FEED THE FUTURE

WEST AFRICAN REGIONAL HORTICULTURE CONFERENCE

Horticulture for Food, Nutrition, and Livelihoods

31ST MAY-1ST JUNE, 2022

UNIVERSITY OF GHANA

USAID FROM THE AMERICAN PEOPLE

HORTICULTURE INNOVATION LAB

UCDAVIS UNIVERSITY OF CALIFORNIA

WEST AFRICAN REGIONAL HORTICULTURE CONFERENCE

THEME

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ACKNOWLEDGEMENTS

The successful organization of this conference depended upon the valuable input of stakeholders and the assistance of all the coordinators. Firstly, the team acknowledges the conference participants for their efforts and thoughtful articulation of challenges and opportunities in the horticulture sector from the local to regional levels.

The effective contributions of members of the steering committee have made this workshop a success. This committee was made of Prof. Irene S. Egyir (Dean of the School of Agriculture), Prof. Anna Lartey (Professor of Nutrition; Former Director of Nutrition of FAO, UN) Dr Naalamle Amissah (Department of Crop Science), Dr Freda Asem (Department of Agricultural Economics and Agribusiness), Dr Angela Parry-Hanson Kunadu (Department of Nutrition and Food Science, University of Ghana), Prof. George Nkansah (Director, Institute of Applied Science and Technology, University of Ghana), Prof. Amos Laar (School of Public Health, University of Ghana), Ms Esther Agyekum (Ministry of Food and Agriculture (MOFA)), Dr Charles Nyaaba (Peasant Farmers Association of Ghana (PFAG)) and Mr Philip Quaye (Ghana Institute of Horticulturist).

Special thanks go to Erin McGuire, Associate Director of USAID Feed the Future Innovation Lab for Horticulture, University of California, Davis.

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LIST OF ACRONYMS

ACRONYMS	
WA	West Africa
AI	Artificial Intelligence
DBG	Development Bank of Ghana
EU	European Union
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
MOFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organization
USAID	United States Agency for International Development
WIAD	Women in Agricultural Development
EPA	Environmental Protection Authority
FDA	Food and Drug Authority
FI	Financial Institutions

A MAP OF WEST AFRICA SHOWING PARTICIPATING COUNTRIES (marked with red dots)

INTRODUCTION

Horticultural crops especially fruits and vegetables have a tremendous potential to contribute to food and nutrition security in West Africa by enhancing the nutritional quality of diets by, providing key minerals (zinc, iodine & iron), vitamins (A and C) and fibre. Micronutrient malnutrition as a result of the inadequate intake of fruits and vegetables has been known to cause serious disorders, especially in women and children. These nutrients are essential for pregnant and lactating women to ensure the proper development of the brain of the unborn and breastfeeding child. They are also required for growing children to ensure normal growth. It is estimated that about 2 billion people globally who are mostly concentrated in developing countries suffer from micronutrient deficiency, referred to as hidden hunger. Hidden hunger not only causes the lowering of a person's IQ but also stunting and blindness, with children and women being especially vulnerable.

The location, climate, and suitable soil conditions of West Africa (WA) make it ideal to become Europe's next large supplier of horticulture products at a time when the EU imports large quantities of fruits and vegetables to meet growing demand and broadening taste for new, high quality, and ready-to-eat foods. Fruits and vegetable export growth have the potential to significantly boost economic growth in West African countries, generate employment and income in rural areas, while creating opportunities for smallholder inclusion in the value chain. In addition, the sector provides year-round sources of income in rural and urban areas for women, thus improving their standard of living. Women play an essential role in many aspects of the horticulture value chain.

The West Africa horticulture conference was organized together with local horticulture experts and other stakeholders to identify on-the-ground challenges and opportunities in the sector. This is to inform specific capacity development activities for stakeholders, including industry experts and leaders. This is also to encourage local engagement and ownership, influencing the sustainability of this work to continue beyond the Horticulture Innovation Lab's involvement. Thus, contributing to inclusive economic growth and a more resilient system led by the regional experts.

The Horticulture Innovation Lab will focus its efforts in four regions with a country region serving as a hub. This includes West Africa (Ghana), Eastern Africa (Kenya), Asia (Nepal) and Central America (Honduras). It aims to implement locally-led, globally supported programs that will lead to improvement in the horticulture sector.

Conference Approach

The West Africa Horticulture Conference was held in Accra, from 31st May to 1st June 2022, bringing together leading experts and key stakeholders in the horticulture sector from 10 countries in West Africa. The conference approach stressed on the participation and involvement of a wide variety of stakeholders. Presentations were made by guest speakers who highlighted the emerging regional trends in the horticulture sector. The thematic areas for the presentations included (i) contribution of horticultural crops to healthy diets and improved nutrition (ii) food safety and post-harvest handling of horticultural produce (iii) role of the youth and gender in transforming horticulture (iv) horticultural funding and financing (v) role of research for horticultural development and (vi) challenges faced by smallholder horticulture farmers.

In the breakout sessions, participants were put in four different working groups each consisting of at least 10-12 people. The groups discussed the following topics, highlighting the challenges and opportunities in the sector;

Groups	Topics
Group 1	Research and Development–Funding, Seed Systems, Improved Varieties, Climate-smart horticulture
Group 2	Youth and Gender in Horticulture
Group 3	Postharvest Technology-Losses, Key Challenges, and Opportunity
Group 4	Nutrition and Health; Nutrition-Sensitive Horticulture, Role Horticulture Crops, and Nutrition Awareness

Simultaneous translation for all plenary sessions ensured effective communication and participation between French and English speakers. The four groups later presented the outcome of their group discussions in a plenary.

In addition, presentations by country coordinators were done highlighting emerging trends, challenges and opportunities in their respective countries. The participating countries include Burkina Faso, Cote d'Ivoire, Ghana, Liberia, Mali, Nigeria, Senegal, Sierra Leone, Togo, and the Gambia.

Welcome, Address-Prof. Irene Susana Egyir

The participants of the conference were welcomed by Prof. Irene Susan Egyir, the Dean of the School of Agriculture, University of Ghana. She also explained that the University was chosen by the Horticulture Innovation Lab to lead the organization of the conference. According to her, the University of Ghana aims to become a world-class research-intensive university. The School of Agriculture has 10 units with 7 Departments and 3 Research Centers. She noted that all the units have direct research activities relating to the horticulture sector. These include investigating suitable soils, crops for food, extension service and capacity building for smallholder farmers, agribusiness models, and consumer sciences. She further explained why the theme 'Horticulture for Food, Nutrition, and Livelihoods' is appropriate for the conference and encouraged participants to actively participate in the discussion.

Chairperson's Remarks-Prof. Boateng Onwona-Agyeman

The chairperson gave his introductory remarks and introduced the speakers and country coordinators of the conference. He explained that the conference was organized by the University of Ghana in collaboration with the Horticulture Innovation Lab of UC Davis with funding from the United States Agency for International Development (USAID). The conference aimed to bring together major stakeholders in the horticulture value chain, i.e. regional leaders in production, processing, academia, and NGOs to identify the challenges and opportunities in the sector. He noted that fruits and vegetables are important in achieving food and nutrition security. However, the FAO recommended requirement for 400g per day has not been met in most developing countries. Sub-Sahara Africa recorded 75g per day. The challenge in West Africa is how to

increase fruits and vegetable production to achieve the Sustainable Development Goals of ending all forms of malnutrition by 2030.

He explained that some of the problems of fruits and vegetable production in West Africa include (i) high cost of farm inputs (ii) obsolete agriculture technology (iii) extensive use of agrochemicals (iv) use of untreated wastewater for irrigation (v) high post-harvest losses and (vi) poor infrastructure. These problems are worsened by climate change resulting in unpredictable rainfall patterns. Recently, the impact of Covid-19 has made the situation dire. To obtain the full benefits of fruits and vegetables, policies and strategies need to be implemented by member countries which aimed at increasing production and consumption. He concluded his address by declaring the conference opened and wished all the participants a pleasant stay.

1. PRESENTATIONS

Theme 1: Contribution of Horticultural Crops to Healthy Diets and Improved Nutrition
Mrs Paulina S Addy

(Directorate of Women in Agricultural Development (WIAD) – MOFA)

Classification of Horticulture Sector

The horticulture sub-sector in Ghana is made up of five commodities including fruits, vegetables, medicinal, aromatic, and ornamental plants. In Ghana, major fruits produced are mangoes, pineapples, melons, citrus, soursop, sweetsop, avocado, banana, guava, shea fruit, vitex (shoh), Velvet tamarind (yooyi/Akatsi gold), tamarind (Agboku yooryi), Africa star apple (Laasa/Alaasa), berries (strawberries), coconut (Green), pear and cashew apples. Vegetables include bulbs (onions, garlic), flower (cauliflower), fruit (pepper, okra, garden eggs, tomato, cucumber), leaf (kontomire, amaranthus, spinach, lettuce, cabbage), root (beetroot, carrots, potato) stem (Asparagus), seed (peas, french beans).

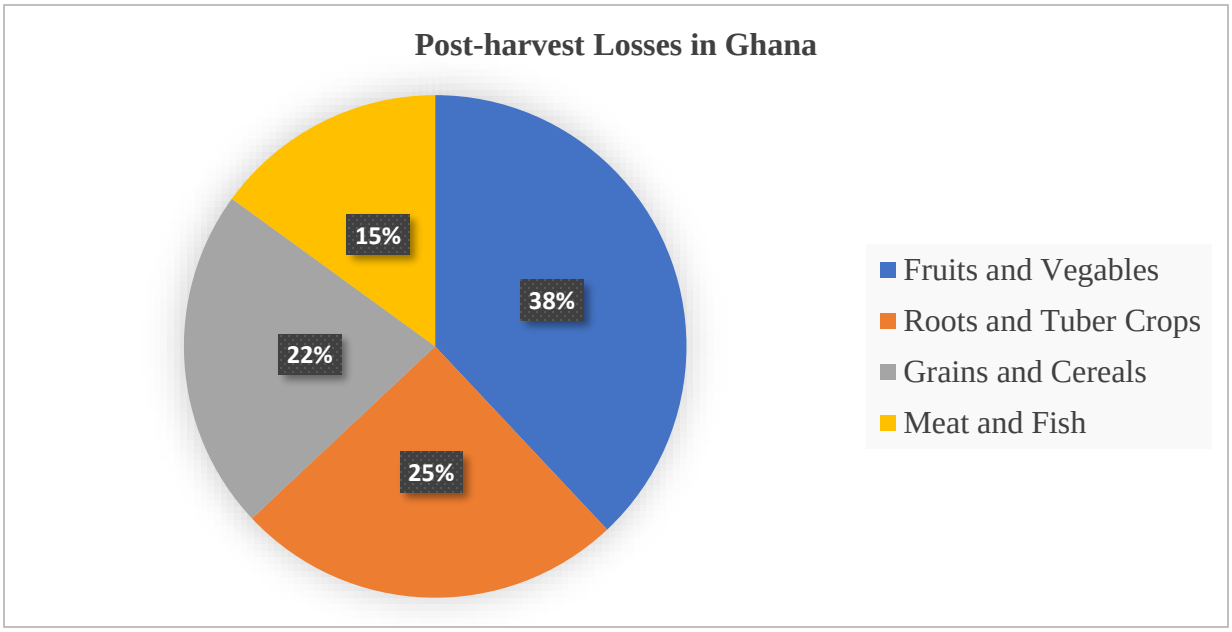
Nutritional Benefits of Fruits and Vegetables

Fruit and vegetables are rich sources of vitamins and minerals such as vitamin A (vision/cell health), vitamin C (cellular health/iron absorption), folate, vitamin K, vitamin E, and iron as well as other micronutrients that are essential for a healthy life. They also provide organic acids, which stimulate appetite, help digestion and provide dietary fibres and natural compounds (antioxidants, phytochemicals, anti-inflammatory agents) that can protect health. These nutrients are also essential for pregnant and lactating women to ensure the proper development of the brain of the unborn and breastfeeding child. They are also required for growing children to ensure normal growth. Inadequate consumption of fruits and vegetables poses serious health consequences.

Challenges of the Fruits and Vegetables Sector

Pre- and post-harvest losses for fruits and vegetables in Ghana are very high. In 2021, post-harvest losses for fruits and vegetables were 38% compared to other crops such as cereals (22%), roots and tubers (25%), and meat and fish (15%). Losses are highest in sub-Saharan Africa, commonly between15 to 50 percent. Losses are lower in East and South-Eastern Asia (with a maximum of 13 percent) and ever lower in Central and South Asia (with a maximum of 7 percent). The main causes of post-harvest loss and food waste are (i) unsuitable harvest timing (ii) unexpected harsh climatic conditions and environment (iii) Insect and pest infestations (iv) harvest and handling practices (v) infrastructure and marketing challenges (vi) lack of storage facilities

Other challenges facing the sector include the high price of fruits and vegetables leading to low consumption, excessive application of agrochemicals, and inadequate land for urban/peri-urban are for production and water quality.



Source: AGI/MoFA

Way Forward

She concluded by suggesting the following for the development of the sector:

i. Planned production systems that require documenting the production process in addition to information sharing.
ii. Promoting increased consumption of fruits and vegetables. This entails sustained promotion efforts and sensitization of consumers.
iii. Promoting safe production and handling – Ghana CARES programme on improved handling of F&V – Green Label and GAPS – Support to UPA Farmers (safe water)
iv. Value addition (Diversity) – Producing fruits and vegetables into juices, frozen veggies, etc
v. Improved Transportation systems – Reefer/Refrigerated vans

Theme 2: Food Safety: Post-harvest Handling and Sanitation of Horticultural Produce in West Africa

Prof. Obadina, Adewale Olusegun

Department of Food Science and Technology,
Federal University of Agriculture, Abeokuta, Nigeria

Food Safety and Horticulture Sector

Horticulture can be classified into vegetables, fruits, edible nuts, and other ornamental crops. Fruits and vegetables are known to convey health benefits which are vital sources of fibre, micronutrients, vitamins, antioxidants, steroids as well as flavonoids (Olatona et al., 2018; Hussain and Gooneratne, 2017; Angela et al., 2010; Mathilda et al, 2012). Food safety is a major concern because food systems may have adverse impacts on nutrition and health through food-borne diseases, naturally occurring toxicants, indiscriminate use of agrochemicals, exposure to pesticides and other chemicals, antimicrobial resistance, and other factors related to food and agriculture. Horticulture produce (fruits and vegetables) could be contaminated by physical and biological hazards before harvesting, during harvesting period and cross-contamination during transportation, handling, and storage as a result of poor agricultural and hygienic practices, thus predisposing consumers to food-borne illnesses.

Pre and Postharvest Handling of Fruits and Vegetables in West Africa

Good pre-harvest, harvest, and post-harvest practices are essential in preventing fruits and vegetables from being contaminated. For instance, untreated manure when used in growing fruits and vegetables can harbour pathogenic microorganisms including *L. monocytogenes*, *E. coli* O157:H7, *Salmonella* spp., *Mycobacterium* spp., *Brucella* spp., *Bacillus anthracis*, *Yersinia enterocolitica*, *Clostridium perfringes*, and *Klebsiella* spp. These microbial contaminations of fruits and vegetables in the field are more likely in West Africa where growing conditions are unhygienic and protective practices such as the use of plastic mulch that prevents contamination of soil-borne microorganisms are lacking.

Additionally, harvesting methods also predispose fruits to microbial contamination; these often involve violently shaking tree branches so that the fruits fall to the ground or hitting them with sticks or similar objects leading to harvest injuries which promote infection. Transportation of fresh produce from the farm gate to the primary and secondary collection centers is primarily done using head loads or using farm animals, wheelbarrows, carts, bicycles, motorcycles, and motor vehicles of all sorts. At the collection centers, fresh fruits and vegetables are often heaped together in piles in the open without any form of protection.

From these centers, the produce is transported by road to urban central wholesale markets mainly in open non-refrigerated trucks with capacities ranging from less than 10 tons to up to 30 tons. The common practice in the fresh produce supply chain in West Africa is to transport products in bulk or packed in raffia or bamboo baskets, wooden containers or salvaged fiberboard cartons, and other improvised containers previously used to package imported or locally manufactured products.

The central wholesale market occupies a prime position in the fresh produce supply chain in West Africa and it is here that the price levels of commodities are determined to a large extent by market players. Regrettably, these markets are often in very poor shape. They are, invariably, badly

located, heavily congested, badly maintained, and lack the physical facilities and essential infrastructure including electricity and potable water from municipal sources and waste disposal facilities to handle the large volume of produce that pass through them. Since potable water is often lacking, practices such as wetting leafy vegetables with water or placing them in a bucket of water to control moisture loss and wilting, though desirable for maintaining freshness, may lead to contamination with waterborne disease organisms.

Sanitation of Horticulture Produce

The majority of the farmers and vendors do not assess the quality of the water used in washing their harvested produce. Smallholder farmers use drain water, pipe or well water for irrigation. Few of them who have daily contact with animals do not always wash their hands after touching animals.

The vehicles are not always washed while those washed are not with clean water. The vehicles are not disinfected before loading with fresh produce. Most of the vehicles for transporting fruits and vegetables are opened.

Most of the vendors do not practice the hygiene of washing hands before preparing fruits and vegetables for sale. Very few wash their hands after using the toilet, before eating, and none of them washes their produce after harvesting. Many of the vendors do not use disinfectant to clean containers nor do they clean their containers before reusing them. Most of the consumers eat vended produce without washing. Some use salt or vinegar solution in washing their produce at home before eating. The eateries/restaurants also wash the fresh produce with clean water while some add chlorine bleach and potassium permanganate.

Conclusion

Food safety is a critical issue and promoting good practices in the production, harvesting and post-harvest handling of fresh produce lowers the risk of food contamination and helps maintain quality. In the last three decades, there is the widespread of indiscriminate use of agrochemicals in West Africa. However, legislations that regulate pesticide residues and other chemicals in foods are often simply not in place, are poorly enacted, or not enforced. In recent years, there is growing food safety concerns concerning fresh fruits in West Africa. For instance, the use of cheap, readily available calcium carbide for artificially ripening fruits is a growing concern. Calcium carbide is alkaline and can irritate the mucosal tissue of the abdominal region causing stomach disorders that has been reported after eating mangoes artificially ripened with calcium carbide. Food-borne illnesses due to microbial and chemical contamination are a major public health concern and fresh fruits and vegetables are the likely primary sources. Poor handling practices along the fresh produce supply chain from farm to market and from rural to urban areas, poor infrastructure including transport and market infrastructure, and lack of refrigeration capacity in a tropical environment (within West Africa) promote the growth of pathogenic organisms with adverse consequences for food safety and public health.

Theme 3: Challenges Faced by Smallholder Horticulture Farmers in West Africa

Mr. Emmanuel Oduro Owusu

GLOBAL FARMRITE

The horticulture sector has been identified as the key driver for sustainable growth in West Africa. In recent years, there has been a high demand for horticulture produce in domestic, export markets (the EU), and other emerging markets. However, horticulture production continues to be dominated by smallholders and farmer groups with about 80-95% of farm sizes less than 2ha. The smallholder farmers in the sector are confronted with several challenges including:

Marketing

The marketing challenges confronting the sector include (i) unreliable/glut at certain times of the year (ii) limited market information (iii) poor quality produce (iv) price competition with imports from other countries and (v) unavailability throughout the year. Access to high-value markets requires food safety, quality, and private voluntary standards conformance (health and safety, MRLs, GLOBAL G.A.P).

Credit Access

Inadequate credit facilities for the farmers (women and the youth) are some of the major challenges of the sector. High-interest rates from banks and delays in the release of approved funds have significant impacts on the sector by affecting the cost of burrowing money and investment decisions. Government and other financial institutions should reserve special funds for the smallholder farmers, particularly for women and the youth in horticulture.

Quality and Cost of Inputs

The high cost of good seeds also poses a challenge to smallholder farmers. For example, 1000 seedlings of tomato cost about US$120. The use of poor-quality seeds/planting materials, fertilizer, and plant protection products has a negative effect on crop yield. There is an urgent need for improved vegetable seeds (okra, chillies, tomatoes) tolerant to viral diseases.

Poor Agronomic Practices

Poor nursery practices such as over sowing, overcrowded seedlings, etiolated seedlings leading to very weak seedlings, and damping-off are common. In addition, seedlings are transplanted too early or too late when almost flowering at the nursery, and inadequate protection of seedlings from pests and diseases at the nursery stage. This results in the complete loss of seedlings.

Limited access to recommended fertilizer because of the high cost poses a huge challenge to smallholder farmers. Inadequate knowledge of fertilizer recommendations for some horticulture crops grown by smallholders leads to misapplication. The performance of the sector is poor due to inadequate extension services or limited capacity to provide the services needed by farmers.

Another major challenge for smallholder farmers is poor knowledge regarding the harvesting and post-harvest handling practices. For instance, inadequate knowledge of maturity indices of some crops for good quality and long shelf life of some crops may result in produce being harvested too early or too late (watermelon, avocado, citrus, okra, pineapple, etc).

Lastly, high pest and disease infestation leads to crop failures. In some instances, a whole field of okra, tomato, watermelon, melon, and chillies may fail due to diseases and pests' infestation.

Difficulties in managing some specific quarantine pests (fall armyworm, fruit flies, thrips, whiteflies, eggplant fruit and shoot borers) have advers effects on agricultural productivity.

Way Forward

- Improve accessibility to fields through the construction of farm roads
- Private investment in nurseries in communities to sell good quality seedlings to farmers.
- Provide continuous training in the nursery, and integrated Pest and postharvest management to reduce pre-and post-harvest losses.
- Educate and sensitize farmers to use certified planting materials through the provision of subsidies on agricultural inputs.
- Harmonization and production of extension materials to be used by all offering training.
- Build Capacity of Extension Staff to provide efficient and effective extension services.
- Ensure ready markets for produce through identified contract farming arrangements.

Theme 4: Role of the Youth and Gender in Transforming Horticulture in West Africa
Mrs. Gifty Kafui Mensah

Executive Business Director (Maphlix Trust Ghana Limited)

The global population is projected to reach 9 billion by 2050. The number of young people (aged 15-24) is also expected to increase to 1.3 billion by 2050, accounting for almost 14 percent of the projected global population. While the world's youth cohort is expected to grow, employment and entrepreneurial opportunities for youth particularly those living in developing countries and economically stagnant rural areas remain limited, poorly remunerated, and of poor quality. The unemployment rate for youth is currently three times that of adults in all regions of the world (Food and Agriculture Organization (FAO, 2021). The horticulture sector constitutes a significant segment of the total agricultural production value chain, in most West African countries. The horticultural sectors' ample potential to provide income-generating opportunities for the youth, will require full participation without any form of gender disparity on the part of the youth and intends bring major transformation to the sector.

Youth and Gender in Transforming Horticulture in West Africa

Young entrepreneurs in this sector should be more innovative, thus tapping technologies like greenhouse production, artificial intelligence (AI), remote sensing, drone technology and a variety of precision tools to provide services. The youth need to adopt block-chain (forecast, recording, and tracking) and decision-making technologies to better understand produce supply chains and make informed choices for improving crop yield, to secure higher prices. To transform the horticulture sector, the youth need to understand the need to increase capacity as many do not have the required knowledge and skills to take advantage of the opportunities in this sector (e-learning platforms, short hands-on practical training). The youth should create online platforms to market their products instead of the conventional approach.

Women should have equal access to agricultural training, use of machinery and adoption of new advanced technologies, to enable them to engage in improved agricultural practices. In addition, there is a need to improve women's access to education. Access to land and finance is a major challenge for women in the sector.

Theme 5: Horticultural Funding and Financing
Mr Kwasi Korboe

CEO of GIRSAL LTD

The attractiveness of the Horticulture Sector

Horticultural products form an integral part of human nutrition and health needs and are demanded on a daily bases. Financing of horticultural production is attractive because horticultural products/produce have a higher yield per acre compared to other value chains. That is the output per acre for most horticulture products is more than cereals and grains. In addition, the pricing per yield for horticultural products is higher than those in other value chains. Due to their high value,

they can be cultivated throughout the year under irrigation and greenhouse technology. The risk associated with cultivating horticulture products is mitigated because of the use of modern technologies and good agronomic practices.

Positioning Agribusiness for Funding

To access funding, agribusiness has to go beyond identifying the market or off-takers of their products and understand the details of quality standards or specifications required by buyers. Additional market information on the size of the market, market share, knowing players in the target market, and the financial capacity of the off-taker.

Good Production / Activity Plan

Agribusiness must have a clear indication of the various activities to be undertaken as part of a project. This entails details of the approach/technologies you intend to use, identified risks, mitigation measures, and resources (inputs, expertise, equipment, and other logistics) needed at each stage. A good activity plan demonstrates knowledge of your business and helps to justify your fund requirements.

Detailed Funds Utilization & Cashflow

It is important to indicate the level of funding needed at each stage and provide as much detail as possible. A good plan helps the financial institutions to determine your funding needs, and to structure your loan appropriately. Agribusiness firms requesting funding must determine how much is needed for activities planned for funds to be made available to you as and when it is needed. Financial Institutions (FI) may be more comfortable disbursing funds as and when needed than in-bulk in advance (less risk of diversion). This helps the FI to determine a client's expected inflows to enable them to design a repayment plan. An incomplete fund utilization plan may result in approval of less than or more than is needed.

Transparency is necessary for acquiring funds for business activities. The accuracy and completeness of supporting documentation are of prime importance. Credit history or previous debts may not necessarily harm a client's application. This could be due to circumstances beyond the client's control or general business environment/industry challenge (e.g. Covid-19, pests, and diseases). Propose a plan to pay off alongside your new loan where possible.

Loan application assessments take time (especially for complex projects), thus sufficient time may be needed to review, validate or confirm certain aspects of an application. The FI may reach out for additional information or to clarify certain aspects of an application. Late applications may result in late disbursement resulting in funds being released while production season may have passed. Also, conditions around the project may change (pricing, etc.) or missed opportunities. FIs may also be the source of delay.

Funding sources include long-term funding from the Development Bank of Ghana (DBG) - GIRSAL PFI which benefits from agriculture CRG and TA. Funding from equity investors, family, and friends.

Theme 6: Role of Research for Horticultural Development in West Africa

Dr. Rosaine N. Yegbemey
Interim Regional Director for WCA, World Vegetable Center

Globally, agriculture is a high-priority sector on the development agenda. Well-known as the backbone of the economy and providing 30–50% of GDP for most countries in West Africa, The sector is the primary source of livelihood, providing employment, income and food and nutritional security. However, public and private investments in agriculture are largely focused on staple and oil crops, not on commodities rich in micronutrients. Out of its 308 million inhabitants, 40 million people are undernourished and suffer from chronic malnutrition. Every year, food crises affect millions of people. In recent years, both food security and the importance of dietary diversity for good health are now acknowledged. A consensus is that the horticultural sector can make an important contribution to food and nutritional security and also enhance the livelihoods of smallholder farmers.

Benefits of Vegetables Production and Consumption

Fruits and vegetables can be produced on small amounts of land, have high profits in a relatively short period, and the existence of ready markets. Technical: Farm diversification strategies, can reduce farmers' vulnerability to climate change (diversity of vegetable crops, short growing cycles, and efficient use of irrigation), and ability to fit into year-round production systems.

Fruits and vegetables are low in fat and calories, no cholesterol, sources of many nutrients, including potassium, dietary fiber, folate (folic acid), vitamin A, and vitamin C. Vegetables are essential and irreplaceable parts of healthy diets. Additionally, their role in preventing diet-related non-communicable diseases is well established.

Challenges of Vegetables Production and Consumption

Several challenges confront the production and consumption of fruits and vegetables in West Africa. These include:
(i) Low knowledge of good agricultural practices among producers (ii) High pests and diseases occurrence (iii) climate change (iv) poor soil quality (v) limited access to inputs (seeds, fertilizers, and pesticides) (vi) poor inputs quality (seeds, fertilizers, and pesticides) (vii) perception of vegetables to be not commercial crops (viii) poor postharvest handling practices (ix) limited knowledge/awareness on the benefits of vegetable consumption (x) limited household income (xi) price and availability of vegetables and (xii) consumers preferences (education, cultural beliefs, norms, etc.)

Potential areas of intervention to realize the potential of vegetables

The presenter identified both supply and demand-side factors as potential areas for intervention. On the supply side, he noted an increase in the availability of a diverse range of safe vegetables. This requires (i) improving on-farm productivity (Improved vegetable varieties, safe and sustainable pest management, protected cultivation) (ii) ensuring that vegetables are safe to eat (iii) Reducing postharvest losses, and (iv) improving market access

In addition, the demand side entails increasing vegetable consumption to improve nutrition. This requires (i) increased awareness of a balanced diet and concept of nutritional security (ii) behaviour change communication on vegetable consumption (iii) home gardens, rural vegetable consumption, school meals, and (iv) modify food systems for better nutrition

Role of Research for Horticultural Development

Current Challenges	Research needs	Research Priority Areas
Yields of most vegetables are very low in most West African countries	How to improve productivity through the use of sustainable production methods	Vegetable breeding research to improve variety performance
Adoption of improved varieties and other inputs is also low	How we can improve the adoption rate of improved varieties?	Work with the private and public seed sector (capacity strengthening) - AVBC
Market relations are often unstable /opportunistic	How to strengthen vegetable value chains to improve quality and reduce losses	Strengthening of vegetable business networks
Vegetable (and fruit) consumption is low	How do food environments influence people's choice to eat fruit and vegetables?	Research on food environments
Food environments are not always conducive: vegetables and fruits are often expensive or not accessible	What interventions can influence people to eat more fruit and vegetables?	Addressing access to vegetables through, for instance, school meal provision
Fruit and vegetables are often not explicitly considered in policies or regulations (most are developed with cereals in mind)	How to get fruit and vegetables more recognized in policy decision-making?	- Analysis of seed policies affecting the vegetable seed sector; capacity strengthening of stakeholders - Analysis of nutrition policies

2. GROUP DISCUSSION AND PRESENTATIONS

Breakout sessions were carried out to discuss the following thematic areas in detail. The following are the summaries of what was discussed.

Group 1: CHALLENGES AND OPPORTUNITIES IN THE HORTICULTURE SECTOR RESEARCH AND DEVELOPMENT

(*Funding, Seed Systems, Improved Varieties, Climate-smart horticulture*)

The group had discussions on areas that researchers need to focus on. These include:

- Research should be done to better understand the food systems in the respective countries.
- In addition, a value chain analysis should be carried out to identify the challenges confronting the horticultural sector and to attract policy attention in the respective countries.
- We should begin by focusing on all the horticultural products for conservation purposes, and then move on to specific crops.
- There is a need for research to assess the seed systems in West African countries, as this was an important topic that came out strongly during the conference.
- Research should also pay attention to market-oriented strategies to promote the consumption of horticultural products, thus creating an avenue for the private sector to come in and fund research.
- Research should be carried out to investigate the most effective funding model for a sustainable horticultural sector in each country. There should be funding to support research as this will help in building well-equipped research laboratories and capacity building for personnel who will operate these pieces of equipment.
- Research should investigate the development of digital technologies for effective use of resources, early detection of pests and diseases, and e-crop budgeting for various countries.

Group 2: YOUTH AND GENDER IN HORTICULTURE DEVELOPMENT

Members of the group discussed several issues which in one way or the other hindered the engagement of the youth and especially women in horticulture.

Barriers to Youth and Women in the Horticulture Sector

Major barriers for the youth and women in horticulture development include:

- Difficulty in acquiring land by the youth and women. This is a cultural problem in many communities in West Africa. Compared to men, women rarely own lands but cultivate smaller pieces of land. Major crops such as tubers, maize, rice, and soybeans are grown by men. Also, land ownership by the youth is difficult due to the land tenure systems in most farming communities.
- Also, due to cultural norms, women in some communities are not allowed to plough their lands or attempt production until the men have. This is in the belief that a woman cannot lead a man.
- Youth and women also lack access to finance to rent or purchase land.
- Also, the absence of specific interventions for people with disability is a barrier that hinders such people from participating in horticulture and this is mostly due to discrimination.

Challenges

The key points discussed were:

- Lack of certification of seeds and planting materials.
- Inadequate education on horticultural agronomic practices
- Women's traditional roles especially with child care increase their workload and restrict them from performing certain farm activities.
- Most men in certain communities in the northern regions are not comfortable with their wives having frequent interactions with male extension officers. This hinders the transfer of new skills and knowledge from male extension officers to women in farming.
- Due to inadequate agricultural mechanization in West Africa, cultivating horticultural commodities is tedious and labour-intensive, making the profession unattractive to the youth.
- The youth want 'quick' money and with certain tree crops, they have to wait for a long time. The risks that come with the waiting period make it unattractive.
- Availability of support services is almost absent in most communities. Hence challenges faced by individuals who venture into horticulture are mostly left unaddressed.
- Poor market development.
- Poor road networks and high cost of transportation.
- Accessing markets are impossible due to the lack of inputs and infrastructure.
- Theft
- No contract agreement with buyers
- Poor internet and telephone connectivity hinder marketing and sourcing for inputs.
- Unattractive packaging of harvested produce
- Some consumers have concerns about chemical residue abundance
- Poor harvesting methods

Opportunities

- Information flow and training: make a conscious effort to bring information to the youth and women and include visuals aid in the training.
- Promote home gardening using modern technologies such as vertical farming
- Advocacy to disabuse certain cultural mentalities
- Mechanize the horticultural subsector and take away some of the drudgery associated with agriculture.
- Government policies should incentivize the youth and women in horticulture
- Establishment of training centers closest to them and innovation centers that would provide the required expertise.
- Media spaces should promote agriculture
- Producer Association should help in pricing commodities to motivate youth and gender in horticulture.
- Use of technology to track consumer preference.

Group 3: POSTHARVEST TECHNOLOGY-LOSSES, KEY CHALLENGES, AND OPPORTUNITY

The group deliberated on whether post-harvest loss and waste is an issue in West Africa. Members present agreed that issues of postharvest losses exist in their respective countries. For instance, in Liberia, post-harvest losses for fresh horticultural produce such as garden eggs, tomatoes, and pineapple can range from 60% to 70%. Distance to market centers and poor road networks are the main causes of the high losses. In addition, produce is also exposed to the sun leading to weight loss. In Ghana, the postharvest loss situation was attributed to a lack of planning. Farmers tend to produce for non-existent markets leading to losses and waste. The discussant also mentioned that transporters sometimes mix different commodities during transportation, resulting in cross-contamination and unwanted ripening. In the Gambia, inadequate curing of onions causes deterioration and shortens the storage life.

Key Challenges of the Horticulture Sector

The following are the key challenges that were discussed;

- Poor road network linking producing communities
- Inadequate knowledge by farmers on harvesting procedures
- Inadequate knowledge of the appropriate harvesting indices
- Poor packaging (use of traditional packaging such as traditional buckets and cane baskets leading to bruising of fruits and vegetables as well as contamination of the tissues)
- Unavailability of transportation facilities
- Poor and inadequate storage facilities
- Inadequate processing facilities
- No means of preservation
- Inadequate technology transfer
- Inadequate value addition
- Huge expenditure associated with processing
- Issues of the seasonality of harvested produce
- Unavailability of data on production volumes, consumer demand, food safety etc

Opportunities for the Sector

- Use of solar dryers
- Packaging of produce
- Processing of produce into food ingredients instead of the usual finished product
- Capacity building of all the actors along the value chain
- Technology transfer (e.g. Zero Energy Cooling Chamber), advisory and extension services
- Revamp feeder roads department to enable the construction of roads leading to producing communities
- Establish Produce Buying Companies and National Food Distribution Companies
- Establishment of cold chain storage facilities
- The use of Controlled Atmosphere Storage and Modified Atmosphere Packaging
- The use of ice chests with ice cubes on vending bicycles

Roles of the Various Stakeholders in Preventing Post Harvest Loss

Stakeholders	Roles in Preventing Postharvest loss
Local Government	• Construction and repair of dilapidated roads especially, feeder roads • Building capacities of actors along the postharvest value chain • Investigation of food-borne disease outbreak • Raise the standard of compliance of horticultural produce meant for local consumption • Set aside a day for the closure, cleaning, and disinfection of marketing and retailing centers • Provision of Water Sanitation and Health facilities at marketing and retailing centres • Segmentation of a market to prevent cross-contamination
Agric Officers or Extension Officers	• Capacity building of farmers • Monitoring and Evaluation • Collection of data • Test new postharvest technologies and transfer knowledge to farmers
Farmers	• Take advice from researchers and extension officers • Take advantage of contract farming and the establishment of off-taker agreements • Adoption of good agro-ecological practices • Application of climate-smart agriculture and precision farming • Proximity farming
Researchers (Academia)	• Invent low-cost innovative post-harvest technologies that can be easily adopted by farmers and other actors along the postharvest value chain (eg, the use of corn starch, cassava starch, and bee wax as edible coatings, Zero energy Cooling Chambers, Solar Dryers) • Proximate analysis after processing should be intensified • A regular and periodic gathering of data on postharvest issues to inform policy • Research on labelling and traceability of fresh horticultural produce and how it can be integrated into our local settings
Consumers	• Consumers must be willing to pay for value-added products • Consumers should be encouraged to buy fresh agricultural produce from credible sources

Group 4: NUTRITION AND HEALTH: NUTRITION-SENSITIVE HORTICULTURE, ROLE OF HORTICULTURE CROPS AND NUTRITION AWARENESS

The group identified some underutilized, indigenous horticultural crops in West Africa. These include taami, miracle berry, Frafra potatoes, baobab fruit tree, star fruit, turkey berry, roselle, tamarind, almond, jute mallow (Ayoyo). Also, reasons for the low consumption of fruits and vegetables in West Africa were discussed. The following were some of the reasons; (i) That we do not have the habit of using them in our diet (ii) The lack of promotion and marketing of these indigenous crops (iii) Low production leading to its unavailability on the market (iv) The lack of knowledge about the nutrition content of these crops.

As part of our solution, it was suggested that we incorporate these indigenous crops into school lunch plans so that children grow up understanding these crops, their health advantages, and the right techniques to prepare these crops to get the most nutrition out of them. Since food safety is not tangible, it is difficult to identify some concerns. A challenge that came up was the lack of diverse ways in which these crops could be used or consumed. Also, the factors that drive consumer food choices include;

- High cost of fruits and vegetables: High-cost fruits and vegetables are mainly due to the cost of transportation from the farm gate to market centers in cities.
- Others include high perishability, the safety of food, trust in the quality of produce, convenience, and social desirability.
- The improper practices by farmers such as the use of contaminated water in the irrigation of fruits and vegetables, the use of chemicals with disregard for the use of approved application rates, preharvest intervals before harvest is done to be sold in the markets, the indiscriminate use of agrochemicals on these crops. All these were said to reduce the trust consumers have in fruit and vegetable farmers.
- Unknown source of produce: It was also mentioned that if the source of the product is unknown, we are unable to verify the quality and safety of the produce. This discourages people from consuming such produce.
- High-cost technologies for proper handling and packaging of fruits and vegetables deter local consumers from purchasing and consuming.
- Lack of confidence in the safety of the produce of farmers (local) calls for education and awareness creation to help drive up the consumption of these crops. Even the safety of produce (fruits and vegetables that are indigenous) sold in the supermarkets and shopping malls are questionable.
- Another issue raised was food losses and wastage.

To prevent it, the representative of MOFA stated that the ministry is training farmers on how to increase production and at the same time help prevent or reduce food losses and wastage. He also stated that farmers must be educated on farming as a business. This will encourage farmers to produce food that meets the established or required standard of quality and safety.

There is a need to collect information on market trends in various regions to assist farmers in determining what to produce, in what amounts, when to produce it, and for how much. This would reduce postharvest losses and waste while also providing a secure market for their produce.

Another challenge was the availability and use of data management services to help farmers make informed decisions. It was also mentioned that it was up to the right bodies to monitor the activities of farmers to ensure and enforce the use of safe practices in the production of food crops. Another challenge discussed is the issue of certification. That there is a lengthy process that a farmer must go through to register and receive a license or certificate to authenticate his or her produce as organic or of high quality, and even after this, it is quite expensive. As a result, farmers are discouraged from obtaining one.

Research Opportunities and Way forward

The lack of information on the proper use of agrochemicals was mentioned and the opportunity in this is that researchers can generate or come up with the needed information and get it to the right stakeholders for implementation. Also, conducting good reviews, looking at the value chain and filling the gaps that are identified. In addition, the production of reports can be done and shared with government agencies for action and implementation. A participant from MoFA mentioned that there is currently no direct policy on the horticultural sub-sector and that the ministry is working on a document/ policy for the fruit and vegetable sub-sector.

Opportunities/Way forward

Collaborations between state agencies such as the Environmental Protection Agency (EPA), Food and Drug Authority (FDA), and MoFA are required to achieve a proper supervision or monitoring system to rid the system of malpractices and the use of unapproved agrochemicals. It was noticed that food safety was the main concern or the issue of most concern to the consumer. On how government agencies could work together, it was identified that the duties of these agencies overlap, and to solve this, the agencies need to come together to get a clear policy from their mother institution that would regulate all agencies to work in synchrony.

Alternatively, a clear division of labour and separation of powers should exist. Furthermore, the state must be prepared to support all of the agencies' functions adequately.

- Farmers must change their attitudes towards the production of such foods.
- The prices of these indigenous foods must be affordable to all.
- Knowledge of the health and nutritional benefits of indigenous foods must be readily available; this can be done by carrying out in-depth research into the composition of said foods.
- More research should be carried out into the rates of organic fertilizers which give optimum yields to help in easy use by farmers to discourage them from using inorganic fertilizers.
- Innovative ways to integrate the use of bio-pesticides into farming.
- The need to understand the effective communication channels available to farmers and the use of data management systems.
- Improvement in post-harvest and supply chain methods.

3. REGIONAL REPORTS

REGIONAL CONTEXT, OPPORTUNITIES AND CHALLENGES

GHANA

Context: The horticulture sector is important to the economy of Ghana as it provides income for farmers and the government. The sector is dominated by fruit and vegetable production. Ghana's fruit and vegetable production is among the highest in West Africa. Fruits and vegetables contributed to about 24 percent of the total value of non-traditional agricultural export in Ghana. Fruit export has grown by about 4 percent per year, exceeding vegetable export over the last decade. Commercial fruit production is concentrated in eleven regions spanning the middle belt to the south. Tomatoes, onions, green chillies, and pepper are mainly produced in Upper East, Northern, Brong Ahafo, Ashanti, Eastern, and Volta regions.

Opportunities and Challenges of the Horticulture Sector in Ghana

	Opportunities	Challenges
Input supply	-High demand for inputs -High potential for fertilizer production in Ghana -Proximity to input market (Morocco and Libya)	-Poor targeting of horticulture farmers for providing government input subsidy -Side selling of government-subsidized inputs
Production	-The rapid emergence of the middle-income class, fast-food joints, the hospitality industry, and supermarkets -High domestic and international market demand for fruits and vegetables in Ghana	-Use of poor seeds -Use of excess pesticides -Limited access to greenhouse technology -Low application of irrigation -Low supply of credit to farmers -Low supply of extension services
Trade and standards	Ghana has a good stand in fruit and vegetable export.	High importation of basic fruits and vegetables
Engineering and Technology	-Promotion of greenhouse technology by the government and private sector -Presence of higher education and research institutions	-There is minimal use of engineering and technology in horticulture production in Ghana. -Farmers practice irrigation using watering cans, buckets, knapsack sprayers, and small powered pumps. -There are no mechanized implements for weeding, planting, and harvesting horticulture crops. -Fruits and vegetables are sold on the open market without proper storage, processing, and packaging practices.
Research, Education and Training	-Most universities: The University of Ghana (UG), University for Development Studies (UDS), and Kwame Nkrumah University of Science and Technology are the only	-Lack of reliable data on the horticulture sector -Inadequate research into fruits and vegetables

	Opportunities	Challenges
	public universities majoring in horticulture programs -Ohawu, Kwadaso, Ejura, and Damango offer courses in Diploma and Certificates in agriculture Adidome, Wenchi, and Asuansi are farm institutes that train individuals in horticulture production in Ghana	

COTE D'IVOIRE

Context: The horticulture sector in Côte D'Ivoire is characterized by fruits and vegetables both for local market consumption and export. The local market comprises mainly smallholder farmers growing fruits and vegetables on a low technological level. Horticulture export consists mainly of bananas, mango, pineapple, and papaya. Cote D'Ivoire has a high production of bananas, followed by pineapple, and chillies. Horticulture exports are an important source of revenue for the country.

Opportunities and challenges of horticulture in Cote D'Ivoire

Sector	Opportunities	Challenges
Input supply	-High demand for chemical inputs and improved seeds -Good climatic conditions for commercial fruit and vegetable production. -Investment in inputs yields profitable outcomes. -There is increased potential for all-year-round production.	-Poor access to input (fertilizer, pesticide, and seed) markets due to poor road network. -Over-dependence on imports and low supplies of good fertilizers and pesticides. -Lack of mechanization, affordable loans, and cheap labour. -Poor land tenure security, limiting input application.
Production	-Cote D'Ivoire has a suitable climate for horticulture production -Horticulture products have better taste and high consumer demand. -More international demand than supply. -The high willingness of farmers to adopt improved technologies.	-Lack of effective pesticides for pest and disease control. -Inadequate credit provision to farmers. -Limited access to extension services. -Low adoption of irrigation farming. -Low government support.
Market and consumption	-High access to the urban market. -Rich customers purchase their fruits and vegetables from specialized shops and supermarkets. -Some Companies in Côte d'Ivoire, like Prosuma, buy fruits and vegetables from farmers and sell them to supermarkets.	-Supply is seasonal, with fluctuation in prices. -Inland distribution and marketing are a problem due to poor road networks. -High transportation cost. -Lack of proper storage facilities to ensure product quality.

Sector	Opportunities	Challenges
Trade and standards	-Proximity to Europe markets and North America. -Local and foreign markets for fruits and vegetables are rapidly growing.	-However, there are delays and congestion in exports at the port. -Lack of processing industries for value-added export.
Engineering and Technology	The use of greenhouses and netting is becoming a common practice to safeguard local production in Cote D'Ivoire.	Low dissemination and adoption of greenhouse technology by farmers
Research, Education, and Training	-The National Agricultural Research Department is into the development and commercialization of new varieties of vegetables and other crops. -Ongoing research and practical trials to improve and intensify the existing production systems are already carried out on a small scale	-Lack of reliable data on the horticulture sector -Inadequate research into fruits and vegetables

THE GAMBIA

Context: Horticulture occupies a major portion of The Gambia's Agriculture, accounting for 65% of the agricultural labour force. The Gambia produces more vegetables than fruits. Production of fruits and vegetables increased steadily between 2000 and 2020, but exports remained low and unstable. Less than 3% of the country's arable land is currently under fruit and vegetable production The Gambian horticulture farmers farm on One (1) hectare of land even though land area is increasing.

Opportunities and challenges in The Gambia

Sector	Opportunities	Challenges
Input supply	-The Gambia imports a lot of fertilizers and pesticides for agriculture. -Efficient domestic supply of inputs by the private sector.	Input application is minimal; 47%, 13%, and 21% of farmers use fertilizer, pesticides, and irrigation in agriculture respectively.
Production	-Good climate, -Labour availability increasing consumer market -Suitable land for cultivation	-Climate change -Poor yields -Low adoption of improved technologies -Lack of government support
Market and consumption	-High domestic and international market demand for fruits and vegetables.	-Postharvest losses remain high due to poor management practices and value addition. -Low consumption of fruits and vegetables
Trade and standards	Proximity to European markets and North America.	High importation of basic fruits and vegetables

TOGO

Context: The horticulture sector contributes more than 20% to the agricultural GDP and employs more than three workers per farm unit. Fruit and vegetable exports have been increasing in recent years. However, growth in fruits and vegetable export has remained stable in recent years.

Opportunities and challenges in Togo

Sector	Opportunities	Challenges
Input supply	-High potential for local production of organic fertilizer -An increasing number of input dealers in production zones.	-High importation of inorganic fertilizers and pesticides -High cost of inputs -Limited knowledge of pesticide application -Poor storage of chemicals
Production	The high market for fruits and vegetables both locally and internationally.	-Low yields, lead to low domestic supply. -Over-reliance on rainfall -Pests and diseases -Lack of government support and policy -Low adoption of improved technologies
Market and consumption	High demand for fruits and vegetables both locally and internationally	-Low fruit and vegetable consumption -Fruit and vegetable production in Togo only meets a quarter of domestic demand
Trade and standards	Proximity to the major export market	-Togo fruit and vegetable exports end in sub-Saharan Africa. -Low compliance with export standards for the international market

NIGERIA

Context: Nigeria is the leading producer of major fruits (pineapples, mangoes, and pawpaw) and vegetables (tomatoes, onions, and chillies) in West Africa. Horticulture represents a major sub-sector of agriculture in the country. Fruit and vegetable production and export are widely dispersed across Nigeria. The Middle Belt, which comprises the states of Kaduna, Kano, and Jos Plateau, produces over half of the country's tomatoes, onions, and potatoes. Except for mangoes, yields of several horticulture crops are lower than those in other West African countries.

Opportunities and challenges in Nigeria

Thematic areas	Opportunities	Challenges
Input supply	-Presence of the National Agricultural Seed Council (NASC) for the development and supervision of local seed production. -High demand for primary production inputs. -Emerging private commercial input producers (eg. Dangote Fertilizer)	-Low adoption of improved seeds, fertilizers, and pesticides. -High cost of primary inputs -Poor road network and transportation systems for input supply

Thematic areas	Opportunities	Challenges
Production	-Increasing domestic demand for fruits and vegetables due to population growth and urbanization. -High market value for horticulture products. -High international market demand for horticulture products in Nigeria. -Favorable climate for horticulture production	-Insect pests and diseases -Lack of knowledge about pesticide application. -Lack of irrigation facilities. -Low mechanization -Postharvest losses -Lack of access to credit -Land tenure insecurity
Market and consumption	-High demand for fruits and vegetables due to population growth -Local market for fruit and vegetable offers opportunities for women	Low fruit and vegetable consumption
Trade and standards	Proximity to major the European market	-Lack of policy -Absence of institutional support -Absence of agricultural extension -Poor technological infrastructure -Lack of credit facilities
Engineering and Technology	Greenhouse technology and artificial intelligence is fast emerging	Limited application of engineering and technology in the horticulture value chain in Nigeria
Research, education, and training	-The National Agricultural Research Institutes (NARIs) play a significant role in the production of seeds. -Nigeria has a large national agricultural research and extension service supporting farmers in the country	-Lack of data on horticulture -Low research on horticulture

SIERRA LEONE

Context: In Sierra Leone, the horticulture sector has developed very slowly, compared to other West African countries Horticulture accounted for less than 5% of the country's GDP in 2019. Onion, okra, pepper, eggplant, and tomato are the major vegetables produced in the country, while mango, pineapple, orange, lime, pear, and banana are the major fruits produced in the country.

Opportunities and challenges in Sierra Leone

Sector	Opportunities	Challenges
Input supply	-High demand for fertilizers and pesticides. -Potential for agribusiness exists at various points along the horticultural crops value chain from production to retail level.	-Supplies of fertilizers and pesticides are inadequate for domestic requirements. -In addition, these inputs are expensive and inadequate for the majority of fruit and vegetable farmers.

Sector	Opportunities	Challenges
	-Suitable land to expand production and increase the use of complementary inputs.	-Quality seeds of locally cultivated fruits and vegetable crops are not available.
Production	-High demand for fruits and vegetables by households, schools, hotels, restaurants, street food joints, and petty traders -High international market demand for fruits and vegetables	-Yields of major crops such as tomatoes, onions, and okro fall short of potential yields. -Low domestic supply improved seeds, fertilizer, and pesticides -Lack of access to credit, markets, and extension -Pests and diseases -Limited source of water for irrigation
Market and consumption	Fruits and vegetables have a high market demand in Sierra Leone.	-Daily fruit and vegetable consumption in Sierra Leone is below the FAO/WHO recommended amount of 400g/capita -Uncertainty of changes in prices of fruits and vegetables -Lack of access to a ready market is a challenge -Poor road network -Lack of proper distribution systems
Trade and standards	Proximity to the European market	Low compliance with food safety standards
Engineering and Technology	-Sierra Leone Agricultural Research Institute (SLARI) is the institution charged with the responsibility to develop technologies to enhance crop production in the country.	-Limited application of engineering and technology in the horticulture sector
Research, Education, and Training	Sierra Leone Agricultural Research Institute (SLARI), Njala University (NU), and the University of Sierra Leone (USL) are involved in horticultural research	-Lack of reliable data on horticulture -Low research on horticulture

SENEGAL

Context: Senegal is a net importer of food, including horticulture products such as onions. Fruit production has increased more than vegetable production over the last two decades. The region Niayes extending from Dakar to St. Louis produces more than 60% of onions, tomatoes, and pepper.

Opportunities and challenges in Senegal

Sector	Opportunities	Challenges
Input supply	-Senegal has a well-organized market for horticulture inputs. -Availability of certified seeds from Europe. -Domestic production of improved seed. -High demand for fertilizers, pesticides, and improved seeds.	-Local multiplication of improved seeds does not meet demand. -Supplies of fertilizers and pesticides are inadequate for domestic requirements. -Costs of importing primary production inputs are high, reducing input supply.

Sector	Opportunities	Challenges
Production	High demand for fruits and vegetables	Low yields of major fruits and vegetables High post-harvest losses
Market and consumption	Increasing urban demand for fruits and vegetables	-The Senegalese market is characterized by a low quality of horticulture products. -Lack of ready market in the local market -Lack of cold storage facilities -Low consumption of fruits and vegetables
Trade and standards	Proximity to major the European market High international market demand	Low compliance with international food safety standards.
Engineering and Technology	High potential for greenhouse technology	Engineering and technology for horticulture value chain activities are not yet developed in Senegal.
Research, Education and Training	ISRA / CDH has produced early maturity varieties of onions for Senegalese farmers.	-Lack of reliable data on horticulture -Low research on horticulture

MALI

Context: Mali is one of the largest producers of fruits and vegetables in West Africa. Primary production zones include Sikasso, Koulikoro, Mopti, Ségou, Kayes, and Bamako. Trade-in horticultural products represent more than half of total agricultural product exports to West Africa. Horticulture production accounts for between 21.6% and 35.9% of farmers' income. Fruit and vegetable production and export are high in recent years. Fruit exports are higher than vegetable exports.

Opportunities and challenges in Mali

Priority Areas	Opportunities	Challenges
Input supply	High demand for fertilizers, pesticides, and improved seeds.	Low domestic production of primary inputs (fertilizer, pesticide, and quality seed)
Production	High demand for fruits and vegetables	-Erratic rainfall -Poor soil fertility -Lack of access to land for production by women and youth -Limited application of irrigation
Market and consumption	-Horticulture products have a high market value -Domestic market trade transactions take place at farm-gate, village market, and urban markets	Fruit and vegetable consumption in Male is inadequate
Trade and standards	-Proximity to major the European market -High international market demand	Low compliance with international food safety standards

BURKINA FASO

Context: Fruits and vegetables play a crucial role in food security, nutrition and export earnings. Fruit and vegetable production is dominated by market gardens, of which 65% were managed by men in 2018.

Opportunities and challenges in Burkina Faso

Priority Areas	Opportunities	Challenges
Input supply	-High demand for fertilizers, pesticides and improved seed -Potential for organic inputs -Presence of local input dealers at the village level. -High dry season production	-Low supply of appropriate fertilizer -Low supply of local seed -Low supply of appropriate pesticides -Lack of appropriate storage facilities
Production	-Horticulture production provides more income to market gardeners in Burkina Faso. -This opportunity exists because of the high demand for fruits and vegetables both locally and internationally. -Fruits and vegetables have high market value in Burkina Faso -Most crops have a shorter maturity period	-Low yield -Water shortages -Declining soil fertility -Limited access to fertilizer -Pests and diseases -Lack of access to credit and extension services for horticulture farmers
Market and consumption	Consumption of fruits and vegetables is increasing over late Sales at farm-gate are high (>50%)	-Poor road networks -Lack of storage and processing facilities -Poor quality of vegetables leading to product rejection -The remoteness of production areas -High post-harvest losses
Trade and standards	-The domestic market is also growing with the installation of medium and large factories, especially for mangoes. -Export is also increasing in recent years	Farmers have a challenge meeting the export standards of the EU

4. PRIORITY RESEARCH AND DEVELOPMENTAL ACTIVITIES

Postharvest Technology and Food Safety

- Identify and develop appropriate postharvest technologies to reduce losses in quantity and quality of produce
- Development of a postharvest system to meet market demand and food safety standards
- Provide suitable post-harvest handling and safety information to all levels of value chains
- Improve post-harvest handling of fruits and vegetables in local markets in West Africa

Nutrition and Human Health

- Design programs to promote the production and consumption of indigenous, neglected, and orphan fruits and vegetables
- Establish a West Africa regional center to study and analyse disease risks of fruits and vegetables
- Develop selected indigenous horticulture crops and cultivars for their nutritional properties.

Youth, Gender, and Horticulture Development

- Empower youth and women in technology generation, transfer, adoption and capacity building through participatory methods
- Emphasize research on youth and women's participation in horticultural export production

Research and Development in Horticulture

- Food systems research from the respective countries in West Africa
- Commodity-based value chain analysis
- Research to assess the seed systems in various countries in West Africa
- Identify and develop varieties for local conditions, pests and diseases
- Develop local capacity to conduct advanced research and development and train the necessary extension personnel, private consultants, and industry leaders.
- IPM system for disease and pest problems

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APPENDIX 1: REGIONAL CONSTRAINTS ANALYSIS

CONSTRAINTS	Ghana	Togo	Nigeria	Mali	Senegal	Sierra Leone	Liberia	Gambia	Cote d'Ivoire	Burkina Faso
BIOPHYSICAL										
Input Supply	**	***	***	**	***	***	**	**	**	
Productivity and Production	**	***	**	***	**	**	**	***	*	
Improved Varieties	***	***	**	***	**	**	**	**	***	
Pests and Diseases	***	***	**	**	**	**	**	**	***	
NATURAL RESOURCES										
Soil	*	-	*	-	-	-	-		*	
Water	*	-	*	-	-	-	-		*	
Climate	**	-	*	-	-	-	-		*	
MARKET AND CONSUMPTION										
Market Access	**	*	**		**	**	**		*	
Value-addition (Processing)	***	***	***		**	**	**		***	
POSTHARVEST HANDLING, TRADE AND STANDARDS										
Standards	***	****	***		***	***	***		***	
Food safety	***	***	***		***	***	***		***	
Infrastructure	***	***	***		***	***	***		***	
Post-harvest Practices	***	***	***		***	***	***		***	
RESEARCH, EDUCATION AND TRAINING										
Extension	*	-	**		*	*	*		**	
Research	***	-	**		*	**	*		***	
Lack of Information	**	-	**		*	**	*		**	
SOCIO-ECONOMICS										
Women and Youth in Horticulture	**	*	***		*	*	***		**	
Indigenous Peoples in Horticulture	**	*	*		*	*	***		**	
ENGINEERING AND TECHNOLOGY										
Processing, Storage etc	***				**	**			***	
REGIONAL AND NATIONAL POLICY ENVIRONMENT										
Land/Capital	***	***	**		**	**	***		***	
Policy	***	***	**		**	**	***		***	

APPENDIX 2: RECAP OF DAY 1 PROCEEDINGS

- The conference was opened by Prof. Irene Egyir (Dean of the School of Agriculture) and she introduced the Chairman of the conference. The chairman was Prof. Boateng Onwona-Agyeman.
- The chairman gave his introductory remarks and introduced the speakers and country coordinators of the conference.
- The overview of the conference was given by Erin McGuire (Associate Director, Feed the Future Innovation Lab for Horticulture University of California, Davis)
- Dr Amissah gave the details of the 2-day conference
- Prof. Anna Lartey, a professor of nutrition moderated the panel discussion on:

    - **Theme 1**: "contribution of horticultural crops to healthy diets and improve nutrition",
    - **Theme 2**: "Food safety: post-harvest handling. And sanitation of horticultural produce in West Africa"
    - **Theme 3**: "challenges faced by smallholder horticulture farmers in west Africa"
- The speaker for **Theme 1** was **Ms Paulina Addy** (Deputy Director Ministry of Food and Agriculture; Women in Agriculture Development Directorate (WIAD)).
    - She emphasized the importance of horticultural crops; especially on their nutritive, health and economic benefits.
    - She mentioned high losses of horticultural produce making it expensive. She highlighted some opportunities in the horticultural sector and encouraged backyard gardens and urban agriculture.

- The speaker for **Theme 2** was **Prof Adewale Olusegun Obadina** (Federal University of Agriculture, Abeokuta, Nigeria).

    - He mentioned that the annual cost of treating food-borne diseases in SSA is about 10.5 billion dollars.
    - He also mentioned that horticultural produce could be contaminated by physical and biological harvest before, at harvest and cross contamination during transportation, handling, and storage.
    - He highlighted some safety challenges including indiscriminate use of agrochemicals, poor pre-harvest practices including untreated manure, poor harvesting methods and the use of contaminated water for cleaning food.

- The speaker for **Theme 3** was **Mr Emmanuel Owusu** (CEO of Global FARMRITE).
    - The recovery of the African economy will be through horticulture.
    - He highlighted some challenges within the horticultural sector including poor road networks to farmer fields, markets, poor quality of planting materials, high cost of inputs and high occurrence of pathogens and diseases.
    - He made some recommendations including the provision of adequate extension services, adequate sources of financial support for women and youth, and the protection of crops using nets and row covers.

- The keynote address of the conference was given by Mr. Emmanuel Asante Krobea (Technical Advisor to the Minister) on behalf of the Minister of Food and Agriculture, Dr Owusu Afriyie Akoto.
    - He indicated that some stakeholders have drafted and submitted a proposal to establish the horticulture development authority to help strengthen the sector.
    - He also mentioned that the youth are being trained in vegetable greenhouse production and introduced to exchange programs in Israel.

- Prof. Oduro Nkansah, a professor of horticulture and the Director of IAST moderated the panel discussions on
    - Theme 4: "Role of the youth and gender in transforming horticulture in West Africa",
    - Theme 5: "Horticultural Funding and Financing", and
    - Theme 6: "Role of Research for Horticultural Development in West Africa"

- The speaker for **Theme 4** was **Ms Gifty Kafui Mensah** (Executive business Director, Maphlix Trust Ghana Limited). She highlighted the need to create income-generating opportunities for the youth and women. She advised the youth to take advantage of training opportunities to add value to themselves and leverage the use of artificial intelligence to sustain horticultural crop production and marketing.

- The speaker for **Theme 5** was **Mr Kwesi Korboe** (Chief Executive Officer, Ghana Incentive-based Risk-sharing System for Agricultural Leading (GIRSAL Ltd.)). He advised participants on how to position their businesses for funding. He made a profound statement that "*in credit, character is everything*". He pointed out that the cost of loans is expensive and as a result, shareholders must be identified for equity's sake.

- The speaker for **Theme 6** was **Dr. Rosaine Yegbemey** (interim Regional Director, World Vegetable Centre). He spoke of the need to strengthen the horticultural, nutritional and functional value chains. He also emphasized awareness creation regarding the consumption of fruits and vegetables

- Several interesting questions and answers were raised during the panel discussion session. Some of the questions raised were:

    - "*who is a farmer*"? how do you manage the challenges with women and youth in agriculture?
    - do smallholder farmers get the finances budgeted for them?
    - are smallholder farmers able to meet the requirement of preparing a good business plan?
    - Are there training opportunities available for smallholder farmers?

- An online survey on "Horticulture innovation" was administered to participants, led by Erin McGuire

- Seven (7) Country coordinators from Ghana, Nigeria, Gambia, Sierra Leone, Liberia, Senegal and Mali gave presentations on the state of the horticultural sector in their respective countries, highlighting their challenges and opportunities.
    - Some of the challenges include inadequate inputs, poor access to funds, poor road network, and post-harvest losses.
    - Some opportunities include high international demand for fruits and vegetables, favourable weather, available training and research facilities.

APPENDIX 3: COUNTRY PRESENTATIONS

- Country Presentation – Ghana pdf
- Country Presentation – Nigeria pdf
- Country Presentation – The Gambia pdf
- Country Presentation – Sierra Leone pdf
- Country Presentation – Liberia pdf
- Country Presentation – Senegal pdf
- Country Presentation – Mali pdf
- Country Presentation – Togo pdf
- Country Presentation – Ivory Coast pdf
- Country Presentation – Burkina Faso pdf