKRA (ABELMOSCHUS ESCULENTUS (L.) MOENCH) PRODUCTION, NUTRITION AND HEALTH BENEFITS BY *Uwiringiyimana T. et al.*

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Okra (*Abelmoschus esculentus* (L.) Moench) belongs to the family of *Malvaceae* in the genus *Abelmoschus*. It is commonly known as lady's finger or gombo in different countries including Rwanda. Okra is nutritious vegetable crop with numerous health benefits. Consumption of adequate quantity and quality vegetables is vital for the proper functioning of the human body. A general review of okra vegetable was done to increase understanding and awareness in cultivation and utilization of different varieties of okra and undertake more comprehensive research. Knowledge of climate and soil requirements, soil fertility, proper management practices and health benefits are essential to promote okra. It is mainly cultivated in tropical and sub-tropical regions, especially in warm climates with annual rainfall and mean temperature in the range of 900-1,000 mm and 18 oC to 35 oC respectively. Cultivation of okra requires sandy or clay loam soils with medium drainage for good yield and a pH ranging from 6.0 to 6.8. Generally, okra requires 150 kg of Nitrogen, 112 kg of Phosphorus (P2O5) and 75 kg of Potassium (K2O) per hectare. Moreover, proper plant population is crucial for optimum growth, yield and quality. The plant population density that gives optimum okra yield and quality is obtained at a spacing of 50 cm x 40 cm. Pest and diseases are the major production constraints of okra. The most reported ones are okra yellow vein mosaic virus, okra enation leaf curl virus, powdery mildew, Cercospora leaf spot and fruit borers. Losses are observed in yield quantity but mainly in the lower quality of the produce. The emphasis on the control of pests and diseases is being put on breeding for resistance, safe application of chemicals and use of botanicals. Okra is nowadays known as food with healthy and medicinal benefits due to its composition. Okra leaves, pods and seeds are edible and are all very nutritious. The composition of okra pod per 100 g edible portion is water (88.6 g), energy (144.00 kJ / 36 kcal), protein (2.10 g), carbohydrate (8.20 g), fat (0.20 g), fiber (1.70 g), Ca (84.00 mg), P (90.00 mg), Fe (1.20 mg), β carotene (185.00 g), riboflavin (0.08mg), thiamin (0.04 mg), niacin (0.60 mg), ascorbic acid (47.00 mg). Okra leaves, per 100g edible parts, protein (4.40g), fat (0.60g), fiber (2.10g), Ca (532mg), P (70mg), Fe (0.70mg), ascorbic acid (59 mg), β-carotene (385ug), are thiamine (0.25mg), riboflavin (2.80mg) and niacin (0.20mg) which makes it to possess anti-inflammatory, anti-hyperglycemic, anti-hyperlipidemic and antioxidant properties. This paper reviews okra in general from cultivation, climates, soil nutrients requirement, pests and diseases control as well as its healthy and nutritional benefits. A good understanding of the proper practices for okra cultivation and its health benefits will motivate the farmers and actors in agriculture and health sector to promote this vegetable and its consumption, especially those from tropical and sub-tropical countries.

Keywords: Okra (Abelmoschus esculentus (L.) Moench), cultivation requirements, pest control, nutrients, health benefits

1.3. OPTIMIZED LETHAL DOSES OF *Tagetes minuta* FOR THE CONTROL OF MAIZE WEEVILS UNDER STORAGE CONDITIONS BY *Rutikanga A. et al.*

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Agriculture is at the heart of Rwanda's economy and maize is an important staple crop in Rwanda both as a food and source of incomes. Maize cultivation has many challenges such as pests and diseases, both in the field and during the storage period. The most serious pest of stored maize grains is Sitophilus zeamais which causes stern damage during storage conditions. Synthetic insecticides are the most used control method for this insect pest in Rwanda. However, synthetic insecticides are expensive and hazardous to humans and the environment. Alternatively, the application of natural plant extracts has been reported effective and safer for the control of maize weevils under storage conditions. The main objective of this study was to optimize lethal doses of crude extracts from wild marigold (*Tagetes minuta*) for the control of maize weevils under storage conditions in Rwanda. To achieve this objective, bioassays were carried out through a Complete Randomized Design (CRD) with nine repetitions. Samples of 100 maize grains were put in small bags and infested with 10 weevils and treated with various volumes (doses) of liquid extracts from *Tagetes minuta* mixed with soluble starch to come up with a powder formulation suitable for grain protection. That is, (1) T0: negative control that consisted of untreated maize grains (UTMG), (2) T1: 1mL of *Tagetes minuta* extract (TME) + 9gr of soluble starch (SS), (3) T2: 2mL of TME + 8gr SS, (4) T3: 3mL of TME + 7gr SS, (5) T4: 4mL of TME + 6gr SS, (6) T5: maize grains (MG) + SS, while (7) T6: MG + Malathion (MAL). The bioassay was monitored at a three-day interval for a period of 30 days. It is worth noting that, data collection focused on Weevil Mortality Rate (WMR) and Grain Damage Rate (GDR). Recorded data in WMR showed that high WMR (100%) was observed in T3: 3mL of TME + 7gr SS, while the lowest WMR (7%) was recorded in T0: UTMG and T5: MG+SS. Regarding GDR the highest rates were observed in T5: MG + SS. Based on previous studies which confirmed that *Tagetes minuta* (powder crude extract) controlled Sitophilus zeamais at 42%, the current results proved that liquid crude extract can far better control maize weevils as nearly 100% death of weevils was recorded 3 days after treatment of maize grains.

Key words: Marigold (Tagetes minuta); Maize weevils (Sitophilus zeamais); soluble starch

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THEME 2: SWOT ANALYSIS OF THE AGRICULTURE SECTORS' RESOURCES (INSTITUTIONS, RESEARCHERS, FARMERS, LANDS, WATER, INDUSTRY, FINANCE, MARKETS, POLICIES) AND DEVELOPMENT OF GUIDELINES

2.1. THE EFFECTS OF FLOODING ON SOIL STATUS, IT'S IMPACTS ON CROP PRODUCTIVITY AND LIVELIHOOD OF FARMERS IN MUGOGO WATERSHED, BUSOGO SECTOR, MUSANZE DISTRICT, RWANDA BY *Twagirimana E. et al.*

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The study focused on effect of flooding on soil status, its impacts on crop productivity and livelihood of farmers in mugogo watershed. Hence the soil samples were collected from two differences sections such as flooding zone and controls / upland at the depth of 0-15cm and the data were analyzed to test the hypothesis. The soil samples in flooding zone were replicated five times the same as in controls/uplands and the data were analyzed using statistical package for social science (spss) and t test. The Results demonstrate that there is significance different in soil pH, soil organic carbon, soil organic matter and soil texture at 0.05 level of significance. Hence the soil PH (H20) in flooding is acid than controls as from the range 5.01-5.6, simply high availability of aluminum in soil and the soil texture in flooded zone are sand clay loam as the clay particles transported by water erosion from the hill side to marshland and in controls / upland the soil is sandy loam. Organic carbon, organic matter were tested and the results showed that at flooded soil organic carbon were lower than in controls with the range 0.75-5.479% while organic matter is from 1.3567-9.4457% in flooding zone, this caused by low oxygen and poor aeration which lead to low organic matter decomposition and interfere microbial decomposition and low activities, in controls / upland the range is from 9.8957-12.592% of organic matter. There is high strong correlation between the effect of flooding on soil status and effect of flooding on ecosystem with 0.639 due to during flooding the sequences of environmental ecosystems destroyed and significance correlation between the agriculture output and farmer livelihood with 0.695 because as output from agriculture reduced also farmer income reduced. There is weak correlation between the flooding effects, agro forestry practices and mitigation.

Keywords: Flooding, Soil status, Crop productivity, Watershed, Livelihoods

3

DEVELOPMENT OF SUCCESSFUL FARMING BUSINESS MODELS THAT FOCUS ON MARKETING OF AGRICULTURAL INPUTS AND PRODUCE BY ENCOURAGING EXPORT OF HIGH VALUE PRODUCE/PRODUCTS

3.1. LANDSLIDES OCCURRENCE AND RELATED CAUSAL FACTORS IN THE GISHWATI AND MUKURA LANDSCAPE OF RWANDA BY *Fashaho A. et al.*

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The Gishwati and Mukura Landscape of Rwanda was affected and is still susceptible to landslides occurrence events. The research aimed to establish the relationship between landslides occurrence and some major related causal factors including precipitation, slope gradient, lithology, soil type and depth, and land use/ cover type. In total, 45 landslide locations with visible features were identified through field observation and survey. With the aim of contributing to the landslide hazard evaluation of the Landscape, a detailed analysis of the rainfall events from 1981 to 2017 was carried out on monthly basis. Other secondary data were also collected. The data recorded were analyzed and compared with the occurrence of landslides. The results revealed that heavy rainfall clustered during two rainy seasons were the principal triggering factor of landslides in the Landscape. It has been revealed that 56.5% of the observed landslides falls into the slope category of 8.7 –27.5% followed by the category of 27.5 –39.0% with 41.3% of the total case identified. The areas occupied by the crop land was found to be the most affected with 50.0% of the total identified sites, followed by forest (34.8%) and built-up areas (15.2%). The soils with high percentage of clay content (>35%), originated from granite and quartzite, dominate the identified zones that were affected by landslides. Based on these findings, the outcomes of this study will help to build short and long-term flexibility into landslide risk management planning processes and decisions at the Gishwati and Mukura Landscape level.

Keywords: landslide occurrence, landslide related causal factors, landscape

3.2. INFRARED PESTS DETECTION SENSOR BY *Dushime L.*

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The excessive and indiscriminate use of pesticides in agriculture has led to several environmental and health problems. One of the main reasons for this issue is the inability to accurately detect and target pest infestations in agricultural fields. This study aims to develop an infrared pest detection sensor that can accurately and quickly detect the presence of pests in agricultural fields, providing an effective solution to this problem. The methodology involved designing and testing the sensor in a laboratory setting and conducting field trials in various locations over two weeks. The procedures involved testing the sensor's ability to detect pests by analyzing the infrared radiation emitted by plants in the presence of pests. The analytical techniques used involved analyzing the data obtained from the sensor using statistical methods in software to determine its accuracy. The principal results of the study indicate that the infrared pest detection sensor is highly accurate in detecting pests, with a success rate of 95% or more. These results are statistically significant, indicating that the sensor can be relied upon for pest detection in agricultural fields. In conclusion, this study emphasizes the new and important aspects of the research, specifically the development of an accurate and efficient tool for pest detection. The infrared pest detection sensor has the potential to greatly reduce the use of pesticides in agricultural fields by allowing farmers to target pest infestations with greater precision. This technology could also lead to a more sustainable and environmentally-friendly approach to pest management in agriculture.

Keywords: infrared, pest, detection sensor

3.3. ANALYSIS OF CHALLENGES FACED BY SMALLHOLDER FARMER IN AVOCADO PRODUCTION IN GISAGARA DISTRICT, RWANDA BY *Zaninka C. et al.*

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Avocado fruit plays an important role in human health, because of its nutritional value. Eating the fruit may result in boosting immunity of the body against diseases such as heart ailment, cancer, obesity, and diabetes. Despite the importance of the avocado crop in Rwanda, there is an inadequate avocado yield that can fetch good prices in the local and international markets. Moreover, there is little knowledge among smallholder farmers on avocado varieties and good quality for local and export purpose. The purpose of this study was to analyse the challenges faced by smallholder farmers in avocados production in Gisagara District, Rwanda. A survey research design was used in the study. The target population was 22143 households. 143 farmers were selected to participate

in the study using a simple random sampling process. Purposive sampling method was used to select sectors in the Gisagara District. A questionnaire with closed and open-ended questions was used to collect data from household heads. Thirty farmers from Gatare Sector of Nyamagabe District were randomly selected for a pilot survey to pre-test the survey instruments and their reliability. The internal consistency of the instruments was measured using Cronbach's. The reliability coefficient of the instrument was 0.79. Data were analyzed using the Statistical Package for Social Science (SPSS). The results were presented using descriptive and inferential statistics including frequency, percentages, Likert scale, and multiple regression. The challenges affecting avocado production were getting quality seedlings, knowledge about good farming practices, access to production inputs, access and control over the market, and pest and diseases. there was a significant positive correlation between challenges faced by smallholder farmers and the average production of avocado. Availability of good quality avocado seedlings is requisite to good quality avocado fruits for local and international markets. The study findings could provide useful information among the avocado value chain actors on avocado production in Gisagara District, and Rwanda in general. The study recommends promotion of participatory research and joint innovation in avocado innovation platform to enhance capacity building of farmers and other actors in the avocado value chain.

Keywords: avocado value chain, avocado innovation platform, smallholder farmers, participatory research and development

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Theme 4: Transformation of the agricultural value chain, African Nutritious Food Systems, and the African Continental Free Trade Area (AfCFTA)

5

THEME 5: IMPACT OF CLIMATE CHANGE/VARIABILITY ON AGRICULTURE PRODUCTION AND DEVELOPMENT OF MITIGATION AND ADAPTATION MEASURES

5.1. STUDY OF THE PERFORMANCE AND ECONOMICS OF SOLAR OPERATED THRESHERS AND COMPARISON WITH OTHER SOURCE OF POWER FOR SMALL SCALE FARMERS *Harerimana L. et al.*

Leonce Harerimana[1*], Jean de Dieu Iyakaremye [1], Indra Mani[2], P.K Sharma [3], Roaf Ahmad Parray [3], Satish Devram Lande [3], K.K. Bandyopdhayaya [3], S.K. Sarakar [4]

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Threshing is one of the energy and time consuming activities in grain crop production. The study was undertaken to develop the solar operated multicrop thresher for small holding farmers, to study its performance and economic parameters and to compare it with the threshers in the same category that use other sources of power. The evaluation of the prototype performance was carried out using response surface methodology (RSM), central composite Design (CCD) with four factors each at 3 levels namely for feed rate (3kg.min-1, 4.5 kg.min-1, 6 kg.min-1), the cylinder speed (400rpm, 550rpm, 700rpm), concave clearance (10mm, 15mm, 20mm) and on three spike types (spike types1, spike types2, spike types3). The solar-powered multicrop thresher's performance was optimized to find the best combination of operational parameter for sorghum crops. The economic cost was determined for the optimum parameter and compared to other threshers in the same size range. The threshing efficiency was found to range between 97.2% to 99.86%, the mean cleaning efficiency was within a range of 88.28% and 93.05%. The total grain loss ranged from 1.64 to 3.47 with overall average of 2.59 %. The grain breakage was found to vary between 0.5 and 1.34 with the overall mean of 0.92%. The energy consumption was found with average of 1.21 kWh.q-1 of threshed grains. The cylinder speed was found to significantly influence all the performance parameters. The reduction of feed rate reduced the power requirement and could be based upon to increase the duration time in different harvesting periods of India and Rwanda. The optimal combination was of 4.5kg/min feed rate, 650 rpm cylinder speed, 15 mm concave clearance and spike type 3. The operating cost with 1 worker was of Rs.921.8 per tonne of threshed grains of sorghum. These costs are competitive in comparison to other threshers in the same category of capacity because the farmers are relieved of the fuel or electric bill cost while the solar panels are more utilized for target users with cost reduction of 1.34% and 28.9 % for, respectively, the electric motor operated multicrop thresher and diesel engine operated multicrop thresher. Additionally, the solar operated thresher has an advantage of being environment friendly with carbon foot print reduction of 25 kg of CO2 per tonne of grains threshed as compared to diesel engine operated thresher. In

conclusion, the solar powered multicrop thresher was advantageous to the farmers in saving time and money and helping him to judiciously utilize the solar panel by diversifying its uses.

Keywords: Multicrop Thresher, Threshing efficiency, Response surface methodology, Threshing energy consumption, Cleaning efficiency

5.2. IMPACT OF CLIMATE CHANGE ON AGRICULTURE AND THE DEVELOPMENT OF ITS ADAPTATION BY *Igabe J.*

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Agriculture is a major source of greenhouse gases which contribute to the greenhouse effect and climate change. However, the changing climate is having far reaching impacts on agricultural production, which are likely to challenge food security in the future. This means that projected increases in temperatures, changes in precipitation patterns, changes in extreme weather events, and reductions in water availability may lead to reduced agricultural productivity. While gradual increases in temperature and carbon dioxide may result in more favorable conditions that could increase the yields of some crops, in some regions, these potential yield increases are likely to be restricted by extreme events, particularly extreme heat and drought, during crop flowering.

Keywords: Agriculture, Green house gases, Climate change

5.3. DETERMINANTS OF URBAN TREE PLANTING ADOPTION AS A CLIMATE CHANGE MITIGATION STRATEGY IN ENUGU METROPOLIS BY *Chikamso C. A. et al.*

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Urban trees are essentially beneficial to the environment. They help in providing abundant ecosystem services that help in maintaining livelihoods and ecosystem regulation for both rural and urban dwellers often at no cost. Aside from habitat provision and climate change mitigation through the absorption of pollution, urban trees help to increase property values, facilitate recovery and reduce fatigue. Though these are valuable services, there are no monetary values attached, making it ambiguous to estimate their economic value. This results in poor utilization of these ecosystem services, leading to climate change. Urban areas are the key player in Nigeria's carbon footprint because of the infrastructures, and economic and industrial activities going on in these areas which are key sources of greenhouse gases. One of the strategies for addressing this issue of high global carbon footprint could be through urban households' adoption of tree planting. This study which aimed at assessing the determinants of urban tree planting adoption as a climate change mitigation strategy was conducted in Enugu Metropolis. Using a simple convenience random sampling technique, a sample size of 255 households comprising 85 households in each of the three local government areas (LGA) that made up the metropolis was studied. The study was guided by a well-structured questionnaire administered to the respondents through the help of research assistants across the three local government areas in the metropolis to determine their willingness to adopt urban tree planting as a carbon sequestration strategy. Data were analyzed using descriptive statistics such as percentages, means and Logit regression to determine factors affecting urban households' willingness to pay for tree planting. The result indicates that 67% of households were willing to adopt tree planting while 33% reported non-ownership of land and landlords' non-approval for tenants to plant trees in their compound as the major reasons for their unwillingness to adopt tree planting. The mean willingness to pay for adopting tree planting was N875.74K, with a range of N400 to N1,500. Gender, age, education, land ownership, landlord's decision, access to trees, occupation, and lack of climate change information were recorded as factors affecting households' decision to adopt tree planting in the metropolis. Among others, we recommended an urgent policy framework for compulsory house-to-house and street tree planting in the state.

Keywords: urban trees; climate change mitigation strategy; carbon sequestration

5.4. ASSESSMENT OF THE ROLE OF AGROFORESTRY IN BUILDING LIVELIHOOD RESILIENCE TO FLOODS IN NORTHWESTERN HIGHLAND OF RWANDA, NYABIHU DISTRICT BY *Nkamiyabanga T. et al.*

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Highland region of Rwanda is prone to adverse effects of climate change including floods, landslide, etc. Therefore, Climate change is a major challenge for the agricultural sector worldwide. Smallholder farmers are particularly vulnerable to the impacts of climate change owing to their high dependence on agriculture for livelihood sustenance. Building smallholder farmers' livelihood resilience to the adverse effects of environmental change is critical to addressing their vulnerabilities. However, vulnerability of communities residing in mountainous areas to climatic hazards, mainly inundation, has compelled them to modify their livelihood through various approaches like agroforestry. Agroforestry, the integration of trees into an agricultural landscape, is touted as providing benefits for the environment such as acting as wildlife habitat and preventing soil erosion, and providing benefits for people such as fruit, income, fuelwood, medicine, and construction materials. Futhermore, agroforestry is considered as an efficient means to building resilience towards climate stress in recent years. In additional, Agroforestry can address food security, climate change vulnerability, along with the adaptation needs of local inhabitant. This research was carried out in Nyabihu district, November 2020 in the communities of Mukamira sector to evaluate the role of agroforestry system in enhancing adaptation during flooding and assessing its effectiveness Field visit and household surveys approaches were used. A sample of 120 households was interviewed and data were processed using Microsoft Excel and the analysis was done by using SPSS version 16 and STATA software. Participatory Rural Appraisal (PRA) tools. More than 90% of respondents believed that trees on farmland helps to fight against soil erosion at 34.16%. Similarly, majority farmers (>80%) with trees on their farms mentioned that agroforestry aided them in terms of financial capital by curtailing risk of being in debt. Local community considered agroforestry as an integral part of their adaptive plan during prolong floods period, where trees are mostly grown on terrace raisers, home gardens, etc. The main agroforestry trees species in Mukamira sector were *Eucalyptus spp., Alnus Accuminata, Ficus tonningii, Erythrina abyssinica, Vernonia amygadalina, Persea amercana, Cyphomandra Betaceabetacea and Maessa lanceolata.* During floods, those agroforestry species supported to improve livelihood resilience by giving livelihood and environments benefits. On the basis of these results, it is recommended that climate change adaptation interventions and policies should take a critical look at the determinants of resilience in order to come up with effective plans of action that can enhance farmers' resilience to environmental changes occurring in Rwanda, particular in highland region.

Keywords: Climate change, Resilience, Floods, Eucalyptus spp. and Agroforestry

5.5. EFFECTIVENESS OF CLIMATE SMART AGRICULTURE IN MANAGING FIELD STRESSES IN ROBUSTA COFFEE BY *Kirabira A. et al.*

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This study is an investigation into the effectiveness of climate smart agriculture (CSA) technologies in improving productivity through managing biotic and abiotic stresses in the coffee agro-ecological zones of Uganda. The motive is to enhance farmer livelihoods. The study was initiated as a result of the decreasing productivity of the crop in Uganda caused by the increasing prevalence of pests, diseases and abiotic stresses. Despite 9 years of farmers' application of CSA, productivity has stagnated between 700kg -800kg/ha/yr which is only 26% of the 3-5tn/ha/yr which CSA is capable of delivering if properly applied. This has negatively affected incomes of the 10.6 million people along the crop value chain which has in essence affected the country's national income. In 2019/20 FY for example, Uganda suffered a deficit of 40m out of singularly the increasing incidence of one pest; BCTB. The amalgamation of such trends cripples the realization of the SDG 1 and 13 which are eradication of poverty and mitigation of climate change, respectively. In probing CSA's effectiveness of curbing such a trend, this study is guided by the objectives of; determining the existing farmers' knowledge and perceptions of CSA amongst the coffee farmers in the diverse coffee agro-ecological zones of Uganda; examining the relationship between the use of CSA and prevalence of selected coffee pests, diseases and abiotic stresses; ascertaining the difference in market organization and pricing between conventionally and CSA produced coffee; and analyzing the prevailing policy environment concerning the use of CSA in coffee production. The data collection research design is descriptive in nature; collecting data from farmers and the agricultural extension workers in the districts of Ntungamo, Iganga and Luweero; each of these districts representing a distinct coffee agro-ecological zone. Policy custodian officers at district, cooperatives and at the crop's overseeing national authority were also interviewed.

Keywords: Climate Smart Agriculture, Field stresses, Robusta Coffee

5.6. Impact of Climate Change/variability on Agriculture Production and Development of Mitigation and Adaptation Measures in Rwanda, Case Study Gatsibo District by *Ndayisaba J.*

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Climate change has posed a serious threat to food security in developing countries in Africa. This has led developing countries to heavily rely on foreign aid in the form of food handouts to avert hunger. The shift in climatic conditions across the Sub-Saharan region from semi-arid to arid has sparked widespread concern about Africa's ability to feed itself. The past three decades have been characterized by an erratic rainfall pattern over Africa's sub-tropics and a significant decline in the amount of rainfall. The main objective of this research was to assess the impact of climate change/variability on agriculture production and the development of mitigation and adaptation measures in Rwanda. Exposure and sensitivity of grain legumes' yields to climate variability and the ability of farmers to adapt to the effects of exposure and sensitivity of grain legumes to climate impacts have been selected as the main indicators for this research. To achieve this, random sampling will be used to select Sample Study area is located at lat = -1.65325 and long = 30.47022 with buffer area is lon-buffer = 0.01km, and lat-buffer = 0.01km and set the range of dates for the analysis time-range = ("2012-01-01", "2012-12-20") and ("2022-01-01", "2022-12-20") finally combine central lat, lon with buffer to get area of interest lat-range = (lat - lat-buffer, lat + lat-buffer) and lon-range = (lon - lon-buffer, lon + lon-buffer). With the intention of clarifying some aspects not captured in the survey, interviews were organized with local authorities in charge of agriculture and social affairs at both sectoral and district levels. The Cropland Climatological Phenology (CCP) model and Analysis of Variances (ANOVA) will been used to analyze NDVI climate data and information from sampled area of interest with Digital Earth Africa (DEA). This has resulted time series of greenness on sampled plot. Crops and livestock have failed to quickly adapt to these harsh climatic conditions. Research on the impacts of climate change in Rwanda shows that the country's agricultural sector is already suffering from changing rainfall patterns, temperature increases, and more extreme weather events, like floods and droughts. Longer and more frequent droughts have substantially reduced crop yields, and this has negatively impacted food production in the country. A shift in the country's agro-ecological regions and national strategic plan about agro-forestry has been observed, and this shift has been attributed to climate change. The research analyzes the various drought mitigation measures that the government of Rwanda has put in place to avert the consequences of climate change. It has become apparently clear that

the only way Rwanda will be able to outrun the effects of climate change on food security would be to scale up production in the agricultural sector by setting up schemes to assist farmers so that they attain maximum crop yields. These measures are analyzed, looking at their strengths and shortfalls. For a better mitigation of climate change and variability impacts, land consolidation and the formation of cooperatives, improving the economic capacity of local farmers, cultivating seeds that are resilient to climate variability, and, if possible, starting other off-farm activities should be given greater attention. Key words; Food security, Mitigation, Adaptation, Weather Events and Sustainable Development.

Keywords: Food security, Mitigation, Adaptation, Weather Events and Sustainable Development

5.7. SMALLHOLDER TO SMALL BUSINESS: TECHNOLOGY, INCLUSION, INVESTMENT, AND IMPACT BY *Ayenoto A. P.*

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Smallholder Farmers (SHF) make a substantial contribution to the agricultural industry and the GDP of Sub-Saharan Africa. However, they are the most financially marginalized, uneducated, and highly susceptible to the consequences of climate change. In response, national governments, international organizations, and charities have worked in collaboration with the private sector, to effectively and sustainably grow Smallholder Farmers' operations from subsistence farming to small agric-enterprises, thereby decreasing poverty. However, these policies are not met with strategic commitments from the private sector which is evident in the business model employed in engaging with this demography. The policy environment around Know-Your-Customers (KYC) and other related requirements in some markets are barriers that further marginalize the massive SHF population below the economic pyramid. Indeed, mobile penetration has continued to rise, but many solutions created to leverage these technologies have struggled to deliver sustainable value to Smallholder farmers. Due to the time and financial constraints of this research, secondary data was culled from publications of the National Bureau of Statistics, Nigeria (NBS), Consultative Group to Assist the Poor (CGAP), The Palladium Group, and IDH - the Sustainable Trade Initiative. The Nigeria Smallholder Household Survey which employed a stratified multistage sampling strategy to generate a nationally representative sample of smallholder homes, with a sample size of 3,000 families also informed the findings of the study. In analyzing the data, this study employed a social constructivism approach to gain actionable insight into the life of the SHF and the various socio-economic challenges they face. Agro-value chains are considered weak based on the number of smallholder farmers involved which is attributed to the

difficulty in transitioning from subsistence farming to market-focused production, this is a major challenge faced by SHFs in Nigeria. Various service delivery models have been developed for engaging with Smallholders such as Informal, Intermediary, multipartite, centralized, and nucleus estate. The centralized service delivery model fits perfectly with the values of an inclusive business model, it creates an ecosystem that enables a win-win situation for business whilst allowing farmers freedom and access to the market. In conclusion, private investment is crucial in spawning and driving sustainable development in the Nigerian agricultural industry. Businesses in the value chain need to take a more active leadership role in alleviating the weakness in the value chain while thinking long-term. There is a limit to the financial capabilities of private businesses to sustainably and profitably fill this gap. Hence, funding from governments and related bodies must therefore be designed more in line with the guiding principles of impact investments which are: Intentionality, Evidence and Impact data in Investment Design, Manage Impact Performance, and Contribute to the growth of the industry. So as to achieve the desired return on investment while making an impact.

Keywords: Smallholder, Small Business, Technology, Investment, Impact

5.8. DOES INTRA-AFRICA AGRICULTURAL TRADE CORRESPOND TO THE NEEDS OF PEOPLE WITHIN AFRICA? BY *Lubinga M. H. and Nakigudde R.*

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In this research, we use a novel export aspiration index to assess the trend of how intra-African agricultural trade is aligned with the needs of the African population. We focus on the top two agricultural products exported within Africa for each of the five pilot countries selected under the African Continental Free Trade Area (AfCFTA) namely: Cameroon, Egypt, Ghana, Kenya, and Mauritius for a period between 2010 and 2021, depending on data availability. The products were disaggregated at the hs-6 digit level. The five countries were selected on the basis of being representative of some of the major trading blocs on the continent such as the Economic Community of Central African States (ECCAS), the Community of Sahel Sahara States (CEN-SAD), the Economic Community of West African States (ECOWAS), the East African Community (EAC), the Southern African Developmental Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA). Whereas South Africa is not among the countries participating in the piloting of free trade under the AfCFTA, it is one of the major exporters

of agricultural products within Africa. Cameroon's top two agricultural exports destined for Africa are chocolate (hs 180690) and soups broths (hs 210410), while for Egypt, the most exported products are food preparations(hs 210690) and soyabean oil and its fractions (hs150790). For Ghana, palm oil and its fractions (hs 151190) and wheat or meslin flour (hs 110100) are the top agricultural exports yet fermented black tea (hs 090240) and food preparations (hs 210690) constitute the top two agricultural exports for Kenya. Mauritius registered cane or beet sugar (hs 170199) and raw cane sugar (170114) as the most exported products as South Africa mostly exports apples (hs 080810) and animal feed preparations (hs 230990). Preliminary export aspiration results for Cameroon suggest that there is a wide variation in export aspiration trends between Gabon, Congo, and Equatorial Guinea (the top three importers of chocolate). Results further indicate that Cameroon exhibits the highest mean export aspiration index for chocolate destined for Congo (124.3), followed by Gabon (18.1) and Equatorial Guinea (0.75). However, there was a general increase in the export aspiration index for Cameroon's trading partners in Chocolate considered in this paper. In the case of soups broths (hs 210410), Cameroon's highest export aspiration was with the Central African Republic (CAF), followed by Gabon and then Equatorial Guinea. For the 2010-2018 period, there was diverse variation in trends for each of the top three countries importing Cameroon's preparations of soups broths. All in all, the preliminary results indicate that Cameroon's chocolate exports correspond more to the needs of Congo and Gabon and to the least extent to the needs of the people of Equatorial Guinea. For preparations of soups and broths, Cameroon's exports correspond more to the needs of the people of the CAF, Gabon, and Equatorial Guinea in that order.

Keywords: African Continental Free Trade Area, Agricultural trade, Export aspiration

5.9. AGRICULTURAL CLIMATE FINANCING FOR SUB-SAHARAN AFRICA AFTER THE 2015 PARIS AGREEMENT DECLARATION BY *Lubinga M. H. et al.*

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It is projected that the agricultural sector in developing countries will be the most negatively affected by the climatic changes manifesting in various extreme events, including droughts, floods and high temperatures. Since the enactment of the Paris Agreement,

governments of many countries committed to minimising greenhouse gas emissions responsible hastening climate change phenomenon. However, there is scanty literature on agricultural climate financing especially for Sub-Saharan Africa. In this paper, we assess the extent to which the agricultural sector in Sub-Saharan African countries has been financed before and after the Paris agreement declaration. Climate finance is used as a measure of climate governance towards attaining the globally agreed upon target of limiting warming to 1.5 degrees Celsius as per the Paris agreement commitment. Poisson Pseudo Maximum Likelihood (PPML) estimator was used distinguish determinants of adaptation and mitigation climate finance received within the agricultural sector for a 21-year period spanning from 2002 until 2020. Preliminary results suggest that agricultural per capita production, the perception of a government exercises good governance principles positively influence agricultural climate funding received irrespective of whether it is used for adaptation or mitigation activities. Thus, the ability of citizens of in Sub-Saharan African countries to participate in selecting their government as well as having the right and freedom to express their voices in accordance to the law have a very strong influence on the amount of agricultural climate finance received. As a recommendation, governments need to improve upon citizens' participation in selecting their respective governments as well as create a favourable environment for people to freely express themselves, associate, and have access to media. This is bound to spur agricultural climate financing among Sub-Saharan African countries.

Keywords: Climate finance, adaptation, mitigation, agriculture, Sub-Saharan Africa, governance

5.10. ROLE OF AGROFORESTRY ON THE RESTORATION OF AKANYARU, MURAGO AND CYOHOHA ECOSYSTEM COMPLEX TO ENHANCE RESILIENCE OF RIPARIAN COMMUNITIES TO CLIMATE CHANGE EFFECTS BY *Nzamukosha B. et al.*

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The riparian zones of Akanyaru, Murago and Cyohoha wetland ecosystem complex in southest of Rwanda, Bugesera district is among the most valuabe wetland ecosystem complex in Rwanda. Wetland ecosystems play an important role of protecting environment from climate hazard and enhance the livelihood of its surrounding population.

This riparian zone improve wetland ecosystem complex through delivering a range of ecosystem functions like stream bank stabilization, pollutant and sediment buffering, temperature regulation, provision of energy to river food webs and communities, etc. Besides these ecosystem functions, riparian zones also provide various ecosystem goods and services for human well-being. However, riparian zones are under severe threat due to agricultural activities, urbanization, river flow alteration, overexploitation, climate change, pollution, and biological invasion. To rehabilite and restore this riparian zone is a key strategy to recover goods resources and ecosystems service for enhancing resilience of riparian Communities in the face of climate change in Bugesera district. Riparian zones should include the promotion of agroforestry system. According to different researcher agroforestry provide assets and income from wood energy, improved soil fertility and enhancement of local climate conditions as well as provides ecosystem services and reduces human impacts on natural forests. Many researches reported that incorporated trees and shrubs in food crop systems help to address food insecurity, and reduce vulnerability of agricultural systems. In southeastern Rwanda , Bugesera district, role of agroforestry to restore the wetland ecosystem complex was not reported.. The purpose of this study was to evaluate the contribution of agroforestry to the improvement of livelihoods of the riparian communities of Akanyaru, Murago and Cyohoha wetland ecosystem, in Bugerera district, southeastern Rwanda. The data were collected through household's survey, focus group discussion and the field work observation on 100 correspondents. Results showed that two agroforestry system were used. 86.57% of Agrosilvicultural system and 13.42% of silvopastoral in study area. The major occupation of riparian communities was farming system at 97.45%, while benefits that local peoples gain from the restored ecosystems compared to the time before the restoration were scored 77.5%. .Agroforestry system has contributed to the clean water of lake cyohoha and Murago and Akanyaru that are used by local people in their daily. This research demonstrated how agroforestry systems is able to lead to differents ways to stabilize food security for the poor farmers due to climate change effect. Also,This study contribute to advocate an integrated approach for riparian zone management based on various components such as, policy framework, stakeholder's participation, management practices, legislation, and awareness.

Keywords: Agroforestry, Riparian communities, Restoration, Climate change, Agrosilviculture and Silivopastiral

6

THEME 6: UPDATING SOIL INFORMATION DATABASE FOR ENVIRONMENTALLY FRIENDLY, SPECIFIC LAND SUITABILITY, AS WELL AS FERTILIZER RECOMMENDATION FOR SOILS

6.1. IMPACT OF WATER HARVESTED FROM SAND DAM AS NEW TECHNIQUE IN AGRICULTURE BY *Mitari I.*

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This study assessed the impact of sand dam storage in Nyanza district specifically in Bavakure farm located in Muyira sector. The study uses different statistical methods to assess the impact of sand dam storage as new method of water harvesting in study area. It then assesses the factors that influence adoption of water storage and the pathways through which the use adoption of such dam influence farm income. This study finds that households with sand dam storage have significantly higher income than their counterparts of comparable observable characteristics. The study which took about one month concludes that adoption of water harvesting technologies has positive benefits to farm households. In order to promote increased adoption of sand dam and the inclusion of the poorer farmers, research and development interventions should be aimed at finding ways of reducing the cost of constructing the sand dam and also of adopting the dam. Labor requirements and education status considerations appear to be important factors that influence household's adoption of sand dam technology. This implies that research and development interventions need to take account of the labor and education level demand of the technology. The effectiveness of the technology adoption is mainly constrained by problems related to water lifting and watering equipment's. This implies that support will be needed to provide affordable but improved water lifting and watering equipment's, and give training to farm households on maintenance and use of sand dam.

Keywords: Impact, water harvesting, sand dam, agriculture

6.2. APPLICATION OF SWAT MODEL TO ASSESS THE SPATIOTEMPORAL DISTRIBUTION OF BLUE AND GREEN WATER IN THE NYABARONGO RIVER CATCHMENT, RWANDA BY *Nkundimana E. et al.*

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Water is an indispensable resource to human activities and plays a crucial role in all the physiological processes of both animals and plants. Geographical locations and timing of water users influence the spatial and temporal distribution of water availability across basins. Rwandan water resources face growing challenges due to rapid demographic growth, socio-economic development, degradation from inappropriate land use practices, and climate change uncertainties. Nyabarongo River Catchment (NRC) has a dense network of rivers, wetlands, and lakes. However, the National water resources management policy notes that the data on water in Rwanda is scarce and incomplete. This study evaluated the distribution of rainfall, blue water, green water, green water flow, green water storage, and green water coefficient of the catchment. To achieve the objectives of the study, the Soil and Water Assessment Tool (SWAT) model was set up, calibrated, and validated using SWAT-CUP with SUFI-2. The simulation period was from 1985 to 1998 and the model was evaluated using R2, Nash-Sutcliffe (NSE), Kling-Gupta Efficiency (KGE), and PBIAS. The model showed very good results with 0.83 (0.92) for R2 and NSE, 0.90 (0.96) for KGE, and -2.3 (-0.7) for PBIAS for model calibration and validation respectively (values for validation). The result showed that the annual average rainfall, blue water, green water flow, green water storage, and green water coefficient were 1173 mm, 438 mm, 860 mm, 801 mm, 59 mm, and 0.67, respectively. Blue and green water were differently distributed in subbasins of the NRC based on land use classes.

Keywords: SWAT model; blue water; green water; green water coefficient; spatial and temporal distribution; trend analysis; Nyabarongo River Catchment

6.3. THE IMPACT OF LAND USE CHANGES ON SOIL PHYSIO-CHEMICAL PROPERTIES IN NORTHERN PART OF RWANDA BY *Umuhire P. and Tuyishime O.*

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Land use changes have huge effects on soil properties. This study was conducted to evaluate the effects of land use changes on the soil physio-chemical properties in Musanze district, Northern part of Rwanda. Three different land use types :non-cultivated land (forestland)), fallowed land, and cultivated land were assessed. Nine soil samples

were collected and analyzed in the University of Rwanda's soil laboratory. Eleven soil physio-chemical properties were measured: pH, soil organic matter (SOM), organic carbon (OC), total nitrogen (TN), carbon-nitrogen (C/N) ratio, available phosphorus, calcium, magnesium, soil bulk density, soil texture and porosity. The findings demonstrated that non-cultivated land (forest) has high values such as SOM (5.59%), calcium (390ppm), magnesium (110ppm), TN (0.56%), porosity (64.591%) and pH (6.86) compared to the cultivated land with SOM of 3.12%, TN of 0.29%), calcium (313.33 ppm), magnesium (76.67 ppm) and pH (6.59). A trend of decrease was observed in SOM, calcium, magnesium, TN, porosity, and pH when land use changed from non-cultivated (forest) to cultivated land while the soil bulk density shown an opposite trend for cultivated land which had a bulk density of 1.052g/cm^3 to 0.938g/cm^3. However, for both land use shifts, the amount of available phosphorus did not considerably vary. Therefore, the loss of forestland and other non-cultivated land results in soil fertility depletion and a greater deterioration of soil properties. By comparing the findings in 1989 and 2007 with the results of the current research, no significant temporal variations in soil physio-chemical characteristics were observed. This study had shown that a compromise between forested land and arable land can be found and be applicable to the lands and help in replenishing the nutrients required in the agriculture, the recommendation of this compromise could be agroforestry and land fallowing.

Keywords: Land use, soil chemical properties, soil physical properties

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6.4. ASSESSMENT OF THE IMPACT OF SENNA SPECTABILIS ON SOIL CHEMICAL PROPERTIES: A CASE STUDY OF MAYAGA AND PERIPHERAL BUGESERA ZONE IN RWANDA BY *Sebasore J.P. et al.*

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Senna spectabilis is one of the agroforestry tree species growing in the Eastern Province of Rwanda. Its adoption remains low compared to other agroforestry tree species such as Grevillea robusta. This research aims to assess the effect of Senna spectabilis on soil chemical properties. We collected 16 pairs of composite, samples taken at a depth of 0-30 cm under tree canopy in plots occupied by at least five years old Senna spectabilis trees

(treatments). Another sample was taken away from tree (control). Each pair of soil sample was mixed to make one composite sample. Results show that Senna spectabilis has various effects on soil. It increases soil nutrients such as Nitrogen, Phosphorus, Potassium, Calcium and Magnesium by 68.4%, 33.3%, 25.0, 6.5%, and 16.2% respectively; and soil organic carbon, soil aggregate stability, soil pH, soil moisture content values and it has reduced the exchangeable acidity at 50%, 9.1%, 7.0%, 23.9% and 20.0% respectively. However, it reduces exchangeable acidity. Our findings validate the hypotheses that Senna spectabilis has a positive effect on soil chemical and physical properties, and it reduces soil acidity. Although the results suggest planting more Senna spectabilis in agroforestry systems due to its capacity to improve soil properties, further research on factors that affect its adoption should be conducted.

Key words: Agroforestry, Senna spectabilis, soil nutrients, soil fertility.

6.5. SOIL SUITABILITY INVESTIGATION FOR LAND PLANNING AGRICULTURE IN MBAZI SECTOR *Habiyaremye T. et al.*

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This research was carried out in Mbazi Sector. The objectives of study are to investigate the soil suitability for land use planning for agriculture. This was based on the soil properties information sourced from the Rwanda soil database. The soil suitability investigation has a good impact, due to the selection of seed plantation according to soil suitable. The soil study site has three topographical features including, low, middle and up land. 24 soil samples were considered to different parameters. Rain fall amount is 1200 to1281Mm, the temperature is 18 0C, and soil depth is very deeper in lowland, shallow in hillside, the sloping position is (>16%). The bulk density is 1.38, 1.44 and 1.66 g/cm3 for low, middle and upland. The soil was strongly acid (pH 4.80 to 5.0). Low values of total nitrogen and organic carbon were recorded and the values of available phosphorus are low or middle depends on amendment. The soil moisture content for low (16.97%), middle (9.24%) and upland (6.64%) were generally low. Electrical conductivity for two depths (0-30 cm30-60) cm were 0.029 at and 0.037 for low, for middle were 0.015 and 0.021 ds/m and for upland were 0.038 and 0.027ds/m. The soil texture was sandy loam in low, middle and upland in B horizon but on top horizon was loam sand. Exchangeable bases are very low due to high acidity. The computation data has concluded that

presently, the land was marginally suitable for proposed crops. However if land management and cropping systems were to be applied, some parameters can be improved and best land suitability.

Key words: Soil suitability, soil properties, crop production, topographical features, Rwanda

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THEME 7: DEVELOPMENT OF INDIGENOUS AND IMPROVED SEEDS AND LIVESTOCK FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT

7.1. CURRENT STATUS OF CYPRINID FISHES IN RWANDA *Mwimba R. et al.*

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The present project was conducted to get an overview of cyprinid fish species abundance in Rwandan water bodies and to identify those that may offer potentiality in the Rwandan aquaculture industry. Seven hydrological areas were sampled during 10 months. Species identification was done by morphometric analysis and using a key guide. The ANOVA 1 and the LSD-Fisher test were applied to compare the means on the fish abundance and the specific diversity (alpha diversity). Eight cyprinid species were recorded. The Lower Akagera was the most diversified area in cyprinid species and was significantly different (p0.05) compared to other areas. This area showed higher Abundance, higher Diversity with H'=1.38 (Shannon Weiner Index) and D=0.28 (Simpson Index) probably due to less anthropogenic pressure on aquatic resources than hydrological areas surrounded by dense agglomeration. The Beta diversity displayed the highest similarity (SI=0.8, SI=0.667 and SI=0.571) respectively between Kigali water bodies and Rweru-Mugesera, Rweru-Mugesera and Akanyaru, Rweru-Mugesera and East-Kirehe. The dissimilarity was total; BCI= 0.0 between Rugezi-Burera-Ruhondo and Lake Kivu. Cyprinus carpio and Enteromius cercops were significantly dominant and frequent (p0.05). The capture of the common carp was significant and most of the specimens were big size. Cyprinus carpio revealed to adapt in Rwandan ecological conditions and the species can be used in the aquaculture industry throughout the country. Labeobarbus altianalis and Labeo victorianus were big size native cyprinids, they can offer potentiality in aquaculture sector and further studies on induced spawning and adaptability in aquaculture of these cyprinid species have to be undertaken.

Key words: Cyprinid species, specific diversity, fish abundance, Shannon Index, Simpson Index, hydrological areas, Aquaculture Industry

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THEME 8: PRODUCTION OF NUTRITIOUS FOOD FOR BETTER HEALTH BASED ON CONSUMER DEMOGRAPHICS AND DIETARY NEEDS

8.1. REVIEW ON THE NUTRITIONAL AND HEALTH ATTRIBUTES OF BLACK-JACK, *Bidens pilosa L.* BY *Nyirigira R. A. et al.*

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Although considered a boring weed, the blackjack (*Bidens pilosa L.*) is found in nearly all tropical and subtropical areas. In Rwanda, it is vernacularly known as "*Inyabarasanya*" and/or "*Ibishokoro*". This plant has outstanding nutritional and health benefits. The entire plant, fresh or dried, is utilized for dietary or medicinal purposes. This plant contains protein (3.8g/100g), fat (0.5g/100g), fiber (3.8g/100g), ash (2.2g/100g), gross energy (43 kcal/100g). As far as minerals are concerned, the plant has Na (290 mg/100g), Ca (1354 mg/100g), Ph (504 mg/100g), K (1.21mg/100g), Mn (21 mg/100g), Cu (10 mg/100g), Mg (658 mg/100g), Fe (17 mg/100g) and Zn (22 mg/100g). In Addition to nutritional importance, *Bidens pilosa* has tremendous medicinal attributes. It has been used to prevent and treat over 41 categories of diseases in humans and animals. Currently, more than 200 phytochemicals have been identified from *Bidens pilosa*, which justifies its pharmaceutical usefulness. About 201 compounds comprising aliphatic, flavonoids, terpenoids, phenylpropanoids and other compounds have been identified in black-jack. The plant is reported to possess more than 40 bioactive properties some of which are anti-diabetic, anti-inflammatory, anti-cancer activities, to list these few. The nutritional and health importance of B. pilosa makes it worth being promoted to improve humans' wellbeing and therefore uplift socio-economic conditions of countries. Further studies are called for controlling the amount of bio-active compounds in this plant to prevent them from affecting the human liver. *Key words: Bidens pilosa, medicinal use, nutritional value.*

8.2. ANTIOXIDANT PHYTOCHEMICALS: CLASSIFICATION, RESOURCES, EXTRACTION TECHNIQUES AND HEALTH BENEFITS BY *Kabera A. N.*

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Phytochemicals are generally defined as secondary metabolites in plants that play crucial roles in their adaptation to a variety of environmental stressors. In food science, the phytochemicals include a variety of plant ingredients with different structures that are capable of health-promoting effects and preventing diseases. Their classification is based on their chemical structure and their functional characteristics. The main groups of phytochemicals are composed by Carotenoids, Phytosterols, Saponins, Glucosinolates, Polyphenols, Protease inhibitor, Monoterpenes, Phytoestrogens and Sulfides. Since antiquity, humans used antioxidant phytochemicals in naturopathy in the form of medicinal herbs, spices, teas, and foods. Recently, in agriculture food products, they have become an attractive subject for food, biomedical and nutrition scientists, and food producers. Numerous clinical studies have confirmed that antioxidant phytochemicals can prevent some cholesterol-related and oxidation-induced chronic diseases; for instance, a high dietary intake of phytochemicals from vegetables, fruits, nuts, legumes, and whole grain is associated with a reduced risk for cardiovascular and other diseases. This present paper provides a comprehensive description of antioxidant phytochemicals from natural sources such as food and medicinal plants, and their extraction and analysis technologies. Analytically, Chromatography techniques with different detectors followed by skillful sample preparation are usually applied to quantify these antioxidants in natural sources: food and medicinal plants. These techniques offer sensitive and specific analysis methods for most of the antioxidants.

Key words: Antioxidant, phytochemicals, food, extraction, health.

8.3. OCIMUM GRATISSIMUM: A REVIEW ON ITS TRADITIONAL USE AND POTENTIAL CONTRIBUTION TO MEDICINE AND NUTRITION BY *Umuhozariho M. G. et al.*

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O*cimum gratissimum*, locally known as “Umwenya” in Rwanda, is an aromatic, perennial herb that is widely found in the tropics of Africa and Asia. It is frequently found in open and uncultivated locations such as roadsides in Rwanda. The plant exploitation is very limited. The objective of this review is to increase awareness of tropical coun-

tries, especially Rwanda, on benefits of *Ocimum gratissimum* and motivate its growing and utilization. The method is reviewing different findings and summarize them for conclusions. The plant is mainly known for its aromatic flavour, sometimes mixed to hot water for tea seasoning. It is traditionally used in Rwanda to treat cough and fever. According to literature, *Ocimum gratissimum* is used to treat a number of sicknesses such as stomach-ache, headache, diarrhoea, pneumonia, convulsion, sore eyes, ear infections, coughs, influenza and skin. It has antimicrobial properties, therefore used to treat wounds, infections, inflammations and fever. Despite these health benefits, the plant is unexploited in Rwanda in comparison to some African and Asiatic countries such as Algeria and India where the plant is used for treating different diseases and as food vegetables. It is found containing phytochemicals with preventive and curative significance. Essential oil from leaves and stems is estimated to 0.8-1.2%, formed by eugenol, geranial and linalool. The eugenol is the main compound spicy responsible of the aromatic odour. For nutritional value, many findings revealed that *Ocimum gratissimum* is a good source of fibers, vitamins, especially vitamins B and minerals, namely potassium (around1480mg/100g) which characterizes the plant as a good diet to reduce hypertension and stroke. It is a special source of some trace elements such as copper (around 1.2 mg/100g) when its Recommended Dietary Allowance (RDA) equals to 1.5-3mg/day, iron (around 14mg/100g) with the RDA equals to 10-15mg/day, manganese (around 7.7mg/100g) with the RDA equals to 2-5mg/day, and zinc (around 13mg/100g) with the RDA equals to 10-15mg/day. For all those properties, *Ocimum gratissimum* should be investigated, cultivated in Rwanda and all tropical countries, and promoted for the purposes of medicinal and food uses.

Key words: Ocimum gratissimum, traditional use, medicine, nutrition, Rwanda.

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THEME 9: AGROFORESTRY AND FISHERIES SUBSECTOR AND THEIR CONTRIBUTIONS IN TRANSFORMING AFRICA'S ECONOMY

9.1. EFFECT OF PRE-SOWING TREATMENT ON THE GERMINATION RATE OF *Delonix Regia, Faidherbia Albida and Senegalia Polyacantha* BY *Nsanzumukiza E. et al.*

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Plant seeds provide the most natural means of reproduction, preservation of genetic variability, transportation, and propagation in angiosperm plants. However, some do not germinate even under favorable environmental conditions, and this is termed seed dormancy. The seed germination rate is influenced by internal factors such as seed coat, embryo or inhibitors where seeds germination is prevented even under conditions normally favorable for germination. Hence, some seeds need biological or chemical treatment to suppress dormancy before sowing. The aim of the present study is to find out how different pre-germination treatments facilitate germination of Delonix regia, Faidherbia albida and Senegalia polyacantha species. The study was carried out in the National Tree Seed Center, in Huye district, Southern Province of Rwanda. Four pre-treatments were used: control; concentrated sulfuric acid for 5 minutes; immersion of seeds in cold water and in hot water (100oC) for 24 hours. Germination test was carried out in field conditions and in the laboratory. Data was collected by counting and calculation of percentages of germination. Microsoft Excel was used for data computation. Standard procedures of seed testing stipulated by the International Seed Testing Association was used in comparing the observed data. Our finding revealed that the best treatments observed were soaking Delonix regia and Senegalia polyacantha species in hot water and soaking in concentrated sulphuric acid for five minutes Faidherbia albida species. Considering environmental conditions, the highest recorded germination rates were: 29, 91 and 54% under field conditions and 47, 72 and 65% in the laboratory respectively.

Key words: Seed dormancy, Seed treatment, Delonix regia, Segalia polyacantha and Faidherbia albida

9.2. THE BIOENERGY PERSPECTIVE IN RWANDA: THE POTENTIAL OF TREE-BASED SYSTEM (TBS) IN THE AGRICULTURAL LANDSCAPE FOR FUELWOOD SUPPLY BY *Bapfakurera E.N. et al.*

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Agriculture is the backbone of the Rwandan economy and employs more than 70% of Rwandans. Agricultural land is one of the scarcest resources, and its expansion is pressing the decrease of forest areas and other natural resources. Studies on deforestation and forest degradation in Rwanda indicated that the reduction of forest areas has generally been due to the growing population leading to the expanding agricultural land for food production and a high reliance on biomass as cooking energy. Since agriculture is the backbone of the Rwandan economy, more land will likely be needed to remain under agricultural use. Biomass energy is also likely to remain the primary source of cooking energy, and Rwanda's population is projected to increase; it s impossible to expand the forest areas to meet the fuelwood demand indicating the contribution of integrating trees in the agricultural landscape for the fuelwood supply. Integrated trees in the agricultural landscape is a fruitful farming system in a land-scarce area to optimize land productivity, reduce pressure on forest areas by supplying fuelwood, and enhance the well-being of rural households by reducing the distance and time spent in fuelwood collection. Tree biomass is the country's most popular cooking energy source, accounting for 85% of Rwanda's energy supply. Forest plantations supply only part of this fuelwood, tree-based systems on agricultural land provide more. Hence, it is essential to consider the role played by this wood production outside the "forests" both when it comes to standing biomass in different systems and ecological zones and when it comes to biomass productivity and supply as fuelwoods.

Keywords: Agroforestry, tree-based system, agricultural landscape, fuelwood, bioenergy

9.3. THE BIOECONOMIC PROFITABILITY OF NON-TIMBER FOREST PRODUCTS IN NATION BUILDING: A REVIEW BY *Aleru, K.K. and Agbugba, I.*

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This paper reviews the Bioeconomic profitability of Non-timber forest products with a view to highlighting its importance, potential and economic profitability towards nation building. The significant role of Non-Timber Forest Products (NTFPs) cannot be

over emphasized in nation building. However, the consciousness and information on the economic value for NTFPs for subsistence use and trade is rightly inadequate particularly in households and within the government circles. The sustainable utilization of non-timber forest products (NTFPs) for trade is an appropriate measure to increase people's resilience against poverty and a means to improve a country's Gross domestic product (GDP). The depletion of NTFP resources due to indiscriminate exploitation, deforestation and forest degradation is also a major problem that can affect NTFP-based livelihoods and economies of every nation. As such, raising the awareness of the importance of NTFPs, the economic empowerment of rural dwellers through Small and medium scale enterprises (SMEs), encouragement of improved product handling and with the vast land in Nigeria, a tap into this all-important sector can bring about a boost to the economy and also reduce other social vices in the society.

Key words: Bioeconomy, Profitability, Non-timber Forest Products (NTFPs)

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THEME 10: WOMEN IN AGRICULTURE AND YOUNG AGRO-ENTREPRENEUR

10.1. YOUNG AGRO-ENTREPRENEUR AND WOMEN IN AGRICULTURE FOR ECONOMIC DEVELOPMENT AND FOOD SECURITY IN RWANDA BY *Irakoze A.*

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Engagement of Young Agro-entrepreneur and women in agricultural value chain development is the major issue for economic development and sustainable food system in the developing economies . Despite tremendous efforts made in the past, the performance of agriculture sector has remained inadequate in Rwanda. Agriculture is still a dominant component of the national economy of Rwanda. it contributes about 27.59% of the Gross Domestic Product(GDP)in 2017/2018.over the last decades, the growth rate of Agriculture Gross Domestic Products (AGDP) was 3.1% against 5.3% of non-agriculture sector with overall economic growth rate of 4.6%.according to Economy survey of 2019,agriculturegrowth rate was2.7% in 2017/2018.still large proportion (60.43%) of population is employed in agriculture sector. Majority of the farms in Rwanda are small-scale; the average land holding sizes0.68ha and 35% farmers holding less than 0.5 ha. only 20% farmers have more than 1ha land. about 4.12million ha (28%) area is cultivable land of which only 75% land are under cultivation. A larger proportion of population employed in agriculture adopting subsistence farming system with traditional technology, higher level of biotic and abiotic risks, low profitability, and irregular markets made this sector less attractive to the young agro-entrepreneur and women. This triggered the young agro-entrepreneur male out-mitigation leaving women in agriculture in rural areas. The agriculture sector employs about 74% of the economically active women in the country contributing about 55-82% of total labor force in agriculture. Indeed, rural Rwanda is witnessing a process of feminization in agriculture, which has a deep and wide-ranging impact on agricultural productivity. Feminization in agriculture has two aspects: in) Increased women's participation in agricultural works; and ii)empowered in decision making process. sustainability of growth depends on women and excluded group gaining the power and capacity to control decisions about use of resources. Policy and program interventions could contribute to revitalize the rural young agro-entrepreneur and women in agriculture and rural resource based economic development. Agricultural development should be backed up with value addition, processing, branding and packaging along with strong market linkages. Increased investments in research and development, tie-up with practical education system , capacity building of value chain actors, and assurance of markets for the farmers 'product could encourage young agro-entrepreneur and women in this sector. Meanwhile, an integrated efforts should be made by all line ministries, stakeholders and private sectors for the development of agriculture sector in Rwanda.

Keywords: Agriculture, out-mitigation, youth, women, value addition, Rwanda

10.2. WOMEN'S PARTICIPATION IN CLIMATE SMART AGRICULTURE IN SOUTHEAST NIGERIA BY *Chikamso C.A. et al.*

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Climate change impacts are complex, it affects ecosystems and crops growth and development. Farmers must understand its potential impacts on their crops and climate-smart measures that they can implore to be able to adapt. The choice for a certain climate-smart agriculture (CSA) practice is based on its impact on crop production and resilience to changing climatic conditions. A gender-sensitive approach in the development of CSA policy is essential. This is because women farmers play a critical role in the agricultural sector and need to benefit equally from climate change policies. It creates enormous potential for gender-sensitive innovative ways of tackling the major causes of gender inequality and contributes to the realisation of gender equality, social change and food security. This study aims to identify the traditional climate change adaptation information-sharing mechanisms and ascertain the climate-smart agricultural practices adopted by female farmers in Southeast Nigeria. Using a simple convenience random sampling technique, 300 female farmers were interviewed through a focus group discussion guided by a structured questionnaire involving 60 female farmers in each of the 5 states in the zone in two periods; planting and harvest season. On a four-point Likert scale with a mean score of 2.5 as the decision point, data were analysed using descriptive statistics. The study found that in the face of extreme weather events occasioned by climate change, farmers relied on community leaders (mean (M) = 3.27), women groups (M = 2.68) and relatives (M = 4.05) for direction on immediate adaptive measures to adopt. It further identified that farmers practised key agricultural practices relevant to climate-smart agriculture which includes the use of high-yielding or drought-resistant varieties (M = 3.06), crop diversification (M = 3.08), change in planning calendar (M = 2.96), application of fertilizers and manure (M = 4.35), minimum or zero tillage (M = 3.06), cover cropping (M = 2.80), mulching (M = 3.18), fallowing (M = 2.81), mixed cropping (M = 2.74) and crop rotation (M = 2.54). Irrigation (M = 2.04) and agroforestry (M =

1.98) weren't considered because their mean scores were below the decision point. Some of these practices have been used by farmers as a climate change adaptation strategy for many years. Exploring strategies to cope with climate change are very important to smallholder farmers, especially in Southeast Nigeria where these strategies are not often documented or recognized by service and input providers. Gender parity is a key development goal in itself in addition to being an essential condition for the attainment of sustainable development. Therefore, at the core of any national policy consideration on climate change mitigation, the role of women as participants and contributors to agricultural development should be recognized to ensure that gender-sensitive techniques are adopted to minimize women's exposure to the risks of climate change and its related natural disasters.

Keywords: women farmers; sustainable agriculture; climate vulnerabilities

10.3. GENDER EQUALITY FOR IMPROVED AND SUSTAINABLE AGRICULTURE: A REVIEW BY *Nyirigira R.A et al.*

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Women play a significant and crucial role in agricultural sector and thus are major contributors to global economy and human welfare. Women and girls make almost half of the agricultural workforce in developing countries. Research revealed that more than 60% of all employed women in sub-Saharan Africa work in agriculture. The nature and extent of women's involvement in agriculture and its allied fields (such as livestock and poultry) vary with regions. Female-run farming systems proved to be as productive as those run by men; and in some instances, when given access to the same resources, training and capital, the productivity of women-managed farms is better than the one of men-managed farms. Despite their huge contributions to food and nutrition security, women in agriculture face numerous challenges that their male counterparts do not. This review aims at assessing gender inequality in agriculture and the importance of gender mainstreaming in the sector on food and nutrition security for current and future generation. Woman farmers have less access to operational holdings (resources and services) such as land, finance, training, input, equipment, new technologies/extension services, to list these few. Women still cannot own land or make decisions regarding their households and family farms. Men remain the principle receivers of agricultural

resources and services, deciding what crops will be grown, how they are sold, and what the family can do with the money from agricultural production sells. This reflects the gender disparity in ownership of resources and services in agriculture and therefore hinders sustainable food availability especially in the developing world. Several studies confirm the positive association of increasing women's land rights and poverty reduction. Moreover, synergies of land rights, food security and sustainable agriculture development has been proven. Studies have shown global trend of growing rural to urban migrations mostly by men (than women) in search of better employments and opportunities, leaving women with increased workload and responsibilities, but without equal or direct access to financial, social, and technological resources. This leads to "feminization" of the agriculture sector, with increasing number of women in multiple roles as cultivators, entrepreneurs and laborers. To be able to feed nine billion people by 2050 in a continuously changing environment, it is important, among other strategies, to boost agriculture productivity. This cannot be achieved without addressing gender inequality issue. High levels of inequality make it difficult to increase productivity and reduce poverty and hunger, and therefore slow progress towards Sustainable Development Goal to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" by 2030. Given the predominance of women at all levels of agricultural production, pre-harvest, post-harvest, processing, packaging, marketing of the agricultural produce, to increase productivity in agriculture, it is imperative to adopt gender-specific interventions. These include but are not limited to strengthening land tenure rights among income groups and genders, improve access to credit and agricultural services for marginalized farm populations, and equally empower women and men involved in agricultural activities. When women are empowered, families, communities and countries benefit.

Key words: Gender equality, sustainable agriculture, poverty reduction, hunger reduction, Sustainable Development Goals

10.4. DRIVING INNOVATION IN SUB-SAHARAN AFRICA: ROLE OF WOMEN IN AGRICULTURE BY *Ekine I.D.*

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The role of women in agriculture innovation has garnered increased attention in Africa and other regions across the globe. This could be partly attributed to the rising food security crisis, which is especially dire in sub-Saharan Africa (SSA). This is mostly caused by insecurity, armed conflict, extreme weather events, climate variability, and negative macroeconomic impacts. Thus, this paper provides some insights into the role of women in agriculture in driving the process of innovation in the SSA in accordance with the

United Nations 2030 Sustainable Development Goal 2 (SDG2) on food security. This is based on the recognition that to drive innovation in agriculture for increased output and food security, there is a need for the countries in the SSA to create more opportunities for women's participation to leverage their talents and ability to solve problems and innovate. This will help to increase gender parity in agriculture innovation by building a critical mass of qualified, talented, and innovative women scientists to lead critical advances in agricultural research and value chains across the agriculture sector. As outlined in the 2019 United Nations Economic Commission for Africa, women are increasingly playing a central and critical role in agriculture transformation in the SSA, as they represent 52 percent of the total population in the sector and account for about 50 percent of the agricultural labour. This paper establishes that women are leading research in agriculture to provide solutions to some of the most intractable problems facing the agriculture sector and, in so doing, shape the process of innovation in SSA. For instance, women are pioneering several innovative research projects in livestock, forestry, fisheries, and environmentally sustainable indigenous crops while breaking new ground in water resources management and climate change adaptation. In addition, it is interesting to note that women's agriculture organisations such as African Women in Agricultural Research Development (AWARD), African Women in Agribusiness Network (AWAB), and African Women in Agriculture and Arts (AWAA), among others, have, through gender-responsive agricultural innovation and advocacy for initiatives that enhance women's competitiveness in domestic and international markets, promoted agriculture-driven inclusive growth and prosperity, which drive the process of innovation in the SSA. In view of the increasing role of women in agriculture, it is imperative for policymakers in SSA to move towards closing the gender gap in agriculture participation to optimise women's talents, research ability, entrepreneurship, and technological advancement to transform the agriculture sector for innovative and sustainable development in SSA.

Key words: Women, Innovation, Agriculture, Gender parity, Food security, Sustianable development and sub-Saharan Africa

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THEME 11: WAYS TO SECURE THE 5 FREEDOMS FOR LIVESTOCK AND FARMERS

11.1. ANALYSIS OF THE EPIDEMIOLOGICAL SITUATION OF AFRICAN SWINE FEVER IN THE REPUBLIC OF CHAD: 2010-2022 BY *Ban-bo Bebanto A. et al.*

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African swine fever virus (ASFV) was introduced into the Republic of Chad in 2010 and spread widely throughout the pig farming production area. Due to the lack of knowledge of risk factors, the significant spread in certain parts of the country and the difficulty of management in the wild reservoir threaten pig production in Chad. The purpose of this study is to analyze the epidemiological situation of African swine fever in pig farms in highly infected cities in Chad and to propose control measures for it. Methodology: Analysis of the epidemiological situation of ASF was made based on the work carried out mainly in the Republic of Chad during the period from 2010 to 2022. The administrative and legislative texts (Orders and Law) were consulted. Data from interviews with pig producers, related to the disease, farming practices and the application of texts in the field were analyzed. Results: Pig farming is practiced in a traditional way with very few facilities; sanitary measures are almost non-existent; during periods of epizootics, mortality reached 100% in places; sanitary measures are not applied in most farms. The prevalence in 2022 was 76.9 in 7th arrondissement and 33% in the sub-prefecture of Mandalia and the Department of Chari Baguirmi. The variations in seroprevalence were linked to the rainy season (15.70%), the types of pig farming (16.78%), and the floor of the pigsty (clay earth (24.59%), absence of litter (17.07%). The prevalence rate (19.23%) in males and animals aged between 0 and 4 months was the most affected with a rate of 78.52%. Conclusion and application of the results: the recent seroprevalences of 12.10 and 33.33% variable between the departments, and the prevalence of 14 to 33% in the same departments, show that ASF virus still circulates in pig farms in the Republic of Chad. The presence of this virus in farms is maintained because of the ignorance of risk factors, insufficient biosecurity measures and poor farming practices. While conducting awareness campaigns among breeders to better equip them to permanently break the chain of disease contamination, Ministry in charge of livestock should have the means to control it.

Keywords: African swine fever, seroprevalence, prevalence, pig farming, Chad.

11.2. PREVALENCE AND RISK FACTORS OF MULTI-DRUG RESISTANT SALMONELLA AND ESCHERICHIA COLI IN TRADITIONAL POULTRY FARMING IN THE REPUBLIC OF CHAD BY *Ban-bo Bebanto A. et al.*

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Introduction: Avian colibacillosis and salmonellosis are bacterial pathologies, which have a major economic impact on poultry farming and public health worldwide. The objective of this study was to determine the prevalence of Salmonella spp and Escherichia coli multi-resistant to antibiotics and the risk factors related to these pathologies in traditional farms in the Republic of Chad. Methodology: the stages of the study are: • the survey of poultry farmers in households in rural areas; • preparation of culture media and sample transport; sample collection (faeces); • culturing the samples. • Isolation of strains: isolated strains were identified by Enterosystem 18R gallery • and their sensitivities to 12 antibiotics were tested. Epi Info 7 ™ software was used to perform the statistical analyses. Results: A total of 193 droppings samples were cultured. However, 24 (12.44%) strains were isolated and identified, including 13 (6.74%) Salmonella spp and 11 (5.70%) Escherichia coli. Antibiotic susceptibility testing showed that no isolated strain of Salmonella spp was susceptible to Clotrimazole and Ceftazidime. Asensitivity above 50% was observed with imipenem (92.31%), ciprofloxacin (69.24%) and aztreonam (53.84%). The highest resistances were observed for Clotrimazole (84.62%), Ceftazidime (69.23%). Amoxicillin, Cotrimoxazole (SMX 5), Gentamicin and Nalidixic Acid each had 53.85%. For E. Coli; no strain was sensitive to Amoxicillin. On the other hand, the highest sensitivities were observed for Imipenem (76.92%), Ciprofloxacin and Gentamicin had 69.23% each, Azithromycin and Nalidixic Acid had respectively 61.54% then Ceftazidime (53.85%). The results of survey showed that there are no biosecurity measures or prophylaxis programs. The risk factors linked to the presence of salmonella and Escherichia. coli were: poultry scavenging, and in permanent contact with other nearby domestic and wild animals, certainly having different health statuses; non-compliance with food hygiene and lack of maintenance of the habitat. The resistance of these pathologies to antibiotics was linked: to the treatment of poultry with standard products and traditional plants, and especially with the antibiotics commonly used in poultry farms.

Conclusion: Ignorance of biosecurity measures and the uncontrolled use of antibiotics are a danger for the rural population. The consumption of chickens with such status would promote the emergence of Salmonella spp and Escherichia coli and their resistance to antibiotics in humans.

Keywords: Prevalence, Salmonella spp., Escherichia coli, resistance, antibiotics, Republic of Chad

11.3. SEROPREVALENCE OF AFRICAN SWINE FEVER IN APPARENTLY HEALTHY PIG FARMING IN THE REPUBLIC OF CHAD BY *Naibi Keito A. et al.*

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Introduction: First described in Kenya, ASF is an infectious disease caused by a virus belonging to the Asfarviridae family and Asfivirus genus. Reported in eastern and southern Africa where the virus is known to be present in wildlife as well as incursions into central Africa. Chad first experienced ASF in October 2010. In less than four months, it was reported in four provinces. Failures in biosecurity, poor disease management, uncontrolled movement of animals, marketing and processing would have been the first factors for the introduction of the ASF virus in these different provinces of Chad. Purpose: The objective of this work is to determine the seroprevalence of ASF virus in apparently healthy pig farms in Republic of Chad. Material and method: The study was conducted from September 2021 to September 2022 in the provinces of Chari Baguirmi, Mayo Kebbi East and the city of Ndjamena. Started with is census of 492 farmers who had already registered ASF. Among them 198 consented to participate in this study. A total of 345 sera were collected and analyzed by the competition ELISA technical for the detection of antibodies directed against the ASF virus. The data from the interviews as well as the serological results were analyzed with the R Studio software. Results: The seroprevalences were 12.10% and 33.33% respectively in Mayo Kebbi East and Chari Baguirmi. In the cities, the seroprevalence varied from 10.10% to 33.33%. In the cantons and boroughs, it reached 61.53%. The seroprevalence was above 30% in eight districts, notably

in Darda, Digo, Dogoré, Kabalaye, Malam-Sadi I, Malam-Sadi II, Tchinvogo and Toukra-Massa, respectively 44%, 61.53%, 50%, 33.33%, 45.45%, 50% and 100%. The variations in seroprevalence were related to the rainy season, the types of pig farms (16.78%) and the floor of the pigsty and the absence of litter in the pigsties. Seroprevalence was 19.23% in males; the age group between 0 and 4 months was the most affected with a rate of 78.52%. Conclusion: This study revealed that the ASF virus circulates in pig farms in Chad, despite the absence of visible clinical signs. The presence of this virus in farms would be maintained by the inadequacy of biosecurity measures and poor farming practices. The Ministry in charge of animal husbandry must intensify awareness campaigns aimed at farmers to better equip them to definitively break the chain of contamination of the disease.

Keywords: Seroprevalence, Virus, African Swine Fever, Competitive ELISA, Pig farming, Chad.

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THEME 12: FARMER BASED PROGRAMS IN LINE WITH AG EXTENSION AND ADVISORY SERVICES

12.1. EFFICACY OF STORAGE TREATMENTS IN DELAYING RIPENING IN AVOCADOS AND REDUCE POSTHARVEST LOSSES BY *Rwubatse B. et al.*

Rwubatse Bernard [1]*, Sharma Mandeep [2], Ndungutse Vedaste [1], Ndahetuye Jean Baptiste [1,3]

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The present study investigated the ripening and senescence time, and the loss of avocados after ripening. The different storage treatments used in the study were open air, perforated and closed plastic sachets, Zero Energy Cooling Chamber (ZECC), and cold room. Avocados were harvested and brought to Postharvest Training Center at Mulindi, Rwanda. Nine (9) mature green avocados without defects were selected for each treatment. The pulp temperature (°C) and RH (%) of storage package were recorded three times daily - mornings (8h), afternoons (12h) and evenings (16h). Respective days to ripening and to senescence after ripening of avocados were - 11 and 5 in the open air, 8 and 8 in a perforated sachet, 9 and 7 in ZECC, and 22 and 8 in cold room. The amount considered as a loss after ripening were - 56 % in the open air, 33% in a perforated sachet, 22 % in ZECC, and 11% in cold room. Avocados in closed plastic sachets all rotted and were not attractive for consumption. Overall results showed that cold places with higher RH and ventilation can prolong the postharvest shelf life of avocados by delaying ripening time and thus significantly reducing their postharvest losses.

Keywords: Relative humidity, Ripening, Pulp temperature, weight, firmness, Avocado loss

12.2. FARMER'S HETEROGENEITY CLASSIFICATION AND ITS EFFECTS UPON FERTILIZERS AND HYBRID SEEDS ADOPTION IN RWANDA BY *Niyomugabo B. et al.*

J.D. Niyomugabo [1]*, B. Ufitinema 1, S. Havugimana [1], J. D. Nshimiyimana [2], E. Kabanda Kagiraneza [3], J.C. Iratuzi [4], R. Niyomfura [1,5], D. Mukamana [5], E. Twagirimana [6], T. Nkamiyabanga [6], T. Habiyaremye6, T. Kanyarwanda [6], and E. Bizimana [7]

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The use of one size fits all model to deliver agricultural inputs to boost low crop yield is an alarming debate in Rwanda. This study was conducted in 17 districts distributed in three provinces of Rwanda to assess the model's efficiency and Analyse key farm typologies, and which of their characteristics explain the uptake of agricultural production intensification options such as mineral fertilizers and hybrid seeds. Two-stage cluster sampling techniques were used to select randomly 2754 from 250000 families that worked with One Acre Fund and agro-dealers. Data were subjected to principal component analysis (PCA), a series of regression, and cluster analysis. The results reveal three main principal component (low, medium, and high adopters) associated with socioeconomic aspects. The cluster analysis reveals ten clusters named farm types. The results show that farm types 1,2,3,4 are low adopters and farm types 5,6 and 7 are medium adopters while farm types 8, 9, 10 are high adopters of inputs. Farm types scattering between provinces are unevenly distributed (2, $p < .001$). There is a significant discrepancy in adoption behavior across provinces, particularly farm types 2,6,8 and 10 which are uncommon in the Eastern but common in the Western Province. farm type 7 is more common in the East and South regions than in the West region. Moreover, farmers' characteristics such as irrigation and agroforestry users and training receivers, affect significantly ($p=0.01$) fertilizers adoption and hybrids seeds. The current farm typologies should be applied nationally, and support programs tailored to them as one size does not fit all.

Keywords: Adoption, farm types, hybrid seeds, fertilizers, and Rwanda

Part 2: Speakers and Panel discussions in IBMA 2023

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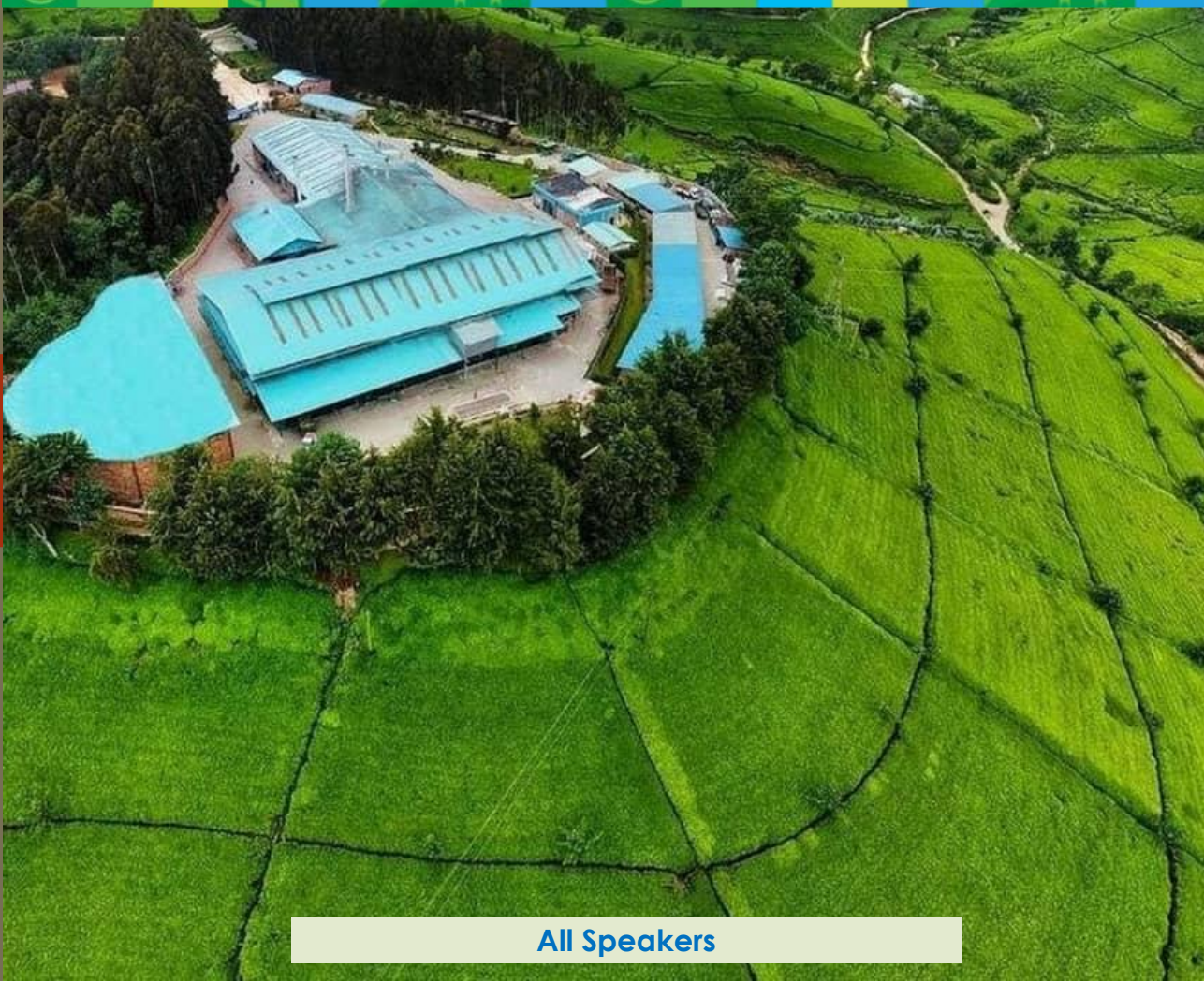
International Conference on Business Models in Agriculture

2023



All Speakers

Panel 1: Soil Health and Regenerative Agriculture Paradigm by Speakers: *Mr. Francis Bosah, Mr. Dan Kittredge, Dr. Alain Ndoli, Dr. Guillaume Nyagatare and Dr. Musemakweri John*

Speakers: Mr. Francis Bosah, Mr. Dan Kittredge, Dr. Alain Ndoli, Dr. Guillaume Nyagatare and Dr. Musemakweri John

Panel 2: Business Models and Approaches to Increase Smallholder Farmers' Income per Hectare by Speakers: *Mr. Marcos RG Brandalise, Mr. Njieforti Princewill Gana, Dr. Nimrod Israely*

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BANANA STEMS FIBRE EXTRACTIONS AND TRANSFORMATION INTO CLOTH AND CARTON PAPER MODELS
BANANA PLANTATION
BANANA FIBRE EXTRACTIED,DRIED
ARTISANAL CLOTH
REFINED THREAD FROM FIBRE
INDUSTRIAL CLOTHES
GARMENT INDUSTRY

Panel 3: Models to Address Hunger Malnutrition on the African Continent. International and Local Policies; The Ecosystem of Farming, and the Value Chain by Speakers: *Dr. Jeannine Uwimana Nicol, Eng. Titus Gakwaya, Dr. Harerimana Leonce, Dr. Daniel Wilson Ndyetabula*

Speakers: Dr. Jeannine Uwimana Nicol, Eng. Titus Gakwaya, Dr. Harerimana Leonce, Dr. Daniel Wilson Ndyetabula

AQUAPONICS & HYDROPONICS -TOMATOES, PEPPER, AND VARIOUS VEGETABLES IRRIGATED WITH RECYCLED FISHERIES WASTE WATER.

Panel 4: Women in Agriculture Models Designed to Support Smallholder Farmers by Speakers *Mrs. Ndeye Gaye, Mr. Cassandra J Dunford, Dr. Sylvere Sirikare, Mrs. Julie Mutoni and Mrs. Dative Imanirareba*

Speakers: Mrs. Ndeye Gaye, Mr. Cassandra J Dunford, Dr. Sylvere Sirikare, Mrs. Julie Mutoni and Mrs. Dative Imanirareba

Panel 5: Investment in Agriculture. Models designed to attract and increase investment in agriculture. A case for Rwanda and Senegal by Speakers: *Prof. Francois X. Naramabuye, Mr. Peter Ayenoto Adeshina, Mr. Oluwole Saheed Azeez, Ms. Diane Sayinzoga and Dr. Jules Rutebuka*

Speakers: Prof. Francois X. Naramabuye, Mr. Peter Ayenoto Adeshina, Mr. Oluwole Saheed Azeez, Ms. Diane Sayinzoga and Dr. Jules Rutebuka


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REFINED THREAD FROM FIBRE
INDUSTRIAL CLOTHES
GARMENT INDUSTRY

Panel 6: Youth-led and University models promoting entrepreneurship and agro-industry by Speakers: *Mr. Robert Ocen, Mr. Abdu Usanase, Mr. Takudzwa Ashley Mlambo, Mr. Musine Juvenal*

Speakers: Mr. Robert Ocen, Mr. Abdu Usanase, Mr. Takudzwa Ashley Mlambo, Mr. Musine Juvenal

PANEL 7: THE ROLE OF ACADEMIA AND RESEARCH SCIENCE IN PROMOTING AGRICULTURE FOR SMALLHOLDERS. MODEL APPROACHES USED BY SPEAKERS: *Mr. Tobias Strijker. Prof. Ikechi Agbugba, Dr. Alexandre Rutikanga and Mr. Augustin Iradukunda*

Speakers: Mr. Tobias Strijker. Prof. Ikechi Agbugba, Dr. Alexandre Rutikanga and Mr. Augustin Iradukunda


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PANEL 8: SUSTAINABLE FARMING ISSUES ON CLIMATE CHANGE AND VARIABILITY BY SPEAKERS: *Mr. Noel Nizeyimana, Mrs. Justine Mbabazi, Mr. Ras Thembalani*

Speakers: Mr. Noel Nizeyimana, Mrs. Justine Mbabazi, Mr. Ras Thembalani


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