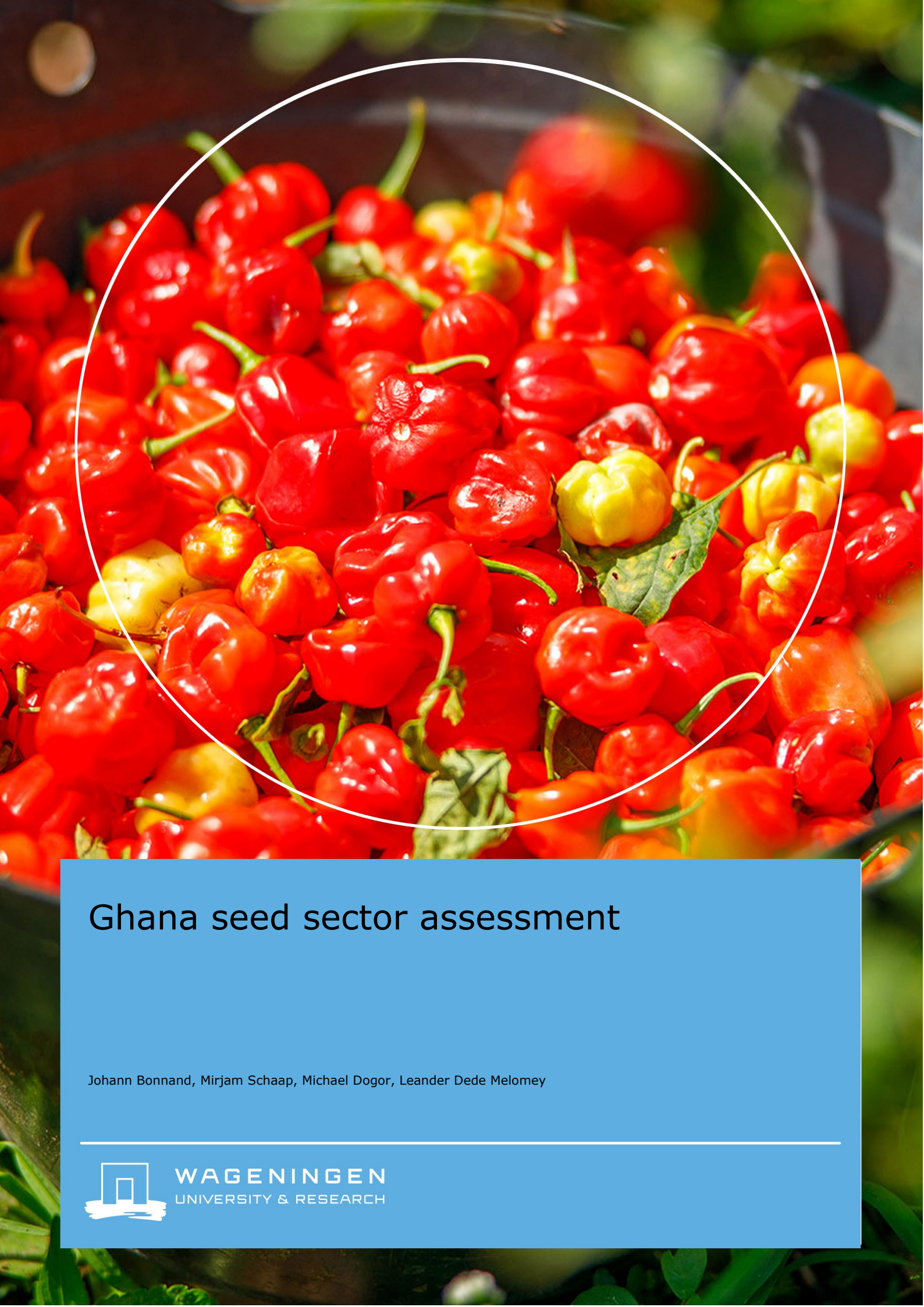

Ghana seed sector assessment

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UNIVERSITY & RESEARCH

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This study provides an assessment of the seed sector in Ghana. In particular, it zooms in on seed systems of commercial vegetables, African fruity and leafy vegetables and, roots and tubers. For each of the crop groups, key bottlenecks as well as ambitions towards the development of a well-functioning Ghanaian seed sector are elaborated. The methodology used in this assessment follows a desk study review and a consultative process held with key stakeholders in the Ghana seed sector. The study was implemented by Wageningen University & Research, The Netherlands.

Keywords: Seed sector assessment, Seed systems, Seed sector development

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Seed Sector Assessment
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Contents

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Summary

The agricultural sector plays a critical role in the Ghanaian economy, contributing 20% and employing about 40% of its workforce. The sector, dominated by smallholders and traditional farming systems, has been impacted by multiple global crises including climate change, the COVID-19 pandemic and the Ukraine-Russia war. The long-term effects of these crises, particularly inflation, are still altering the functioning of the food systems in Ghana. The Government of Ghana wishes to develop a performant agricultural sector, capable of meeting national self-sufficiency. To this end, it set up the Planting for Food and Jobs programme (2017-2022), which recently entered in a second phase, PFJ 2.0 (2023-2028). It aims at developing a modern and commercial agricultural system and increasing the crop yield levels through an improved access to quality agro-inputs. Cognizant of the importance of quality seed to achieve food security, the Ghanaian seed sector has evolved considerably since the 2010s, establishing an elaborate seed enabling environment. So far, seed sector development interventions focused primarily on the formal cereal and legume seed system. Expanding beyond cereals and legumes, PFJ 2.0 includes vegetables and root and tuber crops. To achieve the ambitious PFJ 2.0 plan, the government's attention to vegetables and roots and tuber crops seed systems will be critical.

To explore opportunities for fostering a well-functioning seed sector in Ghana that is innovative, competitive, resilient and inclusive, a comprehensive assessment of its current performance was conducted. This seed sector assessment (SSA) was structured around three fundamental questions: *Where are we now?, Where do we want to go?* and *How do we get there?* It rests on a combination of primary data gathered through participatory approaches involving key seed sector stakeholders and secondary data obtained from literature research. The results were triangulated using a structured methodology supported by multiple analytical tools.

The SSA proposes a review of the vegetable and root and tuber seed systems. Considering the importance of African vegetables in the Ghanaian diet and the fundamental differences between commercial and African vegetable seed systems, a differentiation was made for these two crop groups. The assessment firstly delves into cropping data identifying trends for production and the related seed demand and supply for the selected indicator crops per crop group. It continues with a description of the seed systems configuration completed with listing the seed value chain operators and seed service providers. The analysis of each of these aspects result in the identification of the major challenges limiting the performance of the crop groups related seed systems. The seed sector assessment finally includes the analysis of the policy and regulatory framework governing the sector. It focuses on key aspects such as variety release and registration, seed quality assurance, seed import and export and plant variety protection. It also examines the existing provisions governing intermediary and informal seed systems.

Challenges identified through the desk study and stakeholder consultations, for all crop groups included in this assessment, were observed across all major seed sector functions, including seed production, value addition and distribution, service provision, seed utilization, stakeholder organization, sector regulation, coordination, and funding. These challenges were reviewed and confirmed with seed sector stakeholders in Ghana and the Netherlands. To guide the transformation of the seed sector, constraints were reframed as sector ambitions.

In a multistakeholder workshop, key challenges to transforming the Ghanaian seed sector were identified by prioritizing the challenges compiled from both primary and secondary data. This process led to the recognition of eight key areas for intervention:.

1. Strengthen the gene bank infrastructure.
2. Enhance the enabling environment for seed business and trade.
3. Promote the use of quality seed of improved and adapted varieties of vegetables and root and tuber crops.

4. Strengthen investments and funding for capacitating root and tuber crops breeding and seed systems.
5. Promote the production and consumption of African leafy vegetables.
6. Support the local production of root and tuber crops in Ghana.
7. Support the development of a decentralized quality assurance system for root and tuber crops.
8. Strengthen the production of quality seed in informal and intermediary seed systems.

These areas serve as a basis for identifying opportunities to establish new partnerships and collaborate with existing initiatives to drive transformation in the seed sector.

List of abbreviations and acronyms

ARIPO	African Regional Intellectual Property Organization
AGRA	Alliance for a Green Revolution in Africa
AVBC	Africa Vegetable Breeding Consortium
BNARI	Biotechnology and Nuclear Agriculture Research Institute
CAADP	Comprehensive African Agricultural Development Programme
CIP	International Potato Center
CRI	Crops Research Institute
CSIR	Council for Scientific and Industrial Research
DAES	Directorate of Agricultural Extension Services
DCS	Directorate of Crop Services
DUS	Distinctiveness, Uniformity and Stability
ECOWAP	Economic Community of West Africa Agricultural Policy
ECOWAS	Economic Community of West African States
EGS	Early Generation Seed
EKN	Embassy of the Kingdom of the Netherlands
EWS-KT	East-West Seeds Knowledge Transfer
FAO	Food and Agriculture Organisation
FCB	Farmer and Community Based
FNS	Food and Nutrition Security
GAIDA	Ghana Agriculture Inputs Dealers Association
GIPO	Ghana Industrial Property Office
GLDB	Grains and Legumes Development Board
GoG	Government of Ghana
GSID	Ghana Seed Inspection Division
Ha	Hectare
IITA	International Institute for Tropical Agriculture
IP	Intellectual Property
IPPC	International Plant Protection Convention
ISTA	International Seed Testing Association
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LCIC	Legacy Crop Improvement Centre
LSB	Local Seed Business
ME&L	Monitoring, Evaluation & Learning
MT	Metric tons
MOFA	Ministry of Food and Agriculture

NABC	Netherlands-African Business Council
NASTAG	National Seed Trade Association of Ghana
NEPAD	New Partnership for Africa's Development
NPT	National Performance Trial
NSC	National Seed Council
NVRRC	National Variety Release and Registration Committee
OPV	Open Pollinated Varieties
PFJ	Planting for Food and Jobs
PPRSD	Plant Protection and Regulatory Services Directorate
PVP	Plant Variety Protection
QDS	Quality Declared Seed
RTB	Root- and Tuber Crops, and Bananas
RVO	Netherlands Enterprise Agency
SARI	Savanna Agricultural Research Institute
SDG	Sustainable Development Goal
SEEDPAG	Seed Producers Association of Ghana
TASAI	The African Seed Access Index
UCC	University Of Cape Coast
UPOV	International Union for the Protection of New Varieties of Plants
VCU	Value for Cultivation and Use
WACCI	West Africa Centre for Crop Improvement
WCDI	Wageningen Centre for Development Innovation, Wageningen University & Research
WUR	Wageningen University & Research

1 Introduction

The Ghanaian agricultural sector

The agricultural sector in Ghana, contributing to around 20% of the country's GDP and employing nearly 40% of its workforce, has faced recent challenges due to the COVID-19 pandemic and the Russia-Ukraine war, disrupting the food system and national economy (MoFA, 2023). The COVID-19 pandemic significantly impacted the horticulture sector, introducing a multitude of immediate challenges that put pressure on stakeholders. Producers faced difficulties accessing resources to cover operational costs and reduced access to financing for essential agro-inputs, resulting in decreased household incomes and increasing vulnerability to future shocks. The initial movement restrictions disrupted market dynamics and input supply chains, and constrained physical interactions and gatherings impeding sector coordination efforts (WCDI, 2020). Subsequent inflation had repercussions on the agricultural sector leading to higher costs of production, higher energy costs, higher prices of goods and services and a depreciation of the national currency. Climate change further threatens the sector (MoFA, 2023; Feed the Future, 2021), given the prominence of traditional and rainfed farming systems as only 3% of the cultivated land is irrigated (Delinthe & Zwart, 2022). Farmers have with limited access to quality inputs including climate-resilient or drought-tolerant varieties, irrigation equipment and infrastructure and knowledge to mitigate impacts (MoFA, 2023; Feed the Future, 2021). Besides, the agricultural sector is constrained by outdated policies, inadequate service, and information provision to farmers to support them in facing climate change (Feed the Future, 2021).

Aligning with the Sustainable Development Goals (SDGs), the Government of Ghana (GoG) is committed to developing its agricultural sector and transform food systems by endorsing various agendas and programmes, such as Agenda 2063, the Dakar Summit Food Sovereignty Agenda, the Comprehensive Africa Agriculture Development Programme, and the Malabo Declaration, supported by the African Union at the continental level. As a member of the Economic Community of West African States (ECOWAS), Ghana also aligns with regional policies like the Economic Community of West Africa Agricultural Policy (ECOWAP) (MoFA, 2023).

Planting for Food and Jobs initiative

The GoG implemented the Planting for Food and Jobs (PFJ) programme (2017-2022) aiming at developing the agricultural sector. The PFJ had six objectives: (i) ensure food security, (ii) increase productivity and production levels, (iii) promote import substitution, (iv) promote exports, (v) promote value addition and agro-processing, (vi) create jobs and wealth, especially for young people (MoFA, 2023).

Based on MoFA data (2023), the PFJ programme has achieved significant milestones in the agricultural sector including attaining self-sufficiency for some main staple crops (maize, plantain, cassava) and significantly increasing yields of staple crops for example maize and rice by respectively 135% and 67%, recognized by Pauw (2022) who conducted a review of the programme.

Growth of seed sector with Planting for Food and Jobs

The seed sector in Ghana has grown significantly over the last six years, fuelled by the PFJ programme. In practice, PFJ relied on a system of subsidies for quality seeds and other agricultural inputs for the cultivation of staple crops to encourage their use among Ghanaian farmers, the increase in irrigated cultivated surface area and improved extension services delivery by increasing the extension agents-farmer ratio (MoFA, 2023).

With PFJ, the government purchased certified seed from seed growers. However, the subsidy scheme to distribute agro-inputs on large scale and indiscriminately was partly counterproductive, causing market distortions, disrupting the activities of the private sector. Farmers who previously purchased inputs commercially may switch to subsidized options (Pauw, 2022). Also, the ineffective monitoring of PFJ seed suppliers and distributors led to seed smuggling and adulteration (MoFA, 2023). For the seed companies PJF

has also come with a risk of being over-dependent on one institutional buyer: in 2021, the seed company dependence on PFJ was at 48% for maize seed, 67% for rice seed and 75% for cowpea seed (Mabaya, 2022) The significant achievements in the PFJ led to a new phase, PFJ 2.0 (2023-2028). PFJ 2.0 includes additional crops, such as commercial vegetables and roots and tubers, with a focus on seed sector interventions like improved access to quality inputs, support to variety development initiatives, seed storage infrastructure development, and promoting Good Agricultural Practices. Recognizing the pitfalls from the previous phase, the PFJ 2.0 changed model by moving from subsidized inputs to input credit system associated to market arrangements to facilitate farmers' access and affordability to agro-inputs and services (MoFA, 2023).

Purpose of the study

The Embassy of the Kingdom of the Netherlands (EKN) in Ghana is exploring entry points to enhance collaboration between Ghana and the Netherlands in the seed sector, with a focus on collaboration and growth within the Horticulture sector. Gaining a comprehensive understanding of Ghana's seed sector will be useful in fine-tuning its strategy on horticulture.

The purpose of the study is threefold:

1. To assess the seed sector in Ghana, including the formal, intermediate, and informal subsectors, with a sub-focus on vegetables (this will include an assessment of the local seed producers, production levels and import balance)
2. To identify key challenges in seed systems relevant to all seed sector stakeholders
3. To identify potential opportunities for collaboration between Ghana and the Netherlands that will address those challenges and thereby foster seed sector development.

Outline of the report

The structure of the report is outlined as follows:

- Chapter 2 delves into the methodology employed in the current study. It provides a comprehensive understanding of the approach and tools used to gather relevant information.
- Chapter 3 seeks to answer the question, "Where are we now?" to evaluate the current performance of the Ghanaian seed sector and to identify the challenges it faces. It describes the results of the desk study, categorized by crop groups. It discusses data on crop production, import, and export. It also discusses configurations of seed systems, and the various operators and service providers within the seed value chain.
- Chapter 4 gives an overview of the policy and regulatory framework governing the seed sector.
- Chapter 5 outlines the seed sector challenges identified during the discussions with stakeholders. The challenges are clustered according to eight seed sector functions. For each challenge, a corresponding ambition is provided.
- The report concludes with Chapter 6, which provides a brief explanation of the way forward and how to get there, highlighting eight areas for partnership and collaboration in seed sector development.

2 Methodology and approach

The study methodology for this assessment is based on key guiding concepts, as well as seed sector assessment and national seed road map design tools developed by De Boef & Thijssen (2023) in the *Guide for designing a national seed road map*. This chapter outlines the guiding concepts and tools used in this assessment.

2.1 Concepts and tools in seed sector assessment

2.1.1 Key concepts in seed sector assessment

Five concepts were at the core of the seed sector assessment and the design of the outline of a roadmap for the seed sector in Ghana. These key concepts are summarized below but can be found in detail in the guide (De Boef & Thijssen, 2023):

1. **Systems thinking:** the seed sector is a complex system where interconnected elements (e.g. crops, seed systems, sector functions, activities, stakeholders) dynamically influence one another. Improving its performance requires addressing root causes of problems and engaging in interventions that drive systemic changes, thereby generating impact on the entire system.
2. **Stakeholder involvement:** the seed sector includes diverse stakeholders with unique roles and perspectives across seed sector functions and seed value chains of different crops. Engaging these varied stakeholders leverages the complementarity between seed systems and the private and public sectors, enabling targeted interventions and collaborative actions for a more performant national seed sector (see Figure 1)
3. **Triangulation:** Perspectives on the performance and functioning of the seed sector vary considerably among stakeholders, making triangulation essential. By using multiple data collection methods, combining quantitative and qualitative data, and verifying them with stakeholders, triangulation ensures a reliable assessment of the seed sector.
4. **Integrated Seed Sector Development (ISSD):** ISSD is an inclusive approach that aims to improve farmers' access to quality seeds by recognizing the characteristics and building on the diversity of seed systems. Rejecting a one-size-fits-all model, ISSD facilitates the tailoring of seed sector interventions to meet farmers' diverse needs.
5. **Integrated framework for food system and seed sector transformation:** Employing both the food system and sector frameworks deepens the understanding of overarching topics like agriculture, allowing for focused sector analysis that informs policies and interventions aimed at improving performance and driving food system transformation (see Figure 2).

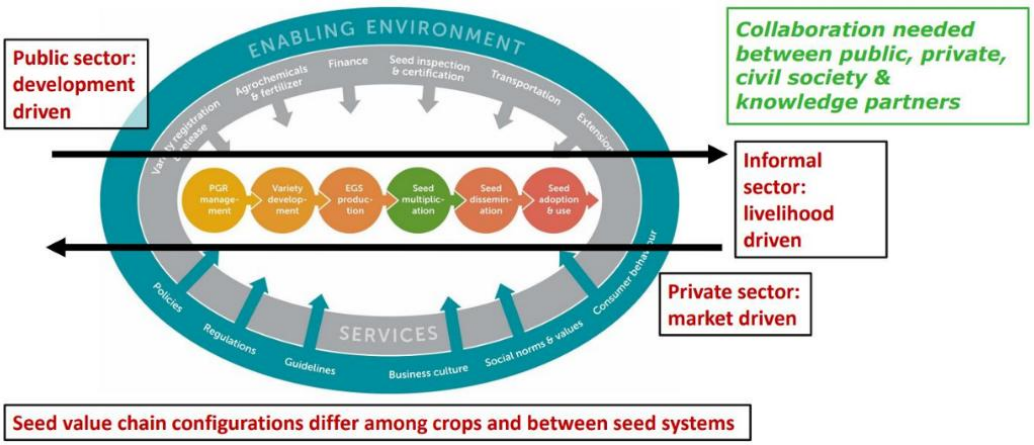

Figure 1. *Multi-actor configuration in seed value chain (adapted from Subedi et al., 2017)*

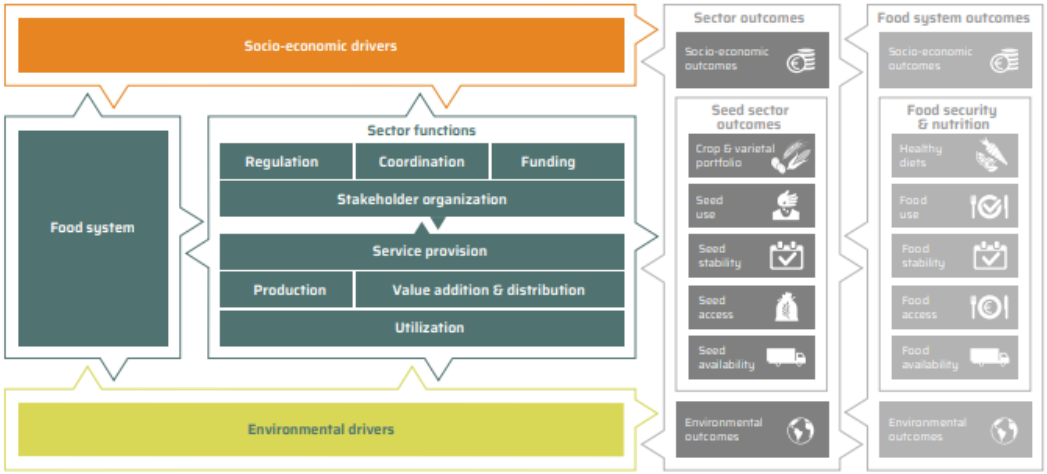

Figure 2. *Integrated framework for food system and seed sector transformation (de Boef and Thijssen, 2023)*

2.1.2 Tools for seed sector assessment

The structured approach developed by de Boef & Thijssen (2023), based on key guiding questions, informed the framework of this report. The assessment begins by addressing the question, *Where are we now?* through an assessment of the seed sector performance. It then progresses to identify challenges and define ambitions for sector development, aiming to answer the questions, *Where do we want to go?* and *How will we get there?* The guide outlines a series of tailored tools designed to gather specific information, combining methods to collect key data and ensure the triangulation of findings necessary for a comprehensive seed sector assessment and roadmap development.

2.2 Methodology

2.2.1 General set-up

The team involved in the Seed Scoping Mission Ghana comprises of two experts from Wageningen Centre for Development Innovation supported by two Ghanaian seed sector experts. Using a participatory approach and key concepts in seed sector assessment (see section 2.1.1.), the team combined data collection methods to including the review of strategic documents combined with participatory activities such as crop group-specific focus group discussions, a series and a multistakeholder workshop.

2.2.2 Steps for data collection

Our approach was organized following three steps to address the questions: *Where are we now?*, *Where do we want to go?* and *How do we get there?* Each question aligns with specific objectives: 1) evaluating the current performance of the seed sector, 2) capturing stakeholders' ambitions (both general and crop-specific), and 3) identifying opportunities and strategies to achieve those ambitions.

Step 1 – State of the seed sector
This step involves the application of various tools (Table 1) to answer the question *Where are we now?*:

Table 1. *Tools used in the seed sector assessment*

No.	Tool	Objective	Date
1	Literature review	Examine existing information on the seed sector, assessing performance and identifying key challenges, related to specific crop groups or global to the seed sector.	September to November 2024
2	Seed system analysis	Evaluate seed system configurations for crop groups, focusing on domains, key crops, variety types, seed quality assurance, and distribution mechanisms.	September to November 2024
3	Seed value chain analysis	Identify key stakeholders involved in functioning of the seed value chain.	September to November 2024
4	Policy and regulatory framework analysis	Review policies, laws, and regulations guiding the activities of diverse stakeholders in the seed sector.	September to November 2024
5	Focus group discussions based on crop groups	Review of seed sector behaviours and characteristics (seed systems, seed value chains, seed enabling environment), identify crop group and sector wide challenges and explore initial strategies to address the identified challenges.	October 2024
6	Elaboration of seed system challenges and ambitions	Identify challenges within seed systems using tools such as literature review, focus group discussions, individual interviews, and multistakeholder workshop. Challenges were validated in Ghana and the Netherlands.	November 2024

For an elaborate description of the tools, we invite the reader to consult the *Guide for designing a national seed road map* developed by de Boef & Thijssen (2023).

Step 2 – Seed sector ambitions

To answer the question *Where do we want to go?*, through a consultative process with seed sector stakeholders, challenges were translated into ambitions both general and crop-specific ambitions are developed. Ambitions are outlined following the eight seed sector functions: (i) production, (ii) value addition and distribution, (iii) service provision, and (iv) utilization; and at governance level: i.e. (v) stakeholder organization, (vi) regulation, (vii) coordination, and (viii) funding. Table 2 details the ambitions of seed sector functions as described by de Boef & Thijssen (2023) in the *Guide for designing a national seed road map*.

Table 2. *Ambition of seed sector functions*

No.	Function	Ambition of the function
1	Production	Seed production systems are viable and sustainable, and they cover all crops.
2	Value addition and distribution	Seed value chains and seed markets are profitable, efficient, fair, and transparent.
3	Service provision	High quality, inclusive and differentiated services are provided to seed producers and stakeholders in seed value chains.
4	Utilization	Farmers' use of quality seed of improved and preferred varieties is increased.
5	Stakeholder organization	Stakeholders are organized covering production, marketing, seed markets, seed regulation, seed quality assurance, services, and promotion of use.
6	Regulation	Rules and systems govern production systems, seed markets, service provision, coordination, and use.
7	Coordination	Appropriate coordination mechanisms are in place, which result in alignment and accountability among different seed stakeholders.
8	Funding	The seed sector has the capacity to generate revenues and make strategic reinvestments.

Source: de Boef & Thijssen, 2023

Step 3 – Innovation pathways
Answering the questions *Where do we want to go?* and *How do we get there?* can only be fully answered in an elaborate national seed road map, which is beyond the scope of this study. In a separate document, and building on the identified challenges, defined ambitions and priorities of stakeholders, initial ideas for potential Ghana-Netherlands seed partnerships are proposed.

2.2.3 Stakeholder contributions

Stakeholder involvement is one of the five key concepts used in the seed sector assessment methodology developed by de Boef & Thijssen (2023). Different Ghanaian seed sector stakeholders (e.g. public organizations, research and knowledge institutes, private sector or civil society organizations) from various geographies were mobilized in focus group discussions, interviews and a multistakeholder workshop. The organizations which contributed in different capacities to this assessment are included in Appendix 1.

2.2.4 Focus of this seed sector assessment

Over the past decade, Ghana's seed sector has undergone significant transformation, primarily focus on the development of the development of a formal seed system, especially looking at cereals and leguminous crops, driven by the government's strategic orientation towards achieving food security and focus of development partners. In this report, we highlight the importance of these initiatives and strategic documents and the recommendations they propose. Despite this strategic orientation for seed sector development, key seed sector documents also recognize the importance of other seed systems, including informal seed systems which today supply the majority of seed in Ghana, all crops included (USDA & GAIN, 2020) and the importance of other crops like vegetables and roots and tubers for food security and nutrition. Alignment and complementarity in seed sector stakeholders' development interventions are essential to effectively address gaps within the sector and thus not to replicate or impede those of others.

Based on the Food and Agriculture Organization (FAO) data, the consumption of vegetables in Ghana is low, averaging 82 grams per capita per day, below the recommended 200 grams per capita per day by WHO (400 grams in total for fruits and vegetables). Recent shocks, such as the COVID-19 pandemic and the subsequent inflation, have threatened the resilience of the Ghanaian food system (WCDI, 2020). In contrast, Ghana presents a 12.9% share of obesity in the adult population in 2022, an increase by more than 2% in comparison with 2012, slightly above the 11.6% for West Africa (FAO et al., 2024). Tomato, onion and chili pepper are the most consumed vegetables in Ghana, but African fruity vegetables, such as okra, garden egg, and African leafy vegetables, like jute mallow or amaranth, represent an important part of the Ghanaian diet, often consumed in stews and soups (Atuna et al., 2022; Clausen et al., 2024). Promoting vegetable consumption must consider the diversity of crops consumed, and therefore the variety of production systems that characterize these crops, seed systems and seed value chains used by farmers to source seeds (de Steenhuijsen Piters et al., 2021).

Farmers obtain seed or planting material from multiple sources, varying in quality, including local or improved, open-pollinated or hybrid, and old or new varieties. This choice may be influenced by a variety of factors including proximity, social network, financial capability, or the end use of crops (food, cash, export). Besides, recognizing the crop-dependent commercial viability of varietal development and commercialization by the private sector for some crops and the diversity of existing seed value chains requires abandoning the conviction that seed sector development equals formalizing seed value chains for all crops. Instead, it suggests embracing the diversity of value chains utilized by farmers to promote tailor-made solutions to support them and ensure complementarity between different seed systems to provide farmers with options to select and use quality seed or planting material of preferred and adapted varieties (de Steenhuijsen Piters et al., 2021).

2.2.5 Scope of this study

This study concentrates on two large crop groups, namely vegetables and root and tuber crops. They were chosen because of their importance for nutrition and relevance in the Ghanaian diet respectively. The study categorizes crops into three groups: 1) commercial vegetables, 2) African vegetables, and 3) roots and tubers. African vegetables are a separate category from commercial vegetables as market dynamics and seed systems differ, particularly with a limited involvement of international seed companies in African vegetable breeding and seed sales. Within African vegetables, to reflect their diversity, further subgroups were identified: African fruity vegetables and leafy vegetables. In addition to consuming roots and tubers, Ghanaians also consume the leaves of these crops, considered as African leafy vegetables. In this report, any product from root and tuber crop plants are all grouped under the root and tuber crop group. Indicator crops were selected for each group and subgroup based on their national importance in terms of consumption. Table 3 provides an overview of the crop groups, subgroups, and their respective indicator crops.

Table 3. *Indicator crops per crop group chosen in this assessment*

Crop group	Sub-crop groups	Indicator crop
Commercial fruit vegetables		Tomato
		Onion
		Chili
African vegetables	African fruity vegetables	Garden egg
		Okra
	Leafy vegetables	Cocoyam leaf
		Jute mallow (Ayoyo)
Roots and tubers		Cassava
		Sweet potato
		Yam

3 Assessment of the Ghanaian seed sector performance

This opening chapter seeks to answer the question, "Where are we now?" to evaluate the current performance of the Ghanaian seed sector and to identify the challenges it faces. This assessment is foundational, as it provides the groundwork for the next step, "Where do we want to go?" by establishing a baseline. The chapter draws on existing literature to conduct a comprehensive seed sector assessment.

Over the past decade, Ghana's seed sector has undergone significant transformation, including the development of key regulatory frameworks and the creation of the National Seed Trade Association of Ghana (NASTAG) in 2017. Interventions in the seed sector by Ghanaian and international organizations (AGRA, USAID) and the resulting strategic documents, including NASTAG's seed sector overview (Nikoi, 2022), The African Seed Access Index's (TASAI) country report (TASAI, 2024), and Alliance for a Green Revolution in Africa's (AGRA) Seed sector strategy and investment plan (AGRA, 2022b), primarily focus on the development of the development of a formal seed system, especially looking at cereals and leguminous crops, driven by the government's strategic orientation towards achieving food security.

To provide a comprehensive understanding of Ghana's seed sector we propose in Appendix 2, a brief overview of seed systems of field crops. To complete this overview, we compiled in Appendix 3, recommendations retrieved from seed sector strategic documents and clustered per seed sector function. For a more in-depth understanding, we recommend consulting the key documents we have used (TASAI, 2024; Mabaya, 2022; AGRA, 2022b, Policy LINK, n.d., SEEDLINK, n.d.; CESSA, n.d.). In Appendix 4, we listed projects and investments that are currently ongoing in the Ghana seed sector.

3.1 Seed systems in Ghana

Farmers in Ghana, for all food crops, source their seed from different seed systems. Seed systems in Ghana can be classified into formal, intermediary, and informal seed systems (Aidoo, 2012; TASAI, 2024).

- The **informal seed system** refers to a system in which seed is produced, maintained, and distributed through informal networks. The informal system includes farmers saving seeds from the harvest and exchanging it with neighbours and relatives and offering it thorough local markets. Seed banks and community-based seed production are also part of the informal seed system.

- The **intermediary seed system** comprises institutionally assisted groups and business-oriented farmers groups, cooperatives, or local seed businesses. Through supervision and support by for instance CSO's, projects and research organizations these groups can produce quality seed, but the seed is not always certified in accordance with the seed certification regulations. The intermediary seed system includes both local and improved varieties.

- The **formal seed system** is the structured and regulated seed value chain for the production and distribution of certified seed of improved varieties.

It is assumed that informal seed systems supply around 80% of seed used in Ghana while import of seeds of various crops including cereals like rice but also vegetables to meet the seed demand are important. For that reason, the Ghanaian seed sector is still considered in its initial stages of development (TASAI, 2024; USDA & GAIN, 2020).

Table 4 presents an overview of the different seed systems present in Ghana. The table details for each seed system the end use of the crop, the major crops concerned, the type of varieties, the quality assurance system associated and the seed dissemination mechanism.

Table 4. *Seed systems in Ghana*

Seed system	Informal seed systems			Intermediary seed systems			Formal seed systems	
	Farmer-saved	**Community based**	**Local market**	**Registered seed growers**	**Institutionally assisted groups**	**Out-growers**	**Purely public seed system**	**Private commercial seed system**
Types of crops	Mainly local food crops	Mainly local food crops	Both local food and cash crops	Mainly cash crops	Both local food and cash crops	Mainly cash crops	Food, cash and industrial crops	High value cash crops
Major crops	Pearl millet, sorghum, legumes, cassava, sweet potato	Pearl millet, sorghum, legumes, cassava, sweet potato	Sorghum, cowpea, groundnut, yam, plantain	Maize, rice, cowpea, soybean, sorghum	Cowpea, groundnut, cassava, yam	Maize, rice, cowpea, soybean	Maize, cassava, yam cocoa, oil palm,	Maize, rice, cowpea, soybean, exotic vegetables
Types of varieties	Local and recycled improved varieties	Local and recycled improved varieties	Local and recycled improved varieties	Mainly improved varieties	Mainly improved varieties	Mainly improved varieties	Improved varieties	Publicly and privately owned improved varieties
Assurance for seed quality	Local, based on trust	Local, based on trust	Unknown	Certified if possible	Supervised, but not necessarily certified	Certified if possible	Certified	Certified
Seed dissemination mechanism	Saved on farm	Exchanged, bartered, or given as gift/charity	Sold at the local market	Sold to agro-input dealers and NGOs	Sold or exchanged among farmers	Delivered on contract with companies	Distributed through agents	Marketed directly to farmers or sold to agro-input dealers

Source: de Roo, 2015

3.2 Commercial vegetables

Tomatoes, chili peppers, and onions are Ghana's most widely consumed commercial vegetables, grown mainly by small and medium-scale farmers using open-field methods (Clausen et al., 2024; van Asselt et al., 2018). Other vegetables like cabbage, cucumber, and carrots are gaining demand, especially in urban areas with increasing health-conscious populations (Saavedra Gonzalez et al., 2014; Clausen et al., 2024). More advanced farming systems such as protected agriculture are used to produce salad vegetables such as cucumbers and lettuce, especially near urban areas where there are formal markets and an urban population looking for healthier diets (Clausen et al., 2024). Table 5 presents production data for major vegetables in Ghana, including commercial vegetables and okra, an African fruit vegetable considered a commercial vegetable in Ghana.

Table 5. *Production and gross production value of the main vegetable crops in Ghana in 2022*

Crop	Production in tons	Gross production in 1,000 USD
Tomatoes	382,247	282,778
Onions and shallots, dry (excluding dehydrated)	151,426	97,426
Chillies and peppers, green *(Capsicum spp.* and *Pimenta spp.*)	119,599	126,440
Okra	69,345	*N/A*
Eggplants (aubergines)	52,685	30,685
Cucumbers and gherkins	135	*N/A*

Source: FAOSTAT, 2024

Ghana's vegetable production falls short of market demand, with major constraints being biotic and abiotic stresses, unfavourable agroclimatic conditions, limited access to machinery and irrigation infrastructure and low adoption of GAP. Advanced systems like protective structures, irrigation, and cold chain infrastructure

are scarce (Saavedra Gonzalez et al., 2016; Assibey-Yeboah, S., & Koomen, I., 2019; Clausen et al., 2024). Reliance on imports from neighbouring countries, including Niger, Burkina Faso, Togo, Nigeria, and Europe highlights the low competitiveness of national value chains in comparison with the well-established supplied chains from neighbouring countries (van Asselt et al., 2018; Assibey-Yeboah, S., & Koomen, I., 2019; Clausen et al., 2024). Official figures of vegetable imports in Ghana may be significantly underestimated by the lax border regulation and the prominence of informal import channels (Clausen et al., 2024; van Asselt, 2018). Seasonal production cycles cause market gluts at time of harvest and price fluctuations (Clausen et al., 2024).

Multiple observations indicate that the vegetable market in Ghana offer business opportunities. Vegetables are an integral part of the Ghanaian cuisine, and the demand for healthier diets, including fresh salads, is rising linked to the country's economic growth and urbanization (Saavedra Gonzalez et al., 2014; Assibey-Yeboah, S., & Koomen, I., 2019; Clausen et al., 2024). Vegetable cultivation offers high returns on investment, surpassing those of staple crops, and presents significant market opportunities, as the country depends on imports from neighbouring nations to meet its demand (Assibey-Yeboah, S., & Koomen, I., 2019; Clausen et al., 2024).

3.2.1 Commercial vegetables data and projections

As the most widely consumed commercial vegetables in Ghana, tomato, chili, and onion are selected as indicator crops for this crop group. Figure 3 presents the commercial vegetable cropping data.

3.2.1.1 Tomato

Production

Tomato is Ghana's most widely produced commercial vegetable, cultivated on approximately 50,000 hectares in 2022 (MoFA, 2023; FAOSTAT, 2024), with production concentrated in the Middle Belt, Upper East, Greater Accra, and Volta regions (Clausen et al., 2024). Yields stagnate at 8 t/ha and are low in comparison with the neighbouring countries (van Asselt et al., 2018; FAOSTAT, 2024), the national production meets only 27% of demand, highlighting a significant deficit (MoFA, 2023).

Challenges in tomato production include reliance on poor quality seed, low adoption of improved varieties, low adoption of GAP, including insufficient and incorrect use of agro-inputs, and inadequate irrigation and protective structures, as most production is achieved in rainfed farming systems (Saavedra Gonzalez et al., 2016; MoFA, 2023; Clausen et al., 2024; van Asselt et al., 2018). The tomato market is dominated by "market queens", farmers suffering from a low bargaining power due to a poor organization between producers. Inadequate transport and storage conditions and infrastructure leading to high post-harvest losses (20-50%), seasonality of production and imports causing market gluts and price fluctuations limit producers' profitability and so create financial risks (MoFA, 2023; ILO, 2024; Clausen et al., 2024). The poor transparency of the value chain discourages investments aimed at professionalizing it and improving its competitiveness (Clausen et al., 2024).

Import and export

Despite significant discrepancies between sources, all agree that Ghana is heavily dependent on tomato imports. Van Asselt et al. (2018) even estimate that actual imports were 415% higher than official figures. Based on Clausen et al. (2024), Burkina Faso exports 90% of its tomato production to Ghana supplemented by important volumes from other neighbouring countries but also from outside West Africa, including the Netherlands reported as the second largest exporter of tomato to Ghana. Ghana is also a major importer of processed tomato products, representing 13% of Africa's total imports, primarily from the USA, China, and Italy, its national industry struggles with prohibitive costs of production and unsuitable varieties for processing (Clausen et al., 2024).

Tomatoes, along with onions, are "highly politicized" crops influenced by national and international stakehodlers and policies. The reliance on well-established supply chains, imports and international trade agreements deter investment in local value chains hindering the development of Ghana's tomato sub-sector (Clausen et al., 2024).

3.2.1.2 Chili pepper

Production

According to FAOSTAT data, the area harvested for chili peppers in Ghana declined significantly from the early 2000s until 2009. Since then, it has stabilized at slightly over 14,000 hectares (FAOSTAT, 2024). The end use of the product, either fresh or dried, determine the variety choice among producers. For instance, red chili varieties such as Birdseye, Cayenne, and Legon 18 can be marketed fresh or dried, while Scotch Bonnet is exclusively sold fresh (Clausen et al., 2024).

Chili pepper yields have shown some improvement over time, doubling between 2005 and 2014 to reach a peak of 8.5 tons per hectare. However, from 2012 to 2022, yields are low and stagnate around 8 t/ha (FAOSTAT, 2024). The challenges facing chili pepper production are similar to those of tomatoes, including limited adoption of quality seed of improved varieties, low adoption of GAP including the inadequate use of quality agro-inputs, and a restricted access to irrigation infrastructure despite the fact that yield levels present minimal variation between rainfed and irrigated farming systems (MoFA, 2023; Clausen et al., 2024).

Import and export

Based on the production and consumption level, MoFA estimated that Ghana achieved a 38% self-sufficiency in 2022. The country fills its demand with imports from neighbouring countries including Burkina Faso, Togo, Côte d'Ivoire but also from India, the Netherlands, Spain or Belgium (MoFA, 2023; Clausen et al., 2024). Nevertheless, chili pepper has export potential: Ghana, once the top fresh chili pepper exporter to the United Kingdom, lost its standing in 2015 due to an European Union ban following failures in sanitary and phytosanitary compliance (MoFA, 2023). The export market represents a large opportunity for Ghana with a growing demand in Europe for both dried and fresh products, particularly for the bird's eye chili variety. If some export companies provide chili pepper farmers with agro-inputs, including the seed of the desired varieties, as well as with extension services, the mass of producers face difficulties in finding the demanded variety to meet this demand and in meeting the Maximum Residue Levels (MRLs) standards (Clausen et al., 2024).

3.2.1.3 Onion

Production

Onion, after tomato, is the most consumed commercial vegetable in Ghana with two popular varieties: Bawku Red and Violet de Galmi. Significant discrepancies exist in statistics regarding annual onion consumption in Ghana: MoFA estimates onion consumption at 314,000 tons while Clausen et al. report consumption almost three times higher (MoFA, 2023; Clausen et al., 2024). In 2022, MoFA and FAOSTAT estimated Ghana's annual onion production at 178,000 tons and 151,000 tons respectively. Clausen et al. (2024) reported a higher figure of 250,000 tons. Yields vary widely from less than 3 t/ha in rainfed systems (van Asselt et al., 2018) to around 18.7 t/ha (MoFA, 2023). These figures are well below the yield level of 35 t/ha observed in Niger, a country that appears to benefit from more suitable agroclimatic conditions for onion production (MoFA-IFRPI, 2020; FAOSTAT, 2024). Production challenges include poor access to irrigation systems (75% of production is in rainfed systems), reliance on recycled seeds or poor-quality seeds or bulbs, and inappropriate farming practices (MoFA-IFPRI, 2020; van Asselt et al., 2018). In addition, pre- and post-harvest practices, such as excessive fertilization, improper irrigation, and inadequate drying, combined with poor transportation and storage conditions reduce product shelf life and contribute to high post-harvest losses (MoFA-IFRPI, 2020; MoFA 2023; Clausen et al., 2024). Despite these challenges, interest in onion production is increasing, particularly in northern regions where agroclimatic conditions are better suited for cultivation (Clausen et al., 2024) but where insecurity persists.

Import and export

Ghana relies heavily on imports, mainly from Niger and Burkina Faso, to meet domestic demand. According to Clausen et al. (2024) and based on the production and consumption data presented in their report, Niger, and Burkina Faso export 600,000 tons of onions per year to Ghana, in addition to 50,000 tons from countries such as China, Morocco, Egypt and Italy (Clausen et al., 2024). Imports from Burkina Faso and Niger alone cost USD 120 million in 2014 (Saavedra Gonzalez et al., 2014). MoFA reported a total of 317,830 tons of imported onions for a value of USD 22 million (MoFA, 2023). Illegal and informal imports from neighbouring

countries is an acknowledged fact in Ghana, partly explaining the differences in data between the diverse sources of information. It was estimated that official onion imports represented 60% of the market (MoFA-IFRPI, 2020; Clausen et al., 2024) while other sources report that between 80 and 90% of the onions consumed in the local markets are imported during off-season for production in Ghana (MoFA-IFRPI, 2020).

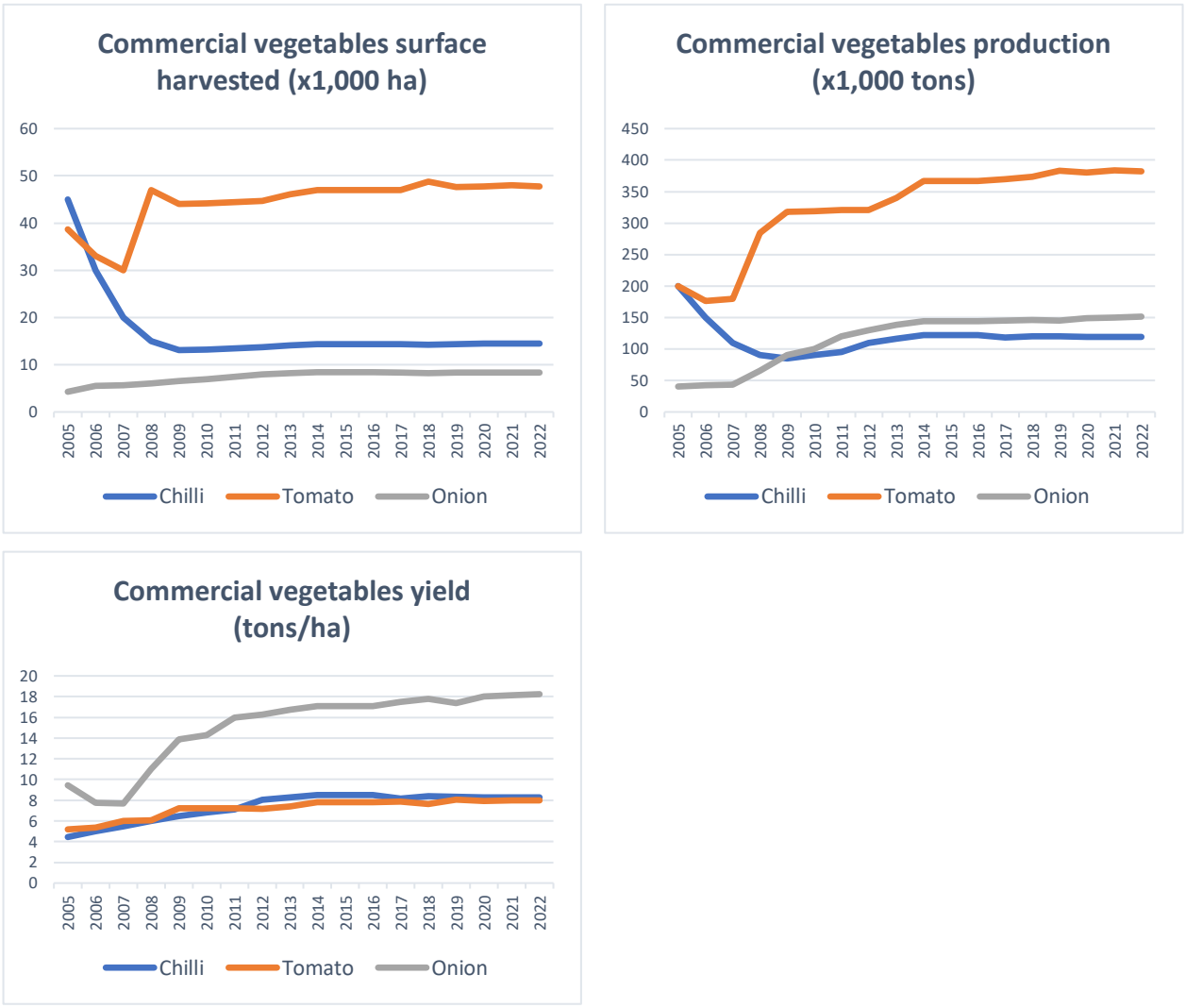

Figure 3. *Commercial vegetable cropping data 2005-2022 (FAOSTAT, 2024)*

3.2.2 Commercial vegetables seed systems

Today, despite the absence of data on the seed source for commercial vegetables, most farmers obtain commercial vegetable seed from the informal seed system (ILO, 2024; Osei et al., 2022; Saavedra Gonzalez et al., 2016). Many vegetable farmers in Ghana depend on farmer-saved seeds from previous harvests, local markets, or their social networks, while others purchase seedlings from local markets. Seeds procured from informal seed systems are mostly of local varieties (Melomey et al., 2022; Osei et al., 2022). The dissemination of new varieties among farmers is driven by the observation of these varieties in other fields, recommendations from social networks, or by the discovery of fresh produce in local markets (Osei et al., 2020).

To date, there is no certified seed production for commercial vegetables in Ghana, largely due to the limited development, release, and registration of vegetable varieties by Ghanaian research institutions (van Asselt et al., 2018) and the limited capacity of GSID, which prevents it from certifying seeds for crops other than cereals and legumes. However, Ghanaian seed businesses and farmers do produce seeds of open-pollinated varieties, which are sold to agro-dealers for commercialization. Seed packaging practices may vary, but some Ghanaian seed businesses offer well-branded and neatly packaged products, which represent a small

share (5 to 10% based on experts' estimates) of the seed supplied to the market (FGD, 2024a; FGD, 2024b).

From the formal seed system, a significant portion (about 35% for tomato based on experts' estimates) of the demand for vegetable seeds in Ghana is fulfilled through commercial imports, primarily from Europe and Asia, facilitated by private seed importers. Imported vegetable seeds are commonly available at agro-input dealers across the country (Osei et al., 2022). The varieties commercialized are both open-pollinated and hybrid. No international seed company focusing on this crop group produces seed in Ghana.

Some farmers focus on growing and marketing vegetable seedlings to sell for cash at the beginning of the growing season in local markets. This system allows farmers to reduce the risks associated with purchasing seed and growing seedlings, thus obtaining healthy and uniform seedlings for planting at the right time (Osei et al., 2020). Interviews with staff of an international seed company confirmed that purchasing seedlings, instead of seeds, is a widespread practice. However, the scale of this activity seems to be limited, while the business opportunity, particularly for youth and women, appears promising.

Table 6 presents the commercial vegetables seed systems configuration, included the estimated seed supply coming from these different systems. These estimations are mostly based on experts' knowledge, but literature sources may present different figures, usually emphasizing the importance of informal seed systems, from which farmers source a major part of their seed for commercial vegetables (Vigneri et al., 2021; ILO; 2024). Many of the literature sources do not detail if purchased seed are certified or not, and data is missing on the seed market, making it difficult to estimate the seed supply per seed system. Data must be used with caution.

Table 6. *Commercial vegetable seed systems configuration*

Characteristics	Farmer-managed	Local market	Ghanaian seed businesses	International companies
Domain	Informal	Informal	Intermediary	Formal
Use of crop	Food, cash potential for export	Food, cash, potential for export	Food, cash, potential for export	Cash, export
Type of varieties	Local, recycled improved varieties	Local, recycled improved varieties	Local, recycled improved varieties	Imported
Type of seed quality	Farmer-saved	Farmer-saved, based on trust	Based on trust, informal quality checks (germination test)	Certified
Type of marketing and distribution	Saved on farm	Local market	Agro-dealer	Agro-dealer
Estimated seed supply for tomato	50%	10%	5%	35%
Estimated seed supply for chili pepper	60%	10%	10%	20%
Estimated seed supply for onion	3%			97%

Source: FGD, 2024a; FGD, 2024b; experts' estimates

3.2.3 Commercial vegetables seed value chain operators

Public institutions like CSIR and Ghanaian universities are engaged in breeding, supported by initiatives such as Ghana CARES, GhanaVeg, the Market Development Programme (MADE), and the ILO Green MSD Project (ILO, 2024; van den Broek et al., 2018; Ghana-Made, 2024), which also support adaptation trials, seed production, and commercialization. Breeding efforts in Ghana primarily target cereals, legumes, and root and tuber crops. Vegetables are gaining interest but have so far received minimal focus due to resource constraints. To date, five tomato and three chili pepper varieties have been developed. International companies, through distributors, are commercializing seed in Ghana, but all breeding and production activities are carried out abroad. Table 7 lists the seed value chain operators for commercial vegetables.

Table 7. *Seed value chain operators for commercial vegetables*

Seed chain	Operators
Genetic resource management	Plant Genetic Resources Research Institute (PGRRI)
Plant breeding and variety development	Council for Scientific and Industrial Research of Ghana- Crops Research Institute (CSIR), West Africa Centre for Crop Improvement (WACCI), University of Cape Coast (UCC), other Ghanaian universities, international seed companies (outside Ghana)
Breeder seed production	CSIR-CRI, WACCI, UCC, other Ghanaian universities, international seed companies (outside Ghana)
Foundation seed production	CSIR-CRI, WACCI, UCC, other Ghanaian universities, international seed companies (outside Ghana)
Certified/truthfully labelled seed production	No production in Ghana at the moment, international seed companies (outside Ghana)
Seed marketing and dissemination	Agro-dealers (including distributors of international seed companies), local market, farmers
Seed use	Farmers

Figure 4, from the Access to Seed Index, lists down seed companies active in Ghana for vegetables. No international seed company produces vegetable seed in Ghana, but most of them focus on seed sales.

Figure 4. *Major private companies engaged in seed sector activities in Ghana (Access to Seed Index, 2019)*

3.2.4 Commercial vegetables seed production, marketing and distribution

Production

No commercial vegetable seed produced in Ghana has, so far, been certified by GSID, which focuses on cereals and pulses due to human, financial, and equipment constraints. As a result, all commercial vegetable seed produced in Ghana falls under the informal and intermediary seed systems. Ghanaian seed businesses produce and package seed, which is then commercialized by agro-dealers. The seed source is often indicated on the seed package, and seed quality is based on trust.

Local seed producers tend to prioritize cereals and pulses due to their expertise, government support, and better opportunities through large institutional markets (Osei et al., 2020). Meanwhile, the observed poor adaptability of commercial vegetable varieties to agroclimatic conditions reduces interest in their production and diminishes profitability prospects (ILO, 2024; Saavedra Gonzalez et al., 2016; Osei et al., 2020). Various stakeholders, including PPRSD, suggest that commercial vegetable seed production practices are inadequate, while extension services, specialized in field crop seed production, cannot provide appropriate advice to seed producers. The obsolescence of seed processing and packaging equipment, observed across the industry, further hampers the quality of locally produced seeds (FGD, 2024a; FGD, 2024b).

Marketing and distribution

The practice of purchasing seed is common for commercial vegetables. Melomey et al. (2022) and Robinson & Kolavalli (2010) reported that 65% and 80% of farmers, respectively, purchased tomato seed from local shops or agro-dealers. The study by Melomey et al. (2022) demonstrated that seed procurement habits are regional, with significant differences between regions. The purchase of seed was associated with higher use of improved varieties and access to irrigation. Farmers were primarily interested in high-yielding varieties (29%), fruit size (25%), colour (18%), and time to maturity (12%). The main argument from farmers to purchase seed was at 62% because of assured quality.

Nevertheless, the commercialization of poor-quality seed has created distrust between seed users and suppliers, undermining efforts to change farmers' habits regarding the procurement of quality seed of improved varieties (Melomey et al., 2022). Seed sector stakeholders indicated that unregistered agro-dealers engage in poor practices that threaten seed quality, including improper storage, inadequate packaging, and unauthorized repackaging. Although seed packages are marketed in small volumes, farmers, aiming to minimize investment and financial risk, often request very small quantities from agro-dealers. This encourages agro-dealers to open packages and sell seeds individually, potentially leading to seed adulteration, damaging the reputation of seed companies, and disrupting the efforts of other stakeholders supplying quality seed of improved varieties (FGD, 2024a; FGD, 2024b).

The adoption of quality seed of improved varieties, particularly those of international seed companies, is low. Improved exposure to quality seed of improved varieties through promotion, varietal demonstration and GAP capacity strengthening initiatives is gradually changing farmers' perceptions and behaviour towards seed procurement for vegetable crops. However, some challenges continue to limit the adoption of quality seed of improved varieties. Smallholder farmers struggle to afford hybrid varieties and may have limited awareness of their benefits and the associated farming practices. Inadequate farming practices and limited record-keeping further restrict their ability to assess the return on investment potential of using quality seed of improved or hybrid varieties. Additionally, seed users, particularly of locally produced and packaged varieties, lack critical information about the proper use and characteristics of the seed. In contrast, packages of imported seeds tend to provide the right information. Finally, last-mile distribution is hindered by poor transportation infrastructure, high logistical costs, and insecurity in the North (FGD, 2024a; FGD, 2024b).

3.2.5 Commercial vegetables seed demand and supply

Based on the commodity production data provided by FAOSTAT, an estimation of the seed demand is provided below for tomato, chili pepper and onion (Table 8). The estimated seed demand for these crops seems low but must be put in parallel with the high imports of vegetable commodities to Ghana. Reducing vegetable imports while meeting a growing demand will imply increasing the vegetable production area and so necessarily the seed demand. The use of this estimation must be treated with caution.

Table 8. *Estimated seed demand for tomato, chili pepper and onion based on commodity production in 2022*

Crop	Estimated demand in kg
Tomato	7,172
Chili pepper	3,120
Onion	2,492

Source: experts' estimates based on production data of FAOSTAT (2024)

Based on interviews with key stakeholders, the seed supply of commercial vegetable from the formal system is constrained by the absence of production of certified seed in Ghana, the limited availability at the right time and accessibility of imported seed. As for the seed demand, it is restricted by the seasonality of vegetable production in Ghana due to the limited irrigation infrastructure available. Issues with pests and diseases and the dominance of rainfed production systems present opportunities for the introduction of disease-resistant and drought-tolerant varieties (Melomey et al., 2022).

3.2.6 Commercial vegetables seed value chain service providers

Commercial vegetable seed value chain service providers are scarce, as there is no certified production of for these crops, and limited investment from public organizations in providing services to seed producers. Informal and unregistered seed producers of commercial vegetable seeds receive minimal technical guidance on seed production, and no alternative quality assurance system exists to certify the quality of commercial vegetable seeds before they are marketed.

International seed companies invest in adaptation trials, variety demonstration plots, and other promotional activities to raise awareness about the importance of using quality seeds of improved varieties, as well as the adapted practices, particularly for hybrid varieties. These private stakeholders also place high importance on training agro-dealers in the technical aspects of vegetable production, as agro-dealers are the main knowledge and information providers to farmers. NGOs and agricultural development programs also train farmers and extension services on GAP in vegetable production (e.g., Hortifresh or MADE) (van den Broek et al., 2018; Ghana-Made, 2024).

3.2.7 Imports of commercial vegetables seeds

MoFA data show a sharp increase in seed imports, rising from 421 MT in 2021 to 6,477 MT in 2023. However, the data lacks clear segregation by crop, as imported batches are often reported as "assortment of vegetable seed." Of the total, 6,444 MT, representing 99% of vegetable seed imports in Ghana, originates from France. This dominance raises questions about the accuracy of the data, although France also accounted for over 87% of Ghana's vegetable seed imports in 2022, with Technisem being a well-established French seed company in West Africa. Other key exporters of vegetable seeds to Ghana include the Netherlands, Italy, India, China, the United States, and Chile. Disaggregated data for 2023 suggests that cabbage, tomato, and carrot are the primary crops for which seeds were imported into Ghana.

Seed imports require import permits, and seeds are inspected at entry points by PPRSD. If the seed is reported as a duty-free product (USDA & GAIN, 2020), international seed companies report paying costly import duties. Unclear regulatory requirements and limited coordination between (air)port authorities and PPRSD make the importation process costly, lengthy, and inefficient. Poor storage conditions at (air)ports may compromise seed quality. Registration processes are costly and cumbersome. Distributors face further obstacles, including high exchange rates, limited access to foreign exchange (FOREX), the need to pre-finance seed purchases from international seed companies, and regulatory barriers. Finally, illegal cross-border trade is not properly addressed by the government, disrupting international companies' activities.

3.2.8 Challenges in commercial vegetable seed systems

Literature research, interviews and focus group discussion with key stakeholders on commercial vegetables informed on the existing challenges in commercial vegetable seed systems.

- Subsidized seed distribution by MoFA, including through PFJ, and NGOs reducing farmers' incentives to invest in quality seed, leading to reliance on recycled seed with poor practices and outcomes (Pauw, 2022).
- Limited investments in Ghana on breeding and varietal development programmes.
- Poor adaptation of some varieties commercialized to the diversity of agroclimatic conditions present in Ghana.
- Limited awareness on the benefits and low adoption of quality seed of improved variety
- Resource constraints of GSID resulting in the absence formal quality assurance system for vegetable seed production
- Poor quality of seed produced in the informal and intermediary seed systems due to high recycling rate, poor seed extraction and storage practices, leading to low yields.
- Seed producers receiving little technical advice about seed production.
- Presence of counterfeit seed on seed markets.
- Repacking practices of agro-dealing leading to seed adulteration.
- Unfavourable regulatory environment and cumbersome processes for seed importation and variety registration.

3.3 African vegetables

3.3.1 African vegetables sector

African vegetables comprise a large variety of species where a main distinction can be made between the African fruity vegetables, with the most widely consumed in Ghana being garden egg and okra, and the African leafy vegetables including cocoyam leaves or jute mallow (Atuna et al., 2022). Table 9 shows a longer list of African vegetables.

Table 9. *List of the African vegetables consumed in Ghana*

African fruity vegetables	African leafy vegetables
Brinjal eggplant / Aubergine (*Solanum melongena*)	African spider plant (*Cleome gynandra*)
Garden egg (*Solanum aethiopicum*)	Amaranth (*Amaranthus spp.*)
African eggplant leaves and fruits (*Solanum macrocarpon)*	Baobab leaf (*Adansonia digitata*)
Luffa (*Luffa spp.*)	Bitter leaf (*Vernonia amygdalina*)
Okra (*Abelmoschus esculentus*)	Cocoyam leaf (*Xanthosoma sagittifolium*)
Pumpkin leaves and fruits (*Cucurbita maxima*)	Kenaf leaf (*Hibiscus cannabinus*)
Turkey berry (*Solanum torvum*)	Jute mallow (*Corchorus olitorius*)
	Moringa leaf (*Moringa oleifera*)
	Roselle leaf (*Hibiscus sabdariffa*)
	Sweet potato leaf (*Ipomoea batatas*)
	Water leaf (*Talinum fruticosum*)
	West Indian nettle (*Laportea aestuans*)

Source: Atuna et al., 2022, FGD 2024c, FGD 2024d

African vegetables are an inherent part of the Ghanaian diet, mostly consumed in stews and soups, accompanying staple food in traditional dishes such as *fufu* or *banku* (Atuna et al., 2022; Clausen et al., 2024).

Little information is generated regarding the production of these crops which can be both commercially produced or foraged by farmers, households or vendors on local markets. The consumption of African vegetables is therefore dependent on the seasonality and so their availability on the fresh market (Clausen et al., 2024). When they are secondary products, such as cocoyam leaves, they commercialized in larger

quantities during the rainy season when the leaf production is more important (Deffor, 2024). Initiatives to popularize the consumption of African vegetables, sometimes disregarded, particularly by the younger generations associating these crops with "food of the poor", must be undertaken to increase their demand and consumption (Atuna et al., 2022; FGD, 2024c; FGD, 2024d). Their consumption is expected to increase as the population grows and since these crops are elemental in Ghanaian diets (Clausen et al., 2024; FGD, 2024c; FGD, 2024d), and at the same time awareness of healthy living is growing among the public. Raising awareness about alternative uses of other parts of the crops, for instance the fibres in jute mallow, would also stimulate demand (FGD, 2024c; FGD, 2024d).

Figure 5 presents the cropping data from okra. Data from other African vegetables could not be retrieved.

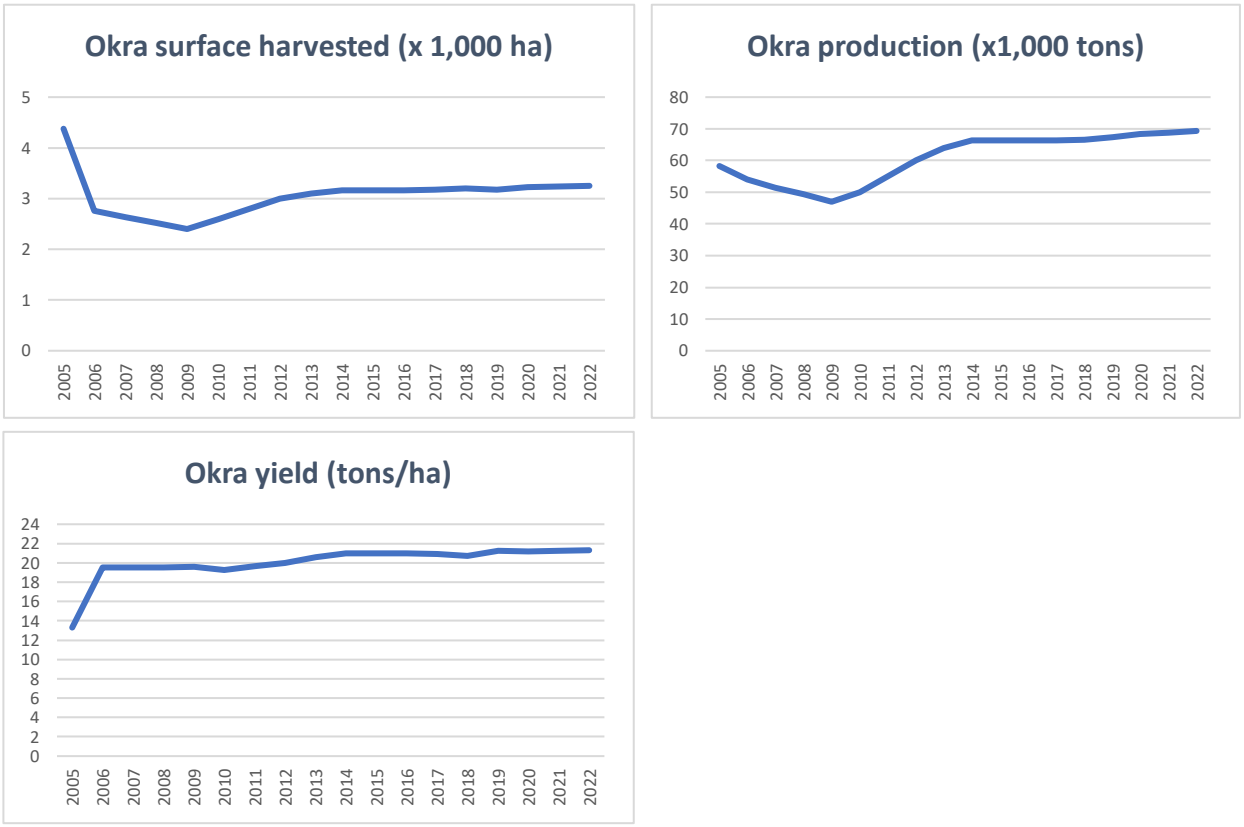

Figure 5. *Okra cropping data 2005-2022 (FAOSTAT, 2024)*

Many of these African vegetable crops, aside from a few African fruity (commercial) vegetables like okra and garden eggs, are often regarded as forage or volunteer crops and are intercropped with staple crops or cultivated on a small area in addition to the main commercial vegetables. The farming system is characterized by low investments, including in quality seed of improved varieties, for the cultivation of African vegetables (apart from the most commercial ones like okra and garden eggs), despite the reported high use of pesticides. Nonetheless farmers keep on cultivating these crops as they perceive that they are competitive on the market and that the diversification of their cropping system may offer additional income (Deffor, 2024).

African vegetables receive limited attention and investment from public and private stakeholders particularly for genetic resource conservation and management, and plant breeding (Clausen et al., 2024). The restricted cultivation of these crops by farmers, combined with the impacts of climate change and deforestation, is pushing some of them toward extinction. This perception stems from the low support and interest in these crops, combined with the limited professionalization of the value chain (Deffor, 2024).

Similarly to commercial vegetables, African vegetables value chains are dominated by traders associations and market queens while farmers operating generally independently have low bargaining power. Producers of African vegetables suffer from weak market linkages, limited generation and dissemination of market intelligence and limited off-farm value addition options. Mobile phones and payments allow farmers to be in

direct contact with traders, so reducing the number of intermediaries in the value chain, which is also true for commercial vegetables. Post-harvest practices and storage facilities are inappropriate to guarantee the quality of the produced commodities (Deffor, 2024).

Meeting the growing demand for African vegetables requires professionalization and increased competitiveness of their value chains. This involves providing farmers with access to quality seeds of preferred varieties through improved genetic resource management. Additionally, farmers require adequate training and extension services to produce these crops effectively and greater technical and financial support to enable the proper use of quality inputs, particularly women and youth (Clausen et al., 2024; Atuna et al., 2022; Deffor, 2024). Furthermore, strengthening market linkages, increasing the transparency of the value chains, improving post-harvest practices, and promoting off-farm value addition are crucial steps to fully develop these value chains (Deffor, 2024; FGD, 2024c; FGD, 2024d).

African vegetables are produced in Ghana but the national production cannot meet the demand, particularly off-season. Imports of garden eggs, okra as well as leafy vegetables from neighbouring countries complete the market demand (Clausen et al., 2024; Deffor 2024). Export opportunities exist outside Africa, for okra and garden eggs, as there is a growing demand among the Ghanaian diaspora in Europe and the USA. Ghana benefits from the proximity to Europe and the existence of cost-effective airfreight options. On the contrary, intra-Africa trade is hindered by high logistical costs and inappropriate transportation conditions to maintain the freshness of the products (Clausen et al., 2024).

3.3.2 African vegetables seed systems

Little intelligence has been collected on the exact seed supply from diverse seed systems for African vegetables. In addition, the situation may vary depending on the crops (fruity and leafy vegetables) and particularly the end-use of the crop. Differences will be observed in the seed supply for a crop destined to the export market or used as food by a farmer. However, African vegetables, both fruity and leafy vegetables, are dominated by informal seed systems, either farmer-saved seeds or through local markets. Eventually, agro-dealers also commercialize certified seed of improved varieties from international seed companies, mostly for fruity vegetables. Table 10 presents African vegetable seed systems configuration.

Table 10. *African vegetable seed systems configuration*

Characteristics	Farmer-managed	Local market	Ghanaian seed businesses	International companies
Domain	Informal	Informal	Intermediary	Formal
Use of crop	Food, cash potential for export	Food, cash, potential for export	Food, cash, potential for export	Cash, export
Type of varieties	Local, recycled improved varieties	Local, recycled improved varieties	Local, recycled improved varieties	Imported
Type of seed quality	Farmer-saved	Farmer-saved, based on trust	Based on trust, informal quality checks (germination test)	Certified
Type of marketing and distribution	Saved on farm	Local market	Agro-dealer	Agro-dealer
Estimated seed supply for African fruit vegetables (e.g. okra)	40%	30%	10%	20%
Estimated seed supply for African leafy vegetables (e.g. jute mallow)	50%	50%		<1%

Source: FGD, 2024c; FGD, 2024d; experts' estimates

Even for commercially oriented crops like okra and garden eggs, most Ghanaian farmers rely on recycled seeds – they keep quality fruits from healthy plants from which they extract seed as planting material for the next season or acquire seeds from peers who also engage in recycling (Deffor, 2024). Interviews with Ghanaian seed stakeholders also highlight that Ghanaian farmers obtain seed or seedlings from the local market as well as from agro-dealers selling seed from unregistered Ghanaian seed producers. Deffor (2024)

also reports examples of farmers buying seed from agro-dealer shops every season, especially for African eggplants,

Based on Deffor's work (2024), there is no clear pattern explaining farmers' behaviour in terms of access to seed but rather several factors influencing their choice:

- Farmers' proximity to agro-dealer shops for purchasing seed is a key factor influencing their behaviour. It is believed that farmers closer to the Accra region purchase seed more prominently from agro-dealers than farmers in rural areas. Farmers sometimes rely on their social network, and so intermediaries, to access specific seed from a trusted source.
- Limited financial capacity prevents many farmers from purchasing seeds from agro-dealers each season.
- Depending on the crop, and observed for garden egg and okra, farmers prefer to recycle seeds of local varieties as they are demanded, specifically on the domestic market. In contrast, some varieties commercialized by international seed companies are more tailored to export markets (Deffor, 2024).

Confusion exists with the terminology used in the literature between "quality seed[1]" and "improved varieties[2]." Deffor (2024) explains that farmers purchase seed from agro-dealers. There, farmers buy imported seed from international companies, certified quality seed of improved, sometimes hybrid, varieties. Often, these agro-dealers also offer seed from Ghanaian companies. This seed is not certified, but often labelled, and the agro-dealer knows its source. Sometimes agro-dealers offer seed for sale from farmers involved in seed extraction. This seed is not certified, often not labelled, but also here agro-dealers most often knows the source. For the imported seed, the quality assurance system is based on an official certification. For seed produced by Ghanaian companies and farmers, the quality assurance system is based on trust (of the agro-dealer knowing the source). The fact that agro-dealers also commercialize uncertified seed, sometimes of poor quality, creates distrust in these commercial channels disrupting the work of other stakeholders including international seed companies, Ghanaian companies or farmers with appropriate production practices.

According to Deffor (2024), recycled seeds often trace back to improved varieties originally distributed by the District Department of Agriculture or purchased from agro-dealers. However, poor seed extraction practices and repeated recycling over several crop cycles compromise their genetic purity and phytosanitary quality, rendering them unsuitable to be classified as "quality seed" or "improved varieties."

3.3.3 African vegetables seed value chain operators

There is currently only one known breeding programme of African vegetables: CSIR-CRI started an okra breeding programme with a recently graduated okra breeder from WACCI. No record of other research on African vegetables from public organizations in Ghana are known. Capacities and infrastructure for breeding programmes and for African vegetable seed production through formal seed systems are minimal in Ghana. International seed companies are the only providers of certified seeds in Ghana (Deffor, 2024). Table 11 presents the African vegetable seed value chain operators.

[1] Quality seed is defined as seed that is varietally pure with a high germination percentage, free from diseases, and with a proper moisture content and weight. The use of quality seed ensures good germination, rapid emergence, and vigorous growth of the crop. Quality seed can be purchased as certified seed through commercial channels, but also obtained from informal sources.

[2] An improved variety is a variety developed by a public or private breeding program that has been officially registered and released. It has been developed using modern plant breeding methods and has been tested and selected for use by farmers, based on its specific characteristics. The variety is selected to be uniform and meets the criteria assessed in the distinctness, uniformity and stability test that ensures the suitability of the variety.

Table 11. *African vegetable seed value chain operators*

Seed chain	Operators
Genetic resource management	Mostly informal, some research activities on documenting ethno-botanical knowledge and collecting germplasm for conservation
Plant breeding and variety development	CSIR-CRI started an okra breeding programme, no record of other research initiative with public organizations in Ghana, international companies (okra, African eggplant), Africa Vegetable Breeding Consortium (AVBC) (World Vegetable Centre, 2023)
Breeder seed production	No production of breeder seed in Ghana
Foundation seed production	No production of foundation seed in Ghana
(quality) Seed production	No production of certified seed in Ghana, international seed companies (outside Ghana) especially for African fruity vegetables (okra, African eggplant), farmers and non-registered seed producers (commercialized by agro-dealers)
Seed marketing and dissemination	Agro-dealers (including distributors of international seed companies), local market, farmers, specialized seedling producers nurse seedlings of African fruity vegetables for smallholder farmers and individuals with backyard gardens
Seed use	Farmers and individuals with backyard gardens

3.3.4 African vegetables seed production, marketing and distribution

Breeding programmes for African leafy or fruity vegetables are not known in Ghana. For leafy vegetables, seed companies are less likely to invest in developing adapted varieties, it is not considered viable business (de Steenhuijsen Piters et al., 2021). Market demand is often small and localized and comes from low-income households. Also, production of certified seed of African fruity and leafy vegetables does not take place in Ghana at the moment. The catalogue of registered crop varieties in Ghana does not feature varieties of African fruity or leafy vegetables (NVRRC, 2019). Some international seed companies (outside Ghana) produce seed of especially African fruity vegetables (okra, garden egg, African eggplant). This seed is imported.

Imported seed can be obtained through agro-dealers. Especially in rural areas, access to imported seed is difficult, and seed value chain stakeholders also report seed preservation challenges at the level of input dealers. Especially frequent breaks in the cold-chain have a negative impact on seed viability (FGD, 2024c; FGD, 2024d). Farmers and non-registered seed producers also produce seed that can be obtained from agro-dealers' shops and local markets.

Seed is marketed through agro-dealers (including distributors of international seed companies), local market, farmers. In some cases, specialized seedling producers nurse seedlings of African fruity vegetables for smallholder farmers and individuals with backyard gardens.

3.3.5 African vegetables seed demand and supply

While the Ghanaian market demands for seed of local varieties grown mostly from recycled seed, exporters require specific varieties based on the preferences of the market in the importing country (Clausen et al., 2024). International seed companies having seed of fruity vegetables in their portfolio indicate that the poor availability of crop production and market information makes it difficult for them to predict potential seed demand and hence make it challenging to introduce new (imported) varieties (FGD, 2024c; FGD, 2024d). Seed importers mention that the current foreign currency exchange rate and high duties makes imported seed expensive, making farmers reluctant to buy imported seed over sourcing seed from local sources. Other seed businesses indicate that farmer-saved seeds among which poor-quality seeds are sold through commercial channels' (input dealers) and advocate that regulations on these channels to sell certified seed only should be enforced (FGD, 2024c; FGD, 2024d). Farmers generally trust that seeds from agro-dealers are of high quality. Therefore, the sale of poor-quality seed can damage the reputation of professional seed

suppliers (national and international) and hinder the adoption of improved varieties. Farmers and MoFA staff indicate that some of the imported varieties are not adapted to abiotic and biotic stresses and call for developing or importing varieties that are disease and virus tolerant and climate resilient (FGD, 2024c; FGD, 2024d).

3.3.6 African vegetables seed value chain service providers

As there is no production of certified seed of African fruity and leafy vegetables now, there is no seed value chain service providers in relation to quality assurance. As most of the seed used is from the informal and intermediary seed sector, PPRSD could train seed producers in informal and intermediate systems in (so farmers, members of farmers groups, local seed businesses) in seed production, seed selection and seed storage. Seed sector stakeholders call for awareness raising on the use of quality seed of improved varieties. International seed companies and seed dealers could promote varieties of African fruity vegetables through demonstration trials. International seed companies, agricultural development programmes and NGOs may train farmers and extension services of good agricultural practices in African vegetable production and could support in promotional trials and Business to Business events. Development programmes and NGOs may raise awareness about the health benefits and alternative uses of other parts of the crops to stimulate demand.

For the post-production seed quality control, seed companies importing seed and their dealers call for PPRSD to enforce regulation in distribution channels and punish stakeholders engaged in selling adulterated certified seed (FGD, 2024c; FGD, 2024d).

3.3.7 Imports of African vegetables seeds

In 2023, disaggregated data on seed imports to Ghana revealed that okra ranked second in import volume, following cabbage. Cases of imported seed of African leafy vegetables were observed but representing an insignificant share of the market.

3.3.8 Challenges in African vegetable seed systems

Below some key challenges related to African vegetable seed systems mentioned in focus group discussions are listed:

- Inadequate African vegetable seed production practices leading to poor quality of seed in informal and intermediary seed systems
- Limited supply of quality seed and availability in time
- Seed conservation challenges for farmers and agro-dealers
- Poor packaging methods and repacking of seed leading to issues with seed viability and germination
- No quality assurance system or tracking and tracing system to ensure seed quality and traceability
- Limit support to research institutions for breeding programmes
- Poor adaptability of varieties to agro-climatic conditions and biotic and abiotic stresses
- Limited awareness on improved varieties available on the market
- Low awareness on potential health benefits and knowledge on profitability prospects leading to low interest by farmers in production of some African vegetables
- Investment in seed of African vegetables seen as expensive considering the end use of the product (home consumption)
- Inadequate size of seed packages
- Low-inputs farming system limiting the demand for quality seed of improved varieties
- Limited information available on seed package for optimal use of seed
- Limited farmers' organizations for knowledge sharing and access to services

3.4 Root and tuber crops

3.4.1 Root and tuber crops data and projections

Root and tuber crops are an essential part of the Ghanaian diet. According to data retrieved by Kennedy et al. (2018) from FAOSTAT in 2017, Ghana is the largest consumer of starchy roots (cassava, Irish potato, sweet potato, taro, yam, and minor roots) per capita in the world, with an average of 408 kg per capita per year. Cassava and yam production are increasing due to both an expansion in cultivated area and higher yields. Sweet potato, considered a minor crop and recently promoted by international organizations for its nutritional benefits, is cultivated on a small scale but is gaining interest, as its market is appealing to producers, including for export. Generally, the production of root and tuber crops is limited by low input use, as well as biotic and abiotic stresses, while producers face challenges such as difficult access to stakes, limited storage options, poor infrastructure, and high production costs. Figure 6 presents cropping data for the indicator crops of roots and tubers (FGD, 2024e; FGD, 2024f).

Cassava
Based on MoFA (2023) data, Ghana is self-sufficient in cassava (113% self-sufficiency) with an annual production of over 26 million tons. To support the cassava value chain, particularly to increase production levels, the GoG has implemented several programs: the Presidential Special Initiative on Cassava (PSIC), the Roots and Tuber Improvement and Marketing Programme (RTIMP), and the West Africa Agricultural Productivity Programme (WAAPP). The average yield of 24 t/ha is high in comparison with Nigeria and West Africa (FAOSTAT, 2024). Cassava is widely consumed by the population and is also produced for industrial use. Despite the release of a substantial number of improved varieties by public research institutions, their adoption remains limited. Cassava production is characterized by a low-input farming system, which limits the demand for planting material. Production can also be done under contract farming for processors, who may provide planting material and other agro-inputs (FGD, 2024e; FGD, 2024f).

Yam
Yam production has steadily increased since 2005 (Figure 6). Ghana is currently the second-largest producer in the world, after Nigeria (FAOSTAT, 2024). Yam is primarily produced by smallholder farmers in Ghana for food. The dominant farming system is traditional, with limited use of agro-inputs (FGD, 2024e; FGD, 2024f), but the yield is high in comparison with Nigeria and the rest of West Africa (FAOSTAT, 2024). High post-harvest losses are observed, despite yam's reported better storability compared to other roots and tubers (FGD, 2024e; FGD, 2024f). The main production regions are concentrated in the Savannah Belt. According to FAOSTAT (2024), sweet potato and cassava imports and exports are minor. Ghana exported over 57,000 tons of yam in 2022, which, while insignificant in comparison with domestic production levels, represents around 30% of the yam traded internationally.

Sweet potato
In Ghana, sweet potato was considered a minor root crop, although it is the fourth most important after cassava, yam, and cocoyam (Abidin, 2016; Abidin et al., 2024). Additionally, other constraints limited the interest in the crop, including a lack of information on its potential for processing and transformation, as well as its high perishability (Abidin et al., 2024). Since 2010, international initiatives such as Feed the Future and the International Potato Center (CIP) have gained prominence in Ghana, particularly for promoting orange-fleshed sweet potato to combat vitamin A deficiency. Key Ghanaian organizations involved in these programs include research institutes like CSIR and universities for variety development, Women in Agricultural Development and DAES for extension services, and health-focused entities like the Ghana Health Service and the Ghana School Feeding Program (Abidin et al., 2024; Horticulture Innovation Lab, 2014).

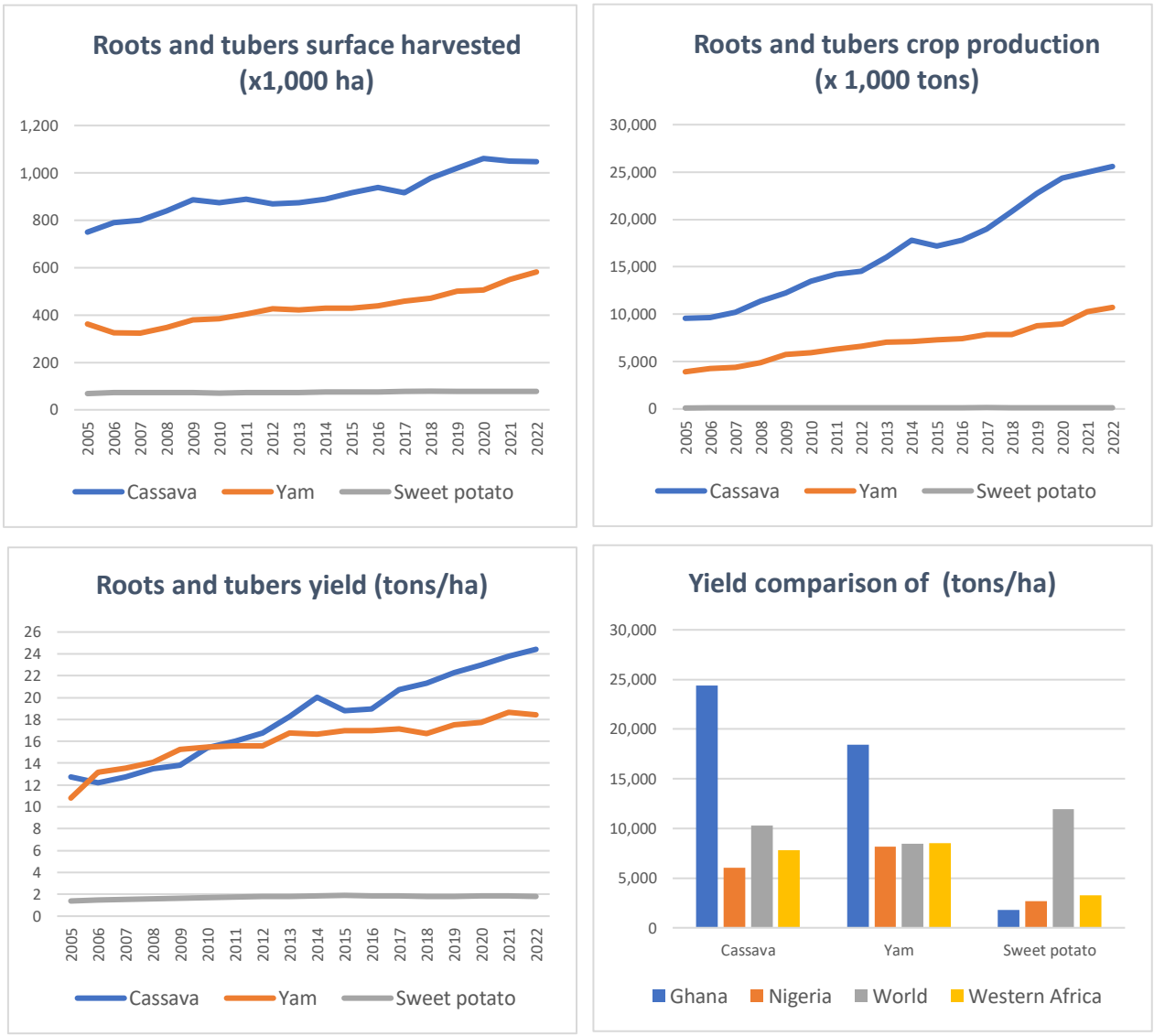

Figure 6. *Root and tuber cropping data 2005-2022 (FAOSTAT, 2024)*

3.4.2 Root and tuber seed systems

Traditionally, farmers source planting material from peers and sometimes communities, seeking clean and high-yielding varieties (Abidin, 2014; Deffor, 2024). According to seed sector stakeholders, approximately 90% of yam and cassava planting materials are sourced from informal seed systems, primarily through farmer-saved planting materials and local seed businesses. In 2023, the first community seed bank, supported by the Netherlands Agricultural Network (LAN), was established in Ghana. The objective of this community seed bank is to promote neglected and underutilized species through their conservation and value chain development. The procurement through this system remains limited, considering the recent creation of the community seed bank (LVVN, 2024).

The institutionally supported seed system, an intermediary seed system, is particularly important for access to clean planting material of improved varieties. This system, which is highly dependent on international donor funds but plays a critical role in the sector, involves public organizations including the gene bank, research institutions, and universities for breeding (Poku et al., 2018a). An initiative led by CIP includes the implementation of a decentralized vine multipliers system. In this initiative, multipliers produce certified planting material from clean breeder vines or planting stock from research institutions and supply it to sweet potato farmers. When these planting materials become infected with viruses or diseases after 3–4 seasons of continuous use, the vine multipliers return to acquire fresh, disease-free materials for planting (SASHA,

2018). Additionally, Feed the Future has facilitated the creation of vine multiplication sites at research facilities like CSIR-SARI and in northern regions. Through these sites, lead farmers distribute disease-free germplasm and train others in best management practices, strengthening local capacity and improving the availability of high-quality planting materials (Horticulture Innovation Lab, 2014).

The public seed system (formal) through which planting material of root and tuber crops is distributed by agricultural development programs, is a significant source of root and tuber planting material. Such programs include the Root and Tuber Improvement Programme (RTIP), the Root and Tuber Improvement Marketing Programme (RTIMP) (MoFA, 2013), and the Ghana Agriculture Sector Investment Programme (GASIP) (MoFA, 2024).

Based on a discussion held with a root and tuber planting material producer in Ghana, Iribov, while there is a clear market opportunity for private sector production of clean planting material and demand in the market, several hurdles are creating difficulties for the expansion of their activities. These include difficult access to parental lines for the production of clean planting material of a given variety, planting material propagation habits by farmers, poor seed demand forecasting, and low interest in improved varieties by farmers. Despite significant improvement with the adoption of the PVP bill in 2020, questions about its implementation and the absence of a royalty system represent a high-risk environment for the private sector to invest in variety development. Iribov tried to produce yam minisett[3], but this technology appeared to be too costly for farmers who also prefer landraces.

Table 12 present the root and tuber seed systems configuration.

Table 12. *Root and tuber seed systems configuration*

Characteristics	Farmer-managed	Community based	Institutionally assisted groups	Public	International companies
Domain	Informal	Informal	Intermediary	Formal	Formal
Use of crop	Food	Food	Food	Food	Food, Contract farming
Type of varieties	Land race varieties, farmer selection	Local, recycled improved varieties	Local, improved varieties	Local, recycled improved varieties	Improved varieties
Type of planting material quality	Farmer-saved	Farmer-saved, based on trust	Supervised, but not certified	Certified	Certified
Type of marketing and distribution	Saved on farm	Exchanged or purchased by farmers	Decentralized vine multipliers	Distribution though programmes	Provided by contractor, private company (direct sales)
Estimated planting material supply for cassava	70%	20%		5%	2%
Estimated planting material supply for yam	70%			5%	2%
Estimated planting material supply for sweet potato	30%			25%	5%

Source: FGD, 2024e; FGD, 2024f; , experts' estimates

3.4.3 Root and tuber seed value chain operators

CSIR-SARI, CSIR-CRI and WACCI engage in regeneration and conservation of germplasm as well as breeding. They are strongly supported by agricultural development programmes, including Seed For Resilience, NextGen cassava or the RTBs breeding programme funded by the Bill & Melinda Gates Foundation and implemented by CIP (CSIR-PGRRI, n.d.; NextGen, n.d., International Potato Center, n.d.). Ghanaian universities are also involved in root and tuber breeding (Poku et al., 2018a). CSIR-SARI and CSIR-CRI released so far 24 cassava varieties (Poku et al., 2018a).

[3] "The minisett technique involves the cutting of 'mother' seed tubers into small setts (minisetts) of 25-100 g which must possess a reasonable amount of peel (periderm) from which sprouting can occur" (Aighewi et al., 2014).

Agricultural programmes funded by international institutions include a range of interventions to develop the seed value chain, such developing new varieties, conducting on-farm testing, establishing commercial seed systems, enhancing seed and commodity value chains, and researching improved storage and shelf-life solutions. CIP has also published a Quality Declared Planting Materials (QDPM) protocol (Abidin et al., 2024).

Table 13 presents the main seed value chain operators for root and tuber crops.

Table 13. *Seed value chain operators for root and tuber crops*

Seed chain	Operators
Genetic resource management	CSIR-PGRRI supported by International Institute of Tropical Agriculture (IITA), CIP, and other national and international initiatives, community seed bank
Plant breeding and variety development	CSIR-SARI, CSIR-CRI, UCC, Biotechnology and Nuclear Agriculture Research Institute (BNARI), WACCI supported by IITA, CIP, and other national and international initiatives
Breeder seed production	CSIR-SARI, CSIR-CRI, UCC, BNARI, WACCI supported by IITA, CIP, and other national and international initiatives
Foundation seed production	CSIR-SARI, CSIR-CRI, UCC, BNARI, WACCI supported by IITA, CIP, and other national and international initiatives, designated seed companies, Departments of Agriculture, Mampong and Wenchi Agricultural Research stations
Certified/truthfully labelled planting material production	Farmers and commercial producers sometimes supported by programmes funded by international institutions and development partners, seed companies
Planting material marketing and dissemination	Agro-dealers, seed companies, local market, farmers, Departments of Agriculture, Mampong and Wenchi Agric Research stations
Planting material use	Farmers

3.4.4 Root and tuber production, marketing and distribution

Most of the production of planting material is carried out by smallholder farmers in a farmer-managed seed system characterized by a low replacement rate. Recently, some commercial producers, particularly of cassava and sweet potato for processing and export, have also engaged in planting material production and commercialization (FGD, 2024e; FGD, 2024f). Under the seed production laws of Ghana, a company can only produce planting material or seed of released and registered varieties. Since most landraces, preferred by farmers, are not registered, the multiplication and commercialization of these varieties is forbidden. Registering these landraces for multiplication is a cumbersome process. Iribov, a company engaged in the production of root and tuber planting material, wanted to multiply these landraces to meet customer demand. They engaged in dialogue with relevant stakeholders in the seed value chain, including PPRSD and CSIR-SARI, to identify the parental lines available at the national gene bank, obtain exemptions, and seek approval for the registration of these landraces by CSIR-SARI, as Iribov is not a national institution, and eventually receive a license from CSIR-SARI for the production of planting material. This process took nearly five years and required significant efforts. The production of planting material for root and tuber crops is also supported by a variety of stakeholders, including the National Agricultural stations (AGRA, 2022b).

The commercialization of root and tuber planting material is effectively limited by the dominance of a farmer-managed seed system for their production and the limited replacement practices. However, national and international development programs, such as the Root and Tuber Improvement Programme, have played a critical role in producing and distributing planting material, assisting public organizations in doing so.

3.4.5 Root and tuber seed demand and supply

Using the FAO data (FAOSTAT, 2024) on the cropping area for cassava and yam and considering a planting density of 10,000 plants/ha and a replacement rate of five years, the planting material demand were respectively evaluated at over 2,000 and 1,100 million plants.

3.4.6 Root and tuber seed value chain service providers

International organizations including the Bill & Melinda Gates Foundation, FAO, IITA, and the International Fund for Agricultural Development (IFAD) play a critical role in root and tuber seed system in funding and supporting seed value chain stakeholders through various interventions including planting material multiplication (Poku et al., 2018a).

Policy development for root and tuber crops has been guided by their central role in ensuring food security in Ghana, with a particular focus on increasing productivity. However, these policies have failed to support the development of a commercial and profitable value chain, limiting the demand for new and clean planting material of improved and specialized varieties (e.g. for processing) (Poku et al., 2018a). Limited market opportunities are believed to have restricted interest in developing and providing adequate services to the sector.

Currently there is no formal quality assurance system for planting materials produced in Ghana. Some programmes report the production of certified planting material without mentioning the quality assurance system (MoFA, 2013). CIP has nevertheless developed Quality Declared Planting Materials (QDPM) protocols for a range of vegetatively propagated crops including cassava, cocoyam, sweet potato, taro and yam (Abidi, 2016; Fajardo, 2010)

3.4.7 Imports of roots and tubers planting material

Imports of roots and tubers seed and planting material were not reported.

3.4.8 Challenges of root and tuber crops seed system

Based on the literature and focus group discussions, root and tuber seed systems are facing a range of issues including:

- Prohibitive costs of maintaining the field gene bank
- Inadequate tissue culture facilities for in vitro maintenance
- Difficulties in accessing parental lines
- High costs associated with multilocational trials and registration process
- Limited capacities for EGS production and so restricted access to EGS for multiplication
- Limited sources and access to disease-free clean seed and planting material, no traceability system
- Limited land availability, inadequate equipment (including irrigation) and infrastructure to produce planting material
- Slow multiplication of planting material
- Weak collaboration between planting material producers, research institutions and agricultural officers
- Limited awareness on the existing improved varieties and the benefits derived from their use and high costs associated with their purchase.
- Low replacement rate limiting demand for clean planting material and improved varieties and leading low output
- Limited knowledge of producers on appropriate planting material practices and limited access to technical guidance explained by insufficient resources within the public extension system
- Low-input production systems of root and tuber crops limit the demand for planting material
- Inappropriate storage conditions leading to dry up and disease infestation of planting material

- Poor timely availability of planting material at the beginning of season strengthened by the slow multiplication of crops, bulkiness for storage and absence of an operational seed forecasting system.

4 Policy and regulatory framework

4.1 Context

Ghana began transitioning toward privatization in its seed sector in the late 1950s, with a gradual reduction in public sector involvement (Osei et al., 2020), but until the 1990s, the seed sector was dominated by public institutions. The introduction of Ghana's Plants and Fertilizer Act, 2010 (Act 803) provided a regulatory framework to formalize private sector participation. Under this framework, the private sector is primarily responsible for the production and commercialization of certified seed, while the public sector focuses on policy development and enforcement, varietal development, and seed inspection (USDA & GAIN, 2020). Ghana has established seed policy instruments and regulatory framework to regulate the seed sector which TASAI rated as excellent in its country report for Ghana (TASAI, 2024). Aspects of seed policies and regulations include variety development, variety release and registration, seed quality control and certification, seed business and trade (import and export), conservation of genetic resources, utilization and exchange, protection of intellectual property rights, and institutional arrangements for decision-making and implementation mechanisms (Subedi, et al., 2024). The National Seed Council, supported by a range of stakeholders including the different directorates under MoFA, namely the Plant Protection and Regulatory Services Directorate (PPRSD), the Directorate of Crop Services (DCS), and NASTAG, oversees the overall coordination of the sector and the development of the seed enabling environment. NASTAG is eventually convening annually a National Seed Business and Networking Forum (SeedLINK), where key seed sector stakeholders, both Ghanaian and international (e.g. AGRA, Policy Link), are invited to discuss key challenges hindering the development of the seed sector.

The main national policy documents governing the Ghanaian seed sector are: the Seed (Certification and Standards) Regulations (1973 and 2018), the Plant and Fertilizer Act (2010), the Biosafety Act (No. 831) (2011), the Plant Protection Regulations (2012), the Ghana National Seed Policy (2013), the National Seed Plan (2015), the Seed Certification & Standard Regulation (2018) the Plant Variety Protection Act (2020) and the Plant Variety Protection Regulations (2022). A Catalogue of Crop Varieties Released & Registered in Ghana was lastly updated in 2019. The Ghana Seed Inspection Division of PPRSD published a Seed Quality Assurance and Certification Manual in 2018. Although some documents recognize the existence of an informal seed system, the regulatory framework mainly concerns and regulates the formal seed system.

Part Two of Ghana's **Plants and Fertilizers Act of 2010**, which deals with the seed industry, regulates the production, inspection, importation, exportation, and commercial transactions related to seed in Ghana as well as the activities of growers, cleaners, importers, and exporters of seed (Etwire in Kullmann,2016). It is the actual seed law.

The **National Seed Policy of 2013** was formulated in the context of the policies focusing on agricultural sector growth and productivity in Food and Agriculture Sector Policy Framework, the goals of which are aligned with the Growth and Poverty Reduction Strategy and NEPAD's CAADP. The National Seed Policy's main objective was to support the development and establishment of a well-coordinated, comprehensive, and sustainable private sector-driven seed industry through systematic and strategic approaches, which would create a continuous supply of new improved varieties for farmers' use. It also sought to support successful seed production, certification, marketing, and seed security systems, which would underpin food security and support overall development of the agricultural sector (Vernooy et. Al., 2024; Republic of Ghana, 2013).

The **National Seed Plan of 2015** was formulated as an instrument to guide the implementation of the Ghana Seed Policy of 2013. It is aimed at transforming Ghana's seed industry to attain food security and enhance agricultural productivity. The plan seeks to strengthen the private sector to drive commercialization whilst addressing key institutional and oversight challenges (AGRA, 2022; Vernooy et.al., 2024). The Plan outlines four areas of reforms centred around four broad themes: (i) Direct Private Sector Interventions, (ii)

Supportive Services for the Seed Industry Growth, (iii) Addressing gaps in the Strategic Components of the Seed Sector, and (iv) Seed Sector Governance and Coordination. The status of implementation of the plan has been mixed. On one hand, the government has enacted laws and passed regulations, the National Seed Trade Association of Ghana was formed, facilitating the establishment of an enabling environment for seed sector development. On the other hand, most of the projects that were proposed as tools for implementing the plan were never funded and therefore did not materialize (AGRA, 2022).

Ghana, member of ECOWAS, has adopted the **Regulations on Harmonization of The Rules Governing Quality Control, Certification and Marketing of Plant Seeds and Seedlings** in ECOWAS Region (C/REG.4/05/2008) (2008). The Regulation covers eleven major crops that are important to food security and trade within the region: maize, pearl millet, rice, sorghum, cassava, Irish potato, yam, cowpea, groundnut, onion, and tomato. The ECOWAS Regulation includes establishment of the West African Catalogue for Plant Species and Varieties (West Africa Seed Catalogue). Any variety entered the national catalogue of a member state should also enter the regional catalogue and can be freely traded and allowed for multiplication throughout the region without any further registration requirement (Kuhlmann & Zhou, 2016).

In addition, the Ghana has ratified several international treaties related to the seed sector including the International Plant Protection Convention (IPPC), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Ghana is a member of UPOV since 2021.

In 2024, AGRA initiated and facilitated a process with key Ghanaian -mainly formal public and private- seed sector stakeholders, using the SeedSAT methodology to get input for the **Seed sector strategy & investment plan for Ghana**. AGRA has facilitated similar processes for investment plans in other African countries. The Seed Sector Strategy and Investment Plan for Ghana is presented as one of the instruments to help implement the National Seed Policy of 2013 and is intended to replace the Ghana Seed Plan of 2015. The strategy and investment plan proposes another approach for fundraising than the project-based funding strategy of the 2015 National Seed Plan (AGRA, 2023).

4.2 Variety release and registration

For variety development and release, researchers or institutions must apply to the National Variety Release and Registration Committee (NVRRC). The institution nominating a variety to be released must prepare and submit a dossier (release data, including DUS and NPT/VCU) on the variety to the NVRRC for assessment before the variety is recommended for official release. The NVRRC conducts at least two inspections before submitting recommendations to the National Seed Council (NSC) for approval to release and register the variety in the National Catalogue (TASAI, 2024; Centre of Excellence for Seed Systems in Africa, 2022b; Osei et al., 2020).

4.3 Seed certification and seed quality control

Seed certification and seed quality control is ensured by PPRSD which was established in 2010 by the Plants and Fertilizer Act, 2010 (Act 803). PPRSD hosts the Ghana Seed Inspection and Certification Division (GSID) which supports the production of certified seeds, registers seed growers, dealers and importers/exporters who are respectively and by law, the only persons allowed to produce certified seed, commercialize seed, and import or export seed.

For seed certification, the GSID conducts field inspection, monitors certified seed production, analyses seed samples in laboratories and eventually certifies seed. GSID main facility, including the laboratory, is located in Pokuase, close to Accra, while seed inspectors are deployed throughout the country and regional

laboratories can be found in various, but not all, regions of Ghana. Ghana is a member of ISTA but has no ISTA accredited lab.

PPRSD conducts awareness raising initiatives on the benefits of the utilization of certified seed or planting material. Other technical directorates under the MoFA, DCS and the Directorate of Agricultural Extension Services (DAES) also support and promote the production and distribution of quality seed and planting material of improved varieties.

There is an inadequate number of seed inspectors for seed field inspection of cereal and leguminous crops. For a seed batch coming from a specific field to be certified, seed field inspectors must visit the seed field a minimum of four times within one production season (Azumah et.al. 2022) Moreover, the PPRSD laboratory and logistical equipment are inadequate. TASAI recommends strengthening PPRSD's capacity in national seed quality control, seed certification, seed analysis, and seed testing (TASAI, 2024)

As a result of the limited PPRSD capacities, the potential to expand activities to vegetable crops is limited, despite having the procedures in place for certifying vegetable seeds. Until 2024, no vegetable seed nor root and tuber planting material has been certified by the GSID.

Developing guidelines for accrediting third party certification service providers and training and licensing third-party inspectors, including public extension agents and private seed producers' staff, is being proposed to strengthen and increase the reach of seed quality control services. (AGRA, 2023)

There are five authorized seed classes in the national seed policy: 1) Breeder Seed, 2) Pre-basic, 3) Basic, 4) Certified Seed, 5) Quality Declared Seed. The Quality Declared Seed class has not yet been rolled out (Centre of Excellence for Seed Systems in Africa, 2022a)

4.4 Seed import and export

Part Two of the Plants and Fertilizer Act 2010 (Act 803) outlines regulations and monitoring processes for the exportation, importation, and commercialization of seeds and related activities (Sections 30–47). Individuals or organizations involved in vegetable seed production or trade must register with PPRSD to obtain the necessary license or permit. Anyone intending to import vegetable seeds must first apply for an import permit to bring samples for testing by an accredited research organization. Only after a recommendation has been granted, can commercial quantities be imported (Osei et al., 2020).

Cumbersome regulations and long import processes are acknowledged challenges. Seed importers report a duration of over 90 days between the start of the process to obtain the import permit and the clearance at borders. TASAI considers seed import and export regulations clearly detailed in policy documents (TASAI, 2024).

4.5 Plant variety protection

The Plant Variety Protection Act was first introduced in Ghana's parliament in 2013 as the Plant Breeders Bill, but was later withdrawn following opposition by some civil society groups. Further consultations took place. In 2020, the bill was reintroduced in parliament as Plant Variety Protection Bill; it was passed into law in November 2020 and was given presidential assent in December 2020. The bill establishes a legal framework for the protection of the rights of breeders of new plant varieties. The bill ensures that Ghana complies with the 1991 International Union for the Protection of New Varieties (UPOV) Convention to which Ghana is a signatory and conforms with the World Trade Organization's Agreement on Trade and Related Aspects of Intellectual Property Rights (Vernooy, et.al., 2023).

The PVP Act is designed to protect the rights of breeders, that breeders can benefit from their efforts in developing new and improved plant varieties. Uncontrolled multiplication of their protected varieties is no longer allowed. It aims to promote the development of new varieties adapted to Ghana's local environment and specific needs.

The bill also provides confidence to foreign investors and plant breeders that Ghana will provide effective protection for their intellectual property of new genetics from abroad and new varieties they generate. This is expected to lead to increased availability of "foreign" new varieties from an expected increase in number of applications for protection from foreign plant breeders. The Plant Variety Protection Bill can provide confidence to seed companies that a variety licensed to them by a national breeder or a foreign breeding company to produce planting materials or produce certified seed can be protected. This might for instance be conducive for Iribov, a company in Sogakope producing clean planting materials for farmers. They can register the variety of sweet potato licensed to them and protect it under plant breeders' rights. When registered, they can start multiplying with this imported new genetics with reduced risk of other stakeholders multiplying the variety.

The Ghana Industrial Property Office (GHIPO), also known as the IP Office, is implementing the legal framework for the plant variety protection. Currently the IP office is putting in place the necessary structures and building capacities to implement the PVP bill. Up to date the IP office has received six national and one international application requesting varieties to be protected under the PVP bill. It is worth noting that only varieties released in the last four years will be considered for protection. Those varieties are categorized as 'New Creation'.

Ghana is a member of the African Regional Intellectual Property Organization (ARIPO). As of July 2022, ARIPO has 22 member States which are all English-speaking African countries except Nigeria and South Africa. This means that when varieties have been accepted and registered to be protected in other member states of the ARIPO, they will automatically be granted protection in Ghana, without having to go through the registration process in Ghana. One of the most important technical requirements for registration of a variety with the IP office is the Distinctiveness, Uniformity and Stability (DUS) test report. For international companies, UPOV compliant DUS test results for the variety from other countries can be obtained and submitted with the application for registration. Currently, the DUS test results of DUS tests conducted by PPRSD to register a variety in the National Variety Register is not accepted as the required UPOV compliant DUS test for registering the variety under the PVP Act.

The enforcement of the intellectual property right of the holder of the plant breeders' right is the private right of the company or institution that submitted the variety for registration.

Variety licensing is a tool for plant breeding organizations or companies to commercialize their varieties and get the new genetics in the hands of farmers in the form of seed. It is a way of transferring intellectual property rights from breeders to seed producers. Variety licensing is being practiced in Ghana. The Crop Research Institute has developed a system for licensing improved varieties of maize, soya bean and tomato to seed companies for seed production and commercialization. It is not clear whether this variety licensing is functional or how many licenses were issued to seed companies under this arrangement (Centre of Excellence for Seed Systems in Africa, 2022b). WACCI has also licensed improved maize and tomato varieties to companies for seed production and commercialization. The company licensed to produce the tomato seeds is yet to commence commercial production of the seed. At the moment, no registered seed company in Ghana is producing certified tomato seeds.

No royalty programme exits for varieties released by public institutions and no royalties are paid to breeding programmes or to breeders (AGRA, 2022c).

4.6 Informal and intermediary seed systems in the seed policies and regulations

While Ghana's seed policy of 2013 recognizes the informal seed sector, it does not recognize farmer-managed seed systems explicitly according to the TASAI country report for Ghana (TASAI, 2024). Also, the Seed Plan refers to the immense importance of the informal seed sector to farmers (Vernooy et.al., 2023). One of the projects of the National Seed Plan has the objective to support the informal seed sector to improve its critical features to be more useful as a source of quality seeds to most farmers who depend on it and to systematically strengthen linkages with the formal sector. Proposed activities in this project were to strengthen informal seed sector performance, developing seed quality management guidelines to support quality seed production among farmers, capacity development for farmers groups and to popularize improved and farmer preferred varieties (Republic of Ghana, 2015). However, many of the projects in the National Seed Plan were in the end not funded and implemented (AGRA, 2024).

This supporting the informal and intermediary seed systems is not aligned to what is stated in the Plants and Fertilizer Act of 2010. Part II of this act (the actual seed law) criminalizes the production or sale of seeds without appropriate labels and packaging, thereby rendering the farmer-based seed production, exchange, and sale system illegal.

"Section 38: Seed production and marketing (1) Subject to subsection (2), a person who is registered to produce or market seeds of a particular class may only market or produce seeds of that class. (2) Subject to the Exports and Imports Act 1995, (Act 503) a person shall not produce, condition or market any seed unless (a) the seed is of a registered variety (b) it is of a standard prescribed by this Act or its regulations; (c) it is multiplied in a seed multiplication farm, conditioned in a seed conditioning plant or tested in a registered laboratory; and (d) it is packaged and labelled as prescribed by this Act or its Regulations."
(Republic of Ghana, 2010).

Also, the passing of the Plant Variety Protection Bill constrained farmer-based systems as it banned local farmers from multiplying and distributing improved seeds. The PVP Bill is also described as being hostile to smallholder farmers and farmer-based seed exchanges and sales systems as it does not allow farmers to sell and exchange seeds from so-called "improved varieties" (Vernooy et.al. 2023).

Although the seed policy describes supporting informal seed systems as an important opportunity, in the past decade, almost all efforts to improve the seed sector have been focusing on the formal seed sector (Vernooy et.al., 2023).

5 Seed sector challenges and ambitions

This chapter elaborates the challenges and ambitions for the three crop groups considered in this assessment. The challenges and ambitions highlighted in this chapter emerged out of the consultative process with key stakeholders including crop group-specific focus group discussions and a multistakeholder workshop. In Appendix 1 are indicated seed sector stakeholders who took part in these activities. The key steps which have been pursued in the synthesis process (of both challenges and ambitions) follows in full the standard methodology utilized by Thijssen et al., (2023). The key steps we followed are described hereunder.

Challenges
In this seed sector assessment, we collected primary and secondary data, conducting a desk study and holding stakeholder consultations at regional and at national levels. From the literature research and focus group discussions, we established a long list of challenges that negatively impact the performance of the seed sector. We used the integrated framework for seed sector and food system transformation (see Figure 2 in Chapter 2) to cluster these challenges into eight key seed sector functions: (i) production, (ii) value addition and distribution, (iii) service provision, (iv) utilization, (v) stakeholder organization, (vi) regulation, (vii) coordination, and (viii) funding. This list was discussed and confirmed during the multistakeholder workshop.

During the multistakeholder workshop, after reviewing challenges, a prioritization exercise was conducted to identify the most concerning challenges for the sector globally and for the crop groups selected. For this, a precise methodology was used to identify the major challenges. Five inter-professional groups were formed: research institutions, regulators, private sector, seed users and extension workers, and development partners. Each group first prioritized the challenges according to four crop groups: commercial vegetables, African fruiting vegetables, African leafy vegetables, and roots and tubers; then identified, for all crop groups combined, the major challenges for the sector as a whole. To do so, they were tasked to distribute 10 points per crop group and for the sector as a whole. To give the sector-wide score the same weight as the score for individual crop groups, it was multiplied by four. The scores were finally added to designate the most important challenges.

In total, eight priority challenge areas (challenges were categorized based on their interconnectedness) were identified, of which five were deemed high priority (highlighted in green in the tables) and three were deemed lower priority (highlighted in yellow in the table). This prioritization exercise reflects the perspective of the participants in the multistakeholder workshop and therefore does not necessarily reflect the vision of a particular stakeholder. Nevertheless, each interprofessional group represented at the multistakeholder workshop had equal weight in prioritizing the challenges that the sector faces.

Ambitions
Each of the eight seed sector performance functions has its own ambition described in de Boef & Thijssen (2023). Together these ambitions contribute to the vision of a well-functioning seed sector in Ghana, which is innovative, competitive, resilient, and inclusive. The challenges and ambitions are designated by a topic and organized according to seed sector functions (Tables 14 to 21). Appendix 5 lists all the solutions proposed by the stakeholder consulted to address the identified challenges. These solutions were used to frame the ambitions as presented in the following tables.

The ambition: seed production systems are technically feasible and economically viable and sustainable.

5.1 Production

Seed production systems are technically feasible and economically viable and sustainable, and they cover all crops.

Table 14. *Topics, challenges, and ambitions prioritized related to seed production*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Improved varieties of African leafy vegetables	ALV	No in country production of seed of improved high yielding varieties of African leafy vegetables.	19	Linkages between research, extension, (community) seed banks and farmers are strengthened to produce adapted varieties of African leafy vegetables.
Equipment for planting material and processing	RT	Insufficient access to equipment for planting material production, storage, and processing of planting material.	14	Enhance access to modern equipment for the production, storage, and processing of planting materials to ensure quality, reduce losses
Quality of seed in informal seed systems	CV, ALV, AFV	Produced and traded seed in informal seed systems are of poor quality.	12	Seed produced in the informal seed systems are of improved quality as seed producers benefit from technical guidance.
Volume of planting material production	RT	Limited availability, accessibility, affordability of planting material of land races.	9	Planting material production of land races is supported to meet the market demand.
Access to adapted varieties	CV, AFV, ALV	Limited availability and access to climate-resilient, pest and disease tolerant.	8	Quality seed of improved varieties (climate-resilient, pest and disease tolerant) are produced in sufficient quantities to meet the market demand.
Multiplication rate roots & tubers	RT	High cost associated and slow multiplication rate of roots and tuber crops.	3	Explore and promote cost-effective, efficient multiplication techniques for roots and tuber crops.
Land availability for seed production	AFV, ALV	Limited land availability in middle and southern belt for seed production.	2	Advocacy is conducted and modalities are developed to improve land availability for production of African vegetable seed.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.2 Value addition and distribution

The ambition: seed value chains and seed markets are profitable, efficient, fair, and transparent.

Table 15. *Topics, challenges, and ambitions prioritized related to value addition and distribution*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Cold storage infrastructure	RT, AFV, ALV	Poor storage conditions, including breaks, in the cold chain lead to seed preservation challenges.	15	Storage conditions for seed and planting material are appropriate to maintain seed quality over time.
Timely availability of seed	RT, ALV, AFV	Poor timely availability of quality seed or planting material in farming communities.	8	Seed of African leafy vegetables are available on time in farming communities.
Market for African leafy vegetable seed	ALV	African leafy vegetables are not part of PFJ 2.0 limiting the dissemination of quality seed of improved varieties	3	Increased interest from the government on African leafy vegetables opens market for African leafy vegetable seed.
Politicization of input distribution by the government	CV	Institutional market, including the PFJ programme, lead to unfair practices disrupting the national seed market and the activities of the private sector.	1	A market-driven, dynamic, and functioning seed sector operates with minimal interventions from the government.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.3 Service provision

The ambition: High quality, inclusive and differentiated services are provided to seed producers and stakeholders in seed value chains.

Table 16. *Topics, challenges, and ambitions prioritized related to service provision*

Topic	Crop group	Challenges	Prioritization score	Related ambition
Gene bank infrastructure	RT, CV	Inadequate storage facilities (cold rooms, space) to maintain the national seed gene bank	67	The national seed gene bank benefits from adequate infrastructure to ensure conservation, management, and utilization of plant genetic resources
Resources for national breeding programmes	CV, AFV, ALV	Inadequate access to resources and investments in national breeding programmes and research institutions at national and regional levels for the development of adapted varieties.	11	Research institutions are provided with sufficient resources to conduct national breeding programmes leading to the development, release, and production of adapted varieties.
Trials of new varieties	AFV, ALV	Adaptation trials are not covering the different Ghanaian climates and geographies	9	Variety trials number are increased and cover all climates and geographies of Ghana.
Adaptability of commercialized varieties	CV	Poor adaptability of released and commercialized varieties.	4	Varieties released thanks to agro-economic adaptation trials are adapted to the agroclimatic conditions of Ghana.
Mobilization of genetic resources	RT, CV	Difficult mobilization of genetic resources for the varietal development and quality seed or planting material production	4	Access from genetic resources from the gene bank and access to land races materials is facilitated allowing breeders and private sector to develop new varieties and produce quality seed or planting material.
Extension services to seed producers	CV	Support from public extension services to seed producers is limited.	2	Human and technical capacities of public extension services are strengthened to meet seed producers needs to produce quality seed.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.4 Utilization

The ambition: farmers' use of quality seed of improved and preferred varieties is increased.

Table 17. *Topics, challenges, and ambitions prioritized related to seed utilization*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Awareness on improved varieties	RT	Farmers unaware of potential of quality seed/planting material and improved varieties (climate smart, tolerant too biotic stresses).	38	Farmers understand the benefits of utilizing quality seed/planting material of improved varieties and adopt them.
Adoption of improved varieties	CV, AFV	Low number of variety trials and demonstration conducted limit the adoption of new varieties.	33	Agro-economic trials and demonstration of new varieties released on the market are organized promoting the use of new varieties.
Awareness on importance of African vegetable for improved diets	AFV, ALV	Limited awareness-raising initiatives on the importance of the consumption of African vegetables restrain the prospects of profitability and so the willingness of farmers to produce these crops.	17	Awareness raising campaign are instrumental in promoting the production and consumption of African vegetables.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.5 Stakeholder organization

The ambition: stakeholders are organized, covering production, marketing, seed markets, seed regulation, seed quality assurance, services, and promotion of use.

Table 18. *Topics, challenges, and ambitions prioritized related to stakeholder organization*

Topic	Crop group	Challenge	Prioritization score	Related ambition
		No challenge identified		

5.6 Regulation

The ambition: policies, rules and systems govern production systems, seed markets, service provision, coordination, and use.

Table 19. *Topics, challenges, and ambitions prioritized related to regulation*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Taxation on imported seed	CV, AFV	High import duties affect pricing of certified imported seeds	39	Import duties for seed are reduced.
Import process efficiency	CV	Cumbersome import processes (high costs and delays)	13	Optimized import processes to reduce costs and delays.
Alternative quality assurance system	CV, AFV, RT	No certification of in-country production of commercial and African fruity vegetables due to limited capacities of PPRSD	12	Investigate alternative quality assurance system for commercial vegetable seed production
Traceability	CV	Repackaging and poor packaging practices from agro-dealers cannot guarantee seed traceability.	4	Establish and enforce robust packaging and labelling standards for agro-dealers to ensure seed traceability.
Breeders' rights protection	RT	Plant breeders' right are not yet implemented.	2	Speed up implementation of the PVP Act for plant breeders' rights
Unregulated seed dissemination	AFV	Unregulated seed dissemination channels leading to seed adulteration.	2	Develop and enforce a regulated seed dissemination system to ensure quality control.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.7 Coordination

The ambition: appropriate coordination mechanisms are in place, which results in alignment and accountability among different seed stakeholders.

Table 20. *Topics, challenges, and ambitions prioritized related to coordination*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Coordination for variety development	RT	Weak coordination between research- agricultural research stations- seed business- farmers	5	Coordination between seed sector stakeholders is improved facilitating the adoption of improved varieties.
Data on the seed sector	AFV	Poor availability of market information to estimate seed demand	3	A system for information dissemination about the seed market is operational.

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

5.8 Funding

The ambition: the seed sector has the capacity to generate revenues and make strategic reinvestments.

Table 21. *Topics, challenges, and ambitions prioritized related to funding*

Topic	Crop group	Challenge	Prioritization score	Related ambition
Investments and funding in national breeding programmes	RT	Inadequate funding to support research institutions and district MoFA stations in breeding programmes and EGS production.	20	Research stations at national and district levels are provided with sufficient funding for variety development and EGS production

CV: commercial vegetables, AFV: African fruity vegetables, ALV: African leafy vegetables, RT: Roots and tubers

6 Way forward

6.1 Where are we now?

The SSA, focusing on three distinct crop groups, provides in this report an overview of the seed sector in Ghana. Through mixed methods for data collection, including literature research and consultation with key seed sector stakeholders, we were able to describe the current state of the sector, answering the question *Where are we now?* The SSA also highlights the range of challenges constraining the development of the sector. These challenges may be relevant for the sector as a whole but also may be specific to a given crop group. Similarly, they may be impacting the sector as a whole or also concern specific stakeholders or seed systems. Challenges may reflect the specific perspective of one actor in the seed sector and therefore not match with the understanding of others, but all were considered. But these challenges help identify opportunities for improving the seed sector performance and frame initiatives to support change.

6.2 Where do we want to go?

To transform the seed sector into a well-functioning, innovative, competitive, resilient, and inclusive, we translated these challenges into ambitions. This helped us answer the question *Where do we want to go?* Defining ambitions was an arduous task considering the limited support the crop groups selected received until now, the prominence of informal and intermediary seed systems and the stakeholders we were able to convene and consult, mostly involved in the formal seed system. But through consultations, seed sector stakeholders were able to propose their vision and some solutions to address the challenges the seed sector faces, helping us framing these ambitions.

6.3 How do we get there?

A prioritization exercise, conducted during a multistakeholder workshop, during which participants were grouped in inter-professional teams to maintain a fair representation of the sector, enabled the identification of the most pressing challenges in the seed sector. This highlighted eight areas for partnership and collaboration in seed sector development, listed below:

1. Strengthen the gene bank infrastructure.
2. Enhance the enabling environment for seed business and trade.
3. Promote the use of quality seed of improved and adapted varieties of vegetables and root and tuber crops.
4. Strengthen investments and funding for capacitating root and tuber crops breeding and seed systems.
5. Promote the production and consumption of African leafy vegetables.
6. Support the local production of root and tuber crops in Ghana.
7. Support the development of a decentralized quality assurance system for root and tuber crops.
8. Strengthen the production of quality seed in informal and intermediary seed systems.

To eventually address the question *How do we get there?*, strategies for the eight areas for partnership and collaboration are developed in a separate document, informing on potentially relevant investment opportunities, their related modalities, interventions and partners.

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Appendix 1 Stakeholders consulted

Table 22. *Names of experts interviewed and participants in multistakeholder workshop*

Name	Organisation
Interviews	
Kwasi Wih	Plant Protection and Regulatory Services Directorate (PPRSD-MOFA)
Charles Appiah-Nti	Plant Protection and Regulatory Services Directorate (PPRSD-MOFA)
Dr. Courage Besah-Adanu	Ghana Industrial Property Office –Registrar General's Department (GHIPO-RGD)
Paa Kow Acquaye	Ghana Industrial Property Office –Registrar General's Department (GHIPO-RGD)
Samuel Anum	Ghana Industrial Property Office –Registrar General's Department (GHIPO-RGD)
Daniel Nyadanu	Coordinator of the NUS Network Ghana and Technical Advisor of the community seedbank
Yunus Abdulai	Country Lead Feed the Future Ghana Policy LINK Activity
Annie Dela Akanko	Programs lead Feed the Future Ghana Policy LINK Activity
George Prah	Directorate of Crop Services -Ministry of Food and Agriculture (DCS-MOFA)
Deodatus Temu	East West Seed Ghana
Coen Everts	East West Seed
Rien van Bruchem	Bakker Brothers
Multi stakeholder workshop	
Kees Veldhuizen	Iribov Ghana
Eloy Boon	Iribov Ghana
Felix Kwaku Ampong	Agriseed
Celestina Danso Arhin	Holland Greentech
Busia Dawun	IWAD Ghana LTD (African Tiger)
Tom Durang	IWAD Ghana LTD (African Tiger)
Barnabas Apom	Horticultural Business Platform (HBP)
Martin Aboagye	participant
Felix Mawuli Kamassah	Vegetable Producers & Exporters Association Of Ghana (Vepeag)
Roger Akanbisik	Peasant Farmers Association of Ghana (PFAG)
Emmanualla Rejoice Lucas	Farmer
John Ahiakpor	Farmer
Jemima Djah	East West Seed Knowledge Transfer
Samuel Yao Adzivor	TASAI representative Ghana
Augusta Nyamady Clottey	Preciso Consult (former CEO NASTAG)
Linda Quartey	Plant Protection and Regulatory Services Directorate (PPRSD), MoFA
Akosua Agyekumwaa Adofo	Plant Protection and Regulatory Services Directorate (PPRSD), MoFA
Akosua Agyekumwaa Adofo	Plant Protection and Regulatory Services Directorate (PPRSD), MoFA
K Baah Asiedu	Plant Protection and Regulatory Services Directorate MoFA
David Nii Kwansa Annorbah-Sarpei	DCS MoFA
Deborah Adjei-Baiden	DCS MoFA
Victor Nketiah	CSIR – Plant Genetic Resources Research Institute (PGRRI)

Rashied Tetteh	CSIR – Plant Genetic Resources Research Institute (PGRRI)
Matilda Ntowaa Bissah	CSIR – Plant Genetic Resources Research Institute (PGRRI)
Wilfred Elegba	Biotechnology and Nuclear Agriculture Research Institute (BNARI)
Naalamle Amissah	University of Ghana, Department of Crop Science
Hilda Abambire	IDH
Seidu Abu	Policy LINK
Inge Tenniglo	Embassy of the Netherlands
Marian Armoo	Embassy of the Netherlands
Dede Leander Melomey	Facilitator
Michael Dogor	Facilitator
Johann Bonnand	Wageningen University and Research, WCDI, facilitator
Mirjam Schaap	Wageningen University and Research, WCDI, facilitator

Appendix 2 Review of cereals and leguminous seed systems

Certified seed production

The GoG supervises the production and the certification of few cereals and leguminous crops, including maize, rice, sorghum, groundnut, cowpea, and soybean (see Table 23). In 2023, maize, rice and soybean represented the largest bulk of seed certified in Ghana accounting for over 95% of all certified seed in Ghana. Through the PFJ programme, subsidizing seed, and therefore creating large institutional markets, the number of registered seed growers and the certified seed production volumes have increased significantly since 2016, when only 2,689 metric tons of seed have been certified (TASAI, 2024; USDA & GAIN, 2020). To answer the market demand, particularly pulled in the last few years by the government demand for certified seed in the PFJ programme, Ghana needs to import seed of field crops (USDA & GAIN, 2020).

Table 23. *Overview of tonnage of seed certified in 2023*

Crop	Volume of seed certified in 2023 (in metric tons)
Rice	15,816.55
Maize	9,083.06
Soybean	4,071.10
Cowpea	599.37
Groundnut	421.74
Sorghum	233.20
Total	**30,225.01**

Source: GSID, 2024

Cereals and pulses seed value chain operators

Genetic resource management is ensured by the CSIR-PGRRI while the CSIR-SARI and the CSIR-CRI are the two main public institutes involved in plant breeding and variety development supported by some Ghanaian universities and other international organizations. The adequacy of national agricultural research institutes breeding programmes was rated low penalized by a limited number of breeders, insufficient funding, and equipment. The crop varietal choice to farmers for maize, rice, soybean, and sorghum is considered poor (TASAI, 2024). The production of Early Generation Seed (EGS) was evaluated as good, despite the EGS production falling short of demand as the capacities of research institutions are insufficient (TASAI, 2024; AGRA, 2022b). There is no operational EGS forecasting system (AGRA, 2022b).

Certified seed is produced by local seed businesses, registered seed growers and international seed companies established in Ghana. The latter tend to specialize particularly on the production of maize seed of hybrid varieties (TASAI, 2024). According to Nikoi (2022) the five largest seed companies, including SEEDPAG, producing seed in Ghana accounted for about 40% of the market share for field crops, depicting a concentrated seed market. However, TASAI reported the opposite with an extremely low concentration reported in its 2022 country report (Mabaya, 2022). The share of seed sales through institutional markets is high, sometimes up to 60%, in the total seed sales of Ghanaian seed companies focusing on field crops. Many of the Ghanaian seed companies face challenges in seed production and processing affecting seed quality. Seed producers and companies register in professional associations, 85% in SEEDPAG but only 19% in NASTAG (Nikoi, 2022).

Table 24 provides a list of seed value chain operators for cereal and leguminous crops.

Table 24. *Seed value chain operators for cereal and leguminous crops*

Seed chain	Operators
Genetic resource management	CSIR-PGRRI
Plant breeding and variety development	CSIR-CRI, SARI, WACCI, UCC and CGIAR centres, other Ghanaian universities, private seed companies
Breeder seed production	CSIR-CRI, SARI, WACCI, UCC and CGIAR centres, other Ghanaian universities, private seed companies
Foundation seed production	GLDB, SEEDPAG, private seed companies
Certified/truthfully labelled seed production	Registered seed producers, private seed companies, SEEDPAG
Seed marketing and dissemination	MoFA, CSIR-CRI, CSIR-SARI, private seed companies, agro-dealers, wholesalers
Seed use	Farmers

Source: USDA & GAIN, 2020; TASAI, 2024.

Figure 7, developed by Poku et al. (2018b) provides a clear mapping of the commercial seed supply in Ghana compiling both seed value chain operators and seed service providers.

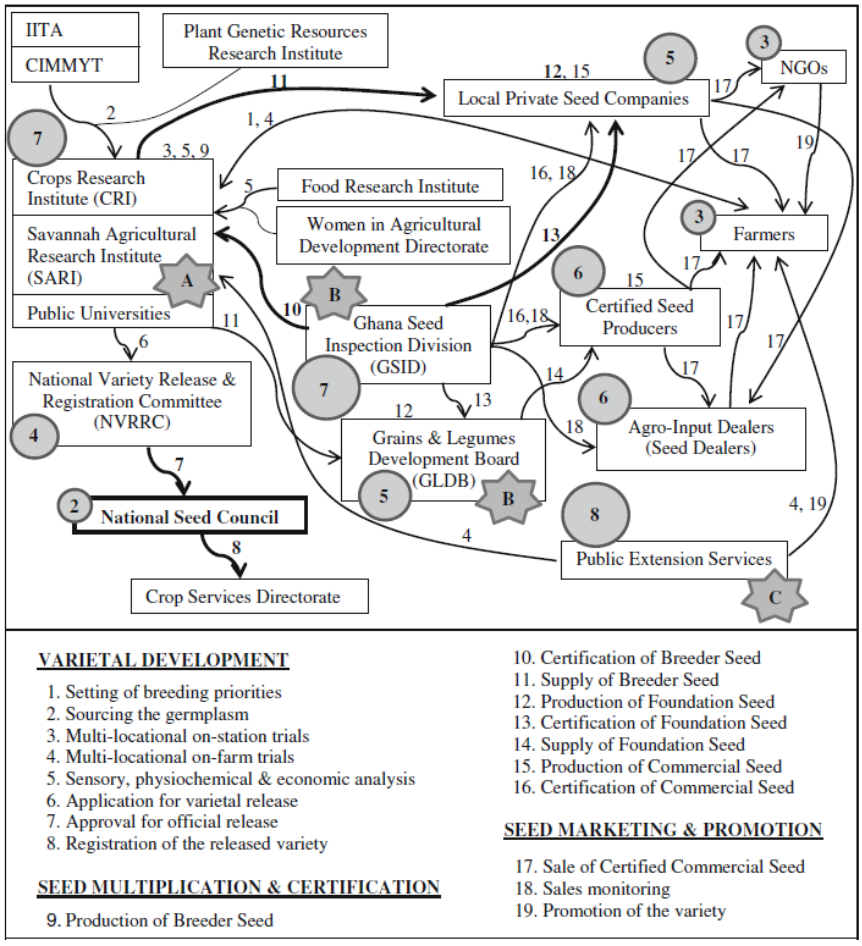

Figure 7. *Aggregated process NetMap of commercial maize seed supply in Ghana (Poku et al., 2018)*

Seed service providers

Although TASAI considers seed service provision in Ghana to be good (TASAI, 2024), seed sector providers face systemic challenges. Weak institutional links and unclear mandates within the public sector, along with insufficient collaboration among stakeholders (silo working behaviour between NSC, PPRSD and DCS) and information sharing, hinder effective operations. Additionally, seed sector stakeholders, including service providers, often lack the necessary human, material, and financial resources to fulfil their tasks and scale up their activities to meet sector needs. This affects both public service organizations and private seed entities (Osei et al., 2020). Development initiatives, sponsored by a range of partners including USAID or AGRA,

support these stakeholders and the overall seed sector through capacity building, technical and logistical support, sensitization campaigns on the seed enabling environment, pilots for third-party certification, strengthening stakeholder organization, including NATSAG, or coordinating sector dialogues (Cooke, 2019; USAID, 2018).

The formal seed quality assurance system focuses on key field crops (Table 4) and is ensured by the GSID, performing DUS tests, field inspection and seed certification. But GSID capacities are restricted by inadequate funding, a limited number of seed inspectors and under-resourced laboratories (AGRA, 2022b, Mabaya, 2022). Besides, inadequate access to packaging material at the GSID and the absence of a seed source tracing system leads to the presence of counterfeit seed on the market (AGRA, 2022b). These challenges prevent GSID from certifying larger amount of seed and increasing its crop portfolio. No other quality assurance system exists in Ghana.

Seed distribution is ensured directly by seed companies but also by agro-dealers and supported by programmes and DCS. Most seed companies provide services to clients, including extension and variety demonstration (Nikoi, 2022). Insufficient information access, inappropriate transport and storage infrastructure and conditions were reported as causing issues in distribution altering seed quality (Nikoi, 2022; AGRA, 2022b).

According to TASAI (2024), the use of quality commercial seed by farmers was considered excellent supported by an adequate network of registered agro-dealers by PPRSD, while Nikoi (2022) and AGRA (2022b) reported a low awareness among farmers of newly released varieties due to limited human and technical capacities of public extension services, inadequate investments from the private sector in promotion and marketing activities and a limited network of agro-dealers.

Respectively more than 80% and 60% of seed companies received training on seed production, including hybrid varieties, and on seed conditioning and marketing (Nikoi, 2022). Seed dealers also received technical support from DAES (AGRA, 2022b).

Table 25 presents a list of service providers in the seed sector.

Table 25. *Seed service providers in the Ghanaian seed sector*

Seed service	Service providers
Conservation of germplasm	PGRRI-CSIR
DUS testing	GSID-PPRSD
Variety release and registration	NVRRC, NSC
Plant variety protection	Ghana Industrial Property Office (GIPO)
Seed quality assurance in production	GSID-PPRSD
Seed quality assurance in marketing	GSID-PPRSD
Seed quality assurance in seed import	Plant Quarantine Division
Seed extension and promotion	Directorate of Agricultural Extension Services (DAES), seed companies
Seed distribution	Directorate of Crop Services (DCS), agricultural development programmes

Appendix 3 Compiled recommendations from strategic documents for seed sector development in Ghana

Recommendations from key strategic documents have been compiled in the following tables (Tables 26 to 33).

Table 26. *Recommendations on production from seed sector strategic documents*

Topics	Recommendations	Strategic document
Capacities of seed growers for quality seed production	Strengthen the seed quality control capacities within seed companies and growers.	AGRA Seed sector strategy and investment plan
	MoFA should collaborate with NASTAG and relevant institutions to continuously train seed companies/producers in the use of the National Seed Demand Forecasting Tool, Quality Assurance and Business Enterprise Management to enhance seed business.	SEEDLINK
	NASTAG should lead hands-on/on-the-job capacity building in Hybrid Seed production and processing.	SEEDLINK
Technical capacities strengthening for EGS and hybrid varieties production	Sustain efforts to build seed companies' capacity to multiply basic seed for maize hybrid varieties.	AGRA Seed sector strategy and investment plan
	Increase support to research institutes to produce breeder and foundation seeds of improved varieties of particularly millet, groundnut, sesame and sorghum to engender a positive impact on crop yields in these commodities and overall agricultural productivity.	SEEDLINK
	Strengthen capacity through training for EGS production.	seedSAT
	Invest in irrigation infrastructure at some research institutions and universities to enable these institutions keep up with the production of Climate Smart Resilient EGS, anticipating advancements in climate-smart agriculture	SEEDLINK
EGS forecasting system	Develop an EGS planning and demand forecasting system.	seedSAT
	Seed companies use the Seed Demand Forecasting Tool to facilitate the estimation of national seed requirements for both farmers and market-preferred crop varieties to improve seed availability.	SEEDLINK
Design and use of digital tools	Design digital tools for increased seed volume production and efficiency.	seedSAT
Promotion of national seed production	Promote hybrid seed production locally of maize staples and promote the production of fruit and vegetable seeds locally to reduce reliance on imported seed.	Policy LINK

Table 27. *Recommendations on value addition and distribution from seed sector strategic documents*

Topics	Recommendations	Strategic document
Dependence of seed growers on subsidy schemes	Develop a reliable and efficient marketing strategy to reduce seed growers' dependence on government seed support programs.	AGRA Seed sector strategy and investment plan
Capacities of agro-dealers	Enhance agro-dealer training in a range of topics, including business management, product knowledge and agronomy and handling of carryover stocks.	AGRA Seed sector strategy and investment plan

	Facilitate capacity building in business management and scaling for agro-dealers.	seedSAT
Tackling of counterfeit seed	Sustain government efforts to address the challenge of counterfeit/ fake seed and monitor their effectiveness.	seedSAT
	Reduce prominence of low quality and counterfeit seed on market.	seedSAT
Topics	Recommendations	Strategic document
Volume of seed packages	Make seed available in small packages.	SPI - TASAI
Farmers awareness and participation	Support and or strengthen functional farmer outreach communication channels.	seedSAT
Last-mile distribution	Seed companies are encouraged to make quality certified seeds accessible and available to the last mile farmer	SEEDLINK

Table 28. *Recommendations on service provision from seed sector strategic documents*

Topics	Recommendations	Strategic document
Variety conservation	Invest in resourcing and establishing procedures for variety maintenance.	seedSAT
Biotechnology in crop improvement	Increase the use of biotechnology as breeding tools to solve emerging crop productivity issues as well as improve other crops to withstand biotic and abiotic stresses that Ghana's agriculture faces	SEEDLINK
Breeding programs	Design and fund breeding program based on clear definitions of product profiles and target crop growing environments.	seedSAT
	Develop mechanisms for consultation of breeding programs with commercial seed producers to create partnership.	seedSAT
Simplified processes for field visits	Streamline approval process of the NVRRC.	PolicyLINK
Capacity of state agencies for seed inspection and certification	Expand the crop scope/portfolio for seed quality assurance.	seedSAT
	Strengthen capacity of state agencies to inspect and certify seeds.	PolicyLINK
	Strengthen PPRSD's capacity in national seed quality control, seed certification, seed analysis, and seed testing	SSPI - TASAI
Laboratories for quality assurance	Conduct scoping studies for functional quality assurance laboratories.	seedSAT
	Establish ISTA-accredited seed laboratories.	seedSAT
	Provide financial support to accelerate the accreditation of the National Seed Testing Laboratory at Pokuase, recognizing the pivotal role it plays in enhancing quality assurance in the seed industry	SEEDLINK
Seed processing and storage facilities	Refurbish of the government seed processing and storage facilities in six regional centres.	AGRA Seed sector strategy and investment plan
	Refurbish the government seed processing facilities.	seedSAT
	Invest and/or partner with seed producers in the establishment Of smaller standard cold storage infrastructure for seed companies at vantage points	SEEDLINK
Access to adequate financial services	Put special facilities in place for the seed entrepreneurs to facilitate access to finance.	seedSAT
	Link private distributors to information and/or affordable credit facilities.	seedSAT
Extension on seed and GAP (Good Agricultural Practices)	Support the provision of regular training to public and private extension officers on seed matters.	seedSAT
	Establish an online resource database of relevant extension and agricultural training material.	seedSAT

	MoFA should collaborate with NASTAG and relevant institutions to build the capacities of farmers, input dealers and extension agents on GAP and ways to reduce post-harvest losses, envisioning increased productivity, sustainability, and adherence to best practices in agriculture.	SEEDLINK

Table 29. *Recommendations on seed utilization from seed sector strategic documents*

Topics	Recommendations	Strategic document
Variety promotion and adoption	Promote the uptake of newly released and well-performing varieties among farmers.	AGRA Seed sector strategy and investment plan
	Establish processes and procedures to assure better adoption of released varieties.	seedSAT
	Increase levels of awareness on newly released varieties.	SPI - TASAI
	Scale up inclusive public and private sector extension and input models that train and demonstrate new improved varieties.	seedSAT
	PPRSD should collaborate with seed companies/producers to improve the quality of locally produced seeds to increase demand and adoption	SEEDLINK

Table 30. *Recommendations on stakeholder organization from seed sector strategic documents*

Topics	Recommendations	Strategic document
Sustaining NASTAG mandate and capacities	Sustain the NASTAG as an effective platform for private sector representation and industry advocacy.	AGRA Seed sector strategy and investment plan

Table 31. *Recommendations on regulation from seed sector strategic documents*

Topics	Recommendations	Strategic document
Third-party inspection and certification	Develop guidelines for accreditation by third-party certification.	AGRA Seed sector strategy and investment plan
	Implement and Support Private (Third Party) Seed Inspection.	seedSAT
Policy revision and harmonization	Revise the National Seed Policy (May 2013) and update the seed policy plan to improve implementation of the policy.	Policy LINK
	Revise Plant and Fertilizer Act	Policy LINK
	Establish a stronger enabling environment for private sector participants.	seedSAT
Seed import	Improve regulations and inspections governing importation of seed.	Policy LINK
Seed tracking and tracing system	Expand pilot on seed traceability and establish the system countrywide.	Policy LINK
	Upscale the Seed Traceability pilot project to encompass a broader spectrum Of seed companies, to evaluate its effectiveness in seed quality control and its adoption at the National level.	SEEDLINK
Capacity for regulatory framework enforcement	Support in-country capacity to implement laws and regulations.	seedSAT
DUS and NPT protocols	Update DUS and NPT evaluation protocols.	seedSAT
Awareness raising on variety release	Increase sensitization of stakeholders on the PVP Act, 2020 (Act 1050) and its Legal Instrument (L.I 2463), recognizing that an elevated understanding would foster a culture of intellectual property protection and promote the	SEEDLINK

and plant variety protection	commercialization of protected varieties to stimulate innovation for a more robust and sustainable seed industry.	
	Raise awareness in seed companies on the variety licensing system.	AGRA Seed sector strategy and investment plan

Table 32. *Recommendations on coordination from seed sector strategic documents*

Topics	Recommendations	Strategic document
National Seed Council resources	Support the National Seed Council with human and financial resources in carrying out its mandate for overall seed sector planning and coordination.	AGRA Seed sector strategy and investment plan
Seed sector dialogue and coordination	Conduct sector dialogue among seed industry players.	seedSAT
	Establish a functional seed planning and coordination team.	seedSAT
Feedback mechanisms in the seed sector	Develop platforms with feedback mechanisms so that farmers can readily give feedback on seed quality, variety development, seed access, and more.	seedSAT
	Strengthen the monitoring mechanisms along the seed production value chain to ensure quality and safeguard against adulteration.	SEEDLINK
Information sharing	Provide clear information for stakeholder decision-making.	seedSAT
	Publish seed data in the national Facts and Figures Bulletin.	SEEDLINK
PFJ 2.0	Sensitize key seed value chain actors on the modalities of PFJ 2.0 for a more effective and sustainable implementation of the policy.	SEEDLINK
	Consider NASTAG as an aggregator under PFJ 2.0 to maximize the use of locally produced certified seeds.	SEEDLINK
	Outline sustainability strategies for PFJ 2.0, to ensure enduring success and impact.	SEEDLINK
	Develop a comprehensive plan/strategy to support youth, women and PWDs to access seeds and other farm inputs, envisioning increased engagement and contributions from these groups to the agricultural sector.	SEEDLINK
Vulnerable groups	Special considerations should be given to PWDs and other vulnerable groups such as youth and women to have equitable access to quality certified seeds to build their resilience	SEEDLINK

Table 33. *Recommendations on funding from seed sector strategic documents*

Topics	Recommendations	Strategic document
Investments for research programs for variety conservation and variety release	Develop a business case and prioritize investments to ensure research programs are supported with suitable infrastructure to carry out their research activities.	seedSAT
	Provide adequate budget to meet goals for upscaling variety release and maintenance of germplasm with commercialization.	seedSAT
Funding for EGS production	Fund EGS production, quality control and infrastructure support.	seedSAT
	Increase funding to CRO and SARI for the production and supply of quality EGS.	SPI - TASAI

Appendix 4 Initiatives and investments in seed sector Ghana

Table 34. *Initiatives and investments in the seed sector in Ghana and neighbouring countries*

project	Organization	Duration	Countries	Description
Feed the Future Policy LINK Activity	USAID	2021-2026	Ghana	The Feed the Future (FTF) Ghana Policy LINK Activity is a five-year project supporting the Government of Ghana (GoG) and policy stakeholders as they implement evidence-based, inclusive development processes. The Policy LINK Ghana activity therefore seeks to support inclusive, multi-stakeholder, evidence-backed, and more sustainable policy outcomes. To foster a more inclusive policy and decision-making system in the seed sector, the Feed the Future Ghana policy LINK Activity has sponsored stakeholders from sub-national level to participate in National Seed Forums held every year in Ghana. Also, a Policy Landscape Assessment / policy brief for seed policy system has been finalized (Policy LINK, n.d.) https://policylinkglobal.org/ghana
Partnership for an Inclusive Agricultural Transformation in Africa (PIATA) program	Partnership for an Inclusive Agricultural Transformation in Africa (PIATA) USAID-AGRA	ongoing	Ghana	Multiple activities are planned under Phase II, in two broad areas: • Building systems to catalyse adoption of quality inputs: (i) Scale-up EGS and CS Supply, (ii) Seed Quality Assurance (scale-up scratch code, private seed certification), (iii) Seed Extension, Farmer Awareness, Last-mile input supply, and (iv) Variety Development and Release for Resilience (specific crop profiles). • Improve the enabling environment for private sector participation: (i) Strengthening National Seed Planning and Coordination, Data Management, Digitization, (ii) Strengthened dialogue among industry players, (iii) Operationalizing the PVP Law (iv) establishing agricultural insurance fund (AGRA,2022).
Seed and Inputs Fairs	NASTAG, with funding from PIATA,	2024	Ghana	Seed and input fairs to catalysing Agricultural Growth and Innovation Across Northern Ghana. Throughout the fair, 21 top agricultural companies took the opportunity to exhibit a wide array of products, including quality-certified seeds and cutting-edge agrochemicals. These exhibitions interactive platforms for knowledge exchange and technological demonstrations, directly connecting farmers with innovations that could transform their agricultural practices. The fairs are organized in collaboration with Farm Radio International, the Ministry of Food and Agriculture and the World Food Programme.
East-West Seeds Knowledge Transfer Project	Ministry of Foreign Affairs of the Netherlands	2023-2025	Ghana	Equip farmers in the Bono, Bono East and Ahafo regions with knowledge and techniques needed to effectively grow and market vegetables, utilizing high-quality seeds and sustainable farming methods. Through showcasing increased crop yields and presenting compelling economic evidence of the benefits of superior seeds and farming practices, the initiative strives to encourage small-scale farmers to view vegetable cultivation as a profitable endeavour. As a result, it will stimulate the development of a competitive market for agricultural inputs.

Planting for Food and Jobs Phase II	Ministry of Food and Agriculture Ghana	2023-2027	Ghana	The second phase of the Planting for Food and Jobs Phase II (PFJ 2.0) programme phase aims to transition from a direct input subsidy to a direct credit system linked to a structured market arrangement. The five-year period of implementing PFJ 2.0 is expected to increase the availability and access to improved inputs (including certified seed), mechanization, extension services, and output markets. Under PFJ 2.0, eleven commodities have been prioritized for promotion and development of the agricultural sector. The commodities are Grains (maize, rice, soybean, sorghum); Vegetables (tomato, pepper, onion); Roots and tubers (cassava, yam) and plantain; Poultry (broilers). The PFJ 2.0 engages input suppliers to provide the requisite agricultural inputs including certified seeds, high-quality fertilizers, vaccines, day-old chicks, feed, agro-chemicals etc. to registered farmers as input credit to be paid back at the end of production.
Integrated Seed Sector Development in the Sahel (ISSD Sahel)	IFDC funded by the Embassy of the Kingdom of the Netherlands	2020-2024	Ghana	The ISSD Sahel project focuses on the development of new commercial seed producers, professionalization of seed traders, mobilization of Dutch and international private seed sector expertise for the seed sector in Mali and Niger, and large-scale promotion of quality seeds to grow the market toward a stable and self-sufficient commercial agriculture sector. https://ifdc.org/projects/integrated-seed-sector-development-in-the-sahel-project-issd-sahel/
Strengthening Local and Indigenous Food Systems in the Upper East Region of Ghana	TRAX Ghana with The Beela project	2022-?	Ghana	Trax Ghana in partnership with Beela is implementing a project dubbed "Strengthening Local and Indigenous Food Systems in the Upper East Region of Ghana." The project seeks to strengthen local seed systems and promote farmers' rights using the training of trainer model called "Farmer Leads" and focusing on four areas of action: a seed security assessment and seed fair; community seed banking for conservation, production and exchange of local seeds; agroecology for food, nutrition and income security; and supporting farmer-led policy advocacy on seed laws. https://traxghana.wordpress.com/2024/02/14/trax-ghana-beela-partnership-project/ https://beela.org/about-beela
Strengthening the Seed and Agro Input Systems	NASTAG with grant from ACDI/VOCA	2023-2025	Ghana	The project "Strengthening the Seed and Agro Input Systems to enhance productivity and livelihood of smallholder farmers in Ghana" seeks to strengthen agricultural systems that will result in greater productivity, efficiency, and investment in goods and services that drive agriculture-led economic growth ultimately increasing household incomes for a better and more fulfilling life for smallholder farmers in Northern Ghana.
SeedSAT	AGRA with sponsorship of BMGF	2022 - ?	Ghana	The SeedSAT programme analyses key indicators of a country's seed system, evaluating them on eight thematic areas, and then providing crucial recommendations on how to boost the delivery and usage of better seed varieties. The tool often combines data from existing resources and assessments with subject matter expertise to help uncover the main cause of a country's seed system's shortcomings. https://foodforafrika.com/2022/06/17/agra-launches-project-to-boost-ghanas-seed-quality/

Green Market Systems Development for Decent Work (GMSD)	ILO	2022 - ?	Ghana	The project has supported the production and commercialization of two (2) indigenous OPV tomato varieties (CRI – Kopia and CRI – Kwabena Kwabena) in Ghana, which are the first locally produced certified tomato seeds, using the systems approach. The ILO's Market Systems Development (MSD) for Decent Work which started pilot activities in the tomato sector Ghana in 2023 aims to address key systemic challenges that limit the adoption and uptake of greener, more resilient, and more productive farming practices in the vegetables sector, especially the tomato sub-sector. https://www.ilo.org/resource/news/ilo-supports-production-and-commercialization-indigenous-tomato-seeds-ghana
Greater Rural Opportunities for Women 2 (GROW2)	MEDA funded by Government of Canada	2021 - 2026		The project implemented by the Mennonite Economic Development Associates is building on the momentum from the GROW project to broaden women's access to land, labour-saving, climate-smart technologies, affordable inputs, and sustainable business development services. The project promotes good agricultural and nutritional practices as well as community engagement for women's economic empowerment. One of the activities is to train and support selected women in women's groups to produce quality seed for other group members. https://www.meda.org/news/meda-ghana-launches-greater-rural-opportunities-for-women-2-grow2-project/
SafeVeg	World Vegetable Center, funded by the EU and the Government of the Netherlands	2020 - 2025	Mali Burkina Faso Benin	The SAFEVEG project will develop, test and scale technologies that help farmers increase their productivity while ensuring that products are safe from contamination. The project will assess innovative interventions with a focus on food safety and quality to make vegetables more accessible, affordable and acceptable to consumers. Small-scale farmers will adopt improved vegetable seed, and adopt sustainable, climate-smart practices. Also, vegetable producers connected to vegetable business networks will increase their productivity and incomes. SAFEVEG aims to create an axis of innovation in the vegetable sector (Benin / Burkina Faso / Mali) which will allow its expansion to other countries ECOWAS. https://avrdc.org/safeveg-local-production-of-safe-vegetables-for-west-african-consumers/
BASICS-II project	IITA funded by BMGF		Nigeria Tanzania	The project aims to provide farmers with access to affordable, quality-assured seed of cassava varieties in demand by local food and processor markets by strengthening a commercially viable seed value chain operating across breeder, basic, and commercial/certified seed levels. https://www.iita.org/news-item/basics-ii-project-sets-the-stage-for-public-private-stakeholders-to-promote-the-sustainable-cassava-seed-delivery-system-in-tanzania/
Seeds for Resilience (SFR)	Crop Trust funded by German Development Bank	2019-2024	Ghana, Nigeria	Collaborating with five national gene banks, the project aims to enhance agricultural resilience by conserving, sharing, and utilizing key crop collections, including climate-resilient varieties. https://report.croptrust.org/2023/our-work/sowing-the-seeds-of-resilience-across-africa/ http://pgrri.csir.org.gh/our_projects.php

Collaborative Seed Programme Nigeria Netherlands	Stichting Wageningen Research funded by the Embassy of the Kingdom of the Netherland		Nigeria	The Collaborative Seed Programme (CSP) brings together Nigerian and Dutch seed sector stakeholders with the aim to enhance the performance of the Nigerian seed sector. It takes a systemic approach for sustainably addressing key challenges in the seed sector. CSP contributes to the vision of the National Seed Road Map (NSRM) of Nigeria being the seed sector to become more competitive, resilient, profitable, innovative and adaptive, sustainable, inclusive, resistant and transparent. To achieve and contribute to this vision, the NSRM outlines 22 Strategic Innovation Pathways (SIPs) with ambitions and steps. The CSP contributes to the implementation of eight selected SIPs. These selected SIPs shape what are referred to as CSP Topics. The following topics have been selected: (i) decentralization of seed quality assurance; (ii) extension on seed and cultivation practices; (iii) seed company marketing and promotion; (iv) institutional markets; (v) sector governance and coordination; (iv) alignment of donor interventions; (vii) plant variety protection; and (viii) variety release. https://csp-nigeria.org/
ACHI project	TU Delft with Holland Greentech Ghana (HTG) funded by Dutch Enterprise Agency (RVO)	2020-2024	Ghana	The project focuses on addressing the potential of Ghana's horticulture sector to create jobs, enhance food security, and improve food safety, while leveraging Dutch expertise. It aims to bridge the knowledge and skills gap between theoretical education and real-world climate-smart agricultural practices, which are essential for successful horticulture farming in Ghana. The project, initiated by TU Delft, Kwadaso Agricultural College (KAC), and Holland Greentech Ghana (HGT) as part of the ACHI program, works across five regional agricultural colleges. The main objectives are to stimulate economic development by promoting green growth and tackling youth unemployment through skills development, to promote climate-smart horticulture practices for food security, and to generate business opportunities for Dutch companies in Ghana's horticulture sector.

Appendix 5 Proposed solutions for seed sector challenges

Throughout our interactions with seed sector stakeholders, we harvested proposed solutions to answer challenges in the seed sector. These solutions only depict the perspectives of the seed sector stakeholders involved in our activities. These solutions were used as a source to define our recommendations for the prioritized challenges. These solutions are either global to the seed sector or crop group specific and clustered per seed sector function and per seed system.

Table 35. *Sector wide solutions proposed by seed sector stakeholders*

Proposed solutions	Informal seed system	Intermediary seed system (Ghanaian seed businesses)	Formal seed system (international seed companies)
Service provision			
Support the setting up of community seed banks for vegetables and roots & tubers	o	o	
Facilitate links between community seed banks and the national genetic conservation services	o		
Develop plant breeders' capacities	o	o	o
Fund breeding of new adapted varieties of vegetables for different agro-ecological zones and seasons (climate smart, resistant to biotic stresses)		o	
Liaise with government and donor agencies to co-fund gene-bank infrastructure	o	o	o
Support development of cost effective (mobile and district) cold storage to store seed		o	o
Provide funds from Development partners and government to PPRSD to fulfil their mandate		o	
Regulation			
Reduction of import duties			o

Table 36. *Solutions for commercial vegetables proposed by seed sector stakeholders*

Proposed solutions	Informal seed system	Intermediary seed system (Ghanaian seed businesses)	Formal seed system (international seed companies)
Production			
Purify and maintain pure lines of farmer varieties of onion and chili		o	
Support / empower / develop capacities of Ghanaian seed growers to produce certified commercial vegetable seed		o	
Service provision			
Develop plant breeders' capacity		o	

Make facilities available for efficient production of bigger volumes of vegetable breeder seed (seed extraction, drying, labelling, cold-rooms)		o	
Provide training in vegetable seed production for staff and out growers of seed companies that are interested in starting Ghana-based vegetable seed production		o	
Ensure availability of cold storage rooms in (sea) ports where seeds enter Ghana and in major climatic zones where the seeds can be stored in bulk before re-distribution at the beginning of the season.		o	o
Conduct adaptation trials in all regions where varieties will be marketed, across multiple seasons, and share results with extension workers and agro-dealers			o
Provide extension advice to seed producers		o	
Utilization			
Awareness raising on the potential of new (hybrid) varieties through demonstration and training of farmers. Organize local seed fairs.		o	o
Train farmers, agro-dealers and extension workers in good agricultural practices, with specific focus on fertilizer and pesticide selection and application			o
Regulation			
PPRSD to train and license third party regulatory inspectors (licensed seed inspectors) to decentralize seed quality control and reduce reliance of PPRSD officers			
Support PPRSD in mobility of the seed inspectors (regulation)			
Reduction of import duties			o
Coordination			
Establish PPRSD as an independent seed authority so that fees paid by users can sustain its operations (coordination)		o	o

Table 37. *Solutions for African vegetables proposed by seed sector stakeholders*

Proposed solutions	Informal seed system	Intermediary seed system (Ghanaian seed businesses)	Formal seed system (international seed companies)
Production			
Recognize and empower farmer and community groups as community-based seed businesses to produce, manage and distribute seeds of locally-preferred and adapted varieties within their community or region, safeguarding local diversity and fostering entrepreneurship	o		
Encourage small – one (wo)men- seed producers to form cooperatives / seed companies		o	
Service provision			
Provide training in quality (foundation) seed production of African fruity and leafy vegetables for seed producers in farmers groups.	o	o	
Integration of quality assurance for formal and community-based seed systems, including looking into options to use	o		

third party licenced seed inspectors for seed quality inspection in farmers groups or community-based seed businesses			
Characterize available landraces of African fruity and leafy vegetables		o	
Invest in developing new varieties for different agro-ecological zones Ghana and seasons (African eggplant and others)		o	
Utilisation			
Create demand for quality seed by awareness raising on nutritional value, other uses and product development of African leafy vegetables	o		
Conduct adaptation trials in all regions where varieties will be marketed, across multiple seasons		o	
Regulation			
Review the plant and fertilizer act to operationalize QDS as seed class for production of quality seed of selected African fruity vegetables crops that are less or not economically viable for seed companies	o		
Enforce regulations to fight seed adulteration of African fruity vegetables		o	o
Coordination			
Raise awareness amongst seed sector stakeholders that Farmer and Community-based Seed Systems are complementary and not competing with commercial seed companies	o		
Collect data / do market research to estimate demand		o	o
Include African fruity vegetables in crop focus PFJ 2.0		o	

Table 38. *Solutions for roots and tubers proposed by seed sector stakeholders*

Proposed solutions	Informal seed system	Intermediary seed system (Ghanaian seed businesses)	Formal seed system (international seed companies)
Production			
CSIR-CRI and CSIR-SARI should improve the availability of planting materials of yam land races		o	
Enhance large scale production of roots and tubers planting material by CSIR-CRI, CSIR-SARI, and seed companies		o	
Increase the availability, accessibility, and affordability of planting material of all seed classes		o	
Adopt innovative technologies that speed up planting material production of roots & tubers			
Service provision			
Support loan or grant for SARI to obtain irrigation for breeder seed production. Also support Agricultural Research Stations under MoFA to obtain irrigation for planting material production		o	
Provide training in quality foundation seed production for seed producers in farmers groups or for individual farmers	o		

specialising in clean planting material in Farmer Managed Seed Systems		
Provide training for farmers to clean roots and tubers planting materials in their fields	o	
Facilitate access to credit and funds by government and DAs for-infrastructure development to produce and store Root and Tuber seed		o
Provide funds from government and development partners to research and district MoFA stations		o
Utilisation		
Awareness raising on the potential of quality seed and improved varieties through extension and through demonstration and training of farmers		o
Regulation		
Operationalize QDS as a seed-class for production of quality root & tuber planting material	o	
Speed up implementation of the PVP Act for plant breeders' rights		
Coordination		
Strengthen / enhance coordination between stakeholder's roots & tubers: research – seed business – extension - farmers		o

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