Assessing the performance of Egypt's seed sector

Marja H. Thijssen, Zewdie Bishaw, Hamdino Ahmed and Arnab Gupta

WAGENINGEN UNIVERSITY & RESEARCH
ICARDA
Science for resilient livelihoods in dry areas
seedNL
NL Netherlands

Assessing the performance of Egypt's seed sector

Marja H. Thijssen[1], Zewdie Bishaw[2], Hamdino Ahmed[3] and Arnab Gupta[1]

1 Wageningen University & Research, Wageningen Centre for Development Innovation
2 ICARDA
3 Private consultant

This study has been conducted with the support of the Food & Nutrition Security (FNS) Support Facility. The FNS Support Facility is financed through the Ministry of Foreign Affairs of the Netherlands, and supports the Netherlands Embassies and Ministry in innovation and learning trajectories that contribute to the achievement of their policy ambitions in the context of FNS and food systems. The Facility is coordinated jointly by the Netherlands Food Partnership (NFP) and Wageningen Centre for Development Innovation (WCDI), part of Wageningen University & Research.

Wageningen Centre for Development Innovation
Wageningen, May 2023

Report WCDI-23-263

Thijssen, M.H., Z. Bishaw, H. Ahmed and A. Gupta, 2023. *Assessing the performance of Egypt's seed sector.* Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-23-263. Wageningen.

The current study shows the results of an assessment of the performance of the seed sector in Egypt. It elaborates bottlenecks and ambitions towards the development of a well-functioning seed sector that is innovative, competitive, resilient and inclusive. Since seed system configurations vary among crops groups and even crops, it zooms in on seed systems of cereals, food legumes and vegetables, and subsequently synthesizes seed sector challenges and ambitions at sector level. The assessment has been implemented through desk study and a consultative process with key seed sector stakeholders. It was implemented by Wageningen University & Research, ICARDA and an Egyptian seed sector consultant. The study provides entry points for the design of partnerships between Egypt and the Netherlands on seed sector transformation.

Keywords: Seed sector assessment, Egypt

This report can be downloaded for free at https://doi.org/10.18174/629970 or at www.wur.eu/wcdi (under knowledge products).

P.O. Box 88, 6700 AB Wageningen, The Netherlands. T + 31 (0)317 48 68 00, E info.cdi@wur.nl, www.wur.eu/wcdi.

Report WCDI-23-263

Photo cover: Cucumber seedlings. Photo courtesy: Vecteezy.com

Contents

Preface

Egypt is the agribusiness powerhouse of the Middle East and North Africa (MENA-region), watered by the Nile, with age-old soils in the delta, desert oases and the Nile, and with farming experience capable of greening the desert with productive agriculture. It is not only the region's primary producer of many crops like potatoes and onions; with over a hundred million people it is the greatest consumer market and biggest labour reservoir. Egypt is a major producer and exporter of agricultural products such as especially citrus and potatoes, which support Egypt's food security and unlock opportunities for Egypt's local market and export.

To the Netherlands, Masr (Egypt) is not a pure development partner country, like fragile states in the Sahel or the Horn of Africa. Rather it is a 'combi-country' where we work on an integrated cooperation, trade and investment agenda. With a focus on Climate and Water Smart Agriculture the NL-Masr Agri-food Network will work with Dutch, Egyptian and international partners on the basis of mutual interest mutual benefit to create innovative, inclusive and sustainable win-wins.

While the Egyptian agriculture sector is mature, it is not yet future proof. It is facing challenges such as water scarcity, contamination of soils and water due to excessive chemical input use, and land fragmentation, in the face of climate change, disrupted global supply chains and population growth. This creates a pressure to go from agri-business as usual to more resilient farming and agri-business models, based on investing in the soil, investing in collaboration, and investing in local innovation.

The seed sector is central to responding to these challenges, by providing improved varieties for climate resilience. This requires attention that traits beyond productivity, taste and esthetics should be taken along, but also tolerance and resistance to pests, diseases, heat and salinity. The Integrated Seed Sector Development approach, developed by applied researchers at WUR will be especially suited to these challenges. Pluriformity will support the diversity needed for a transition to a food system able to provide sufficient, healthy and sustainable diets for all. This will allow Egypt to develop its own specific public-private approach to provide access to the seeds that farmers need to serve people, planet and profit.

Dr. Melle Leenstra
Agricultural Counsellor, Embassy of the Netherlands in Cairo

Acknowledgements

The authors would like to express their sincere appreciation to colleagues in Egypt and the Netherlands who shared their knowledge and experience in the workshops organized in the context of this study, and were open for further consultation afterwards. Thanks, are also due to the ICARDA-Egypt office for the support with the logistics of the meetings in Egypt, and to SeedNL and Plantum for the organization of the Egypt roundtable discussion in the Netherlands. We thank the Embassy of the Kingdom of the Netherlands (EKN) in Cairo for their encouragement and support throughout the study process. The financial support of the Netherlands Food Partnership (NFP) through the Knowledge Programme for Food Security is acknowledged.

Summary

Agriculture plays an important role in the Egyptian economy, contributing 12%of the Gross Domestic Product, and accounting for an average employment of 28% at the national level. Egypt has both large-scale commercial and smallholder farmers; the latter dominating the sector and still often using traditional practices. Alongside rapid population growth and pressure on scarce natural resources such as land and water, climate change is a major threat to food and nutritional security in the country. Cognizant of this fact, the role of agricultural research and seed sector development is high on the agenda of the Egyptian Government. In the development and scaling of climate and water smart technologies and innovations, seed remains at the forefront of the government's agricultural strategy in national food system transformation.

To identify entry points for supporting the development of a well-functioning seed sector in Egypt that is innovative, competitive, resilient and inclusive, we assessed the current performance of the seed sector. The seed sector assessment (SSA) combined a desk study of secondary data with stakeholder consultations, aiming to get a better understanding of seed sector performance. The study used a combination of tools to allow for triangulation of assessment results.

The SSA reviewed the status of seed systems of key field and horticultural crops with a particular focus on cereals, legumes, and vegetables, including potato. For each crop group, the trends in cultivated area, production and productivity were analysed and seed gaps for indicator crops were estimated. Seed system configurations, and operators and service providers along the seed value chain were examined. Based on available information on crop trends, seed gaps, seed system configurations and seed value chain actors, major constraints hampering the crop group's seed system performance were discussed.

The SSA includes an analysis of the policy and regulatory framework that defines the governance of the seed sector. It addresses the regulation of genetic resources conservation and use; variety development, evaluation, release, and protection; and seed production, marketing, and quality assurance. It indicates domestic arrangements, as well as international bodies, organizations, agreements to which Egypt is a member of. It also elaborates the prevailing institutional arrangements.

To provide directions for seed sector transformation, seed sector constraints identified in the desk study and stakeholder consultations were translated into seed sector ambitions. Challenges were observed in all key seed sector functions, including: seed production, value addition and distribution, service provision, seed utilization, stakeholder organization, sector regulation, sector coordination, and funding. The outcome of the study was shared and discussed with a range of seed sector stakeholders through workshops in both Egypt and the Netherlands. The opinions of these stakeholders were incorporated to chart the final ambitions.

Egyptian stakeholders prioritized a number of key intervention areas. In relation to access to adapted varieties, they indicated the importance of: strengthening genetic resources management; development/access to climate resilient varieties; and access to locally adapted hybrid varieties of vegetables. For seed production and marketing they prioritized: establishment of seed storage facilities; facilitation of international investment; access to finance/foreign currency; and effective control of seed markets. Also prioritized - and key to the success of all interventions - is increased farmers' awareness on the importance of seed quality. In relation to seed sector regulation, importance is given to reviewing the seed law, including some ministerial decrees (currently ongoing). Highlighted was the need for stronger market incentives for increasing crop production; this will create a demand for quality seed. The vegetable sector was mentioned as a key sector to focus on.

The SSA will support stakeholders in Egypt and beyond to find entry points for collaboration improving the performance of the seed sector, including collaboration between Egypt and the Netherlands. The ambitions, as elaborated through the study, inform entry points for Egypt-Netherlands partnerships in seed.

List of abbreviations and acronyms

ARC	Agricultural Research Centre
BS	Breeder Seed
CAAES	Central Administration of Agricultural Extension Services
CAPQ	Central Administration of Plant Quarantine
CASC	Central Administration for Seed Certification
CASP	Central Administration for Seed Production
CIP	International Potato Center
COMESA	Common Market for Eastern and Southern Africa
CS	Certified Seed
DUS	Distinctness, Uniformity and Stability
EKN	Embassy of the Kingdom of the Netherlands
FAO	Food and Agriculture Organization
FCRI	Field Crops Research Institute
FDG	Focus Group Discussions
FS	Foundation Seed
GAFI	General Authority for Investment and Free Zones
GDP	Gross Domestic Product
ha	Hectare; 1 feddan is 0.42 ha
HRI	Horticulture Research Institute
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IMF	International Monetary Fund
ISF	International Seed Federation (ISF)
ISSD	Integrated Seed Sector Development
ISTA	International Seed Testing Association
IT-PGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
kg	Kilogram
MALR	Ministry of Agriculture and Land Reclamation
MENA	Middle East and North Africa
NFP	Netherlands Food Partnership
NGB	National Gene Bank
NSRM	National Seed Road Map
OECD	Organisation for Economic Cooperation and Development
OPV	Open Pollinated Variety
PPP	Public-Private Partnership
PVP	Plant Variety Protection
PVPO	Plant Variety Protection Office
RS	Registered Seed
SSA	Seed Sector Assessment
UPOV	International Union for the Protection of New Varieties of Plants
VCU	Value for Cultivation and Use
VRC	Variety Registration Committee
WCDI	Wageningen Centre for Development Innovation
WUR	Wageningen University & Research

1 Introduction

Agricultural development in Egypt

The agriculture sector is important for Egypt's economy. In 2021 it contributed 12 percent of the Gross Domestic Product (GDP), and accounted for an average employment of 28%, which reached up to 55% in Upper Egypt (USAID Egypt, 2022). The agricultural sector is diverse in agro-ecology, farming systems, crops and type of farmers. Egypt has both large-scale commercial and smallholder farmers; the latter dominate the sector. They depend on agriculture for their livelihood and still often use traditional practices (USAID Egypt, 2022).

Rapid population growth, climate change and competing claims on resources like arable land and water put pressure on the agricultural sector. Climate change challenges include sea level rise, drought and extreme heat, with an increase in the frequency and intensity of weather extremes (Abou-Ali et al., 2023). The Nile Delta is one of the most vulnerable deltas in the world for climate change, due to a combination of factors including intensive water use, seawater intrusion, loss of soil fertility, surface deterioration, groundwater quality, and loss of biodiversity (AbdelMonem et al., 2022). Climate studies show an expected yield decrease of the main crops due to climate change in Egypt (Ahmed et al., 2021).

Policy context

Egypt's *Sustainable Agricultural Development Strategy towards 2030* (Abul-Naga, 2009) aims to provide directions for unlocking the agricultural sector's growth potential by increasing its productivity and competitiveness, and contribute to achieving food security and improving rural livelihoods. The strategy document elaborates its objectives in six different areas: (i) sustainable use of agricultural natural resources (i.e., land and water); (ii) improving agricultural productivity (i.e., for field crops, horticultural crops, livestock); (iii) increasing competitiveness of agricultural products in local and foreign markets; (iv) achieving higher rates of food security in strategic goods (i.e., such as wheat, maize, sugar, red meat, fish); (v) improving opportunities for agricultural investment; and (vi) improving livelihoods of rural inhabitants. Objectives are to be reached through various implementation mechanisms, including, institutional reform, review and development of agricultural policies, and implementation of various development programmes and projects (Abdul-Naga, 2009).

In a recent high-level dialogue on food security in the Middle East and North Africa (MENA) region, organized by the World Bank and the International Monetary Fund (IMF) in 2021, Egypt's Minister of Planning and Economic Development, emphasized the need of creating agricultural job opportunities and increasing the incomes of small-holder farmers while increasing the country's agricultural export. The latter can be done by building upon existing trade agreements with Europe and the MENA region. The government has partnered with several international organisations to connect smallholder farmers with domestic and international value chains, promoting mechanisation and the adoption of new technologies (USAID, Egypt, 2022). At the same time the minister recognized the threats of climate change and emphasized the importance of investing in more sustainable water use, addressing challenges through investment in irrigation technology, desalinization, ground water use, and wastewater reuse.

Quality seed of adapted varieties to improve agricultural performance

Seeds are at the core of food production. Lack of access to quality seed[1] of improved and locally adapted varieties is one of the key factors hindering agricultural productivity increase. Considering population growth and the increasingly stringent competing claims for arable land and water, continuous development and promotion of better adapted varieties is essential to increase production and productivity. The development of new, adapted, disease and pest resistant, and heat, drought and salt tolerant varieties, and the promotion of their use are indispensable in any strategy to mitigate the effects of climate change. A well-functioning seed sector ensuring farmers' better access to and use of diverse and adapted varieties and affordable seed

[1] Quality seed is viable seed or planting material that germinates well, is free from seed-borne pests and diseases, and is true to type i.e. of the variety expected by the farmer.

at the right place and time will have a positive impact on farmers' livelihood resilience with higher farm income, improved food security and nutrition, and the sustainable use of agrobiodiversity and ecosystems. Such a seed sector needs to cater for diverse varietal and seed demands; it is innovative, competitive, resilient and inclusive.

Purpose of the study

The Netherlands is a world leader in the supply of seeds for ornamentals and vegetables, including potato. The SeedNL partnership mobilizes a network of government, private sector, civil society organizations and knowledge institutes to support seed sector transformation in the Global South (SeedNL, 2023). The agricultural team of the Embassy of the Kingdom of the Netherlands (EKN) in Cairo and SeedNL are looking for entry points to extend the Egypt-Netherlands collaboration in the seed sector looking at opportunities for development, as well as trade and investment. At the same time new initiatives need to support the transition towards climate- and water-smart agriculture (Van Weert et al., 2022). The assessment of the current performance of the seed sector in Egypt, and identification of challenges and development of ambitions will support the elaboration of short- and medium-term opportunities for Egypt-Netherlands seed partnerships. The current document focusses on the results of the seed sector assessment (SSA); opportunities for partnerships are elaborated in a separate document.

Outline of the current report

In Chapter 2 we explain the seed sector assessment methodology used for the current study. Chapter 3 elaborates the assessment results organized by crop groups, for cropping data and trends, seed systems configurations, and seed value chain operators and service providers, as well as some key challenges related to the crop groups' seed system performance. In Chapter 4 we provide an overview of the policy and regulatory framework. Chapter 5 presents the seed sector challenges identified during the assessment, and it provides an ambition for each of the challenges. All ambitions together contribute to the vision of a well-functioning seed sector in Egypt, that is innovative, competitive, resilient and inclusive. We conclude with a brief explanation on the way forward in Chapter 6.

2 Study approach

Seed sector assessment tools
In the SSA we used a combination of tools to get a deeper insight into seed sector performance. Combining desk study of secondary data with stakeholder consultations allowed the triangulation of assessment results. The assessment tools are elaborated in the *Guide for designing a National Seed Road Map* (NSRM) (De Boef & Thijssen, 2023). They were combined and adapted based on the purpose and context of the assessment.

Selected crop groups and indicator crops
Since seed system configurations vary among crop groups, and may even vary among crops within a crop group, we decided to zoom in on seed systems of four croup groups, with selected indicator crops: cereals, indicator crop barley; food legumes, indicator crop faba bean; and vegetables, indicator crops onion and cabbage. As an important vegetable root and tuber crop, we specifically focussed on the potato seed system.

Assessment of state of seed sector performance
The following assessment tools were used to answer the seed sector performance question: *Where are we now?* (see Table 1).

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

No.	Tool	Short description
1	Literature review	Review of existing information on the seed sector looking at current performance and challenges in relation to specific crop groups as well as the overall performance of the seed sector in general
2	Seed gap analysis	Analysis of trends for the selected crop groups, looking at the crops' cultivated area, production, and productivity data and national development strategies; and estimation of the current seed gap for indicator crops
3	Seed system analysis	Analysis of the crop groups' seed system configurations by domain, key crops, type of varieties, seed quality assurance, and seed distribution mechanisms
4	Seed value chain analysis	Identification of the stakeholders involved in the operations and services of the seed value chain of seed systems for the selected crop groups
5	Analysis of the seed policy and regulatory framework	Analysis of policies, laws and regulations that guide the activities of the diverse stakeholders active in the seed sector
6	Elaboration of seed system challenges	Identification of seed system challenges based on the assessment tools, through focus group discussions, a short survey, individual consultations and literature review; and consolidation of challenges through multi-stakeholder consultations in Egypt and the Netherlands

Note: Find a more elaborate description of the tools in De Boef & Thijssen, 2023.

Development of seed sector ambitions
We anchored upon the question *Where do we want to go?* by translating challenges into general and crop specific ambitions, which guide the transformation of the seed sector. Like the challenges, the ambitions were also consolidated into general and crop specific through multi-stakeholder consultations. We organized seed sector ambitions according to eight seed sector functions; these functions are eight critical seed sector performance areas at seed production, use and service levels: i.e. (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 elaborates the ambitions of the eight seed sector functions.

Table 2 *Ambition of seed sector functions.*

No.	Function	Ambition of the function
1	Production	Seed production systems are technically feasible and economically 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	Policies, 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.

Developing seed sector innovation pathways

The questions: *Where do we want to go?*, and: *How do we get there?* are often answered in a well elaborated NSRM or national seed sector strategy, which is beyond the scope of the current study. In a separate document, based on gaps, ambitions, and stakeholders' interests and priorities, we provide first ideas of potential Netherlands-Egypt partnerships for seed sector innovation on selected topics.

Facilitation of seed sector assessment

The assessment was implemented by a team of experts with insight in the developments of the global seed industry and the Egyptian seed sector. Besides technical seed sector expertise the team also has knowledge and experience of systems thinking and multi-stakeholder approaches. The team involved experts of Wageningen University & Research, Wageningen Centre for Development Innovation (WUR, WCDI), International Center for Agricultural Research in the Dry Areas (ICARDA) and an independent seed sector consultant in Egypt.

Stakeholder contributions

Egyptian stakeholders contributed to the SSA through participation in one of the four crop group focus group discussions and the multi-stakeholder workshop. Dutch stakeholders contributed through response to a short survey among Plantum (Dutch seed association) members and a roundtable discussion in the Netherlands. These meetings were followed by consultation of few selected experts. The consulted professionals represent a variety of public sector organizations, private seed companies, research and knowledge institutes and few civil society organizations. Find the participating organizations in Annex 1.

Guiding concepts in assessment design

In the SSA we adhered to the five guiding concepts (De Boef & Thijssen, 2023):

1. Systems thinking: considering the seed sector as a complex system, with diverse crops and seed systems, different functions and activities, and multiple stakeholders and interests; looking at both the high level vision and individual elements we aim for systemic change.
2. Stakeholder involvement: involving a wide range of stakeholders in the SSA, with different roles, and sometimes also different perspectives on the performance and functions of the seed sector; these different voices will contribute to identify innovations and collaborative action opportunities.
3. Triangulation: using a combination of methods, with qualitative and quantitative data from different sources, and verifying those data together with different stakeholders; these data and stakeholder perspectives will be transformed into seed sector relevant information.
4. Integrated Seed Sector Development (ISSD): considering that farmers gain access to seed through multiple seed systems, each with their own strengths and weaknesses, and unique configuration of

stakeholders; ISSD links policy and practice by finding systemic solutions to complex seed sector problems (Louwaars & De Boef, 2012).

5. Integrated framework for food system and seed sector transformation: linking envisaged seed sector outcomes to food system outcomes, looking not only at seed security and food security and nutrition, but also at socio-economic and environmental outcomes; see Figure 1.

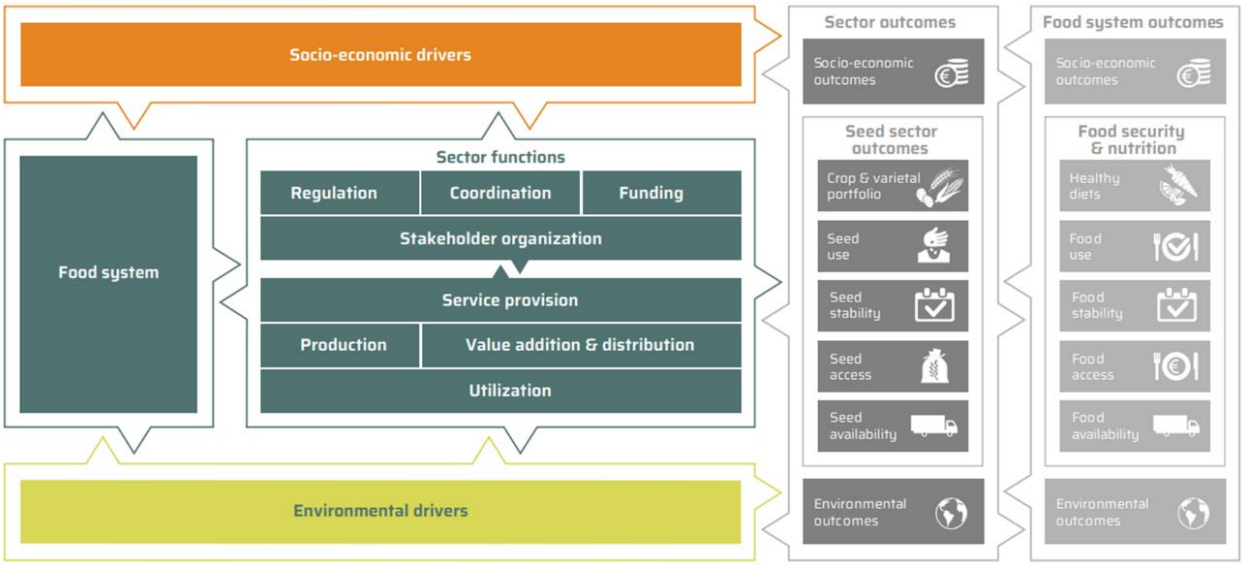

Figure 1 *Integrated framework for food system and seed sector transformation.*
Source: De Boef & Thijssen, 2023.

3 Performance of seed systems

Crop group seed systems and the seed sector
In this chapter we first zoom in on the performance of seed systems for the selected crop groups and indicator crops. In the next chapter we zoom out to the challenges and ambitions for the seed sector as a whole.

3.1 Cereals

Cereal crop data and projections
Wheat, rice and maize are the three most important cereal crops in Egypt; the area harvested, production and yields over the past 10 years are presented in Figure 2. Area harvested and production figures are quite stable over the years, with a sharp decrease in 2018, particularly for maize and rice, with a recovery in 2019. The grain yields show steady growth except for maize in 2019. We present below more details and prospects on the three crops, as well as on barley, which we have chosen as an indicator crop. Projections are based on literature review, but also include the insights of experts in the focus group discussions (FDGs).

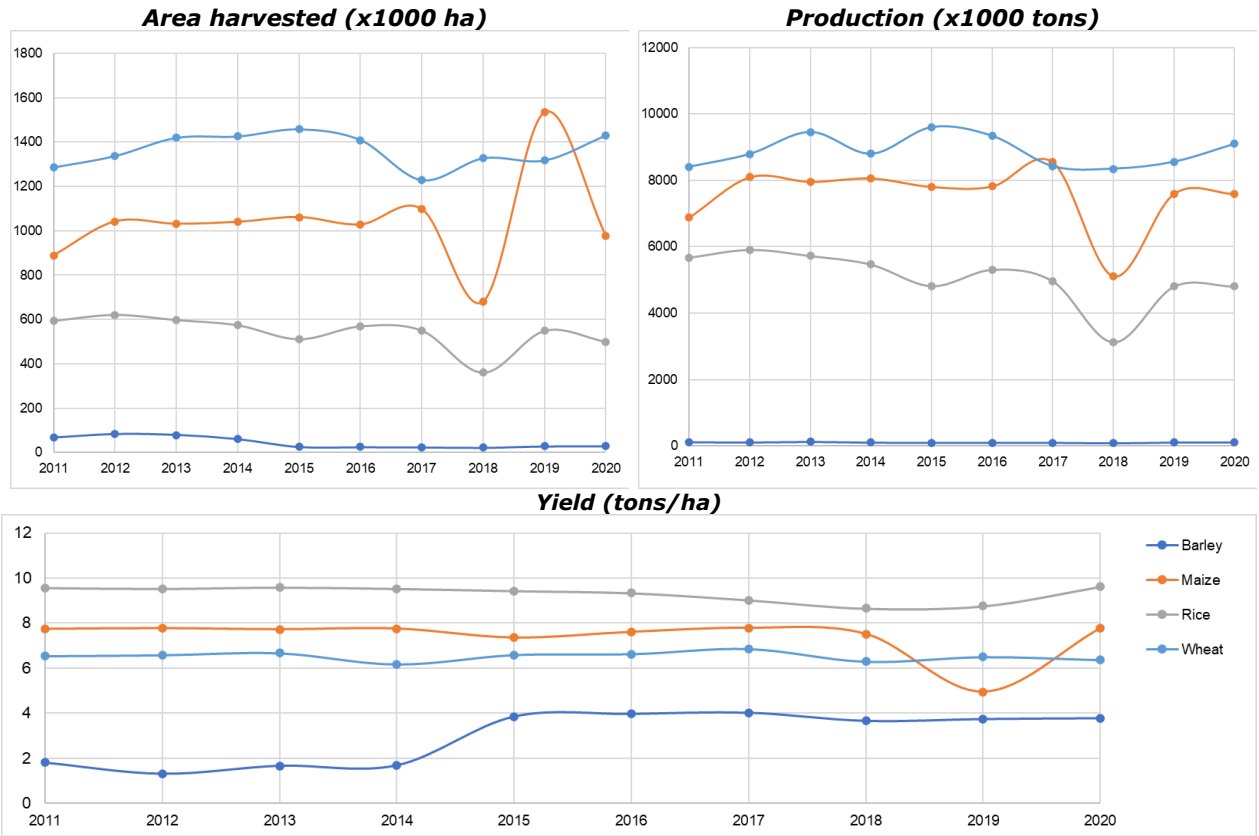

Figure 2 *Cereal cropping data, 2011 – 2020.*
Source: FAO, 2023a (link).

Wheat is key to the Egyptian diet, with approximately 60% of the Egyptian population depending on subsidized bread (Abdalla et al., 2023); and an average wheat consumption of about 145 kg/capita. In 2020 Egypt produced 9.1 million tons of wheat (see Figure 2) and imported an additional 9.0 million tons (FAO, 2023a). In 2021, Egypt was the world's largest wheat importer (USD 3.4 billion), representing 8.3% of

global wheat imports. Sixty-one per cent of total wheat imports came from the Russian Federation and were valued at USD 3.2 billion, while 24% came from Ukraine and were valued at USD 1.2 billion (Dakar 2 Summit, 2023). The conflict between two of the world's largest wheat exporters, disrupted the global wheat market and severely affected Egypt's wheat import (FAO, 2022a). It has forced Egypt to depend on its own domestic wheat production, and in the context of self-reliance looking into the opportunities for increasing production of this important food crop. The government target is to increase Egypt's self-sufficiency for this priority crop from about 50% in 2020 to 65% in 2025, by area expansion from 1.4 million hectares to 1.6 million hectares (expanding to new land); and by productivity increase from 6.4 tons/ha to 7.1 tons/ha through wider use of quality seed of improved varieties and better cropping practices (government target of 100% use of certified seed) (FAO, 2022a; FDG experts). The variety list currently has 27 wheat varieties (Central Administration for Seed Certification, CASC, personal communication) where all are from the public sector except three from the private sector. Find in Annex 2 a list of registered varieties separated by public and private breeding. At the same time efforts are put into limiting food waste and increasing wheat flour extraction (FAO, 2022a).

Rice is the main staple food for more than 50% of the Egyptians (Elmoghazy & Elshenawy, 2018). The crop is important as a land reclamation crop for improving the productivity of the saline soils in the Nile Delta and coastal area; moreover, cultivation costs are relatively low, and rice is an important income earner for family farms in summer (Elmoghazy & Elshenawy, 2018). Egypt is the largest producer of rice in the MENA region, with a production of 4.8 million tons in 2020 (see Figure 2). Rice is an important export crop with an estimated export volume of 0.7 million tons in 2021 (USDA Foreign Agricultural Service; estimated production in that year was 4.5 million tons). The market demand for rice is anticipated to further increase because of the improvements in the processing industry, development of the food and restaurant sector, and changes in consumer lifestyle and food habits. The latest variety list has 17 public rice varieties and one commercial variety (CASC, personal communication). Whereas the rice area is stable, production may increase through productivity increase, introducing new adapted varieties, with higher water use efficiency and salt tolerance (FDG experts).

Maize is the second most important cereal crop grown in Egypt, considering the area harvested (see Figure 2). However, only approximately 50% is being used for food, including its use in a mixture with wheat for bread preparation; the other 50% is used as feed for the growing livestock and poultry industry. Maize production in Egypt is not sufficient to meet the demand and on average 38% of the maize used is imported (Altaie et al., 2022). To achieve increases in production and productivity, as targeted by the government strategy towards 2030 (Abul-Naga, 2009) interventions are needed at the production as well as the policy level, including increased use of quality seed of high-yielding varieties (Altaie et al., 2022). In contrary to the other cereal crops, high numbers of maize varieties have been registered. Of the 147 maize varieties registered by 2023, 116 are developed by the private sector (CASC, personal communication). New maize varieties are needed to emerging pests and diseases due to climate change (FDG experts).

Indicator crop: barley

We choose barley as an indicator crop because of its interesting ability to perform well under marginal conditions, including drought stress. Barley is considered a restorative crop which can improve soil properties, doing well with low fertilizer amounts (FDG experts). It is a robust crop in the context of climate change. In Egypt, barley is grown in winter in both old and newly reclaimed lands that experience problems with soil fertility and salinity, and access to irrigation (El-Khalifa et al., 2022). Barley is also the most adapted field crop grown under drought and poor soil fertility in rainfed areas in Marsa Matrouh and the North Sinai. The pastoralists living in these areas raise livestock (mainly sheep and goats) and grow barley for animal feed (grain and straw). In 2020 the total area under barley reported by FAOSTAT was 29 thousand ha, with an average productivity of 3.8 tons per ha (see Figure 2). In the agricultural development strategy towards 2030, the government targets both area and productivity increase of barley (Abul-Naga, 2009).

Barley can be used as animal feed and for malting, but also has unique human health and nutritional benefits, including its high nutritional fibre content and beta-glucan content, which is assumed to reduce cholesterol levels (El-Khalifa et al., 2022). Egypt's Ministry of Agriculture and Land Reclamation (MALR) recently started promoting new barley varieties to farmers in newly reclaimed and marginal lands; currently there are 20 varieties registered, of which 17 have been developed through public breeding programmes

(CASC, personal communication). Giza 126 and Giza 2000 are highly adapted to the drought prone areas in Egypt. A functional barley seed delivery system is crucial to introduce and disseminate these varieties into the areas of their adaptation through a community-based seed production and distribution system involving farmers, research and extension services.

Although most of Egypt's barley demand is meant for feed purposes, there is a potential market niche for wheat-barley flour mixtures that could help decreasing the country's dependence on imports. The government is raising awareness on the potential of mixing barley flour with wheat flour (15–20%) to address the gap in wheat demand and supply (Elbasyoni et al., 2020). Also the developments of the malting industry presents new opportunities for extending the barley area. Yields have almost doubled since 2014 (see Figure 2), but are still relatively low because of the marginal environment in which the crop is grown.

CASP produces considerable amounts of certified barley seed, which fluctuate per year. The following quantities were produced for the following seasons: 517 thousand tons in 2019-2020; 428 thousand tons in 2020-2021; 185 thousand tons in 2021-2022; and 349 thousand tons in 2022-2023. Quantities of certified seed produced sold in those four seasons were 40%, 96%, 100% and 100%, respectively, showing also quite some differences per season. If taking the assumption that farmers may safely recycle certified seed for another three seasons without losing too much on seed quality, and considering the certified seed quantity produced for 2019-2020 (517 thousand tons), the seed gap would be 40%; this is relatively small (see Table 3). However, as indicated above, only 40% of the seed produced that season was sold. Amounts of barley produced over the years are quite stable (FAO, 2023a). Keeping the same quantity of barely produced but considering certified seed quantity produced for 2021-2022 (185 thousand tons), the seed gap would be 79%, which is almost double.

Table 3 *Current barley quality seed gap.*

Crop and seed data	Metric	2020
Crop area[1]	*1000 ha	28.9
Production[1]	*1000 tons	109
Yield[1]	Tons/ha	3.78
Seed rate[2]	Tons/ha	0.12
Total seed demand	*1000 tons	3.46
Seed replacement rate[2]	%	25%
Quality seed demand	Tons	866
Seed production[3]	Tons	517
Quality seed availability	%	60%
Quality seed gap	%	40%

Source: 1) FAO, 2023a (link); 2) Based on expert consultation; 3) Data from FCRI for the 2019-2020 season.

Cereal seed systems

In a focus group discussion involving eight cereal crop and seed experts (plus three facilitators, including one cereal expert) we discussed the configuration of the seed systems for cereals, taking into consideration the crops maize, wheat, rice, barley and sorghum. Seed systems are based on the following characteristics: (i) the domain: formal, public, private, informal, mixed, others; (ii) crop use: food, cash, feed, export; (iii) type of varieties: local, improved, foreign, OPV, hybrids, public, private; (iv) seed quality: informal/trusted, certified, accreditation, third party; and (v) seed marketing and distribution: public organizations, extension, agro-dealers, contractual arrangements. Table 4 shows four different seed systems for cereal crops. Crops are underlined in their main predominant seed system.

For maize the key seed system is a formal, private system in which seed companies develop their own varieties, mainly hybrids; produce seed of those varieties; and sell certified seed through a network of local agro-dealers. For wheat the mixed public-private system is the major system, with varieties developed through public breeding programmes, seed multiplied by public and private sector organizations, and distributed through both public sale points and agro-dealers. Rice seed is mainly produced through the system fully in the hands of the public sector, with public varieties, seed produced by public institutes, and

distributed through public sales points as well as extension. Barley and sorghum seed are produced and disseminated by farmers themselves; the varieties have their origin in public breeding programmes and are recycled. Whereas seed in the private, public-private and public seed systems is certified, seed in the farmer-based seed system is not quality assured.

Table 4 *Cereal seed systems configurations.*

Characteristics	National and multi-national companies	Companies in collaboration with public organizations	Public organizations	Farmer-managed
Domain	Formal, private	Formal, mix public & private	Formal, public	Informal, farmer-based
Crops	Maize	Wheat, maize, rice	Wheat, barley, rice	Wheat, barley, rice, sorghum
Use of crop	Food, feed, cash, export	Food, feed, cash	Food, cash	Food, cash
Type of varieties	Hybrids, private	Maize: hybrids, private Others: OPVs, public	OPVs, public	All improved, few landraces of barley and wheat
Type of seed quality	Certified	Certified	Certified	Farm-saved
Type of marketing and distribution	Agro-dealers	Agro-dealers, public sale points	Public sale points and extension	Local exchange

Note: Crops are underlined in their main seed system.

Cereal seed value chain operators and service providers

Participants in the cereal crops focus group discussion were consulted on the main actors in the operations and the services in the seed value chain (see Tables 5 and 6). The National Gene Bank (NGB) maintains a collection of local landraces, which can be used as parental lines in public variety development programmes. In addition, all Field Crops Research Institute (FCRI) breeding departments maintain their own germplasm collections as a basis for the development of new varieties. The sector mainly relies on open pollinated varieties (OPVs) developed by public breeding programmes, except maize, for which many hybrids developed by the private sector are available. FCRI produces breeder seed (BS) and foundation seed (FS) of public varieties; which is then further multiplied by the Central Administration of Seed Production (CASP) and private sector through contract growers. Seed companies produce seed of their own parental lines and hybrid varieties. CASP disseminates its seed through public seed outlets; private seed companies use agro-dealers for seed distribution, or supply directly to large-scale private farmers.

Table 5 *Cereal seed value chain operators.*

Operations	Operators
Plant genetic resources management	NGB, FCRI breeding departments have small gene banks, private sector, ICARDA
Variety development	FCRI breeding departments, private sector
Early generation seed supply (BS & FS)	FCRI with own and contracted private farms; seed companies
Seed production (RS/CS1 & C2)	CASP (contractual), private seed companies
Marketing and distribution	CASP through seed outlets & extension; private seed companies through agro-dealers and private farms

The Central Administration of Agricultural Extension Services (CAAES) has only limited focus on seed extension; the extension unit of FCRI can only partly fill this gap. Private seed companies generally invest quite a lot in seed extension, and market information and promotion of their varieties and seed. In relation to variety testing and release, testing for Distinctness, Uniformity and Stability (DUS) is done by the Central Administration for Seed Certification (CASC). Testing for the Value for Cultivation and Use (VCU) can be implemented by various organizations, including the Agricultural Research Centres (ARCs, FCRI, Plant

Protection Research Institute and Plant Pathology Research Institute), Universities (only to a very limited extent), and private seed companies through an arrangement with CASC. Seed producers have their own internal seed quality assurance systems; externally quality is assured by CASC during seed production through field inspection and seed quality testing, at licenced seed sales points, as well as at the location of seed import. Farmer seed users can make use of loans from the Agricultural Bank of Egypt; however, this opportunity is not used on large scale.

Table 6 *Cereal seed value chain service providers.*

Services	Service providers
Rural extension	FCRI Extension Unit, CAAES (limited seed focus), private seed companies
Variety testing and release	DUS: CASC; VCU: FCRI/Plant Protection Research Institute/Plant Pathology Research Institute, (Universities) private seed companies through CASC (FCRI)
Plant variety protection	CASC-Plant Variety Protection Office (PVPO)
Quality assurance in seed production	CASC; all producers internal quality control system
Quality assurance in marketing	CASC; inspection of licenced distributers
Quality assurance at import	CASC; sampling and testing (orange certificate, ISTA certificate, phytosanitary certificate)
Financial services and management	Farmers' loans at Agricultural Bank of Egypt
Marketing information and promotion	FCRI Extension unit, CASP, private companies, CAAES

Challenges of cereal seed systems

Some selected key challenges related to cereal seed systems, as mentioned by experts in the focus group discussions are show below. Challenges are further elaborated in Chapter 5.

- Not all local germplasm in the genebank is characterized because of lack of capacity and funding.
- Limited access to new germplasm for variety development, e.g. for malting barley.
- No access to modern infrastructure and technologies to shorten the duration of breeding programmes.
- Foreign imported varieties not always adapted to the Egyptian environment and market demands.
- Limited quantity of quality seed and varieties for increasing productivity.
- Limited access to hard currency for international business and problems with international transfer of earnings.
- Challenges with logistics related to seed import (mentioned for maize seed).
- Insecurity hampers international business opportunities.
- Low use of cereal certified seed by farmers.

3.2 Food legumes

Food legume crop data and projections

Whereas cereals are the most important calory source in the human diet, food legumes are key in providing proteins, vitamins and minerals which are essential for nutrition. The food legumes, including faba bean, chickpea and pea, are considerably less important taking into account area harvested and production (see Figure 3), but are still an important part of the traditional Egyptian diet. They are a cheap alternative for animal protein. Legume crops are climate resilient, and important for sustainable production systems in relation to soil fertility and health, crop rotation, low water use and low environmental footprint. We have chosen faba bean as the indicator crop.

As mentioned above, food legumes are not among the main crops produced in Egypt as measured by production volume, and not among the priority crops promoted by the Egyptian government, competing with important food crops such as wheat. Areas grown for food legumes saw a decline over the past 30 years (FAO, 2023a). Looking at the food legume crops with the largest harvested areas, i.e. pea, bean and faba bean, production has been fluctuating quite a lot over the past 10 years (Figure 3). Fluctuations in production largely relate to market instability, due to factors such as price fluctuations, trade barriers, competition from imports, lack of market information and market access.

Figure 4 presents the import and export volumes and values of selected food legume crops in 2020. Whereas for beans considerable volume and value of export are noted; lentils and faba bean see high volumes and values of import. Note that since export and import volumes and values of green produce of faba bean and peas are negligible, they were not considered.

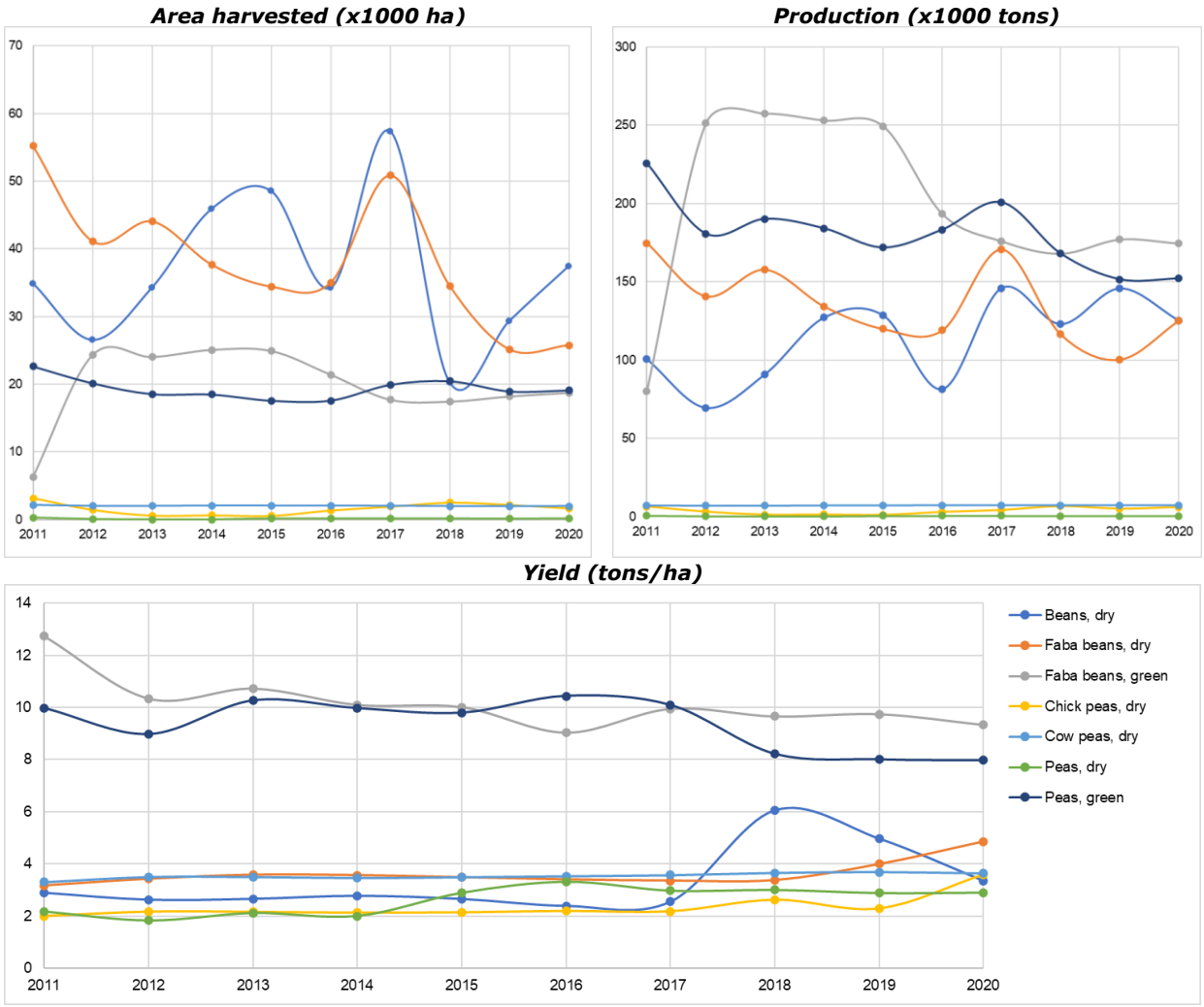

Figure 3 *Food legume cropping data, 2011 – 2020.*
Source: FAO, 2023a (link).

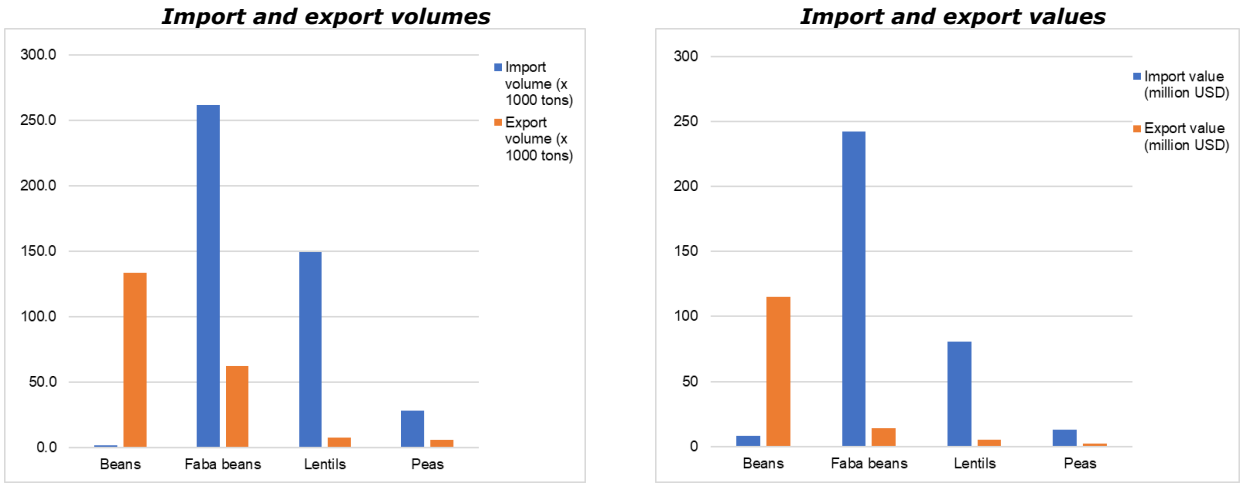

Figure 4 *Food legume import and export data, 2020.*
Source: FAO, 2023a (link).

Considering climate change, and the robustness and environmental benefits of food legumes in a sustainable production system, not to forget the important nutritional value and ability to serve as a cheap protein alternative, it is worthwhile to investigate the current legume production constraints (Foyer et al., 2016). This includes challenges in farmers' access to and use of quality seed of appropriate and adapted varieties.

Indicator crop: faba bean

Faba bean is a winter crop, largely grown by subsistence farmers, particularly in drought-prone areas. The faba bean harvested area amounted to 44.5 thousand ha in 2020, with 125 thousand tons for dry and 175 thousand tons for green production (Figure 3). At the same time faba bean import (dry) in 2020 amounted to 262 thousand tons (Figure 4), showing the gap between production and consumption. The study on cultivated area of faba bean, revealed that farmers' response to farm prices, production costs and net returns of competing crops are major factors affecting its production; such information must be provided so that farmers can make an informed decision (Soliman et al. 2021). The study recommends developing an appropriate price policy to reduce the production costs and to increase net return and encourage faba bean cultivation. Diab et al. (2016) conducted a study to identify the efficiency of the use of agricultural economic resources in the production of the faba bean crop in Sohag Governorate and to estimate the optimal resource combinations among the most important production elements used. The results indicate that the most important economic resources influencing the productivity of per unit area are the quantity of seeds, the amount of organic fertilizer, the amount of nitrogen fertilizer, the amount of phosphate fertilizer, and the quantity of pesticides.

Mohamed et al. (2019) further analysed the evolution of the food gap of faba bean and its underpinning factors. The results show that domestic production of faba bean is decreasing and failing to meet domestic consumption requirements leading to the widening food gap for faba beans year after year. Increase in disease pressure also resulted in decrease in faba bean yields (Figure 3). Abdelmabood et al. (2019), developed a food security indicator to assess the state of faba bean and the results show was less than one and close to zero, which indicates the low food security of the faba bean crop in Egypt.

Egypt has released 20 faba bean varieties; these are all varieties developed through public breeding programmes (CASC, personal communication). Farmers adopting the recommended faba bean packages saw their average incomes increase by 173%. In Orobanche-infested areas of Middle and Upper Egypt, the adoption of a package of glyphosate treatment and partially resistant varieties - Giza 843 and Misr 3 – brought yield increases of 256 kg/ha; reduced production costs by some 350 USD/ha; and increased net incomes by 550 USD/ha (ICARDA, internal report). Recently, ARC and ICARDA have released two additional varieties: Giza 1557, resistant to chocolate spot and recommended for the Nile Delta, and Giza 1813, a short duration variety that is resistant to Orobanche and recommended for Upper Egypt (ICARDA, internal report).

Faba bean is grown intercropped with fruit trees (apple, peach, orange) in new land; with sugar cane in upper Egypt, and with sugar beet in northern Egypt (FDG experts).

Table 7 presents the current quality seed gap for faba bean which is approximately 80%. This is based on faba bean crop production data (FAO, 2023a) and certified seed production data (ICARDA, personal communication), with the assumption that farmers may use a seed replacement rate of 33%. The government keeps the seed price low, and seed is not treated; this results in faba bean seed also being used for food and feed purposes (ARC, personal communication).

Table 7 *Current faba been quality seed gap.*

Crop and seed data	Metric	2020
Crop area[1]	*1000 ha	44.5
Production[1]	*1000 tons	300
Yield[1]	Tons/ha	4.86
Seed rate[2]	Tons/ha	0.2
Total seed demand	*1000 tons	8.9
Seed replacement rate[2]	%	33%
Quality seed demand	*1000 tons	2.9
Seed production[3]	Tons	574
Quality seed availability	%	20%
Quality seed gap	%	80%

Source: 1) FAO, 2023a (link); 2) Based on expert consultation; 3) Data from ICARDA for 2019.

Food legume seed systems

In a focus group discussion involving three food legume crop and seed experts (plus 3 facilitators including one legume expert) we interrogated the seed systems configurations of this crop group, considering the crops bean, soybean, faba bean, chickpea, and lentil. Table 8 shows the four different seed systems for food legumes, of which three are managed by the private sector, the public sector, or a combination of those two; the fourth system is managed by farmers themselves. Crops are underlined in their main seed system.

Bean seed is produced through the system operating in the private domain, with private breeding, commercial seed production and seed sales through agro-dealers; this relates to the export potential of this crop. Faba bean seed is mainly produced through the seed system operating in the public domain, with public variety development programmes, seed production managed by public entities, and seed distribution through public seed outlets and extension, but the amount of certified seed produced is limited. However, experts see the potential for faba bean in the private seed system related to the export potential. Soybean is a food legume in the mixed public-private seed system, with both public and private varieties, seed produced by seed companies, and seed of this cash crop distributed through agro-dealers.

Seed of all food legumes is also managed by farmers themselves in the informal seed system; for chickpea and lentil this is the main seed system. The informal seed system is extremely valuable for food legume crops. Farmers recycle seed of officially released varieties, but popular varieties include some of which are of unknown origin, especially for crops like lentil. FCRI is currently evaluating those varieties to have them officially released.

Table 8 *Food legume seed systems configurations.*

Characteristics	National companies	Companies in collaboration with public organisations	Public organizations	Farmer-managed
Domain	Formal, private	Formal, mix public & private	Formal, public	Informal, farmer-based
Crops	Beans; upcoming for faba bean	Soybean	Faba bean	All food legume crops, including chickpea, lentil
Use of crop	Cash, export	Cash	Food, cash, potential for export	Food, cash
Type of varieties	Private	Public, private	Public	Improved, locally adapted farmer varieties; imported, unregistered varieties of unknown origin (chickpea, lentil)
Type of seed quality	Certified	Certified	Certified	Farmer-saved
Type of marketing and distribution	Agro-dealers	Agro-dealers	Public seed outlets, extension	Local exchange

Note: Crops are underlined in their main seed system.

Food legume seed value chain operators and service providers

Experts in the focus group discussion were consulted on the main operators and service providers in food legume seed value chains (see Tables 9 and 10). Whereas NGB maintains a genetic resources collection including food legume germplasm, breeding departments under the FCRI also maintain germplasm working collections as input to their breeding programmes. Part of the germplasm has its origin in the breeding programmes of ICARDA and ICRISTAT. Whereas FCRI manages breeding programmes for faba bean, soybean, chickpea and lentil; HRI manages breeding programmes for dry bean, green bean, peas, and cowpeas. The Desert Research Institute is involved in the development of large seeded faba bean varieties. Companies are involved into breeding to a limited extent, for example, for soybean. Breeder seed is produced by FCRI; foundation seed is produced by the ARC seed farm, which also collaborates with large private farms for this purpose. CASP and seed companies produce and market certified seed (CS).

Table 9 *Food legume seed value chain operators.*

Operations	Operators
Plant genetic resources management	NGB, FCRI with genebank under breeding department, ICARDA, ICRISAT
Variety development	FCRI, HRI, Desert Research Centre for large seeded faba bean, seed companies
Early generation seed supply (BS & FS)	FCRI (BS), Government and private farms (FS)
Seed production (RS/CS1 & C2)	CASP and seed companies
Marketing and distribution	CASP and seed companies

CAAES has the mandate for rural extension, but focusses on a diverse set of issues, with only very limited attention to seed extension and/or promotion. CASC is managing the variety release process for food legume varieties, in a similar way to all other crops. Egypt is developing its PVP system, which is managed by the PVP Office under CASC. CASC is also responsible for quality assurance, both in seed production, certifying seed, and at market outlets. Promotion of new varieties and quality seed is done by ARCs, which have a modality financing variety demonstration.

Table 10 *Food legume seed value chain service providers.*

Services	Service providers
Rural extension	CAAES
Variety testing and release	CASC
Plant variety protection	CASC-PVPO
Quality assurance in seed production	CASC
Quality assurance in marketing	CASC
Financial services and management	Agricultural Bank of Egypt
Marketing information and promotion	ARC through Academy of Sciences financing demonstration; private seed companies; CAAES

Challenges related to food legume seed systems

Find below some selected key challenges related to food legume seed systems, as mentioned by experts in the focus group discussions. Challenges are further elaborated in Chapter 5.

- Limited support for farmers in legume production, including access to and promotion of quality seed of new varieties.
- Unused opportunity of digital applications for seed and variety promotion.
- Breeding for Orobanche and disease resistance, and high protein content and quality for faba bean.
- Untapped potential of public-private collaboration as well as international collaboration on legume improvement.
- Limited investment in legume research, and no facilities for speed breeding.
- Limited government attention for legume production, including legume seed systems, and untapped potential in new land.
- Insufficient capacity and infrastructure for seed quality assurance.

3.3 Vegetables

Vegetable crop data and projections

Egypt produces a wide range of vegetable crops, both for domestic and export markets. Tomatoes, onions and potatoes are the three most important vegetables, both considering production (see Figure 5 and 7) and export (see Figure 6) (note that potato is specifically addressed in section 3.4). The horticultural sector, concerning both fruits and vegetables, is considered one of the country's fastest growing sub-sectors, which generated a total of USD 2.2 billion export earnings in 2020 (FAO, 2022b). The sector has opportunity to grow because of the export potential and growing urban population in Egypt, with increasing incomes, and rising awareness on vegetable consumption as part of diet diversity and a healthy food habits. Vegetables

are grown by large-scale commercial farms and provide for a living for smallholder farmers. The latter are suffering from pressure on water resources and water quality, and agricultural land reducing at the expense of urban expansion.

The Egyptian government aims to further develop the vegetable sector both in terms of increasing quantity and enhancing quality, for local consumption and export markets (Abul-Naga, 2009). With growing export volumes, and consumers becoming more demanding in relation to product quality and food safety, more attention is needed from growers and exporters on meeting international market standards. The EU and FAO have been supporting Egyptian authorities, exporters, suppliers and farmers in strengthening their capacities on pest and disease control and pesticide residue management (FAO, 2022b). Tomato was one of the targeted value chains. Improving food safety practices across the supply chain will decrease export rejections and create new business and export opportunities.

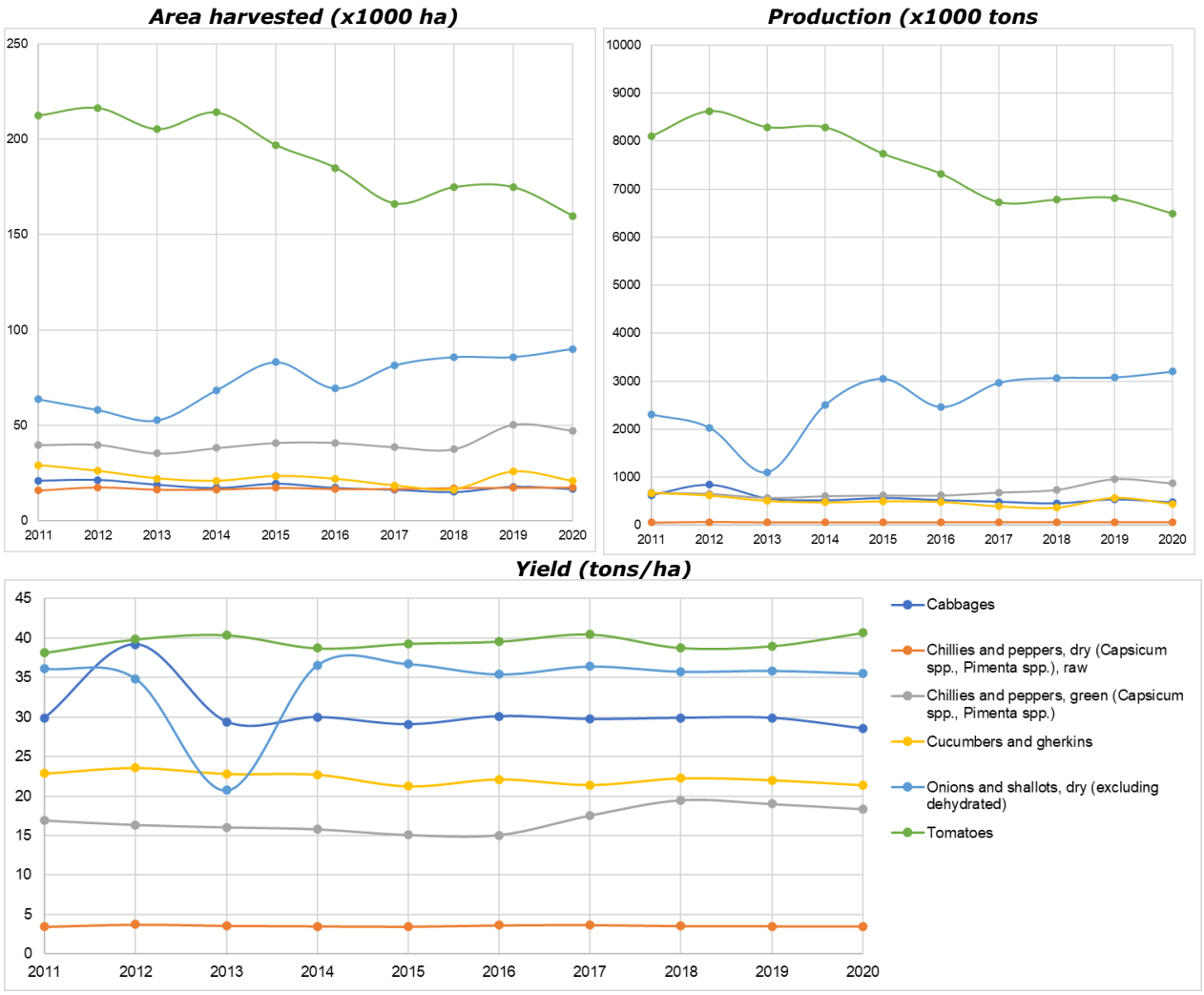

Figure 5 *Vegetable cropping data, 2011 – 2020.*
Source: FAO, 2023a (link).

Over the past ten years the area and production of tomato have been slightly decreasing to 160 thousand ha and 6.5 million tons in 2020, respectively; whereas the area and production of onion have been increasing to 90 thousand ha and 3.2 million tons in 2020, respectively (see Figure 5). During focus group discussion, experts indicated further opportunity of growth of the vegetable sector by expansion of vegetable production to new areas, especially for a crop like tomato.

Yields for tomato and onion were quite stable, especially over the last five years (Figure 5). Onion productivity saw a sharp decline in 2013, and immediate recovery in 2014. The decline was due to several

factors including disease and lack of access to water. Productivity of vegetable crops is still considered to be relatively low, which has different reasons for different crops, which include lack of access to appropriate and adapted varieties, access to and use of quality seed, and sub-optimal growing practices (FDG experts). Experts mention that farmers do have awareness on different vegetable varieties.

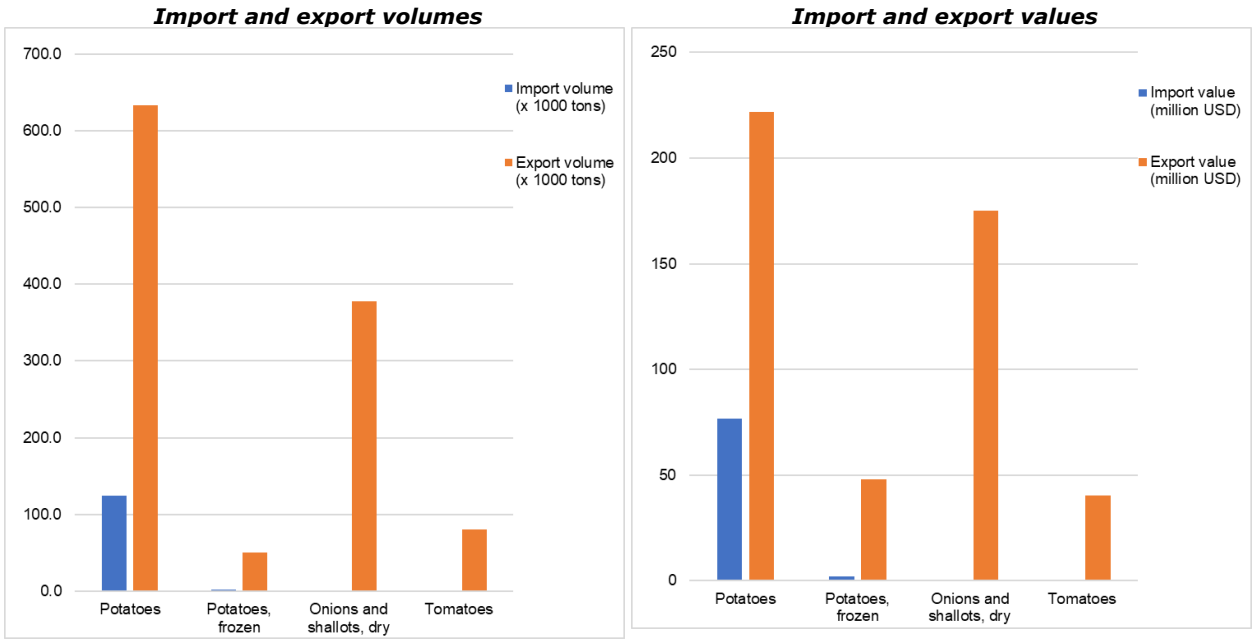

Figure 6 *Vegetable import and export data, 2020. Source: FAO, 2023a (link).*

Indicator crop: onion

Onion is one of the most important vegetables in terms of local consumption and export; it is the third horticultural export crop after oranges and potatoes. Export of onion in 2020 reached 378 thousand tons, with a value of USD 175 million (see Figure 6). Saudi Arabia and the EU are important export destinations, with Saudi Arabia accounting for around 60% of the export volume (Mohamed, 2020). Export markets may even absorb higher quantities in the future. It is important to look at competing export countries, especially in terms of prices, quality and export dates. In 2019 Saudi Arabia imposed a temporary import ban on onions from Egypt because of high rates of pesticide residues (Mohamed, 2020).

Onion is grown in the winter season throughout the country, planted between September and November, with harvesting starting in April/March, which is earliest in the Northern regions (Mohamed, 2020). Most farmers establish their own onion nurseries or buy seedlings from their neighbours (FDG experts). Onion seed is produced through CASP and a few private companies. Egypt grows white, red and golden onions; the onion type is determined by domestic and international market preferences.

FCRI has the mandate for onion research. Onion is a cross-pollinated crop, which requires a long breeding time. Varieties used in Egypt are OPVs; adapted hybrid varieties are not yet available. The variety list has 10 released onion varieties, however, the market is dominated by five varieties only (CASC, personal communication, FDG experts). With farmers generally using their own seed and planting materials, the onion crop shows a lot of variation in performance, including for quality and colour. Private seed companies have invested in selecting within the main varieties to improve performance. Using onion seed of hybrid varieties will have the main advantage of supporting a homogenous quality of the onion crop.

Table 11 attempts to provide insight into the current quality seed gap for onion. Crop production data are based on FAOSTAT (FAO, 2023a). For onion a considerable amount of seed was produced by CASP in 2020 (FDG experts), but it appeared to be impossible to get reliable data on the exact amount. An amount of 12 tons was mentioned. Considering a seed replacement rate for this cross-pollinated crop of once in three years, this would imply a quality seed gap of 96% (Table 11). Experts indicate that at the same time large

amounts of the certified seed produced were not used by farmers, and estimate that only 10% of the seed produced was actually used. Farmers not using the certified seed may have various reasons. For onion seed of hybrid varieties replacement rate is 100%; the quality seed gap is also 100%.

Table 11 *Current onion quality seed gap.*

Crop data	Metric	2020
Crop area[1]	*1000 ha	90.1
Production[1]	*million tons	3.20
Yield[1]	Tons/ha	35.5
Seed rate[2]	Kg/ha	10
Total seed demand	Tons	901
Seed replacement rate[2]	%	33%
Quality seed demand	Tons	297
Seed production[3]	Tons	12
Quality seed availability	%	4%
Quality seed gap	%	96%

Source: 1) FAO, 2023a (link); 2) Based on expert consultation (OPV); 3) Estimate of FDG experts.

Indicator crop: cabbage

Cabbage in Egypt is produced in lower quantities than tomato and onion. Demand for cabbage fluctuates along with rice demand due to its use in stuffed cabbage leaves/roles (malfouf) (FDG experts). Cabbage for used for this type of preparation provides a huge market.

Cabbage is grown in both winter and summer; winter is the main season accounting for approximately 60% of the cabbage production (FDG experts). In winter farmers mainly use seed of OPVs and hybrid varieties from formal sources; in summer they use local varieties and local seed.

Experts estimate that quality seed availability and use is approximately 30% (Table 12), which would be 1.2 tons based on crop production data for 2020 (see Table 12). This seed has its origin from three sources: (i) seed produced by CASP/FCRI, which is approximately 30% (0.4 tons); seed produced by local seed companies, which is approximately 15% (0.2 tons); and imported seed, which is estimated to be 55% (0.7 tons).

The current variety list has 11 cabbage varieties (CASC, personal communication), which are all developed by the private sector. Cabbage yield may increase with 40% when using hybrids (FGD experts); currently the area covered by certified hybrid seed is only 10% (FDG experts). Imported hybrid seed is considered to be very expensive.

Table 12 *Current cabbage quality seed gap.*

Crop data	Metric	2020
Crop area[1]	*1000 ha	16.6
Production[1]	*1000 tons	473
Yield[1]	Tons/ha	28.5
Seed rate[2]	Kg/ha	0.25
Total seed demand	Tons	4.1
Seed replacement rate	%	100%
Quality seed demand	Tons	4.1
Seed production/import	Tons	1.2
Quality seed availability[2]	%	30%
Quality seed gap	%	70%

Source: 1) FAO, 2023a (link); 2) Based on expert consultation.

Vegetable seed systems

We discussed vegetable seed systems configurations in a FGD involving eight crop group and seed experts and the three facilitators (of whom one is a vegetable seed expert). We looked at the crops onion, cabbage, tomato, and other high value vegetable crops in general. Four different seed system configurations were identified as presented in Table 13 (see each crop underlined in its main seed system). This includes the informal system, in which farmers produce seed from their own vegetable crop, or purchase seed from neighbours or other local sources. Both for onion and cabbage this is the main seed system. The varieties used are limited to a few public OPVs; through several generations of own seed saving and cross pollination, the germplasm is highly heterogeneous, resulting also in a heterogeneous product.

The other three seed systems are in the public, private or a mixed public-private domain. The fully public seed system is relatively small, with some investment in public variety development, i.e. FCRI for onion and HRI for other vegetables. Investment has recently been increased through international support to a new national programme on vegetable seed production. This includes support to the development of hybrid tomato varieties. In the relatively small public-private seed system local seed companies produce seed of some public OPVs and hybrids, which is marketed through agro-dealers.

The strongest system next to the farmer-managed seed system is the system in the private domain. For tomato and other high value vegetables 97% is imported hybrid seed from varieties developed by international seed companies. The variety list has 258 tomato varieties (CASC, personal communication) which are all released by the private sector. International seed companies produce seed from their own varieties, and market this seed through a network of agro-dealers, retailer shops and nurseries, as well as through direct contracts with large-scale vegetable producers.

Table 13 *Vegetable seed systems configurations.*

Characteristics	International & national companies	Companies in collaboration with public organisations	Public organizations	Farmer-managed
Domain	Formal, private	Formal, mix public & private	Formal, public	Informal, farmer-based
Crops	Cabbage, tomato, other high value vegetables (cucumber, melon, watermelon, pepper)	Tomato, other high value vegetables	Onion, cabbage, tomato (new national programme)	Onion, cabbage
Use of crop	Cash, export	Cash, export	Food, cash, export	Food, cash, export
Type of varieties	Private foreign hybrids	Public hybrids and OPVs	Public hybrid and OPVs	OPVs
Type of seed quality	Imported certified seed	Certified	Certified	Farmer-saved
Type of marketing and distribution	Agro-dealers, company contracts with large farms, retailer shops, nurseries	Agro-dealers	HRI, seed outlets, extension	Local exchange

Note: Crops are underlined in their main seed system.

Vegetable seed value chain operators and service providers

In the focus group discussion we discussed the main operators and service providers in vegetable seed value chains (see Tables 14 and 15).The NGB conserves a limited amount of vegetable germplasm from Lower-Bahiri and Saidi in upper Egypt. HRI manages vegetable variety development programmes, including a new national programme investing in the development of tomato hybrids. FCRI is involved in the development of OPVs of onion. Domestic Universities are involved in vegetable variety development to a limited degree. Domestic seed companies stopped the development of onion OPVs, because these cannot compete with

hybrids (FRCI, personal communication). But as indicated above, the largest amount seed of high value vegetables has its origin in breeding programmes of international seed companies and is imported from abroad. Most of the varieties are hybrids. Whereas breeder seed of public varieties is either produced by HRI and FCRI, foundation seed and certified seed is produced by CASP. Seed companies produce their own BS, FS and CS. Research and CASP market the seed themselves, and may use a network of public seed outlets.

Most international seed companies are focussing on seed trade, and work with local retailers and distributors for selling their seed on the Egyptian market. Others, like the companies Rijk Zwaan and Bakker Brothers, have started to invest in Egypt, by establishing local subsidiaries with field trial stations (LNV, 2020). The latter serve for testing and selection of vegetable varieties which are adapted to Egyptian and MENA growing conditions. The next step is investment in local plant breeding programmes; Bakker Brothers intents to take this step further.

Table 14 *Vegetables seed value chain operators.*

Operations	Operators
Plant genetic resources management	National Gene Bank, FCRI & HRI genebank units for breeding
Variety development	Seed companies, HRI & FCRI (onion), (Universities)
Early generation seed supply (BS & FS)	BS: HRI/FCRI (onion); FS: seed companies, HRI, CASP for HRI and FCRI
Seed production (RS/CS1 & C2)	Seed companies, CASP
Marketing and distribution	Agro-dealers, HRI/FCRI (onion), CASP, public seed outlets, private companies, retailers

Table 15 *Vegetables seed value chain service providers.*

Services	Service providers
Rural extension	HRI, FCRI (onion), CAAES, private seed companies
Variety testing and release	DUS: CASC, except onion (FCRI does VCU)
Plant variety protection	CASC, Plant Variety Protection Office (PVPO)
Quality assurance in seed production	CASC
Quality assurance in marketing	CASC
Financial services and management	Agricultural Bank of Egypt for credit for farmers
Marketing information and promotion	Private seed companies and National Programme for Vegetable Seed Production

Private seed companies, and their retailers or distributers provide after sale services to farmers on the use of their varieties; HRI and FCRI do so for the public varieties they have developed. CAAES provides farmers' advice on seed only to a limited extent. The newly established National Programme for Vegetable Seed Production also supports the promotion and use of improved varieties and quality seed.

Whereas vegetables are exempted for VCU, FCRI implements VCU of onion, which is considered a field crop. FCRI also does DUS testing for onion; CASC takes the responsibility for the other vegetable crops. CASC is also responsible for seed quality control and seed certification, and quality assurance at seed market outlets, including nurseries. Seed sellers need to be licenced. Quality of vegetable seed in the informal sector is a challenge.

Farmers may take credit for inputs from the Agricultural Bank of Egypt, but it is not clear how often this opportunity is made use of. MALR promotes digitalization in relation to credit facilities.

Challenges of vegetable seed systems

In the focus group discussion experts shared the challenges of vegetables seed systems; find some selected challenges mentioned below. The extensive list of challenges is elaborated in Chapter 5.

- Cumbersome seed import procedures and practices.
- Lack of germplasm for breeding for biotic and abiotic stresses for some vegetable crops; limited germplasm base for onion breeding.
- Non-recognition of property rights, and lack of awareness of stakeholders on PVP.
- Poor quality of propagation materials from nurseries.
- Poor farmer awareness of proper seed use and vegetable growing practices and lack of commitment to company instructions.
- Fluctuations in onion markets and onion seed demand.

3.4 Potato

Potato crop data and projections

Potato is one of the most important food crops grown in Egypt; it is not only important for local consumption, but also for export and for processing. Potato is rich in high-quality carbohydrate, fibre, vitamins like vitamin C and B6, and minerals like potassium; the crop contributes to a healthy diet when combined with other cereal products and vegetables (Kanter and Elkin, 2019). Looking at potato dry weight, its protein content is high as compared to other root and tuber crops, and the same as cereal crops. The International Potato Center (CIP) reports that compared to all other major crops, potato produces most food per unit of water; and compared to cereals the crop is almost seven times more efficient in water use (CIP, 2023).

Egypt is one of the top 20 potato producer countries in the world; the country is among the largest producers and exporters of potatoes in Africa. Rabia et al. (2021) reported that approximately 20% of the vegetable growing area is used for potato cultivation, with 65% of its production located in the Nile Delta. The area grown with potato increased in 2020 to 276 thousand hectares, with a total production of 6.8 million tons. Whereas the average yield in 2020 decreased slightly as compared to previous years to 24.6 tons per ha (see Figure 7), in 2021 it went up again to 29.3 tons per ha (FAO, 2023a). Further increase of yields needs improvements in relation to choice of proper planting dates (avoiding cold stress in January and February), irrigation management (in relation to heat stress), soil management and fertilization, pest and disease management and increased access to quality seed (Rabia et al., 2021).

Egypt has currently released 135 potato varieties (CASP, personal communication) which are all developed by the private sector. Variety choice is mainly based on specific demands of the domestic and the export market; the latter differ by country. PotatoPro (2022) reported that in the 2022 cropping season 131 thousand tons of seed potato were imported from the EU comprising of 76 different varieties (only varieties with over 1,000 tons mentioned): Spunta 45,000 tons, Cara 21,00 tons, Arizona 3,500 tons, Al Barn 3,000 tons, Diamant 2,300 tons, Pampeana 1,800 tons, Dunja 1,600 tons, Synergy 1,480 tons, Bellini 1,400 tons and Ceylon 1,585 tons. Seed potato exporting companies are now investing in the development of salt-tolerant potato varieties.

Potato has three main cropping seasons:

- The summer crop is planted from mid-December to February and harvested from mid-April to the end of June. The crop is 100% planted with imported seed potatoes. Its purpose is for seed multiplication and the local ware potato market. The summer crop yields the highest among the seasons, mainly due to the long sunlight hours. It is approximately 25% of the total production.
- The early winter crop is planted from August to mid-September and harvested from December to January. The crop is planted from farm-saved seed. Its purpose is the local market and early export. It is approximately 10% of the total production.
- The winter crop is planted from mid-September to mid-November and harvested from January to mid-April. The crop is 100% planted with local seeds saved from the previous harvest. Its purpose is for export, processing and the local market. It is approximately 65% of the total production. The winter crop yields 30%-50% less than the summer crop, mainly due to the short sunlight hours, weather conditions/low temperature, and the quality of seeds (FDG experts).

Potatoes are Egypt's largest horticultural export crop (see Figure 6) with a total export volume in 2020 of 684 thousand tons and export value of USD 270 million, of which 7% and 17% accounted for fresh potatoes and frozen potato products, respectively. Egypt has a strong position in the international potato market, with the EU being with 70% to 90% the biggest export market (FAO, 2020). Competing with other export crops like citrus and onion, shipment is sometimes challenging. The potato demand fluctuates slightly from year to year, but overall it stays high, with stable prices. Further increase in potato production is mainly from increase in potato area, with the government investing in land reclamation, providing public and private producers access to new land.

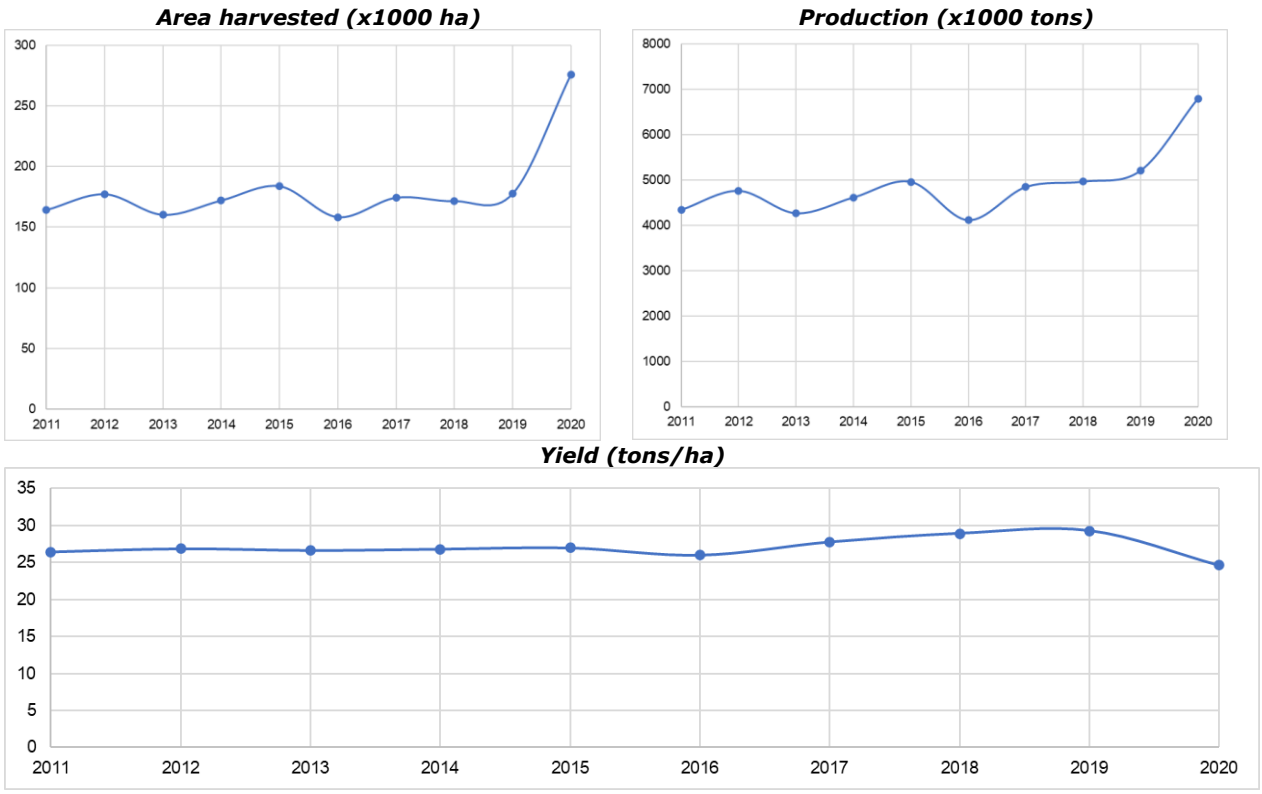

Figure 7 *Potato cropping data, 2011 – 2020.*
Source: FAO, 2023a (link).

Stakeholders indicate that the demand for quality seed for potato is fulfilled (FDG experts). This considers an average seed potato import for the summer season of 150 thousand tons (CAPQ, personal communication); in 2020 the exact amount was 124 thousand tons (Table 16). This amount is sufficient to plant the summer crop, and considers that farmers multiply their own seed for the potato crop for the winter season. If this generation of farmer-saved seed is considered quality seed, the seed gap is 0%; if not, the seed gap in 2020 was 78%. Some stakeholders complain about the quality of the locally produced seed potato.

Table 16 *Current potato quality seed gap.*

Crop and seed data	Metric	2020
Crop area[1]	*1000 ha	276
Production[1]	*million tons	6.79
Yield[1]	Tons/ha	24.6
Seed rate[2]	Tons/ha	2
Total seed demand	*1000 tons	551
Seed replacement rate	%	100%
Quality seed demand	*1000 tons	551
Seed import[1]	*1000 tons	124
Quality seed availability	%	22%
Quality seed gap	%	78%

Source: 1) FAO, 2023a (link); 2) seed experts.

Potato seed systems

In a focus group discussion involving eight potato crop and seed experts (plus 3 facilitators) we investigated the potato seed systems configurations (see Table 17). We can identify two seed systems for potato, which are merely differentiated by the seed source, and therefore also seed quality and seed marketing and distribution channels used. Seed for the summer season is all imported by foreign and domestic private seed companies; seed for the fall/winter season is saved by farmers from the summer crop harvest. Therefore, varieties are the same, and developed by international potato seed companies.

A diverse variety portfolio is used, determined mainly by specific local market and export demand (see also above). Seed import regulations are very strict in relation to seed potato quality. The local seed potato crop faces quite some challenges in relation to pest and diseases. Seed in the formal private system is distributed through a variety of channels, including the Horticultural Union, cooperatives, agro-dealers, and direct contractual arrangements between potato importers and large-scale potato growers. Seed potato importers are requesting enforcement of PVP regulations in relation to farmers' own seed multiplication and use.

Table 17 *Potato seed systems configurations.*

Characteristics	International & national companies	Farmer-managed
Domain	Formal, private	Informal, farmer-based
Use of crop	Local market, seed, limited export	Local market, export
Type of varieties	Foreign, private, imported	Foreign, private, imported
Type of seed quality	Summer crop: certified seed	Winter crop: farm-saved seed
Type of marketing and distribution	Horticultural Union, cooperatives, agro-dealers, contractual arrangements	Local exchange

Potato seed value chain operators and service providers

Tables 18 and 19 provide an overview of the key operators and service providers in the potato seed value chain, based on the discussion with experts in the focus group discussion. Private international potato seed companies maintain their own genetic resources collections, which they use for variety development. These companies also produce their own early generation seed, and import and market certified seed. ARC recently started with production of true potato seed and mini-tubers, but this is still in the experimental phase. Farmers reproduce their own seed for a second generation.

Table 18 *Potato seed value chain operators.*

Operations	Operators
Plant genetic resources management	Foreign private sector
Variety development	Foreign private sector
Early generation seed supply	ARC recently started with true potato seed and mini-tubers
Seed production	Foreign private sector; farmers for 2nd season potato production
Marketing and distribution	Private sector, potato cooperatives, farmers

Private seed companies invest in seed extension as well as promotion of their varieties; HRI supports farmers in saving seed for a next growing season. Variety release and testing is supported by CASC through one year of DUS and VCU testing. CASC through its dedicated PVP Office supports granting of Plant Breeders' Rights, which is important for a vegetatively propagated crops like potato. CASC inspects for quality at sales points; CAPQ is responsible for plant quarantine and pre-import inspections. Seed potato providers use different financial arrangements and business modalities with potato producers, processors and exporters.

Table 19 *Potato seed value chain service providers.*

Services	Service providers
Rural extension	Private seed companies, HRI (seed saving)
Variety testing and release	Authorization from company, testing by CASC for DUS and VCU (1 year)
Plant variety protection	CASC, Plant Variety Protection Office (PVPO)
Quality assurance in seed production	No quality control on local production (farm-saved seed)
Quality assurance in marketing	CASC & CAPQ for pre-import inspection; CASC for inspection at sales point; CAPQ for quarantine
Financial services and management	Different arrangements with producers, users, exporters, VC actors
Marketing information and promotion	Seed companies

Challenges of potato seed systems

The potato seed systems face quite some challenges; find key challenges as brought up in the focus group discussion below. The complete set of challenges will be addressed in Chapter 5.

- Several challenges related to seed import, including the limited importing period, long custom clearance time, and issues with seed quality.
- Increased prices of inputs for potato cultivation like pesticides, machinery, fertilizers, etc.
- Number of obsolete varieties in the market, which are susceptible to pests and diseases.
- Relatively low potato yields (hard to reach the potential of 60 tons/ha).
- Market fluctuations of ware potato.
- Limited local investment in new technologies, i.e. hybrid true potato seed, tissue culture and mini-tubers.
- Ministerial decrees related to potato are only available in Arabic.

4 Policy and regulatory framework

Context
National seed policies, laws and regulations provide governance and guidance to a range of seed sector related activities in the agricultural sector. These include: variety release, registration, and intellectual property rights protection; seed quality assurance and certification; seed business and seed trade; and genetic resources conservation, use and exchange. The way these activities are regulated largely determines the outcome of availability, access and use of seeds and varieties by farmers (Munyi, 2022), which in the agricultural context of Egypt are mostly smallholder farmers.

Regional economic communities like the Common Market for Eastern and Southern Africa (COMESA), and international organizations like the Organisation for Economic Cooperation and Development (OECD), the International Union for the Protection of New Varieties of Plants (UPOV), the International Seed Testing Association (ISTA) and International Seed Federation (ISF) aim to harmonize rules, standards, procedures and measures for seed production, quality assurance and seed trade. The goal is to facilitate the integration of smaller domestic and regional markets into one larger global market, to facilitate the movements of varieties and seeds across countries. Egypt is member of these organizations.

Adherence to harmonized regulations will benefit farmers in increasing the portfolio of varieties and quality seed they have access to. At the same time, it may cause frictions with smallholder farmers' practices of, for example, saving seed, exchanging seed locally, and releasing farmers' varieties. In this section we provide a brief overview of the seed policy and regulatory framework in Egypt and the implications of memberships of international organizations on the national seed sector and farmers practices.

Seed policy
Since the 1990s, agricultural policy reforms in Egypt have reduced the government monopoly in the seed sector, encouraging private sector investment for the emergence of a vibrant seed industry and agricultural sector. For the seed sector reforms focussed on: (i) establishment of an independent agency for testing and release of new varieties; (ii) reduction of government investments and support in seed production of self-pollinated crops; (iii) termination of involvement of the ARCs in large-scale seed production, processing and marketing; (iv) evaluation of pilot schemes identifying pre-conditions for private sector entry; (v) strengthening seed producer/trade associations as part of the seed industry (El-Wanis & Weisbecker, 2001). Whereas the private seed sector is strong in relation to high value vegetable crops, including potato, the Egyptian government continues to play a considerable role in other crop groups including cereals and food legumes (Kasim et al., 2018). For these crop groups the government supports the development of new varieties, early generation seed and certified seed production, and seed marketing.

Seed law
Egypt has laws and many ministerial decrees in place to regulate the seed sector and arrange its institutional set-up. Some of these date to the 1920s and 1940s. Whereas the Seed Law No. 5 of 1926 regulates specifically the production of cotton seed, the Seed Law No. 123 of 1946 regulates the production of seed for other major crops, such as cereals, legumes, oilseeds, forage crops and vegetables (Ahmed, 2010). It sets the standards for seed quality and establishes the procedures for seed testing, certification, registration and distribution. The law was replaced by Seed Law No. 52 of 1957, with the purpose of being more explicit on testing and handling of seeds, especially for export purposes (Ahmed, 2010).

Agricultural Law No. 53 of 1966 (FAO, 2023b), contains comprehensive provisions for the control and regulation of seed production and seed trade, including seed import and export, and is generally mentioned as the most recent comprehensive law addressing seeds. It covers the establishment and management of seed farms, research stations, laboratories and nurseries. It also regulates the registration, the licensing and inspection of seed dealers, and the enforcement of seed regulations (Ahmed, 2010).

Agricultural Law No. 53 of 1966 and the several Ministerial Decrees developed under this law thereafter provide the framework for seed sector regulation giving MALR statutory responsibility in Egypt for all aspects of genetic resources conservation, variety development, and seed production, sales and use. Except for the Plant Variety Protection Law, no new Seed Law has been issued. An overview of seed related Ministerial Decrees and Resolutions is available in the FAOLEX database (FAO, 2023c). MALR and CASC are now in a process of seed law review, developing a new law which incorporates all key issues which are regulated through the many different Ministerial Decrees (CASC, personal communication).

Variety registration and release

The reforms of the seed sector in the 1990s, led to Ministerial Decree No. 926 of 1995 for re-organization of the Central Administration for Seeds and the establishment of the Central Administration for Seed Production (CASP) and the Central Administration for Seed Certification (CASC) as separate organizations. The technical and administrative procedures for variety registration were modified and its management transferred from ARC to CASC, with assigned responsibility of tests for variety registration (DUS) and variety performance (VCU). To date, while variety registration tests are conducted by CASC, the variety performance tests are conducted by national research units, private sector and universities under the jurisdiction of CASC.

The Variety Registration Committee (VRC), hosted by CASC, and composed of representatives from public sector, private sector and national research is responsible for the review and approval process for variety evaluation, registration and release in Egypt. The committee is responsible for determining application requirements such as the variety name, materials to be submitted, evaluation protocols, and assigning technical agencies to execute the evaluation process.

Egypt domesticated the COMESA seed trade harmonized regulation in 2019 (COMESA, 2023), aligning the national seed regulations with the regional Seed Trade Harmonisation Regulations (COMESA, 2014). According to the regulations varieties of key crops released in more than one country can be automatically registered in the regional variety catalogue and traded in member countries. The national variety release system shall, for any variety that is intended to be released into the COMESA Variety Release System, ensure the variety satisfies the requirements for the DUS and VCU tests. The Egyptian seed company Misr Hitech Seed International has registered six maize and two sorghum varieties in the COMESA variety catalogue (COMESA, 2023). The multinational brewing company Heineken has registered a variety of barley in the variety catalogue, and has with support of EKN Cairo successfully requested for barley to be one of the harmonized crops under the variety release system.

Seed quality assurance and certification

CASC is the regulatory agency responsible for seed quality assurance and certification in Egypt. It is also a secretariat and de facto executive arm of MALR, governing the seed sector, hosting and representing MALR in different councils and committees of the seed sector. Since its establishment CASC had reviewed relevant laws and regulations and gaps in the rules and standards for field inspection, certification of seed and planting material, seed trade and market control, which have been issued in respective Ministerial Decrees.

With the domestication of the seed trade harmonized regulation in 2019 (COMESA, 2023), Egypt shall adopt the seed certification standards as set out in certification of basic and certified seed in terms of standards and labels.

Egypt participates in Economic Cooperation and Development (OECD) seed schemes, which promotes the use of internationally standardized and certified agricultural seed (OECD, 2023). The 61 participating countries have agreed upon harmonized procedures and standards for seed certification. This facilitates cross-border movement of seed. Egypt is a member of the OECD Seed Schemes for cereals, maize, sorghum, vegetables, grasses and legumes, and crucifers and other oil or fibre crops.

ISTA aims for world-wide uniformity in seed quality evaluation and is involved in developing internationally agreed rules for seed testing and standard procedures and methods for sampling and testing seeds, also promoting uniform application of these procedures for seeds involved in international trade (ISTA, 2023). All seed testing stations in Egypt are well equipped and ISTA procedures and methods are used to ensure reliability and uniformity of seed testing. The Giza Central Seed Testing Laboratory is an accredited ISTA member and serves as a reference laboratory in the country.

Plant Variety Protection

Law No. 82 of 2002 issues the protection of intellectual property rights, focusing on plant variety protection (PVP). PVP provides breeders, as developers of new varieties, legal intellectual property rights of these varieties. This protection is an important incentive for the development of better plant varieties, allowing breeders recover their costs necessary for further breeding investments. CASC is responsible to implement plant variety protection and established a PVP Office. Egypt became the seventy-sixth member of UPOV on 1 December 2019 (UPOV, 2019). However, awareness about PVP in the seed sector is generally still low. Organizations like EKN Cairo and Naktuinbouw have been supporting awareness raising for effective variety protection.

Genetic resources use and exchange

The International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) provides the international framework for the conservation and sustainable use of plant genetic resources used in food and agriculture, and the fair and equitable sharing of the benefits arising out of their use (FAO, 2023d). It recognizes farmers' rights to save, use, exchange and sell farm-saved seed, subject to national laws. It also establishes a multilateral system of access and benefit-sharing for a list of crops that are important for food security and interdependence. Egypt is a member of the IT-PGRFA since 2002; the NGB of Egypt is the national focal point. The treaty is in harmony with the Convention on Biological Diversity (CBD, 2023), of which Egypt is a member since 1994.

Seed business and seed trade

The General Authority for Investment and Free Zones (GAFI) is a public entity regulating, encouraging, advancing, administrating, and promoting investment in Egypt (GAFI, 2023). Its website provides guidance on how to start a business, including an investor guide, and important business facts. Moreover, it provides access to: (i) investment laws (including, for example, companies law and regulations; and new investment law and regulations); (ii) commercial laws (including, for example, the import and export regulation law); and (iii) financial laws (including, for example the banking law, addressing foreign exchange).

The Central Administration of Plant Quarantine (CAPQ) provides guidance on import and export procedures and phytosanitary standards, and issues phytosanitary certificates (CAPQ, 2023). Egypt is a member of International Plant Protection Convention (IPPC, 2023) which aims at preventing and controlling the introduction and spread of harmful pests of quarantine significance.

Institutional set-up

In the above sections we indicated already the key organizations and bodies in the seed regulatory system in Egypt; below we summarize their roles.

- MALR has the statutory responsibility for the seed sector in Egypt. It has an overall responsibility for the development of the seed sector and is authorized to issue Ministerial Decrees and Resolutions. It is the authority for supervising and controlling the seed sector.
- The National Seed Council (NSC), established in 1988 as a governmental body operating under MALR, represents seed sector stakeholders for advising MALR on seed related issues and policies, and guiding seed sector monitoring and reform (Ahmed, 2010).
- The VRC represents different seed sector stakeholders from the public and private sector, including the regulatory agency, research and private sector associations. The committee provides guidelines, protocols and procedures for variety registration. Moreover, it oversees and approves varieties for release and registration.
- CASC is the executive arm of MALR and is responsible for implementing regulatory frameworks for variety release, registration and protection as well as seed quality assurance and certification. CASC has specific departments and offices responsible for variety registration, plant variety protection, field inspection, laboratory seed testing, certification and market control.
- CAPQ is responsible for guiding import and export, developing procedures and phytosanitary standards, and issuing phytosanitary certificates.
- GAFI is a public organization regulating, encouraging, advancing, administrating, and promoting investment in Egypt, and is important in relation to seed business.

Regulatory framework addressing diverse stakeholder needs

Membership of communities, organizations and conventions that promote harmonization in seed sector facilitates international seed trade, since member countries follow similar procedures in relation to variety release, seed quality assurance, intellectual property rights, etc. It also makes Egypt a reliable trade partner at international level. Increased seed trade will benefit farmers in providing them access to a larger portfolio of varieties and increased sources of quality seed. International seed companies will only bring their best germplasm if their intellectual property rights are protected.

However, at the same time the international regulations may also obstruct farmers in seed saving and local seed exchange (UPOV 91) or releasing farmers varieties (variety uniformity requirements) and not recognizing their rights. It is important that national legislation carefully considers how to recognize farmers rights in relation to their farmer variety and seed management practices, not to criminalize farmers who do not comply with international regulations but exercise their rights, and facilitates their choices. Farmers' seed management practices have contributed to the conservation of agrobiodiversity, which is an important resource for the development of new varieties. Munyi (2022) emphasizes the importance of involving farmers and their organizations to participate in the formulation of seed policy to ensure that policies, laws and programmes are relevant, effective and sustainable.

SWOT analysis of Egyptian seed policy, laws and regulations

Find below a summary of the key strengths, weaknesses, opportunities and threats of the current seed policy, law and regulatory framework.

Strengths:

- The Egyptian seed legislation is aligned with the COMESA Seed Trade Harmonisation Regulations, which facilitates regional integration and trade in quality seeds.
- The Egyptian seed legislations are also in compliance with other international conventions and standards, such as UPOV 1991 and WTO-TRIPS, which protect plant breeders' rights and promote innovation.
- The Egyptian Laws and Ministerial Decrees cover all important aspects of variety testing and release, seed production, seed business and seed trade, and seed quality assurance for different crops.

Weaknesses:

- Lack of seed policy or seed sector development strategy reflecting the changing needs of the seed sector and the agricultural sector in general and providing guidance to seed sector stakeholders.
- The Seed Law needs an update and revision to include all new seed sector institutional and regulatory developments, which are now addressed through many Ministerial Decrees.
- The Egyptian seed legislation is not adequately enforced and implemented due to lack of human and financial resources, coordination, cooperation, awareness, and compliance among different stakeholders.

Opportunities:

- The Egyptian seed legislation can be improved and strengthened by addressing the gaps and challenges identified above, such as increasing resources, capacity building, information dissemination, incentives, and protection of specific seed sector stakeholders.
- The Egyptian seed legislation can benefit from the experiences and best practices of other countries and regions that have developed effective and efficient seed laws and regulations.
- The Egyptian seed legislations can create more opportunities for seed sector development by enhancing seed production, reliability, trade, competitiveness, diversity, innovation, security, and sustainability.

Threats:

- The Egyptian seed legislation may face resistance and opposition from some stakeholders who have vested interests in maintaining the status quo or who perceive the laws as unfair or unfavourable to them.
- The Egyptian seed legislation may be challenged or undermined by external factors such as political instability, economic crisis, environmental degradation, climate change, pest outbreaks, or market fluctuations that affect the seed sector.
- The Egyptian seed legislation may be outdated or irrelevant if it does not keep pace with the rapid changes and developments in the seed sector and the agricultural sector in general.

Conclusions

The seed legislation of Egypt reflects the historical and socio-economic context of the country and its agricultural sector. It aims to regulate and promote the development of new varieties, and the business of seed production and markets of those varieties, providing legal protection to breeders, seed sellers and seed buyers. When enforced it facilitates investments in new innovations and prevents unscrupulous seed merchants from selling poor-quality seed of unknown varieties to farmers. It helps to ensure that seeds produced, marketed and distributed are of high quality, with farmers having access to a wide range of varieties and seed that are adapted to their farming conditions and market demands. However, the laws also face some challenges and criticisms, such as the marginalization of farmer seed systems, and the lack of enforcement and compliance. It is important to review and update the seed policy, and keep updating the seed law/decrees periodically, to ensure that they meet the current and future needs and aspirations of the Egyptian seed sector.

5 Seed sector challenges and ambitions

Complexity of the seed sector

Enhancing the quality seed availability, access and use is complex. Seed needs to be available to farmers in sufficient quantity, of the appropriate quality, at the right place and at the at the right time. Seed needs to be of a variety that adapts to the local agro-ecological conditions, and matches with farmers' preferences and market demands. Moreover, farmers need to be able to afford buying and using the seed. If one of these issues is not right, farmers will not use the seed. Farmers use seed from multiple sources or seed systems. Each seed system has its own strengths and weaknesses, providing options for improvement opportunities. To strengthen the performance of the seed sector, targeted interventions are required in the sector's different seed systems.

Challenges

Through a combination of SSA tools using desk study and stakeholder consultations we identified challenges that negatively impact the performance of the seed sector. The challenges were grouped according to the eight key seed sector functions of the integrated framework for seed sector and food system transformation (see Figure 1 in Chapter 2): (i) production, (ii) value addition and distribution, (iii) service provision, (iv) utilization, (v) stakeholder organization, (vi) regulation, (vii) coordination, and (viii) funding. We elaborate these challenges in eight sections below. We indicate when the challenges are crop group/crop specific. Challenges are further grouped into topics.

Ambitions

Each of the eight seed sector performance functions has its own ambition; see Table 2 in Chapter 2 and the sections below. Together these ambitions contribute to the vision of a well-functioning seed sector in Egypt, that is innovative, competitive, resilient and inclusive. To provide directions towards solving the identified seed sector challenges, these were translated into ambitions. Challenges and ambitions were shared, discussed and further improved during stakeholder meetings. The challenges and ambitions organized according to seed sector functions and the topics are presented in the sections below.

5.1 Production

The ambition: seed production systems are technically feasible and economically viable and sustainable, and they cover all crops.

Table 20 *Topics, challenges and ambitions related to seed production.*

Topics	Challenges	Ambitions
Farmers' seed production	Low quality of farmer-saved seed results in low crop yields	Farmers are supported with knowledge to maintain seed quality
	Farmer seed production focus for potato is on yield instead of quality and number of tubers/ha, which compromises quality of farmer saved-seed	
Access to climate resilient varieties	Limited availability of climate resilient varieties – water-efficient, drought resistance, heat tolerant, salt tolerant, resistant to new emerging diseases and pests	Climate resilient varieties tolerant to abiotic and biotic stresses, tailored to environment, famers' and market demands are available to public and private seed producers
Access to foundation seed	Limitations in access to foundation seed of public varieties	Public and private seed producers have equal access to foundation seed of public varieties

Topics	Challenges	Ambitions
Seed production capacity	Some domestic private seed businesses lack technical capacity in seed production	Technical capacity of private seed companies on seed production is strengthened
New seed production technology	Not sufficient awareness and knowledge on new technologies for potato seed, including micro/mini-tubers and true seed	New potato seed production technologies supported and applied at national level (mini-tubers, true seed), building a local seed potato pipeline
Seed production sites	Insufficient appropriate land for seed production in new areas, including for seed potato production in the winter season (need for isolation and respecting hygiene standards)	Seed producers are supported in finding new (disease-free) land for seed production
Seed production planning	Fluctuating crop demand causes fluctuating farmers seed demand, which makes seed production planning difficult	Stabilization of crop markets limits fluctuations in seed markets
	Limited data available supporting seed production planning	Online database available supporting seed production planning

5.2 Value addition and distribution

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

Table 21 *Topics, challenges and ambitions related to seed value addition and distribution.*

Topics	Challenges	Ambitions
Seed processing	Limited seed processing facilities for smaller amounts of seed (for example, food legumes)	Small scale seed processing units established at ARC, also accessible for private seed companies
Unstable seed markets	Fluctuating product and seed demand, and excess of seed with limited shelf-life, like onion	Stabilization of crop markets limits fluctuations in seed markets; contractual production involving farmers, processors, exporters and seed producers
Business ethics	Some seed companies are not guiding farmers in appropriate seed use, with farmers not getting return on investment in quality seed	Seed companies provide adequate technical information/support along with seed sales
Business focus	Some agro-dealers and input providers operate with a short-term focus on financial gain; seed business needs long term engagement	Agro-dealers/input providers operate their business with long term focus on business excellence
Seed quality assurance at market outlets	Agro-dealers, seed distributers and nurseries are selling unknown vegetable varieties/seeds	Agro-dealers, seed distributers and nurseries are appropriately controlled
Seed promotion	Limited use of social media in seed promotion	Farmers access information about quality seed and new varieties through social media and other digital platforms

5.3 Service provision

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

Table 22 *Topics, challenges and ambitions related to seed service provision.*

Topics	Challenges	Ambitions
Genetic resources management	Insufficient funds and manpower for regeneration and characterization of the landrace collections of the national genebank	Genebank collections are characterized and accessible to both public and private sector for breeding purposes
Climate resilient varieties	Lack of climate resilient varieties that can withstand stresses like drought, heat, salt, and emerging diseases and pests	Climate-resilient varieties tolerant to abiotic and biotic stresses, tailored to environment, famers' and market demands developed/accessible
Accelerating variety development	No access to tools and infrastructure for speeding up the breeding programme (MAS)	Breeding departments have access to facilities for speed breeding and use of molecular tools
Varieties for processing	For specific crop varieties quality traits for processing are available, but not for other crops, like malting barley	PPPs established for variety development/access with specific processing requirements supporting new business opportunities
Hybrid varieties	For some vegetable crops hybrids are not yet available, because foreign varieties do not meet local agro-ecology or market demands (onion, cabbage)	Farmers have access to hybrid varieties of vegetable crops for which they are not available yet (onion, cabbage)
Variety testing and release	Limited cooperation regionally in variety testing and release	Varieties are released at regional level, becoming available at national level
	For some crops, farmers widely grow varieties of unknown foreign origin (e.g. lentil)	Farmer appreciated unofficially imported varieties of orphan crops are purified, characterized, registered and released
	Foreign companies not always bring their best varieties to Egypt, resulting in varieties released which have no added value for the farmers	Newly released varieties perform better than what is already on the market
Seed quality assurance	Limited human resource capacity constraints effective implementation	CASC staff well capacitated for providing seed quality assurance services to seed producers and seed traders
	Problems with quality planting materials in nurseries	Nurseries shall be licensed and quality standards are enforced
	Non-functional quality assurance system of locally produced seed potatoes (farm-saved seed)	Well-functioning reliable and transparent seed potato quality standard and certification system in place
Seed extension	Limited focus of public rural extension on seed issues	Public extension addresses key seed issues supporting farmers in increasing their productivity
Seed import	Logistic challenges with seed import at customs and shipment; process takes too much time	Logistics for seed import operate efficiently and effectively
	Lack of a good storage facility at customs until all tasks for seed clearance are finished	Upon arrival in Egypt, seed is stored safely under the right conditions to maintain quality
Seed export	Untapped seed export potential to Africa and other countries in the Middle East	Increased seed export to Africa and other countries in the Middle East
Finance	International financial transactions take a long time	International financial transactions supporting seed trade are smoothly operated
	Access to hard currency hampers international seed business	Private sector has access to hard currency supporting viable seed business

5.4 Utilization

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

Table 23 *Topics, challenges and ambitions related to seed use.*

Topics	Challenges	Ambitions
Farmers cropping practices	Farmers do not use the most appropriate cropping practices, and therefore achieve lower yields than expected	The yield gap for key agricultural and horticultural crops reduced by farmers applying good agricultural practices, including smart disease and pest control
	Farmers are not aware of new sustainable/regenerative climate smart cropping practices and technologies	Farmers have awareness, knowledge and skills on new sustainable climate smart cropping practices and technologies
Access to technology	Farmers do not have access to small-scale machinery, for example harvesters for lentils, limiting crop expansion	Farmers have access to technology, like small-scale machinery, supporting the professionalizing of crop production and creating demand for quality seed
Farmers' seed awareness	Farmers are not aware of new, climate adapted, disease resistant varieties, and lack knowledge on the advantages of those varieties and the use of certified seed, and continue to grow farm-saved seed of often outdated varieties	Farmers have all information needed to make well informed decisions, and are willing to invest in certified seed of improved and adapted varieties
Seed price	Farmers perception that imported hybrid seed is expensive	Farmers are aware of the advantages of hybrid seed
Quality differentiation	Farmers not rewarded for the quality of their products; this creates reluctance to invest in quality inputs, including seeds	Farmers are rewarded by paying them a higher price for quality products; and thereby their willingness to invest in quality seed is increased
Improving quality of informal seed	For some crops the informal seed system is the farmers' only seed source; varieties are obsolete and seed quality is poor	The informal seed system is recognized as an important seed source for farmers, and farmers are supported to access new varieties and maintain seed quality

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 24 *Topics, challenges and ambitions related to seed sector stakeholder organization.*

Topics	Challenges	Ambitions
Seed industry associations	Private seed sector association is not inclusive	Private seed sector associations represent the interest of all private seed businesses
Public-Private collaboration	Insufficient collaboration between public and private stakeholders in the seed sector	The public and private sector have a fruitful collaboration in all activities supporting farmers' access to quality seed

5.6 Regulation

The ambition: Policies, rules and systems governing production systems, seed markets, service provision, coordination, and use.

Table 25 *Topics, challenges and ambitions related to seed sector regulation.*

Topics	Challenges	Ambitions
Seed law	The seed sector is regulated through the agricultural law no. 53 (1966) and subsequent ministerial decrees; the law is outdated and information is scattered	Updated seed law addresses all new relevant seed sector developments, adheres to international standards, meets global specifications and supports investment in the sector
COMESA	Egypt is a COMESA member and domesticated the law, however this did not result in increased trade yet	COMESA seed law enhances regional seed trade
Plant variety protection	Public awareness on Intellectual Property Rights in Egypt is still low, and seed sector stakeholders are not fully aware of what is new in DUS testing and PVP	Egyptian seed sector stakeholders are aware of advantages and procedures related to PVP, including the newest requirements for DUS testing
Variety release	Vegetables are exempted from VCU testing, but for field crops 3 years of VCU testing is required; except for maize (2 years)	VCU testing for all field crops is minimized to 2 years
	Variety list not available online, and not in English	Up-to-date variety list available online in both Arabic and English
Illegal copying of varieties	Illegal copying of protected varieties brought into the country, causing unfair competition	Plant variety protection is enforced and illegal copying of varieties is punished
Seed quality assurance	Increase in seed borne diseases of imported seed potato, and lack of tracking to the seed lots	Seed tracking and tracing system for potato revisited and improved to ensure seed borne diseases are under control
Business registration	Delays in international business and facility registration for local operation	International seed business investment and registration for local operation mainstreamed
Investment law	Whereas the investment law allows foreign companies to own land, this conflicts with other regulations; decisions on land ownership now requires high level decision making on a case-by-case basis	Laws and regulations on foreign land ownership mainstreamed
Seed import	The period for importing and arrival time seed potato is limited; which is a challenge for potato seed importers	The window for purchase and arrival time for seed potato import is increased to allow sufficient time for all necessary preparations
	Seed import requires a lot of paperwork, including duplication of efforts (ISTA certificate, testing again in Egypt)	Seed import requirements consider only necessary documents and information, removing duplication of efforts (DUS, ISTA)
	The new online system 'Nafeza' for customs clearance needs further improvement	The Nafeza system is further optimized supporting a smooth online process of seed import

5.7 Coordination

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

Table 26 *Topics, challenges and ambitions related to seed sector coordination.*

Topics	Challenges	Ambitions
Seed policy/ strategy	No seed policy or strategy in place and lack of sector guidance	Seed policy or strategy in place supporting the development of a vibrant seed sector
National Seed Council	Limited visibility of the National Seed Council as a coordinating body of the seed sector	National Seed Council recognized and functional to coordinate the national seed sector
Seed related-data	Accurate and reliable data, and a centralized seed information system (data on varieties, seed production,	Centralized and up-to-date digital seed platform in place, with data on crops,

Topics	Challenges	Ambitions
	markets, export-import) are missing; this hampers investment decisions	varieties, seed production, markets, export-import, and regulation
Information for farmers	No mobile applications supporting farmers with information on quality seed	Farmers aware of quality seed and new varieties through mobile applications
	Limited ICT based platforms providing information to farmers for making investment decisions in crop production, like crop choices, sowing time, input use, and markets	ICT platforms supports farmers in decision making in crop production, including the selection of crops, sowing time, input use, markets, etc.

5.8 Funding

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

Table 27 *Topics, challenges and ambitions related to seed sector funding.*

Topics	Challenges	Ambitions
Modalities for reinvestment	Functional modalities for reinvestment in the sector are unknown	Modalities for reinvestment in the seed sector are explored and implemented
Prioritization of investments	Government needs to prioritize investment of its financial resources; wheat is the prioritized key food security crop above other cereals like barley, and legumes like faba bean	Broadened scope of government investment in the development of markets and seed systems of climate resilient crops like barley and faba bean

6 Way forward

Where are we now?
The SSA answers the question on seed sector performance: *Where are we now?* Through desk review and stakeholder discussions in Egypt and the Netherlands we learned that many activities in the sector are well organized; however, also challenges are observed. The challenges provide entry points for seed sector innovation; finding opportunities for improving seed sector performance was the first objective of the SSA. The SSA therefore emphasizes the challenges. Challenges may be perceived differently by different stakeholders, and a challenge for one stakeholder may not be a problem for another stakeholder; we still considered those challenges. Some indicated challenges have been solved recently, but not all stakeholders are aware of the changes; we left challenges those out.

Where do we want to go?
By translating challenges into general and crop specific ambitions we touched upon the question *Where do we want to go?* The ambitions indicate directions of a transformation process towards a well-functioning seed sector that is innovative, competitive, resilient and inclusive. Ambitions have been shared, discussed, and consolidated through multi-stakeholder consultations. We recognize that stakeholders prioritize ambitions differently.

We find topics and options for improvement for all the seed sector functions. The seed sector functions are connected, and some topics appear more than one time. For example, access to climate resilient varieties is important in relation to the function of seed production, as well as to the services function, i.e. variety development. Seed related data is another example: it appears under the function of sector coordination, with the ambition of having a centralized and up-to-date digital seed platform in place supporting seed sector stakeholders in investment decision making, as well as the function production, where seed producers indicated that the lack of such a system hampers their production planning. For a well-functioning seed sector, all seed sector functions need to be addressed.

How do we get there?
Prioritization of ambitions, i.e.: *Where do we want to go?*, and elaboration of innovation pathways, i.e.: *How do we get there?* are often answered in a well elaborated national seed sector road map or national seed sector strategy. Such a strategy is beyond the scope of the current study, and needs further consultation of seed sector stakeholders on priorities, innovation pathways, stakeholders involvement, and short-, medium- and long term targets.

In first round of discussions, current priorities as indicated by stakeholders in Egypt include:
- Facilitation of international investment.
- Increasing access to finance/foreign currency.
- Effective control of seed markets (reducing counterfeiting).
- Strengthening genetic resources management.
- Development/access to climate resilient varieties.
- Improving access to vegetable hybrid varieties.
- Establishment of seed storage facilities.
- Increasing farmers' awareness on the importance of seed quality.
- Stronger market incentives for increasing crop production.
- Development of a new seed law and modification of some Ministerial Decrees.
- Expansion of vegetable production.

Partnerships in seed sector development

The current assessment supports stakeholders in Egypt and beyond to find entry points for collaboration improving the performance of the seed sector, including collaboration between Egypt and the Netherlands. Identifying opportunities for Egypt-Netherlands partnerships was the second objective of the SSA. Egyptian seed sector stakeholders indicate collaboration in strengthening the sector's capacity as first priority, including knowledge development and knowledge exchange. Moreover, they see opportunities related to business development, like support on investment, elaborating business-to-business partnerships, and facilitating trade between the two countries. Dutch stakeholders agree on these priorities. In a separate document, based on gaps, ambitions, and stakeholders' interests and priorities, we provide a list of first ideas of potential Egypt-Netherlands partnerships for seed sector innovation on selected topics.

References

Abou-Ali, H., A. Elayouty & M. Mohieldin, 2023. Keys to climate action. Chapter 3 - Climate action in Egypt: challenges and opportunities. In: A. Bhattacharya, H. Kharas & J.W. McArthur (eds). Keys to climate action: how developing countries could drive global success and local prosperity. Brookings, Washington (link).

Abdalla, A., T. Stellmacher & M. Becker, 2023. Trends and prospects of change in wheat self-sufficiency in Egypt. Agriculture 13(1): 7 (link).

Abdelmaabood, A.A., A.F. Mashhour, A.M.M. Laban & M.R. Ismail, 2019. Economic study of faba bean yield in the Arab Republic of Egypt. Zagazig Journal of Agricultural Research 46(6A).

AbdelMonem, M., T. Wong, O. Elbadawy, J. Faurès, M. Tawfic, F. Abouzeid & F. Matteoli, 2022. Towards climate-smart agriculture in Egypt – Scaling up sustainable practices for enhancing agrifood system resilience and adaptive capacity. Cairo, FAO (link).

Abdul-Naga, A.M., 2009. Egypt: Sustainable Agricultural Development Strategy towards 2030. CIHEAM Analytical Notes 53, December 2009 (link).

Ahmed, H.M.I, 2010. Seed industry in Egypt. African Seed Trade Association (link).

Ahmed, N.Y., H. Delin, C. Belford, V. Shaker & N.A.H. Abdelrahaman, 2021. An estimate of the potential economic impacts of climate change on Egypt's agriculture: a multi-market model approach. Climate and Development 13(3) (link).

Altaie, K.H., H.J. Muhammed & H.B. Habib, 2022. How efficient are Egyptian maize producers? A study of maize production in Egypt using stochastic frontier analysis approach. American Journal of Economics and Business Management 5(3): 32-37 (link).

CBD, 2023. Convention on Biological Diversity (link).

CAPQ, 2023. Central Administration for Plant Quarantine (link).

CIP, 2023. Potato facts and figures. International Potato Center (link).

COMESA, 2014. COMESA seed trade harmonization regulations. Common Market for Eastern and Southern Africa (link).

COMESA, 2023. Egypt domesticates COMESA seed regulations. Common Market for Eastern and Southern Africa (link).

Dakar 2 Summit, 2023. Egypt Food and Agriculture Delivery Compact. Presented to Dakar 2 Summit: Food Sovereignty and Resilience, 26-28 January 2023. Dakar, Senegal.

De Boef, W.S. & M.H. Thijssen, 2023. Guide for designing a national seed road map. Wageningen University & Research, Wageningen (link).

Diab, Y.A.A., D.H. El Showeikh & M.E. Mahmoud, 2016. Study of economic efficiency and demand functions on the most important production resources used in producing of broad bean crop in Sohag Governorate. Journal of Agricultural Economics and Social Sciences 7(3): 323-330.

Elbasyoni, I.S., S.M. Morsy, M. Naser, H. Ali, K.P. Smith & P.S. Baenziger, 2020. Reverse introduction of two- and six-rowed barley lines from the United States into Egypt. Crop Science 60(2): 812-829 (link).

El-Khalifa, Z.S., E.H. El-Gamal & H.F. Zahran, 2022. Evaluation of barley cultivated areas' actual status in Egyptian newly reclaimed lands. Asian Journal of Agriculture and Rural Development: 12(3): 164-172 (link).

Elmoghazy, A.M. & M.M. Elshenawy, 2018. Sustainable cultivation of rice in Egypt. In: A.M. Negm & M. Abu-hashim (eds). Sustainability of Agricultural Environment in Egypt: Part I. The Handbook of Environmental Chemistry, vol 76: 119-149. Springer, Cham (link).

El-Wanis, M.S.A. & C. Weisbecker, 2001. Focus on seed programs; the seed industry in Egypt. Focus on Seed Programs, Country Reports Series. WANA Seed Network Secretariat, Seed Unit, ICARDA (link).

FAO, 2020. Country Showcase – Egypt; Potatoes. FAO (link).

FAO, 2022a. Country Briefs – Egypt. FAO (link).

FAO, 2022b. Boosting Egypt's fruit and vegetable exports by improving food safety and quality. FAO in Egypt. FAO (link).

FAO, 2023a. FAOSTAT, Food and agriculture data. FAO (link).

FAO, 2023b. Agricultural Law No.53 of 1966. MALR. FAOLEX Database, FAO. (link).

FAO, 2023c. Country profile Egypt - Cultivated plants. FAOLEX Database, FAO (link)

FAO, 2023d. International Treaty on Plant Genetic Resources for Food and Agriculture. FAO (link).

Foyer, C.H., H-M. Lam, H.T. Nguyen, et al. (26 authors), 2016. Neglecting legumes has compromised human health and sustainable food production. Nature Plants 2: 16112 (link).

GAFI, 2023. Laws and Regulations. Common Market for Eastern and Southern Africa. Egyptian General Authority for Investment and Free Zones (link).

IPPC, 2023. International Plant Protection Convention (link).

Kanter, M. & C. Elkin, 2019. Potato as a source of nutrition for physical performance. American Journal of Potato Research 96: 201–205 (link).

Kassim, Y., M. Mahmoud, S. Kurdi & C. Breisinger, 2018. An agricultural policy review of Egypt. First steps towards a new strategy. MENA RP Working Paper 11. Washington, DC and Cairo, Egypt. International Food Policy Research Institute (IFPRI) (link).

LNV, 2020. RijkZwaan soft launched field station in Egypt. Nieuwsbericht 15-06-2020, Agroberichten Buitenland. Netherlands Ministry of Agriculture, Nature and Food Quality (link)

Louwaars, N.P. & W.S. De Boef, 2012. Integrated seed sector development in Africa: a conceptual framework for creating coherence between practices, programs and policies. Journal of Crop Improvement: 26(1): 39-59 (link).

Mohamed, R.K., M.B. El-Eraky, M.S. Kandeal & M.A. El-Sawy, 2019. An economic study for the important factor on the gap of Faba beans in Egypt. Arab Universities Journal of Agricultural Science Ain Shams University 27(3): 1761-1770 (link).

Munyi, P., 2022. Current Developments in Seed Laws Harmonisation in Africa. Report to the European Commission. DeSIRA-LIFT (link).

OECD, 2023. Promoting the use of certified agriculture seed. Organisation for Economic Co-operation and Development (link).

PotatoPro, 2022. Egypt imported 131 thousand tons of seed potato and 25 thousand tons of potato products (French Fries and Chips). PotatoPro News 2022 (link).

Rabia, A.H., A.A.A. Mohamed, E.F. Abdelaty, S.F. Shahin & D.M.M. Yacou, 2021. Investigating adaptation strategies developed by potato farmers to cope with climate change impacts in Egypt. Alexandria Science Exchange Journal 42(4): 871-881 (link).

SeedNL, 2023. SeedNL, quality seed for all farmers. SeedNL (link).

Soliman, M.K.A., M.A.K. Kamal & I.F.M.A. Shaban, 2021. An economic study for supply response of faba bean's crop in Egypt. Scientific Journal of Agricultural Sciences: 3(2): 375-387 (link).

USAID Egypt, 2022. Agriculture and food security. USAID (link).

UPOV, 2019. Egypt accedes to the International Convention for the Protection of New Varieties of Plants. UPOV Press Release 123, November 1, 2019 (link).

Van Weert, F., M. Gülpen & G.J. Wilbers, 2022. Climate-smart agriculture in Egypt and Jordan; building blocks for a vision to create a climate-smart agricultural sector. Wageningen, Wageningen Environmental Research (link).

Wally, A. & M.J. Beillard, 2019. Egypt planting seeds sector overview – A growing opportunity for U.S. seeds. GAIN Report EG19001. USDA Foreign Agricultural Service (link).

Appendix 1 Stakeholder consultations

Many organizations and experts have been involved in the SSA. They were involved through participation in crop group focus group discussions and a multi-stakeholder workshop in Egypt; or joined a roundtable discussion in the Netherlands. Selected experts were also consulted through individual discussions, and through a short survey among members of Plantum, the Dutch Seed Association. Together the consulted experts represent a mix of public sector organizations, private seed companies, research and knowledge institutes and few civil society organizations. Find the organizations, which participated in various workshops, organized by country, below.

In the focus group discussions (10 and 11 March, 2023) and multi-stakeholder workshop (13 March, 2023) in Egypt, the following 23 organizations have been involved: Bakker Brothers Egypt, Cairo University, CARE Egypt Foundation, Central Administration of Plant Quarantine (CAPQ), Central Administration of Seed Certification (CASC), Central Administration of Seed Production (CASP), Coptic Evangelical Organization for Social Services (CEOSS), Domiatec Group, EGA Seed Company, Egyptian Seed Industry Association, Embassy of the Kingdom of the Netherlands (EKN) Cairo, Field Crops Research Institute (FCRI), Fine Seeds, Horticulture Research Institute (HRI), ICARDA, Korma-Egyptian Co for Seeds, Oils & Chemicals, Maba Group, Ministry of Agriculture and Land Reclamation (MALR), National Gene Bank (NGB), Nectaerra – Desalt Farm, Plant Variety Protection Office (under CASC), Samtrade, Rijk Zwaan. A total of 46 experts have been consulted.

Find the introductory presentation used in the multi-stakeholder consultation on the SSA's context, approach & preliminary results through this link. Find a summary of the workshop's group discussions through this link.

The following organizations joined the roundtable discussion in the Netherlands (13 April, 2023), in which assessment results were shared: Agrico, Bakker Brothers, BASF, East-West Seed, E Green Global, EKN Cairo, Farm Frites, Fobek, HZPC, Syngenta, Ministry of Agriculture, Nature and Food Quality, Naktuinbouw, Netherlands-African Business Council (NABC), NVWA, Rijk Zwaan, RVO, Skill-ed, Syngenta, WUR-Wageningen Plant Research. This meeting was organized by SeedNL and Resilience BV, and hosted by Plantum. The total number of participants was 22.

Find the introductory presentation on the SSA approach and results, used during the roundtable discussion as a basis for identifying opportunities for identifying Egypt-Netherlands partnerships opportunities through this link.

Appendix 2 Registered varieties

Table 28 provides the number of registered varieties of selected cereal crops, food legumes and vegetables. For each crop is indicated how many varieties have been developed by the public sector and by the private sector. Even if data are a mix of older data (Wally & Beillard, 2019) and newer data (CASC, personal communication, 2023) the list gives an impression of public versus private breeding investments for important field and vegetable crops in Egypt.

Table 28 *Total number of varieties registered in Egypt.*

Crop group	Crop	No. of varieties	No. of public varieties	No. of private varieties
Cereals	Barley[1]	20	17	3
	Maize[1]	147	31	116
	Rice[1]	18	17	1
	Sorghum	12	2	10
	Wheat[1]	27	24	3
Food legumes	Bean	16	1	15
	Chickpea	1	1	0
	Faba bean[1]	20	20	0
	Lentil	6	6	0
	Pea	9	3	6
	Soybean	6	6	0
Vegetables	Cabbage[1]	11	0	11
	Cucumber	118	3	115
	Onion[1]	10	4	6
	Potato[1]	135	0	135
	Pepper	121	0	121
	Tomato[1]	274	5	269

Sources: 1) CASC, personal communication, 2023. Data for other crops are from Wally & Beillard, 2019.

Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0)317 48 68 00
wur.eu/wcdi

Report WCDI-23-263

Wageningen Centre for Development Innovation supports value creation by strengthening capacities for sustainable development. As the international expertise and capacity building institute of Wageningen University & Research we bring knowledge into action, with the aim to explore the potential of nature to improve the quality of life. With approximately 30 locations, 7,200 members (6,400 fte) of staff and 13,200 students, Wageningen University & Research is a world leader in its domain. An integral way of working, and cooperation between the exact sciences and the technological and social disciplines are key to its approach.

To explore the potential of nature to improve the quality of life

Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0) 317 48 68 00
wur.eu/wdci

Report WCDI-23-263

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,200 employees (6,400 fte) and 13,200 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.