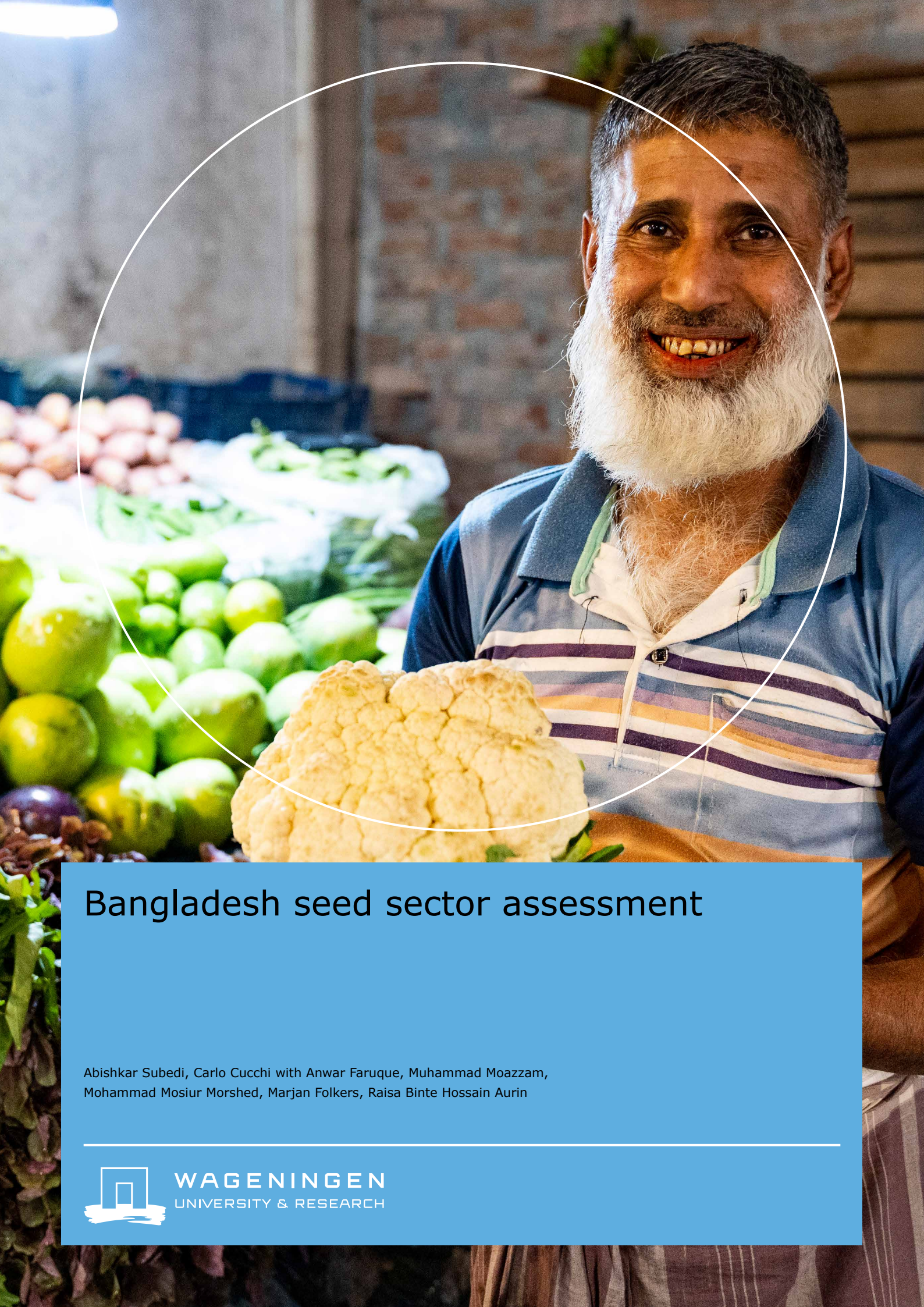

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Bangladesh seed sector assessment

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Wageningen, March 2024

Ministry of Foreign Affairs

seedNL

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nak tuinbouw

INNOVISION Research | Technical Assistance | Project Management

Ministry of Agriculture, Nature and Food Quality of the Netherlands

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This study provides an assessment of the seed sector in Bangladesh. In particular, it zooms in on seed systems of potato, vegetables and flowers. For each of the crop groups, key bottlenecks as well as ambitions towards the development of a well-functioning Bangladesh seed sector are elaborated. The methodology used in this assessment follows a desk study review and a consultative process held with key seed sector stakeholders from Bangladesh and Netherlands. The study was implemented by Wageningen University & Research, Naktuinbouw, Innovision consulting, and the Ministry of Agriculture, Nature, and Food Quality, (LNV), The Netherlands.

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

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This report is part of the collaborative work of the Wageningen Centre for Development Innovation (WCDI) Thematic Cluster on Seed Systems.

Seed Sector Assessment
Assessing the performance of Egypt's seed sector

National Seed Road Map
National Seed Road Map for Nigeria
Feuille de Route Nationale Semenciere du Mali
Feuille de Route Nationale Semenciere du Niger

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Disclaimer: The views expressed in this study are solely of the authors an do not necessarily reflect the opinions of their respective employees. If there are any factual inaccuracies, please contact the authors for updates to the information.

Summary

The role of agriculture in Bangladesh's economy has historically been significant. Although the contribution of agriculture to the country's GDP has gradually decreased because of the growth of other sectors like manufacturing and services, the government still relies on the sector as a catalyst for economic growth and has ambitious plans to transform the agricultural sector. This transformation entails a focus on sustainable and nutritious food production, fostering entrepreneurship, enhancing service access, modernizing institutions and policies in the sector emphasizing high-value crops, and building resilience to climate change. However, numerous challenges, such as population growth, worsening soil fertility, diminishing access to crucial natural resources, increased vulnerability of crop varieties to pests and diseases, and persistent poverty affecting food access, threaten future agricultural growth and food security. Acknowledging these challenges, the Bangladesh Government has placed a high priority on agricultural research, with particular emphasis on seed sector development, as a crucial component of the national food system transformation agenda.

Recognizing the importance of addressing these challenges, The Embassy of the Kingdom of the Netherlands (EKN) in Dhaka and SeedNL seek to identify strategies for supporting the development of a well-functioning seed sector in Bangladesh and fostering collaboration between the Bangladesh-Netherlands governments and private sector actors between the two countries. In the aftermath, this Seed Sector Assessment (SSA) serves as an initial step in evaluating the current performance of the Bangladesh seed sector and set directions for future investments and collaborations between the two countries.

The assessment was guided by three fundamental questions: Where are we now? Where do we want to go? How do we get there? To address these questions, the SSA utilized a triangulation of assessment results combining a desk study of secondary data with primary data emerging from stakeholder consultations and surveys.

The SSA delves into an in-depth review of the seed systems for horticultural crops, with a specific focus on potato, vegetables, and flowers. Analysis was performed on trends in cultivated areas, production, productivity, and seed demand and supply for each crop group. The assessment also investigated the configuration of seed systems for the three crop groups along with the identification of operators and service providers within the seed value chain. An examination of the major constraints hindering seed system performance was an integral component of the assessment. Moreover, the SSA encompasses an analysis of the policy and regulatory framework governing the seed sector and explores the institutional arrangements shaping the sector.

As final practical step, constraints identified in the desk study and stakeholder consultations were translated into seed sector ambitions. Challenges were identified across key seed sector functions, including seed production, value addition and distribution, service provision, seed utilization, stakeholder organization, sector regulation, sector coordination, and funding. The outcomes of the study were shared and discussed with a diverse group of seed sector stakeholders through workshops held in both Bangladesh and the Netherlands. The valuable insights and opinions of these stakeholders were incorporated to shape the final set of ambitions.

Bangladeshi stakeholders have prioritized several key seed intervention areas. Many of these interventions are sector-wide, while others are specific to the sub-sectors of potatoes, vegetables, and flowers. Sector-wide interventions include enhancing public-private partnerships for variety development and research, establishing an independent seed certification authority, establishing an independent plant quarantine authority, establishing national genetic resources centre focusing on vegetables, potatoes, and flowers, implementing the Plant Variety Protection Act, harmonizing seed rules and regulations with international standards, reviewing and simplifying seed import regulatory procedures that delay seed imports, strengthening the capacity of the Bangladesh Seed Association, developing the Bangladesh Seed Portal as a

one-stop-shop to facilitate seed business and trade, strengthening the market inspection system to curb counterfeiting in seeds, and enhancing private sector-led seed extension for the increased uptake of quality seeds of new varieties that are climate-adaptive and in demand in the market. Crop-specific interventions include strengthening capacity in local production of seed potatoes, establishing potato seed producers cooperatives, promoting protected agriculture for vegetable seed production, developing a floriculture sector development policy, building capacity in flower quality seed production, and strengthening the Bangladesh Flowers Society and Nursery Association.

Overall, this SSA report will support stakeholders in Bangladesh and the Netherlands in developing collaboration aimed at transforming the Bangladesh seed sector with a specific focus on potato, vegetables and flowers.

List of abbreviations and acronyms

B2B	Business-to-business
BADC	Bangladesh Agriculture Development Corporation
BARI	Bangladesh Agriculture Research Council
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BINA	Bangladesh Institute of Nuclear Agriculture
BKB	Bangladesh Krishi Bank
BPEA	Bangladesh Potato Exporters' Association
BRAC	Bangladesh Rural Advancement Committee
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
BSS	Bangladesh Sangbad Sandstha
Bt	Bacillus thuringensis
BTP	Bangladesh trade portal
CGIAR	Consultative Group on International Agricultural Research
CIP	International Potato Center
COASTS	Coastal Opportunities and Agriculture Solution to Tackle Salinity
DAE	Department of Agricultural Extension
DAM	Department of Agriculture Marketing
DUS	Distinctness, uniformity, and stability
EFSB	Eggplant fruit and shoot borer
EKN	Embassy of the Kingdom of the Netherlands
EPB	Export Promotion Bureau
FAO	Food and Agriculture Organization
FGD	Focus group discussions
FGDF	Focus group discussions (flower)
FGDP	Focus group discussions (potato)
FGDV	Focus group discussions (vegetables)
G2B	Government-to-business
G2G	Government-to-government
GDP	Gross Domestic Product
HRC	Horticulture Research Centre
HYV	High-yielding varieties
IFAD	International Fund for Agricultural Development
INGOs	International non-governmental organisations
IPPC	International Plant Protection Convention
ISSD	Integrated Seed Sector Development
ISTA	International Seed Testing Association
IVs	Indigenous vegetables
LNV	Ministry of Agriculture, Nature, and Food Quality
MoA	Ministry of Agriculture

MoC	Ministry of Commerce
MSMEs	Micro Small Medium Enterprises
NGO	Non-governmental organization
NL	Netherlands
NPPO	National Plant Protection Organization
NSB	National Seed Board
NSRM	National Seed Road Map
OP	Open pollinated
OPV	Open-pollinated varieties
PGR	Plant generic resources
PVP	Plant variety protection
PGRC	Plant Genetic Resources Centre
R&D	Research & Development
RRF	Rural Reconstruction Foundation
RVO	Netherlands Enterprise Agency
SBKS	Sara Bangla Krishak Society
SCA	Seed Certification Agency
SIO	Seed Investment Opportunities
SRDI	Soil Resource Development Institute
SSA	Seed Sector Assessment
TCRC	Tuber Crops Research Centre
UPOV	International Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
VCU	Value for Cultivation and Use
WB	World Bank
WCDI	Wageningen Centre for Development Innovation
WUR	Wageningen University & Research

1 Introduction

Agricultural development in Bangladesh

The agricultural sector remains a crucial driver of Bangladesh's development, despite its declining share in gross domestic product (GDP) from 31% in 1990 to 11.20% in 2022-2023 (World Bank, 2023). Despite this decline, agriculture continues to be the largest employer in Bangladesh, engaging approximately 36.9% of the total labour force in 2022 (World Bank, 2022a). Over the years, the agricultural sector has played a pivotal role in the country's progress towards food security. The growth in overall food production has consistently outpaced population growth, resulting in an increased per capita availability of food over time (Ahmed et al., 2021). With a population of 171 million, Bangladesh has achieved self-sufficiency in rice production, witnessing a threefold increase over the past three decades. This accomplishment has been attributed, in part, to advancements in seed, fertilizer, and irrigation technologies, all of which have played significant roles in driving agricultural production. Notably, alongside improvements in food availability, there have been positive developments in people's access to food. The advancements in agriculture have contributed to a reduction in the poverty rate from 48.9% in 2000 to 20.5% in 2022 (Asian Development Bank, 2022b).

However, despite these achievements, challenges persist in ensuring long-term food and nutrition security in Bangladesh. Factors such as population growth, declining soil fertility, limited access to natural resources like water and land, susceptibility of improved crop varieties to pests and diseases, and persistent poverty pose serious threats to future agricultural growth. The impacts of climate change, including increased natural disasters and increased levels of salinity, are anticipated to worsen food and nutrition insecurity in the coming decades if proactive measures are not taken (FAO 2019). Specific challenges persist in the production of certain non-rice crops, including pulses, vegetables, and fruits. Land ownership remains a critical issue, with about one-third of all farmers lacking ownership of the land they cultivate. Market-induced risks, particularly price fluctuations, are more pronounced for non-rice crops, indicating heightened market-related challenges for the production of fruits and vegetables. Additionally, high-value crops face constraints because of thin domestic markets, driven by widespread poverty and inadequate purchasing power, leading to sharp declines in market prices with increased production (Ahmed and Ghostlaw 2019). The complex interplay of all these factors contributes to raise concerns over the pace of agricultural transformation that is foreseen in Bangladesh.

Bangladesh Seed Systems, a plethora of opportunities

The pivotal role of seed and seed systems in Bangladesh's development strategy discourse is crucial. Use of quality seed forms the cornerstone of food production, and with the escalating demands of a growing population and competing claims for arable land and water, the continual development and promotion of better-adapted varieties becomes imperative for sustainable agricultural development. Bangladesh has already shown significant progress in seed sector development. Since Bangladesh's independence in 1971, policymakers have allocated substantial public resources to plant breeding programmes, seed production facilities, and the dissemination of improved varieties for key crops like rice, wheat, and others integral to food security and the economy (Ahmed et al., 2021). Moreover, over the years policymakers have introduced new rules and regulations, transitioning the seed system from a predominantly public sector domain to a more multi-actor landscape involving public, private, and civil society organizations. This shift has contributed to moving the country towards a more competitive, market-based seed system configuration, although this largely varies according to what type of crop is considered (Harun-Ar-Rashid, Ali, Gisselquist 2012; Waddington, Lantican, Tripp 2012). This shift has significantly contributed to augmenting agricultural productivity in the past decades (Ahmed 2000; Dorosh 2006; Rashid, Gulati, Cummings 2008; Hossain 2010).

Despite Bangladesh's commendable progress in seed sector development, there are still untapped opportunities within the sector. The lack of access to quality seeds of improved and locally adapted varieties remains a key impediment in the country. The development of new high-yielding varieties that are disease- and pest-resistant, and tolerant to salinity and extreme weather is indispensable in any strategy aimed at mitigating the impacts of climate change. For the Bangladesh seed sector to be effective, innovative, competitive, and resilient, it must meet diverse demands for various crops and varieties across different

agro-ecologies and farming systems. It should cater to local requirements, foster business growth, align with export ambitions, and address the needs of both smallholders and commercial farmers. Additionally, to operate efficiently, a delicate balance must be maintained between formal and informal provisioning strategies, market and non-market delivery channels, and public and private sector investments. The overarching goal is to match the supply of high-quality seeds with farmer demand. Further policy reforms are essential to encourage sustainable private investment in the development, production, and marketing of improved cultivars without compromising access.

Netherlands – Bangladesh collaborations

The enduring partnership between Bangladesh and the Netherlands, particularly in the domains of water management and agriculture, has yielded fruitful results over the years. The mutual exchange of technology and knowledge has not only led to progress but has also fostered the emergence of business partnerships. This collaborative spirit extends notably to the seed sector, where the Netherlands stands as a global leader in supplying quality seeds for vegetables, potatoes, including ornamentals.

The historical collaboration between Bangladesh and the Netherlands in seed-related development has seen joint initiatives and fruitful engagements. Noteworthy examples include seed-related education and training courses in the Netherlands; collaboration on the Onions impact cluster with Dutch companies such as Waterman Onions, Bejo Zaden, Allround Vegetable Processing, and Advance Consulting; and the Potatoes impact cluster involving Dutch companies like Verbruggen Palletizing Solutions, Agroplant Holland, and Allround Vegetable Processing. Moreover, collaborative efforts encompass projects like climate-resilient vegetable production in coastal areas with East-West Seeds and the Department of Agricultural Extension, implemented by Solidaridad, and initiatives like Coastal Opportunities and Agriculture Solution to Tackle Salinity (COASTS) in Bangladesh, involving ICCO/Cordaid, Lal Teer Seeds Ltd, Bejo, SRDI, and BAU. At the moment, various Bangladesh and Netherlands -based institutions are also actively engaged in facilitating and promoting collaboration on seed-related interventions across private sector actors between these two countries.

Purpose of the study

The Embassy of the Kingdom of the Netherlands (EKN) in Bangladesh and SeedNL are exploring entry points to enhance collaboration between Bangladesh and the Netherlands in the seed sector, with a focus on opportunities for development, trade, and investment. The objectives of the current assessment are outlined as follows:

1. Assess the seed sector in Bangladesh, with a specific focus on potato, vegetables, and flowers.
2. Identify key challenges within the seed systems, formulate ambitions and explore potential opportunities for collaboration between Bangladesh and the Netherlands to address these challenges.
3. Provide recommendations for the development of an investment portfolio, encompassing government-to-government (G2G), government-to-business (G2B), and business-to-business (B2B) initiatives.

In summary, the assessment aims to analyze the current performance of the seed sector in Bangladesh, pinpoint challenges, and formulate ambitions. The findings will contribute to outlining the opportunities for collaborative seed partnerships between Bangladesh and the Netherlands.

Outline of the report

The structure of the report is outlined as follows:

Chapter 2 delves into the methodology employed in the current study. It provides a comprehensive understanding of the approach and tools used to gather relevant information. Chapter 3 describes the results of the desk study, categorized by crop groups. It covers crucial aspects such as cropping data and trends, seed trade, seed demand and supply, configurations of seed systems, and the various operators and service providers within the seed value chain. Chapter 4 gives an overview of the policy and regulatory framework governing the seed sector. It offers insights into the existing guidelines and regulations that shape the landscape of seed-related activities in Bangladesh. Chapter 5 outlines the challenges identified during the discussion with Dutch and Bangladesh stakeholders. For each challenge, corresponding ambitions are provided. The report concludes with Chapter 6, which provides a brief explanation of the way forward. It encapsulates the key takeaways from the assessment and provides a list of priority topics synthesized as seed investment opportunities to strengthen Bangladesh-Netherlands partnerships in transforming the Bangladesh seed sector.

2 Study approach

This chapter elaborates the study approach used in this assessment. The study approach used in this assessment comprises a set of key guiding steps highlighted in the Guide for Designing a Seed Sector Roadmap by De Boef & Thijssen (2023).

Guiding concepts of the SSA

The SSA assessments is fundamentally relying on five key guiding concepts which are illustrated here below:

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 contribute to identify innovations and collaborative action opportunities. This concept is guided by the recognition of complementary roles of the public & private sector, formal & informal seed systems for developing a vibrant, competitive and resilient national seed sector; see Figure 1.
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 are 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 (Borman et al, 2022); see Figure 2.

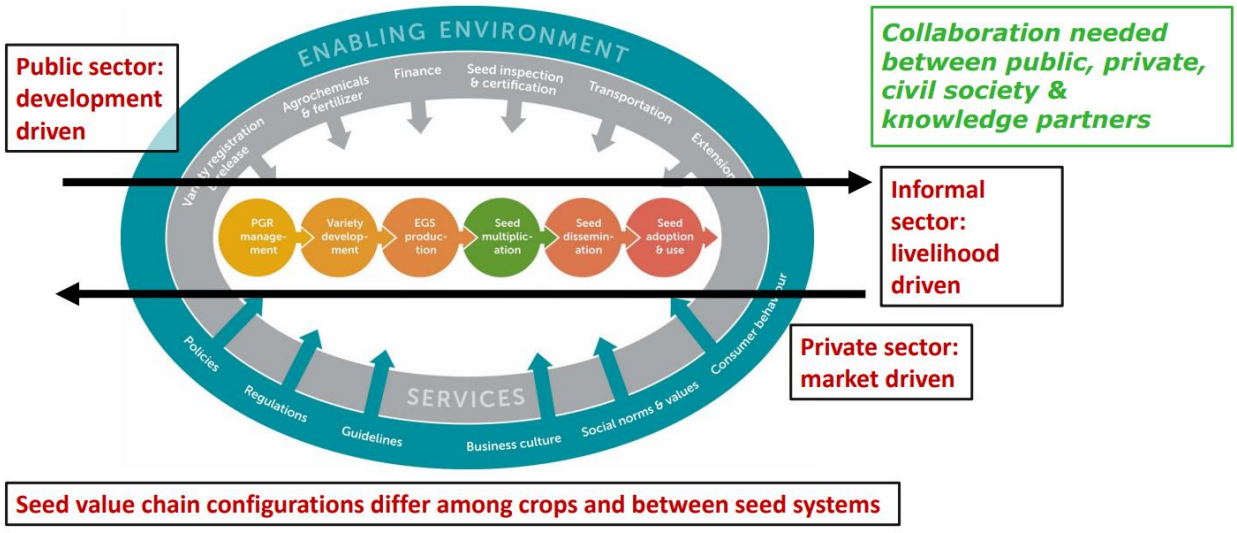

Figure 1 *Multi-actor configuration in seed value chain, adapted from Subedi et al., 2017.*

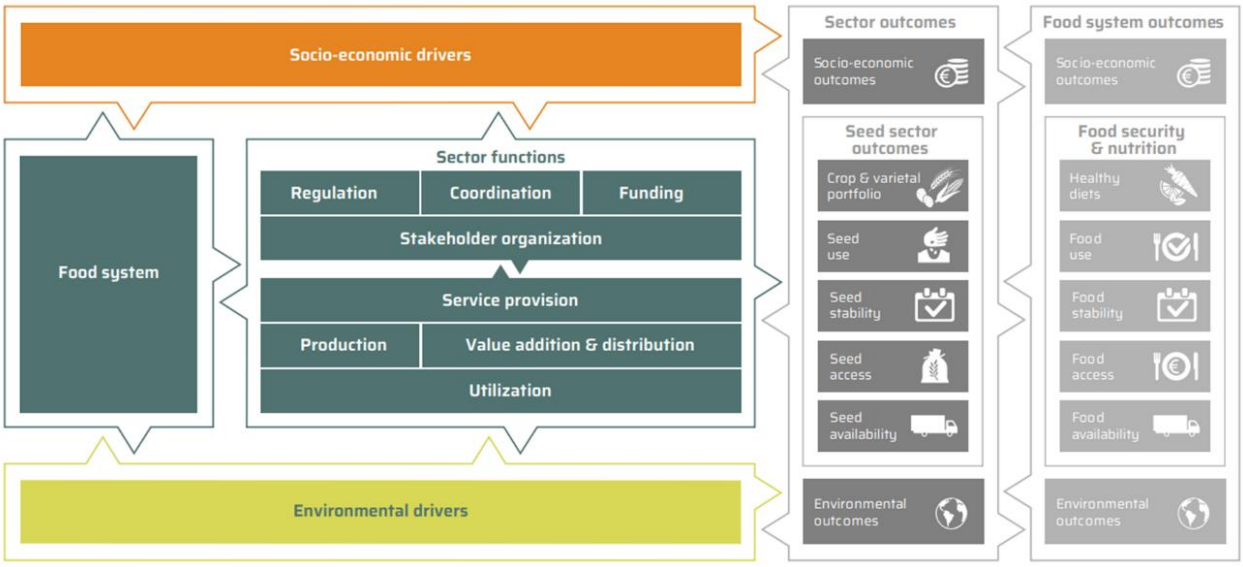

Figure 2 *Integrated framework for food system and seed sector transformation Source: Borman et al., 2022.*

2.1 Methodology

The methodology used in this assessment follows in full the standard methodology utilized by Thijssen et al.,(2023) in the Seed Sector Assessment carried out for Egypt. Although it is important to mention that some steps in the data collection as well as selection of focus crops are unique, as they have been tailored to the Bangladesh context.

Tools of the SSA

In this SSA we used a combination of tools to get a deeper insight into the Bangladesh seed sector performance and future investment trajectories. The tools varied according to the key information which we sought to collect, which comprised both secondary data gathered through desk study and primary data collected with key stakeholders through workshops, consultations and surveys. These different modalities helped to corroborate the findings and allow triangulation of results. The tools used in this assessment are drawn from the Guide for designing a National Seed Road Map (NSRM), and were adapted to fit the purpose and context of the study (De Boef & Thijssen, 2023).

The tools and methods used to carry out a seed sector assessment are of different kinds and could be used in iterations. This allows flexibility as well as the possibility to tailor specific suitable tools to specific needs. Overall, there are 9 key tools which could be used in conducting SSAs. These tools are listed here below:

SSA Tool 1: Seed System Analysis
SSA Tool 2: Seed value chain analysis
SSA Tool 3: Analysis of the seed enabling environment
SSA Tool 4: Comparative analysis of seed indices
SSA Tool 5: Seed sector literature review
SSA Tool 6: Digital seed sector survey
SSA Tool 7: Focus group discussions based on crop groups
SSA Tool 8: Translation of challenges into seed sector ambitions
SSA Tool 9: Analysis of the seed enabling environment

A more detailed overview of different tools is highlighted in details by De Boef & Thijssen (2023).

Key steps and guiding questions

This SSA is based on three key steps, each step addressing specific guiding questions and objectives. The key steps at the basis of the methodology of this SSA are the following: assessment of seed sector performances; development of seed sector ambitions; and development of seed sector innovation pathways. These keys steps are described in the table here below. Major information on each steps and tools used within each of the steps are further elaborated in the subsequent sections.

Table 1 *Guiding questions of the assessment.*

No.	Key Steps	Guiding questions	Short description
1	Assessment of state of seed sector performance	Where are we now?	Assessing key performance of the sector and highlighting key challenges
2	Development of seed sector ambitions	Where do we want to go?	Translating challenges into general and crop-specific ambitions
3	Development of seed sector innovation pathways	How do we get there?	Translating ambitions into first ideas for potential Netherlands-Bangladesh partnerships for seed sector innovation on selected topics

Assessment of state of seed sector performance

The assessment of state of seed sector performance has the objective to address the following question: *Where are we now?*. This step comprises several tools which are further elaborated in the table below (Table 2).

Table 2 *Tools used in the seed sector assessment. Note: Find a more elaborate description of the tools in De Boef & Thijssen, 2023.*

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 system analysis	Analysis of the crop groups' seed system configurations by domain, key crops, type of varieties, seed quality assurance, and seed distribution mechanisms
3	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
4	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
5	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 Bangladesh and the Netherlands

Development of seed sector ambitions

In this step, 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 3 elaborates the ambitions of the eight seed sector functions.

Table 3 *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

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 National Seed Road Map (NSRM) or national seed sector strategy, which is beyond the scope of the current study. However, in a second report (Seed Investment Opportunities Report, published separately, confidentially), based on gaps, ambitions, and stakeholders' interests and priorities, we provide the first ideas of potential Netherlands-Bangladesh partnerships for seed sector opportunities on selected topics. This is key information which can be used by Bangladesh relevant stakeholders as a starting point to develop and strengthen incentives to favour major involvement of Dutch businesses in the Bangladesh seed sector.

Key contributing stakeholders to the assessment

The assessment was implemented by a team of experts with insight into the developments of the global seed industry and the Bangladesh seed sector. The team involved experts from Wageningen University & Research, Wageningen Centre for Development Innovation (WUR, WCDI), Naktuinbouw, Innovision consulting, and LNV. Bangladesh stakeholders contributed to the SSA through participation in interviews, focus group discussions, and a multi-stakeholder workshop. Dutch stakeholders contributed through their responses to a short survey among Plantum (Dutch seed association) members, a roundtable discussion in the Netherlands, and several bilateral meetings held online. An overview of the stakeholders involved in the study is provided in Appendix 1. The section below summarizes the key steps of the data collection.

Key Steps in the data collection

The data collection involved different phases. It started in August 2023 and concluded in February 2024. The key points are highlighted in Table 4 below.

Table 4 *Description of data collection steps.*

No.	Activity	Location	Date	Description
1	Desk study	Netherlands	August 2023	A desk study focusing on the status of the potato, vegetable, and flower seed sub-sector in Bangladesh was carried out by the WCDI team in September 2023.
2	Seed policy and regulatory assessment	Bangladesh	September 2023	The mission was conducted by Naktuinbouw and LNV in collaboration with the Bangladeshi seed scoping mission team. This mission focused on understanding Bangladesh's priorities in the agriculture and seed sector, analyzing seed-related policy and regulatory challenges, and identifying opportunities. The mission conducted key informant interviews and held meetings with higher-ranking officials of MoA, Bangladesh, including the Seed Wing, Phytosanitary Wing, Bangladesh Agricultural Development Corporation (BADC), Bangladesh Agriculture Research Council (BARI), and selected members of the National Seed Board. Additionally, the mission interacted with representatives from the private seed sector and farmers in Bangladesh.

No.	Activity	Location	Date	Description
3	Seed Sector Assessment	Bangladesh	September 2023	This mission was conducted by WCDI together with the Bangladeshi seed scoping mission team. The mission included at least two rounds of focus group discussions (FGD) with representatives from the public and private seed sectors for each crop group (potatoes, vegetables, and flowers). The mission team also interacted with farmers cultivating potatoes, vegetables, and flowers. Various tools, such as seed systems analysis, seed value chain analysis, and seed gap analysis tools, were used to facilitate discussions. The FGDs involved approximately 10-15 representatives from the public and private seed sectors in mixed group settings. Over 70 participants joined various FGDs, representing plant breeders, agronomists, sales and extension agents, and seed quality control staff from the public and private sectors. The FGDs also included faculty members from agricultural universities and representatives of private sector associations (seed associations, flower societies, and nurseries associations). The FGDs focused on key challenges and opportunities in various functions and services of seed sector transformation, including plant breeding, variety development, variety release and registration; seed production, storage, and seed marketing; seed import and export; seed quality assurance; seed policy and regulation, seed sector coordination, seed sector finance, and farmers' uptake of quality seed use.
4	Focus group discussion with Dutch seed sector stakeholders	Netherlands	November 2023	The seed companies that have already been involved in the seed business in Bangladesh for potatoes, vegetables, and flowers were approached to discuss their challenges and business opportunities. This activity was organized in coordination with Plantum. Follow-up bilateral meetings with individual seed companies were organized. A meeting with the International Association of Horticultural Producers (AIPH), based in the United Kingdom, was also organized to discuss opportunities for collaboration with the flower seed sector in Bangladesh.
5	Multi-stakeholder validation workshop with Bangladesh	Bangladesh	December 2023	A highly successful multi-stakeholder workshop was organized in Dhaka, with over 70 participants from various public entities (different departments of the Bangladesh Ministry of Agriculture, BARI, BADC, BRAC), private seed companies, Bangladesh Seed Association, Bangladesh Flowers Society, agricultural universities, and development partners (Netherlands Embassy, World Bank, IFAD), as well as international non-governmental organizations (INGOs) such as Solidaridad, Cordaid, and PUM Netherlands. During the workshop, the validation of crop data and challenges faced by the potato, vegetables, and flower seed sector in Bangladesh was conducted. Five parallel working groups were involved in validation and selected the priority challenges and ambitions that need to be addressed through multi-stakeholder collaboration in Bangladesh, along with potential topics for collaboration between Bangladesh and the Netherlands in the seed sector.
6	Survey of Dutch stakeholders	Netherlands	January 2024	In partnership with Plantum, a short survey was sent to relevant Dutch businesses operating in the potato, vegetable and flower seed business to address key challenges experienced in operating in Bangladesh and the main reasons preventing them from enlarging their business activities in the region.
7	Validation meeting with Dutch seed sector stakeholders	Netherlands	February 2024	In partnership with Plantum, a validation workshop with Dutch seed companies was carried out to discuss priority topics and challenges for potential collaboration between Bangladesh and the Netherlands actors in the seed sector.
8	Reporting	Netherlands	April 2024	The seed scoping mission produced two reports. The first (the current one) with the findings of the seed sector assessment, covers crucial data on seed production, demand and supply, import and export, and challenges in the potato, vegetable, and flower seed sector. The second report focuses on recommendations for potential investments to support collaborations between Bangladesh and Netherlands

Crop selection

Seed system configurations vary among crop groups, and may even vary among crops within a crop group. In light of this aspect, this report zooms in on seed systems of three horticultural crop groups (potatoes, vegetables and flowers) which are the focus of this study. In vegetable crops we have further selected three indicator crops to deepen the analysis: tomatoes, onion and brinjal.

3 Assessment of Bangladesh seed sector performance

This chapter focuses on assessing current seed sector performance and challenges related to specific crop groups. In particular, it addresses one key overarching question in relation to seed sector performances, namely: *Where are we now?*

This question is tackled by reviewing available literature concerning the seed sector for each of the crop groups. The review follows the Integrated Seed Sector Development (ISSD) framework, ensuring attention is given to formal, intermediary, and informal seed systems. In addition, a pluralistic approach is adopted towards the various seed systems, involving public, private, non-governmental organisations and farmers. This chapter zooms in on the performance and main challenges of seed systems for three crop groups or sectors (potato, vegetables, and flowers). In the case of vegetables, specific indicator crops (tomato, onion and brinjal) have been chosen. The following information is provided for each crop group: crop production area and coverage; import and export data; analysis of seed systems; analysis of the seed value chain (including operators, service providers, and the enabling environment); information on seed production; and the key challenges faced. In the next chapter we zoom out to the challenges and ambitions for the seed sector as they emerge both from the literature and from conversation with key Bangladesh and Dutch stakeholders.

3.1 Potato

Potato crop data and projections

Potato is one of the most important food crops in Bangladesh and one of the largest crops in terms of production after rice (Rahim et al., 2023). In the fiscal year (FY) 2021-22, total potato production hit 10 million tons (Table 5), surpassing the production of 8.38 million tons in the FY 2020-21, thus ranking Bangladesh the seventh largest tuber-producing country in the world and third-largest producer in Asia after China and India (Rahim et al., 2023). The annual internal demand of potatoes is around 8 million tons. This implies that 2 million tons are actually surplus. Most of the surplus potatoes are either exported, directed for cattle foods, or wasted because of negligible exports and low capacity for cold storage (Rahim et al., 2023).

Table 5 *Area, Yield Rate and Production of Potato 2019-20 to 2021-22.*

Crop	2019-20			2020-21			2021-22		
	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons
Potato									
Local	181	122.71	828	171	4648	796	167	4787	799
HYV	959	245.18	8777	987	9212	9091	980	9538	9346
Total potato	**1140**	**8421**	**9606**	**1158**	**8538**	**9887**	**1147**	**8844**	**10145**
Sweet potato	61	4052	246	66	4270	280	72	4247.05	304
Total	1201		9851	1224	8306	10167	1219	8571	10449

In Bangladesh, potato farming represents 12.5% of total crop production (BBS, 2022a). Potato production dramatically increased in the past two decades taking into account that less than a decade ago, in the FY 2013-14, the total potato production of Bangladesh was 8.9 million tons which was 2.5 times more than that of the FY 2000-2001. Currently potato is produced in a total area of 11.5 million acres (4.6 million hectares) corresponding to 3% of Bangladesh's total area under crop production.

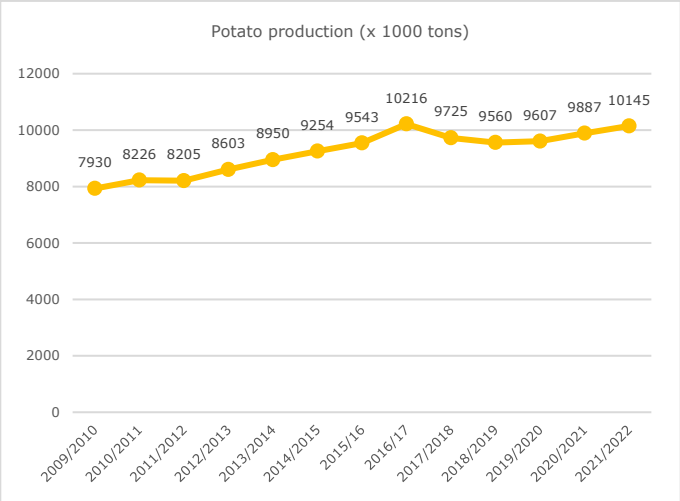

Figure 3 *Potato production, Bangladesh BBS, (2022a).*

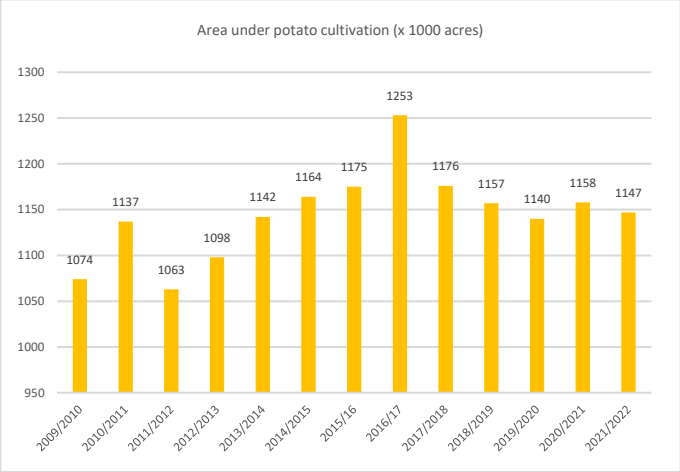

Figure 4 *Area under potato cultivation, Bangladesh BBS, (2022a).*

In Bangladesh soil and climatic conditions offer high potential for potato production. However, over the past three years the yield per acres have seen a relatively flat trend pattern. Current potato yield stands at 21.85 t/ha, a figure which is still low compared with that achieved in other countries (Eatons et al.,2017; Rahim et al., 2023). Some of the reasons causing these lower yields are the use of low-yielding varieties, the low resistance of these varieties to diseases and pests, and the lack of availability of quality seed tubers (Eatons et al., 2017).

Potato is considered one of Bangladesh's most promising crops for several reasons. It has become popular as it can now be consumed almost over a whole year, especially after the introduction of cold storage facilities. Moreover, potato production has also earned popularity because of the weather conditions, which are favourable for potato cultivation (Nasif et al., 2018). Potato is generally grown in the winter season (November to March) and it is grown in more or less all areas in Bangladesh, especially in the north-western region of the country (Munshiganj, Bogura, Rangpur and Dinajpur) (BBS, 2022a).

Potato also plays a key role in terms of consumption because of its high nutritional value. Currently potato provides as many as 6.5% of the daily per capita calories and protein consumed in rural areas because of the abundant supply (BSS, 2022a). It has become an important crop for food security, especially during extreme flooding during the monsoon, as it is one of the few crops for which seed stocks are kept in cold stores ready for immediate planting after floods (Jannat et al., 2021). However, despite the increase in production and the relevance for household food security, as argued above, in the past ten years consumption level has remained relatively stable. As highlighted in the household income and expenditure surveys carried out in

2010, 2016 and 2022, potato per capita per day intake has been recorded at 70.52 grams, 64.8 grams and 69.7 respectively (BBS, 2010; BBS, 2016; BBS, 2022b).

Import and export

Potato exports from Bangladesh are growing. The export potential was tapped by the increase in production of potato varieties more adapted for export, namely varieties having good yield, bigger size and high dry matter content (Islam et al., 2022). Overall total exports indicated a resilient expansion from 2012 to 2021 with a volume of export which has increased considerably over the last nine years. Overseas shipments of potatoes increased by roughly 40,000 tons in the past four years, from 25,000 tons in 2018 to 62,000 tons in 2021 with a value of USD 14.404 million (see Figure 5 & 6). In the FY year 2021-22, potatoes (fresh or chilled) the main destinations were Malaysia (50%), Sri Lanka (30%), Nepal (12.2%), and Singapore (5.6%) (FAO, 2023). The total value of imported potato (fresh or chilled) in 2022 was USD 6.148 million, including USD 3 million for seed potatoes.

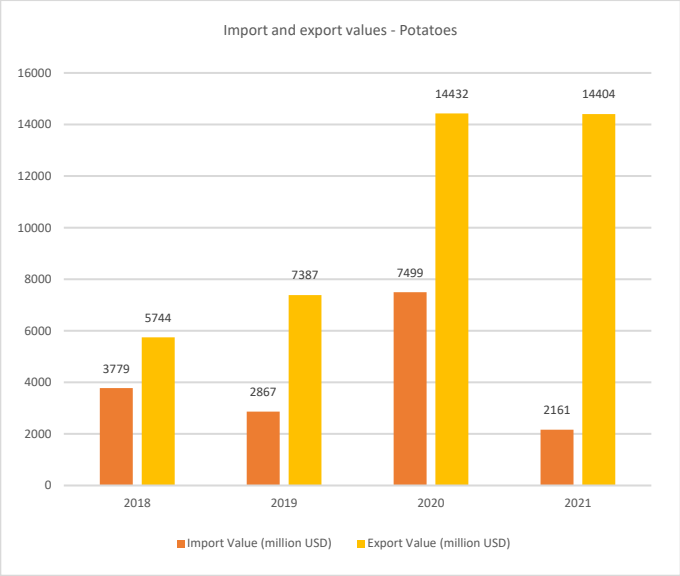

Figure 5 *Potato import and export values, FAO (2023).*

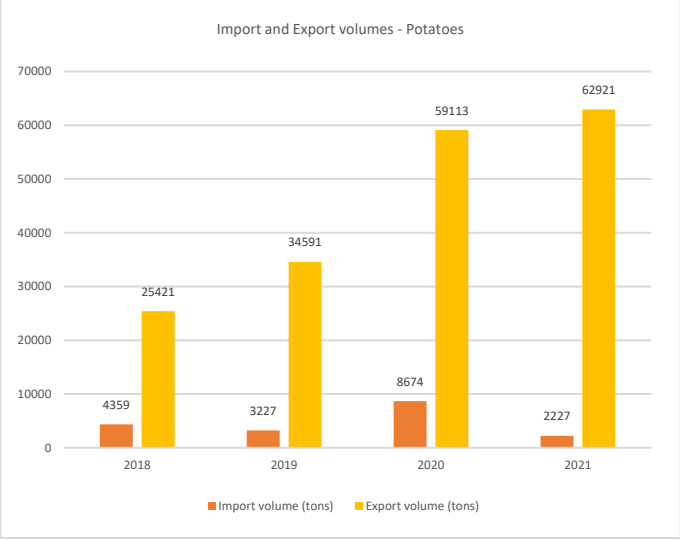

Figure 6 *Potato import and export volumes, FAO (2023).*

Potato seed systems

In Bangladesh there are **four main** seed systems for potato, differentiated by the variety used, source, seed quality, seed marketing, use of crop, and distribution channels. The different seed system configurations for potato are illustrated in Table 6.

Table 6 *Potato seed system configurations.*

Characteristics	Multinational companies, national private companies	Public organizations	Local private companies in collaboration with public organization	Farmer-managed
Domain	Formal	Formal	Formal	Informal
Use of crop	Cash, export	Cash, export	Cash, export	Food, cash, potential for export
Major varieties	Diamant, Cardinal, Granola, Asterix, Santana, Lady Rosetta, Levante	Sagita, Pakhri, Diamant, Asterix, Lady Rosetta, Santana	Diamant, Cardinal, Granola, Asterix, Santana, Alverstone, Sagita	Sheel Bilatee, Lal Sheel, Lal Pakhri, Cardinal, Diamant, Bilatee, Seven
Type of varieties	Foreign private (imported), local private	Local public	Foreign private, imported; Local public	Local indigenous and recycled improved high-yielding varieties (HYV)
Type of seed quality	Certified	Certified	Certified	Farmer saved seeds
Type of marketing and distribution	Contractual arrangements, wholesalers, retailers, outlets	Contractual arrangements, BADC outlets	Contractual arrangements, BADC outlets, wholesalers, retailers, outlets	Local exchange
%	15%	5%		80%

The most prominent seed system for potato is the informal farmer-managed seed system, which accounts for roughly 80% of the potato seed supply in Bangladesh (Rahim, 2023). With this system, farmers keep a portion of their current year's production to use as seeds for the following year in cold storage, and grow both indigenous and recycled improved high-yielding varieties (HYV). All the seeds to produce indigenous varieties of potatoes are derived from the potatoes produced the previous year. These varieties are resistant to diseases and require less fertilizer and pesticides. However, the yield is very low.

The second most prominent seed system is dominated by national and international private seed companies. While the supply of quality seeds through formal system is increasing remarkably (Rahim 2023) only 15-20% of annual seed supply comes from the formal sector. There is a strong presence of both local and international companies. Often local companies follow an import-based system which relies on importing seeds from foreign countries. Within this system, seed companies customarily import foundation seed, multiply, market, and produce these in Bangladesh (Siddique et al 2015).

The local production-based system relies on producing seeds through reliable local contract farmers or seed producers. A few companies (Lal Teer Seed, Advanta Seeds Pty Ltd, Bayer Crop Science, and Bioseed, Bangla Seed Company, Giant Agro, Supreme Seed, Kishan Botanix, Ispahani Agro, and Krishibid) also produce and multiply their own varieties.

The third and fourth seed system are characterized by public organisation involvement in seed production and supply as well as collaborations between public and private sector. According to Rahmin (2023), 5% of potato seeds are provided by the Bangladesh Agriculture Development Corporation (BADC). BADC is the government agency involved in the production, processing and distribution of commercial seeds in the market in Bangladesh (BADC, 2014). BADC uses seed developed by government research institutes and agricultural universities, multiplies them through its own contract farmers, and markets them in the market. A reasonable quantity of potato seeds are also imported every year by BADC from abroad. Thus, though as yet still limited, there is a configuration of mixed public and private seed systems.

Potato seed value chain operators

There are several operators in the potato seed value chain. See Table 7 below.

Table 7 *Potato seed value chain operators.*

Seed Chain	Operators
Genetic resource management (gene bank)	Private sector, BADC, BARI
Plant breeding and new variety development	BARI, TCRC, BADC (started), private sector
Breeder seed production (pre-foundation seed)	BADC, BARI, private (BRAC, ACI, Supreme Seeds)
Foundation seed production	BADC (both BARI and BADC-bred varieties and imported foundation seed), private sector
Certified/quality seed production	BADC (40,000 tons), private (95,000 tons)
Seed marketing and dissemination	BADC, private
Seed use	Farmers

Different organizational bodies are associated with the work of genetic resources management in Bangladesh, but the Plant Genetic Resources Centre (PGRC) plays the leading role in conservation, management, utilization and promotion of plant generic resources (PGR) in Bangladesh. The prime responsibility of PGRC is to survey, collect, regenerate, characterize, conserve, utilize and promote the genetic resources of all the BARI mandate crops (Chowdhury, 2012). However, the institute does not have a gene bank and there is no long-term preservation system for potato genetic resources in Bangladesh.

Both private and public institutions are actively involved in potato variety development in Bangladesh (TCRC, 2023). For the public sector, the Tuber Crops Research Centre (TCRC) of BARI has the mandate for all potato variety development in Bangladesh (see Appendix 4 for an overview of the varieties released by TCRC). About 70% of potato research at the institute is on varietal development; the remaining 30% is on agronomic, management and post-harvest research. TCRC is the institute responsible for breeding and is the institute responsible for maintaining breeder seeds (pre-basic seed). The centre has also programmes on germplasm exchange; it receives a good number of exotic germplasm, and gives local germplasm to other countries. For example, the centre enjoys a strong collaboration with the Consultative Group on International Agricultural Research (CGIAR) and the International Potato Center (CIP). The Bangladesh Agriculture Development Corporation (BADC) has also recently started variety development of seed potatoes. (FGD P, 2023a; FGD 2023b). Apart from TCRC and BADC, several national private sector companies have already started potato variety development, often in collaboration with existing public institutions. For instance, ACI Limited, a national seed producer company, has its own research and development stations (the Rural Development Academy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, and Bangladesh Agricultural University).

Potato seed production, marketing and distribution

Potato seed production is performed by both the private and the public sector. In the public sector domain, the TCRC of BARI produces breeder seed of popular varieties and supplies it to BADC for multiplication (Kolady & Awal, 2018; Shaheb et al., 2015). BADC supplies foundation seeds for certified seed production to contract growers. The seeds are then marketed and distributed by BADC through a network of seed dealers and seed outlets (seed sales centres). (Khurana et al., 2003; Shaheb et al. 2015). These operations are subsidized as sales do not cover the full costs of production, processing, marketing, and distribution (Ahmed et al., 2012). In the formal private system, seed companies (both local and international) develop their own varieties; they produce certified seed potato through contract growers and sell certified seed through a network of local agro-dealers. Companies without their own breeding (R&D) programmes choose one or more of the following approaches for seed multiplication; they rely on TCRC for breeder seeds for subsequent seed multiplication and distribution. In the formal private system seeds are distributed through a variety of channels, including agro-dealers and direct contractual arrangements between potato importers and potato growers/outlets. However, the distribution landscape is largely dominated by MSMEs (retailers and wholesalers) which focus on marketing seeds of high-yielding varieties of potatoes (Rahim, 2023).

Potato seed demand and supply

According to BADC, the annual total demand for potato seed in the country is about 700,000 tons to 770,000 tons. Out of this demand, private companies hold 15-20% of the market share (95,000 tons) and BADC provides 5% (40,000 tons). The remaining 565,000-635,000 tons (80%) is met by the informal seed system. In light of these figures it can be assumed that the supply of quality seed tuber in Bangladesh accounts for 135,000 tons per year, of which private companies (local and importers) hold 70% of the market share and BADC accounts for 30%. Out of the multiplied varieties by BADC, only 5% are BARI bred varieties; others are BARI 'released' but actually originate from private breeding programmes (FGDP, 2023b).

Import of potato seeds

According to Seed Wing, the amount of seed potato imported accounted for 4000 tons and 3000 tons in 2018-19 and 2019-20 respectively (Seed Wing, 2023). Surprisingly, the amount of imported seed potatoes almost doubled in 2022, reaching 6800 tons, because of a disastrous rain which destroyed 90% of seed potato planted in Bangladesh (FGDP, 2023a). In addition, a large number of medium-and large-scale farmers, who typically preserve seed potatoes of above 75% of the produce, sold the seed potato as table potato in June-July, fetching a good price, which is now affecting the potato-seed markets. The production cost of potatoes nearly doubled in 2023 in comparison to 2022, raising concerns about a further increase in retail prices (in peak moments, seed-potato prices for 2023 skyrocketed to Tk 70-Tk 90 per kilogram) (The Financial Express, 2023). According to Potato Pro (2020), Bangladesh imported seed potatoes mainly from the Netherlands (95%). The imported seed potatoes include varieties such as Diamant, Carolus, Margarita, Barcelona, and Accent. HZPC, Agrico, Agroplant, STET Holland, Schaap Holland, De Nijs, and Den Hartigh are the major Dutch potato seed companies involved in exporting to Bangladesh.

Potato seed imports are subjected to the import policy order 2015-18 (MOC, 2016). The policy states that the importer must submit, along with import documents, a quarantine certificate issued by the original supplier and a phytosanitary certificate from the government agency of the potato seed-exporting country. A quarantine certificate must also be obtained from the Plant Protection Authority before clearing imported potato seed from the customs authority, and an import permit issued by the Plant Protection Authority should be also submitted. The import permit is issued by the Plant Protection Wing of the DAE and the phytosanitary certificate is provided by the exporting country (BTP, 2023).

Potato seed value chain service providers

In Bangladesh there are several potato seed value chain providers which carry out several activities. Table 8 illustrates the main ones.

Table 8 *Potato seed value chain service providers.*

Services	Service providers
VCU testing	Seed certification agency (SCA)
DUS testing	Seed certification agency (SCA)
New variety release and registration process	Seed wing (MoA)
Breeders' rights application and granting process	None
Seed quality assurance in production	BADC (internal quality checks), private (truthful labelling)
Seed quality assurance in marketing (e.g. post-control test)	SCA
Seed quality assurance in import	Plant Quarantine Wing
Seed quality assurance in export	Plant Quarantine Wing
Seed/rural extension	BADC, private
Financial services and management	Public and private banks (BKB, RAKB)
Marketing information and promotion	DAE (area production), DAM (price figures, availability), BBS

Extension is carried out both by public and private sector actors. For the public sector, extension is mainly carried out by joint efforts of the Directorate of Agricultural Extension (DAE), as well as by TCRC, which has technology validation and transfer as a key activity within their mandate, as highlighted in its activity statement (TCRC, 2023). Extension activities mainly concern farmers' training in various methods in potato

cultivation and production. Recently, several efforts through extension campaigns has been made by the government to strengthen the potato sector, especially for the export market. For example, in 2019 the Bangladesh government together with other key stakeholders (the Bangladesh Potato Exporters' Association (BPEA); BADC; a national network of farmers' organizations, the Sara Bangla Krishak Society (SBKS); and the Food and Agriculture Organization of the United Nations (FAO)) carried out extension operations promoting the cultivation of export-oriented potato varieties. This programme is part of the 'Missing Middle Initiative' project (BSS, 2023). Along with the public sector, private companies also integrate extension activities in their endeavours; they have an integrated unit with a strong extension component as part of their outreach and marketing strategy, but also work together with national and international NGOs in their outreach and operations (CIF, 2022).

A significant development occurred with the denotification of potatoes in 2019, simplifying the registration and release of new potato varieties. Potato was in the list of notified crop for several decades. However in 2019 the government excluded potatoes from the list for four years, lessening restriction on the introduction of new varieties of potato seeds, their production and marketing, thus liberalizing the potato seed sector (PotatoPro, 2022)[1]. As a response to this favourable policy, the number of released varieties in Bangladesh has increased considerably in the past years. 104 new potato varieties have been registered and released since de-notification occurred (see Annex 1), of which 17 are from BADC[2], 4 from crossing BARI varieties, 2 from CIP and the remainder from 68 private companies (Mallick et al., 2021) (FGDP, 2023a).

Challenges to potato seed systems

The potato seed system faces several challenges. The major ones are as follows: lack of quality seed; lack of inputs; lack of knowledge on better farming practices and quality seed potato production (most potato growers are unaware of optimal management practices for seed production); lack of storage; low investment capacity of the farmers; disease problems, especially late blight viruses; pests problems, especially aphid infestation that helps to disseminate virus diseases to potato plants; high price of quality seed potato; high price of inputs (fertilizer, pesticides etc.); lack of irrigation facilities; unavailability of seed potato at the proper time; high transport costs; lack of educated labour; and seed available through the informal system is of poor quality with unknown origin and no seed potato generation number (Hossain et al. 2008; Hanemann and Ahmed, 2007; Uddin et al., 2010; Hossain et al., 2011; Shaheb 2013; Mian et al., 2013; BARI, 2009).

3.2 Vegetables

Vegetable crop data and projections

In Bangladesh, horticultural farming represents 7% of total crop production (6 million tons of vegetable production) and 2.79% of the total farming area (4 million ha) (BBS, 2022a) (Table 9). Bangladesh produces over 150 vegetable crops (RVO, 2021). Within this group, 19 major and 20 minor indigenous vegetables (IVs) could be identified. Major IVs include brinjal, hyacinth bean, bitter gourd, pointed gourd, ribbed gourd, snake gourd, sponge gourd, wax gourd, teasle gourd, cucumber, and Indian spinach, and are mainly grown in the summer season. Minor IVs include watercress, winged bean, sword bean, ivory gourd, chenopodium, tak palong, water lily, and leaf amaranth, and are cultivated on a small scale (Shahadad et al., 2006).

[1] For all crops which are classified as non-notified crops, the private sector faces less restrictions in the use of new genetic material and relatively less restrictions in the importing, registering, and marketing of seeds (Ahmed et al., 2012). In contrast, for notified crops the private sector faces restrictions in the use of new genetic material and accessing public varieties and breeding lines of these crops. Additionally, the private sector has to pay levies on seed imports for all notified crops and has to undergo time consuming and onerous registration process where the companies pay a fee to the government to conduct **performance tests** to decide whether or not to allow each cultivar. Potato requires on average 4 years to register and release a new variety (FGD TCRC).

[2] The newly-developed potato varieties introduced by BADC are the following- BADC potato 1 (Sunshine), BADC potato 7 (Queen ani), BADC potato 5 (Edison), BADC potato 8 (Labella), Rashida, Bari Alu 41, Seven Four Seven, Bari Alu 62, Fontaine, BADC Alu 3 (Santana), Aluite, BADC Alu 10 (Alkandar), Bari Alu 79, Diamant, Carolus, Bari Alu 40 and Asterix.

Table 9 *Area and production of crops 2021-22 (BBS, 2022a).*

Crops	Production '000'M. tons	Production %	Area '000' acres	Area %
Cereals	43493	52	30853	77
Pulses	432	1	926	2
Oil seeds	1034	1	1236	3
Spices and condiments	4005	5	1084	3
Sugar crops	3558	4	279	1
Fibres	8432	10	1783	4
Drugs & narcotics	825	1	391	1
Vegetables	**6010**	**7**	**1125**	**3**
Potato	**10449**	**12**	**1219**	**3**
Fodder	368	0.	50	0.
Flower	**48**	**0.**	**4**	**0.**
Fruit	5334	6	896	2

In total, over 6 million tons of vegetables are produced annually, including 2.2 million tons of summer vegetables, 3.8 million tons of winter vegetables, 2.5 million tons of onion and 527,000 tons of garlic. The main vegetables and spices produced in Bangladesh are onion, garlic, tomato, brinjal and cabbage (see Appendix 2 for major details). Two distinct production seasons can be identified for vegetables, one in summer (Kharif) and one in winter (Rabi). Summer production is generally more challenging for farmers (because of high rainfall and higher pest and disease pressure), but also more profitable. Production volumes in wintertime are higher, with correspondingly lower prices (RVO, 2021). Concerning vegetable consumption, regular diets in Bangladesh are heavily dependent on rice, although it has been declining in recent years with the increased consumption of fruits and vegetables. Despite this rising trend, daily consumption of fruits and vegetables is still very low in the country. Per capita daily vegetable consumption in 2010, 2016 and 2022 was only about 166 grams (BBS 2010), 167.3 grams (BBS 2016) and 201.9 grams respectively (BBS, 2022b).

Import and export

The total value of vegetable imports was USD 266 million in the FY 2021-22. The most important vegetables that were imported included onion (USD 172 million), garlic (USD 52 million), and tomato (USD 19 million) (FAOSTAT, 2023). Bangladesh at present exports 0.10 million tons of vegetables to 52 countries annually (BSS, 2022). According to the Bangladesh Bureau of Statistics, Bangladesh exports 30 to 35 types of vegetables across Europe, North America, Asia, and the Middle East. Bangladeshi exporters face the most competition from Indian and Pakistani exporters as the cost of exporting vegetables from Bangladesh is comparatively high.

The total value of vegetable exports was USD 34 million in the FY 2021-22 according to FAO. Vegetable export earnings decreased by USD 10 million (15%) from the FY 2018-19 (EPB 2023). Non-operativity of vegetable quality checking, additional freight charges and lack of cargo space were among the main reasons contributing to this decrease, according to major vegetable exporters (The Business Post, 2022).

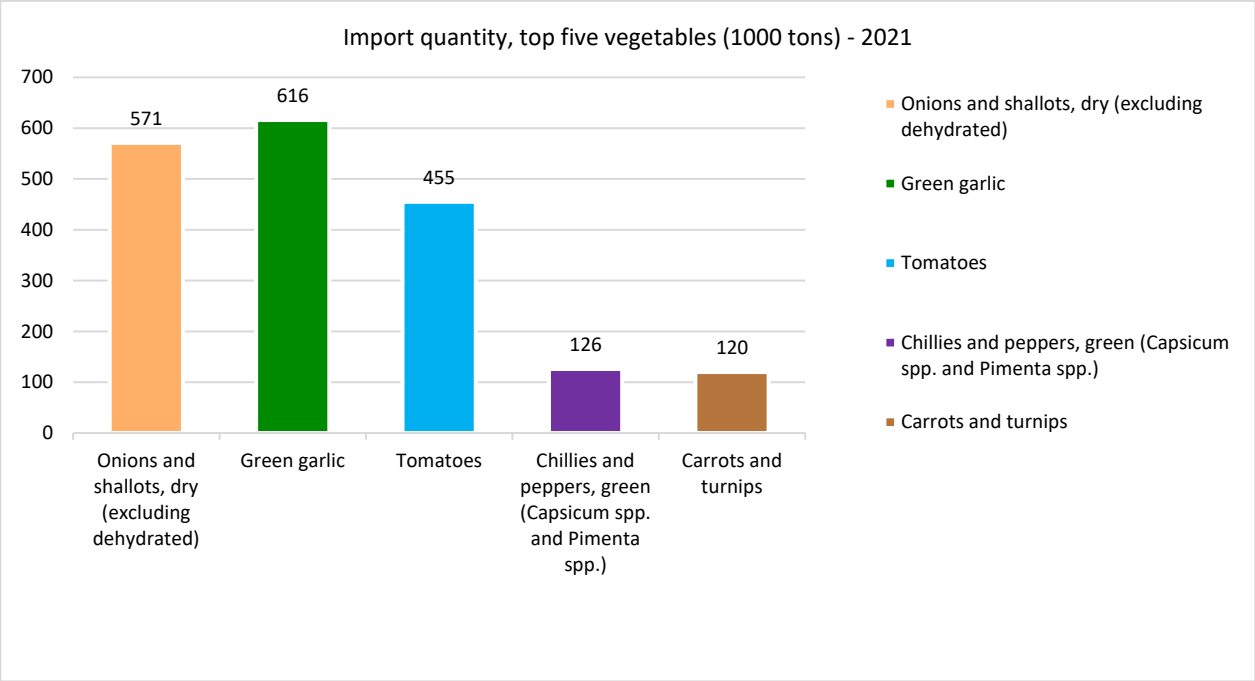

Figure 7 *Import quantity, top five vegetables. FAO (2023).*

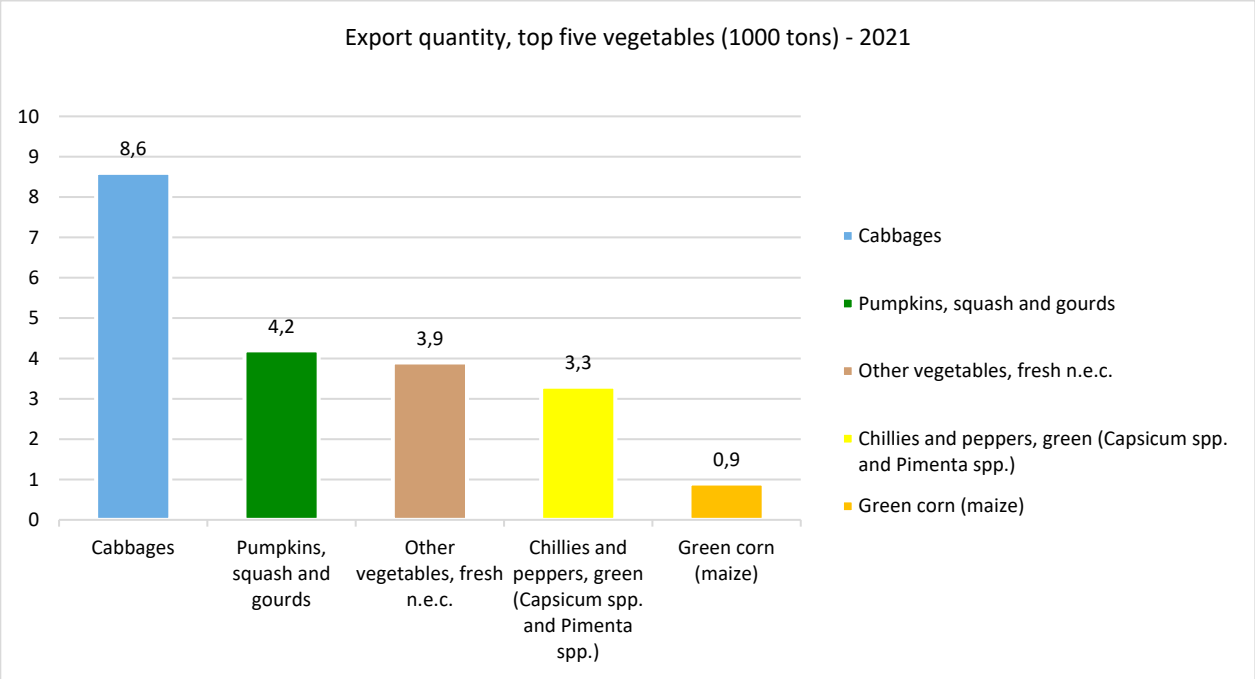

Figure 8 *Export quantity, top 5 vegetables. FAO (2023).*

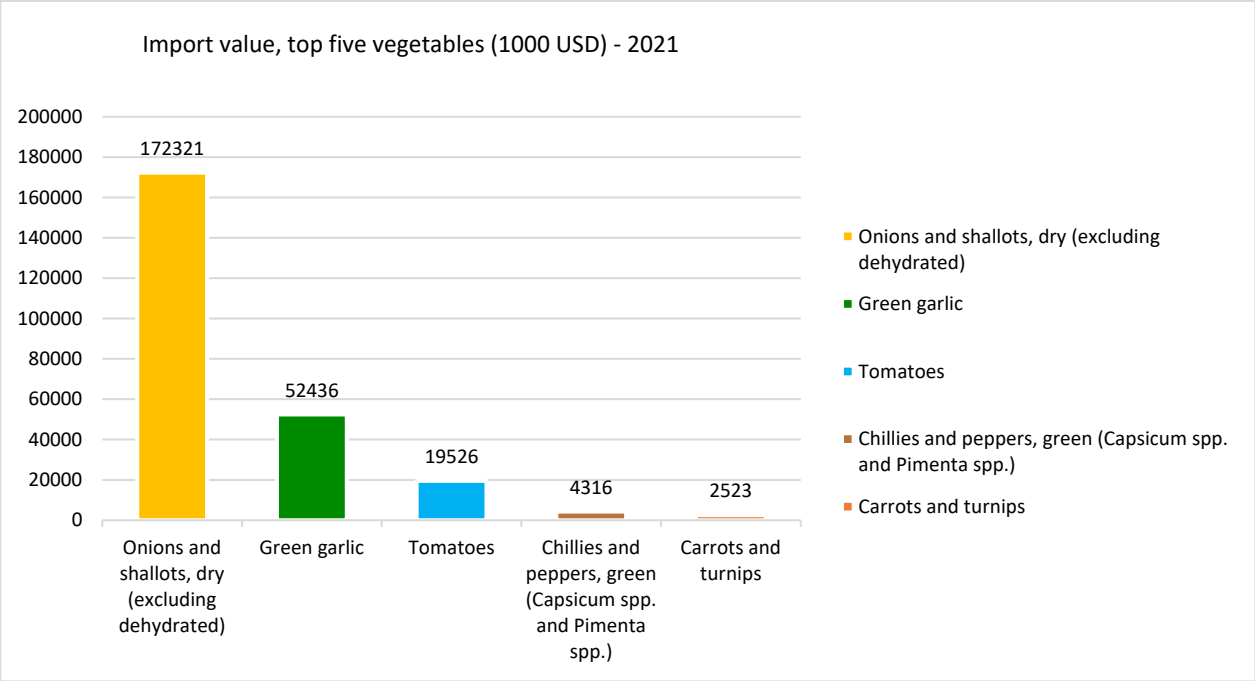

Figure 9 *Import value, top five vegetables. FAO (2023).*

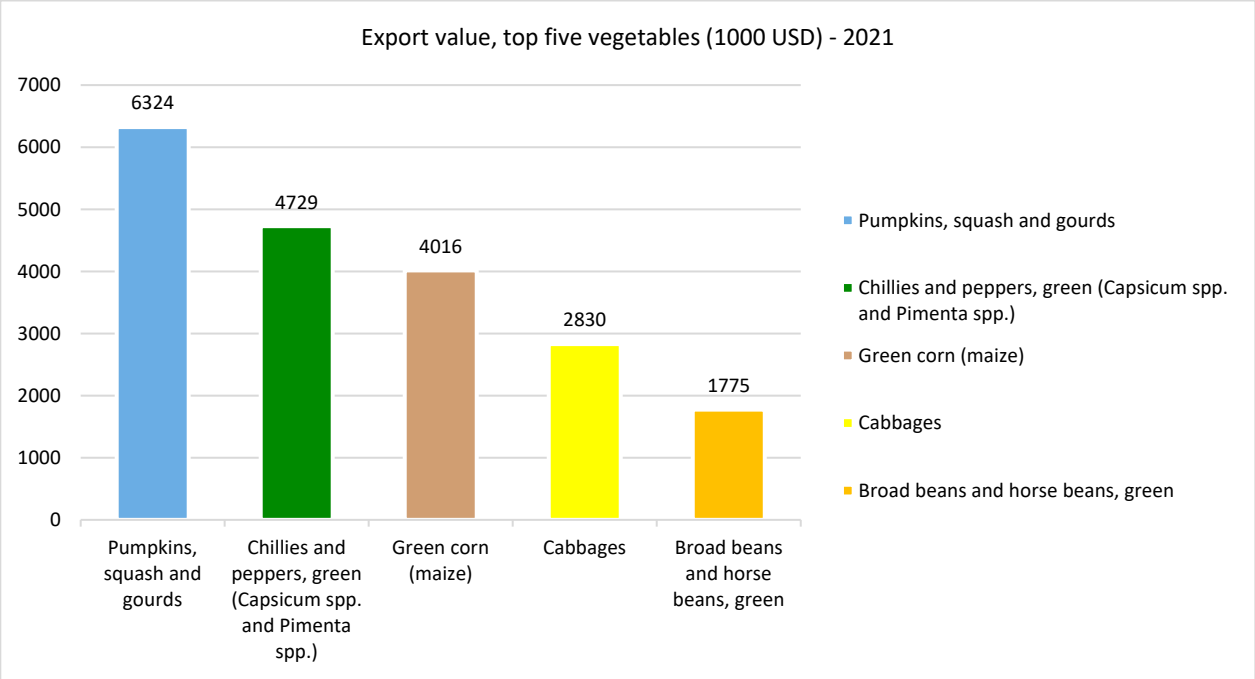

Figure 10 *Export value, top 5 vegetables. FAO (2023).*

Indicator crops

Three horticultural crop were selected for further investigation (tomato, onion and brinjal). First we describe general features of the crop (such as production, import export and area of production covered); in the section after, we provide a short overview of the seed sector for each of the crops.

Indicator crops general information

Tomato

Tomato is one of the most important vegetable crops in Bangladesh. In the FY 2021-22 the total land under tomato cultivation was 73,000 acres (29.542 ha) and total production was approximately 450,000 tons (12%) of all vegetable production in summer and winter (BBS, 2022a). The total cultivated area and production of tomato in Bangladesh has increased gradually over the last few years. In particular it is worth mentioning the records from the FY 2011-12 to the FY 2014-15, whereby tomato production registered an impressive growth increasing from 250,000 tons to 400,000 tons (BBS, 2012, 2015). Tomato yield per ha has also increased in the last few years. Currently, tomato productivity stands only at 14.82 t/ha. Farming output, therefore, can still be improved considerably as tomato yields in the country are still very low compared to the average of world yield (36.30 t/ha) (FAOSTAT, 2023). Tomato is produced all across Bangladesh, with major production areas in Rajshahi, Dinajpur, Comilla, and Mymensingh districts. (See Appendix 3 for major details on import and export data on tomato).

Onion

Onion is one of the most important spices and vegetable crop in Bangladesh. Onion stands first among the different spice crops grown in Bangladesh. Onion production in Bangladesh has doubled in the last decade and has shown impressive growth, especially considering that in the FY 2009-10, onion production was below the 1 million tons. In the FY 2021-22 the total land under onion cultivation was around 500,000 acres (205,000 ha) and total production was approximately 2.5 million tons with yields of 12.25 t/ha. However, while yield productivity has increased in the past years it is still much lower compared to the world average of 21 t/ha (FAOSTAT 2023). The unavailability of good quality onion seeds is partly responsible for such low yield (Ali et al., 2015). The major area of onion cultivation is Faridpur district and northern Bangladesh. Onion cultivation begins in October to early December and late April to mid-June. (See Appendix 3 for major details on import and export data on onion).

Brinjal

Brinjal is a very important indigenous vegetable in Bangladesh where it is grown on about 134,000 acres (50,000 ha) of land in both summer and winter (BBS, 2022a) by roughly 8 million farmers. In the FY 2021-22 Bangladesh produced 600,000 tons of brinjal (21% of total vegetable production). (See Appendix 3 for major details on import and export data on brinjal).

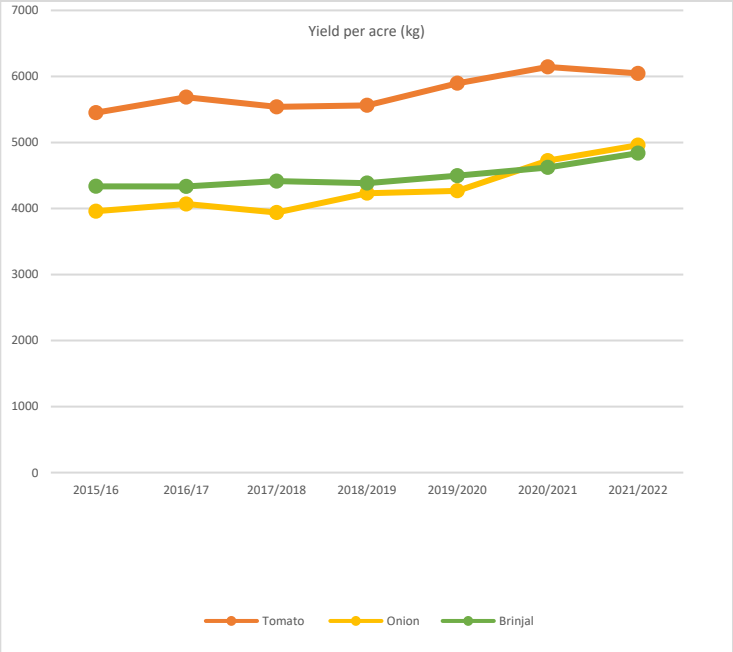

Figure 11 *Yield per acre of tomato, brinjal, and onion BBS (2022a).*

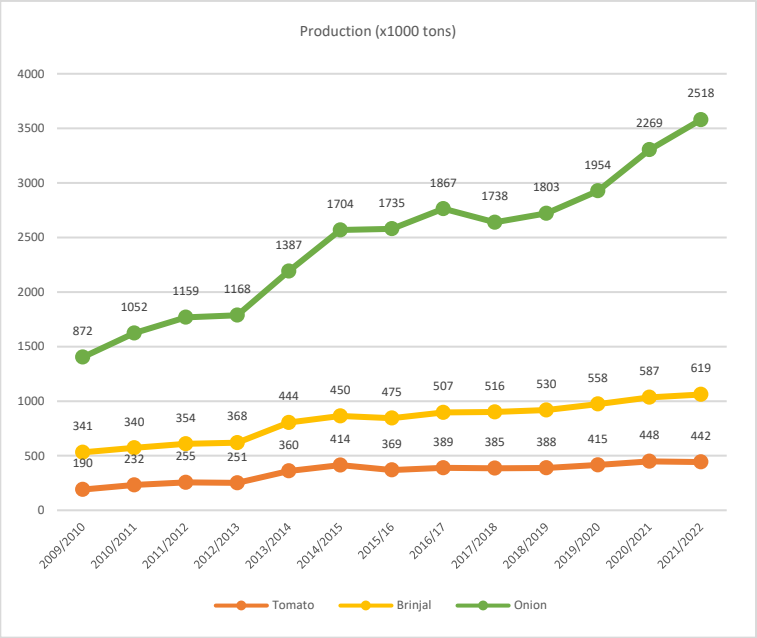

Figure 12 *Production of tomato, brinjal, and onion BBS (2022a).*

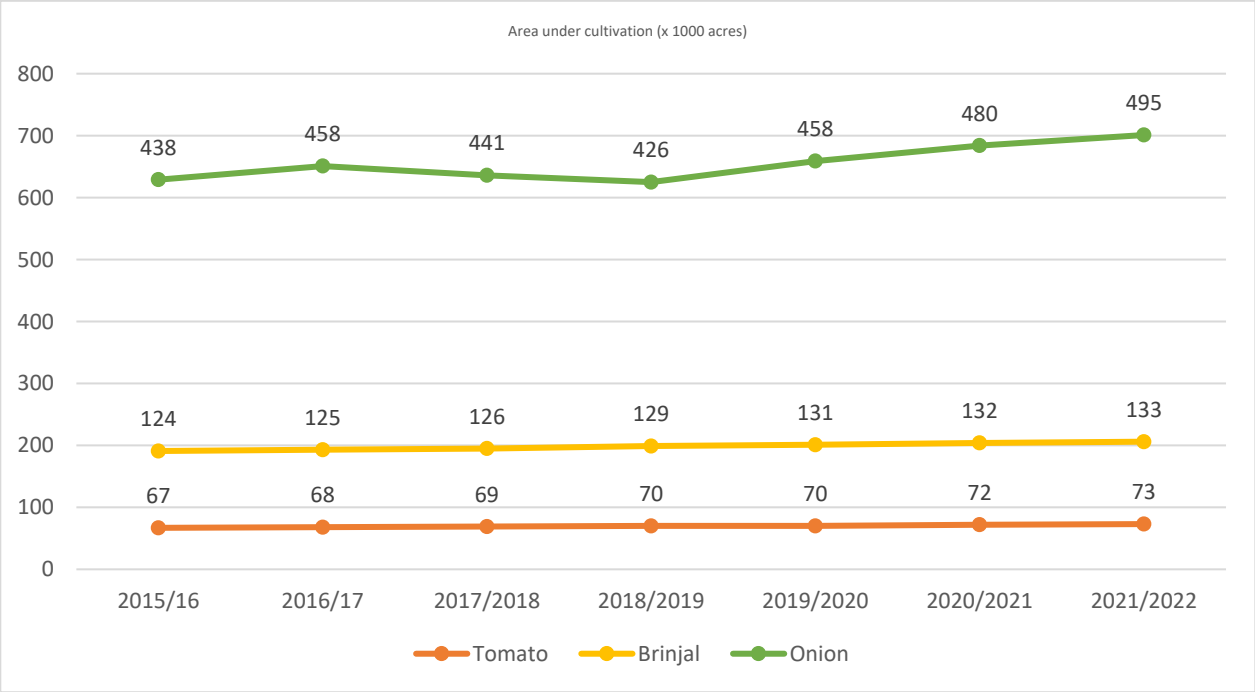

Figure 13 *Area under cultivation of tomato, brinjal, and onion BBS (2022a).*

Indicator crop seed systems

Tomato seed system

The national demand for tomato seeds is estimated at about 5 tons (half of which are hybrids and half are OP/open pollinated varieties) representing a value of around USD 3.5 million based on the average price of USD 700 per kg (RVO, 2021; BBS, 2022a). Hybrid seeds for tomato are mainly imported from different countries like the Netherlands, Japan, USA and China at a very high price or produced by local private companies such as Lal Teer and ACI Limited (RVO, 2021; Ali et al., 2014). Total imports of tomato seeds are stable with an average of 4.2 M tons in the past 5 years. in Bangladesh, a significant portion of tomato seed production is private-led. Because of this, the use of hybrid seed varieties in tomato farming is prominent and increasing, with an overall hybridization rate of 88%. A range of local hybrid varieties is available and accepted by farmers.

Onion seed system

The total production of onion seed in Bangladesh is about 150 tons per year, but the requirement is more than 300 tons (FGDV, 2023a). The quantity of quality onion seeds supplied by the government agencies in Bangladesh is very limited, but the demand for bulb onion as well as quality seeds are increasing day by day and the price of seeds remains fairly high in each season (Ali et al., 2015). Only 0.065% of the total supply of onion seeds is provided by BADC (BADC, 2014); an average of 28 tons of onion seeds was imported in the past 5 years. A significant portion of onion seed production is carried out by farmers themselves. Currently, more than 90% percent of the total seed requirement is met by the informal system, so it is farmer-managed (Mila et al., 2022; Kok, et al., 2021; Biswas 2017; Mila & Parvin, 2019; Haque et al., 2011). Generally farmers select, save, and store onion seeds (small bulbs) from their own harvest for the next planting season. In many cases, they collect their seeds from friends or neighbours (Ahmed, 1999). The quality of the seeds produced by the majority of the farmers is considered of low standard. 3-4 varieties of onions are mainly used for onion production although more than 200 varieties have been developed by different stakeholders. Taherpuri (local) and Lalteer King are the most used and appreciated varieties in smallholder fields (Mintoo, 2019; Biswas, 2017; Mila et al., 2022).

Brinjal seed system

Brinjal was originally a winter crop. Thanks to the advancements in variety development it is now a year-round crop, with different varieties offered in the market depending on the region (each production region has its own preferred variety). Bangladesh has always enjoyed the diverse varieties of brinjals. Currently there are more than 248 varieties cultivated in different agro-ecological zones of the country. Brinjal has had increased attention for variety development both from public and private institutions (Shahadad et al., 2006). This is because brinjal is highly susceptible to pests and diseases and is particularly prone to vicious and sustained attack by the eggplant fruit and shoot borer (EFSB) throughout the growing season. Yield losses in Bangladesh because of EFSB infestation have been reported as high as 86% (Prodhan et al., 2018). For this reason, many crop-breeding efforts have been specifically aimed at introducing resistant varieties in the market. For example, the Horticulture Research Centre (HRC) - the research centre responsible for vegetable crop variety development- has released under its breeding programmes 8 OPV and 4 hybrid varieties. These varieties are very popular among farmers and widely planted in the intensive brinjal-growing regions (Choudhary, 2014). It is estimated that hybrid varieties of brinjal have a market size of approximately 20 tons, of which nearly 12 tons is supplied by the local seed company, Lal Teer Seeds. Bangladesh imports quality brinjal seeds from different countries, mostly China, Thailand and India (RVO 2021).

Bangladesh has imported an average of 2 tons of brinjal seeds annually in the past 5 years. However many smallholder farmers with small pieces of land cultivate mainly local brinjal varieties (RVO, 2021). The local varieties Alta Bulbuli, Lodha Begun, Ghia Begun, Kanai Begun, Shoila Begun, Ramchandrapuri, and Jhumka are widely spread in the country (Choudhary, 2014). As with onions, the farmer-managed seed system is very widespread. Farmers save and exchange seeds from their own harvests which was historically a very popular method of propagating brinjal crops (Choudhary, 2014; Sheltons et al., 2019). In addition to saving their seeds, farmers participate in informal seed exchanges with one another. They share and trade seeds, leading to a diversity of brinjal varieties being cultivated in different regions. However, the private sector's involvement in brinjal variety development in Bangladesh is in expansion and gaining galloping growth (Sheltons et al., 2020; Kumar et al., 2010). A large number of commercial farmers use their land for cultivation of hybrid brinjals. HYV varieties (i.e. IRRI, China-3 and Ired) are grown in the country and are becoming more widespread, also because of favourable government policies and subsidy schemes (UBINIG 2020).

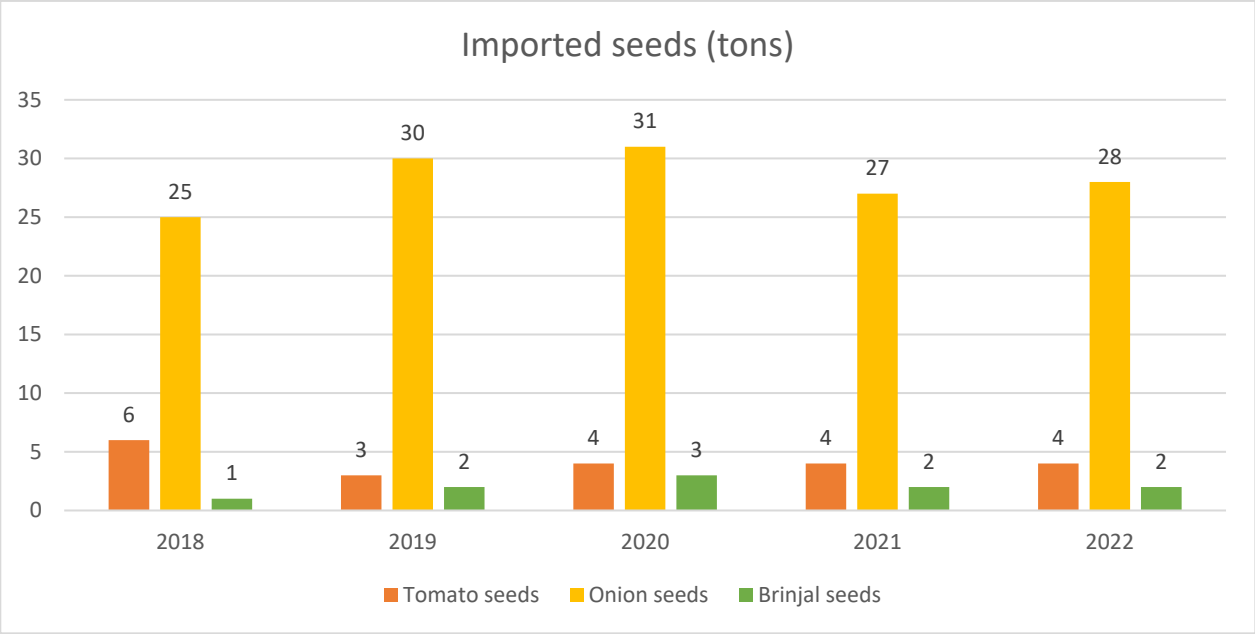

Figure 14 *Imported seed (tomato, brinjal, onion): Wing Communication (2023).*

Vegetable seed systems

There are four main seed systems for vegetables in Bangladesh, differentiated by the variety used, source, seed quality, seed marketing, use of crops, and distribution channels used (see Table 10).

Table 10 *Vegetable seed systems configurations.*

Characteristics	International companies, local private companies	Public	Companies in collaboration with public organization	Farmer-managed
Domain	Formal	Formal	Formal	Informal
Crops	Tomato, gourd, cucumber, bell pepper, brinjal, lettuce, onion	Tomato, eggplant, onions	Brinjal, tomato, onion	Leafy greens (e.g., Lal Shak), certain traditional brinjal, onion
Use of crop	Cash, export	Cash, export	Food, cash, potential for export	Food, cash, potential for export
Type of varieties	Foreign private (imported), local private	Local Public	Foreign private, imported; local public	Local indigenous and recycled HYV
Type of seed quality	Certified, Truthfully labelled	Certified, Truthfully labelled	Certified, Truthfully labelled	Farmer saved seeds
Type of marketing and distribution	Contractual arrangements, wholesalers, retailers, outlets	Contractual arrangements, BADC outlets	Contractual arrangements, BADC outlets, wholesalers, retailers, outlets	Local exchange
	68%	2%	1%	29-30%

A relevant share of the vegetables seeds produced and distributed is controlled by the informal market (30%). As elaborated in former sections, for onion this is a very prominent seed system. The farmers-managed system is also very important for brinjal.

The other seed systems found in the vegetable seed sector of Bangladesh belong to the public, private or a mixed public-private domain. The public sector contribution to the vegetable seed system is very small (less than 2%). However, because of an increase in demand for hybrid seed in recent years, HRC started to devote increased attention to vegetable seed operations. These efforts are limited to specific crops; as described in the sections above, HRC has developed several hybrid tomato and eggplant varieties and released them for commercial cultivation.

Multiple configurations of collaboration across private and public actors are present. For example, BADC customarily imports small quantities of vegetable seed from abroad and produces them on its farms (Daily Sun, 2021). Another prominent example of mixed public and private system is the collaboration between the India-based Maharashtra Hybrid Seed Company (Mahyco) and HRC. This culminated with the commercialization of Bt eggplant, also known as Bt brinjal, a genetically modified eggplant that is resistant to EFSB. The Bt brinjal variety was developed by the Indian company and donated to HRC, who bred it into local varieties (BARI Bt brinjal varieties 1, 2, 3, and 4). In addition to these former examples, it is also worth mentioning that several private companies are collaborating with the public sector in different capacities, thus producing and commercializing HRC (and BARI) varieties (i.e Lar teer). Another small configuration within this domain is well exemplified by the collaboration between BARI and grassroot/producer organizations. BARI provides the technical support and breeder seed to produce organization. Producer organization multiply breeder seeds through farmers and purchase these back. The producer organization then acts as a marketer and resells these. This type of seed production works mainly for brinjal, tomato, and pumpkin. As said previously, this configuration is currently very small and concerns only 2500 kg of seeds (FGDV, 2023).

The private seed system is the strongest configuration in the vegetable seed sector of Bangladesh. The seed system is populated by private seed companies, who play a major role in variety development, seed production, quality control, and distribution of HYV, especially of crops such as tomato, pepper, gourd and cucumber. For brinjal the private sector configuration is gaining more and more traction; private seed companies have been introducing hybrid brinjal varieties and improved open-pollinated varieties that offer advantages such as disease resistance, higher yield potential, and uniformity in fruit size and shape.

Seed companies produce, process and market OP and hybrid vegetable seed varieties and engage thousands of contract farmers in the formal seed production chain. They have a strong seed marketing network throughout the country. The private sector supplies over 95% of vegetable hybrid seeds.

This seed systems encompasses national as well as international seed companies. International and national companies produce seed from their own varieties and market seed through a network of agro-dealers, retail shops and large-scale vegetable producers. A number of private companies are importing hybrid seeds and supplying them to the local market. They import hybrid and OP varieties from India, China, Thailand, Japan Vietnam, Korea, Taiwan and, to a smaller extent, from other countries. Of the imported seeds 90% are hybrid varieties compared to 10% of seed of OP varieties (RVO, 2021). For tomato, this is the main seed system, as shown in the section above.

Vegetable seed value chain operators

The major vegetable seed value chain operators and their operations are illustrated in Table 11.

Table 11 *Vegetable seed value chain operators.*

Seed chain	Operators
Genetic resources management	BARC-BARI, Horticulture department
Plant breeding and new variety development	BARI (mainly open pollinated varieties but also hybrid varieties of brinjal, pumpkin, tomato, and bitter gourd); Bangladesh Institute of Nuclear Agriculture (BINA, mainly tomato varieties), and BADC Bangladesh Agriculture and other agriculture universities involved in open-pollinated variety development Few local private seed companies
Breeder seed production	For locally-bred varieties the operators are BARI (the main producer), BADC (some varieties), seed companies
Foundation seed production	BADC, seed companies
Certified/truthfully labelled seed production	BADC, private sector
Seed marketing & dissemination	Seed dealers, BADC market outlets, DAE, BADC, NGOs
Seed use	Farmers

As with potato, the Plant Genetic Resources Centre (PGRC) of BARI plays a leading role in the conservation, management, utilization and promotion of vegetable PGR. Arguably, PGRC holds the vegetable gene bank, with short and long term storage facilities also for IVs, where they are evaluated and conserved.

With variety development, private seed companies and public agencies are the major institutions involved in new variety development of vegetables.

Within BARI, the Horticultural Research Centre (HRC, one of the six special crop research centres) is the centre focused on vegetable seed varietal development. 11 scientists are currently employed at HRC. Breeding efforts of the centre are generally concentrated on open-pollinated varieties (OPVs), although in recent years there has been increasing focus on developing hybrid varieties in response to demand from farmers. Variety development concentrates mainly to a very few crops such as tomato and brinjal, but also pumpkin and bitter gourd. HRC has released 21 open-pollinated (OP) and 11 hybrid tomato varieties so far. Several leading seed companies are also supplying more tomato varieties and seeds which are being imported from different countries (Islam et al., 2021). BINA also conducts research to develop improved tomato varieties, and BSMRAU carries out research related to vegetable breeding as part of its postgraduate programmes. The Department of Genetics and Plant Breeding and the Department of Agronomy at BAU have been working on several vegetable crops since the 1970s (Chowdhury, 2012). HRC exchanges germplasm also with private seed companies, NGOs and other research institutes. The centre enjoys a strong collaboration with the World Vegetable Centre; the latter provided a total of 3454 accessions of 59 different vegetable crops to HRC (Chowdhury, 2012). HRC has also recently signed an MOU with a private company (ACI Limited) for collaboration in seed production.

Only a few private seed companies have their own strong R&D component for varietal development (for example, BRAC Seed, Agro Enterprise, and Lal Teer). Lal Teer dominates the market with a high share of hybrid seeds and OPV lines. Eight seed companies test varieties in the country (Access to Seed Index, 2023). Figure 15 gives an overview of the private seed companies' different activities in Bangladesh.

Company	Crops in portfolio		Company activities in country					
Companies selected for the Access to Seeds Index	Field crops	Vegetables	Breeding location	Testing location	Seed production	Processing location	Sales	Extension services
Acsen HyVeg		●		●			●	
Advanta	●	●	●	●	● *		●	●
Bayer	●	●			● *		●	●
Bejo		●					●	
Bioseed							●	
BRAC Seed and Agro Enterprise **	●	●	●	●	●	●	●	
Charoen Pokphand	●	●					●	
Corteva Agriscience	●						●	
East-West Seed		●		●			●	●
Kalash Seeds		●		●			●	●
Known-You Seed		●		●			●	
KWS	●						●	
Lal Teer Seed **	●	●	●	●	● *	●	●	●
Limagrain		●					●	
Mahyco							●	
Monsanto							●	
Namdhari Seeds							●	
Nongwoo Bio		●		●			●	
Nuziveedu Seeds	●	●		●			●	●
Sakata		●					●	
Syngenta							●	

Figure 15 *Major private companies involved in the Bangladesh seed sector (Access to Seed Index, 2023).*

Vegetable seed production, marketing and distribution

According to Dadon (2012), about 150 importers, 50 seed companies, 480 wholesalers, 7500 retailers, 8400 mobile seed vendors, and 10,000 seed producing farmers are engaged in vegetable seed production, marketing, and distribution. Around 20 million vegetable farmers buy seed from those sources (Huda,2009). Seed production of vegetables is mainly done by the private sector with the public sector playing a very limited role. The private sector engages in production, processing and marketing of OP and hybrid seed varieties (WBA, 2023). The major local vegetable seed-producing companies include Supreme Seeds, Metal Agro, Lal Teer Seeds, ACI Seeds, and Bangladesh Rural Advancement Committee (BRAC). Another 46 medium to large seed companies (foreign and local) are active in Bangladesh (Access to Seed Index, 2023; WBA, 2023).

Currently 90% of vegetables from the private sector are hybrid varieties. Among private sector seed companies, Lal Teer is the largest local producer and distributor of vegetable seeds. The company currently offers 165 varieties of 33 vegetable crops, including 65 hybrids and 76 are open-pollination varieties (Lal Teer, 2023). Lal Teer claims to produce 25-30% of the quality seeds, about 1,000 tons of seeds per year, of which 85% are of hybrid varieties. For other major seed producers, vegetable seeds represent less than 10% of their total output. ACI produces hybrid vegetable seeds including 2 hybrid tomato varieties. BRAC vegetable seed production work encompassed 8% in vegetable producing and marketing, 10 hybrid vegetable varieties, and 3 open-pollinated vegetable varieties (Hossain, 2020).

Bangladesh private seed companies produce OP and hybrid vegetable varieties mainly through the contract farming system. Through contract farming, there are established production agreements with contract growers. Usually, farmers are contracted for the longer term (more than one year). Seed companies produce various types of vegetable seed through contracts with seed growers. They supply source seed to growers and provide supervision during seed production. In the case of hybrids, farmers receive parental lines from the seed company and produce the first generation (F1). When ready, F1 seeds are bought back by the seed companies at a fixed price. Seeds are then kept in storage facilities where seeds are kept under controlled conditions and repacked before distribution. Thirty-nine of 50 seed companies produced vegetable seed through contract seed growers in Bangladesh, yet the involvement of smallholder farmers in these production activities largely varies (Bhuiyan, 2014). For instance, smallholder farmers are involved in more

than 90% of seed production activities by Advanta and Bayer, whereas only 40% of smallholder farmers are involved in seed production activities for Lal Teer Seed (Access to Seed Index, 2023). Along with private seed companies with contract growers arrangement we can distinguish other actors, namely, independent seed producers (Mallick, 2018). Independent seed-producing farmers are seed growers experienced and skilled in seed production and they produce vegetable seeds on a large scale without having contract arrangements with seed companies (Hasan, 2013).

There are a variety of actors for the distribution of vegetable seeds; seed importers, wholesalers, retailers and mobile street vendors. The wholesalers are the largest group (Mymensingh, 2001); it is estimated that about 72.5% of vegetable seed is marketed through them (Mallick 2018). Wholesalers buy vegetable seeds from seed companies and sell them to local retailers or mobile vendors. In some cases they also sell directly to end users. Retailers also sell seeds to mobile street vendors, who cater to the more remote farmers. Figure 16 illustrates the vegetable seed production and marketing system in Bangladesh. The highest quantity of vegetable seed is distributed through the channel seed companies, wholesalers, retailers, mobile seed vendors, and seed users (Mallick, 2018).

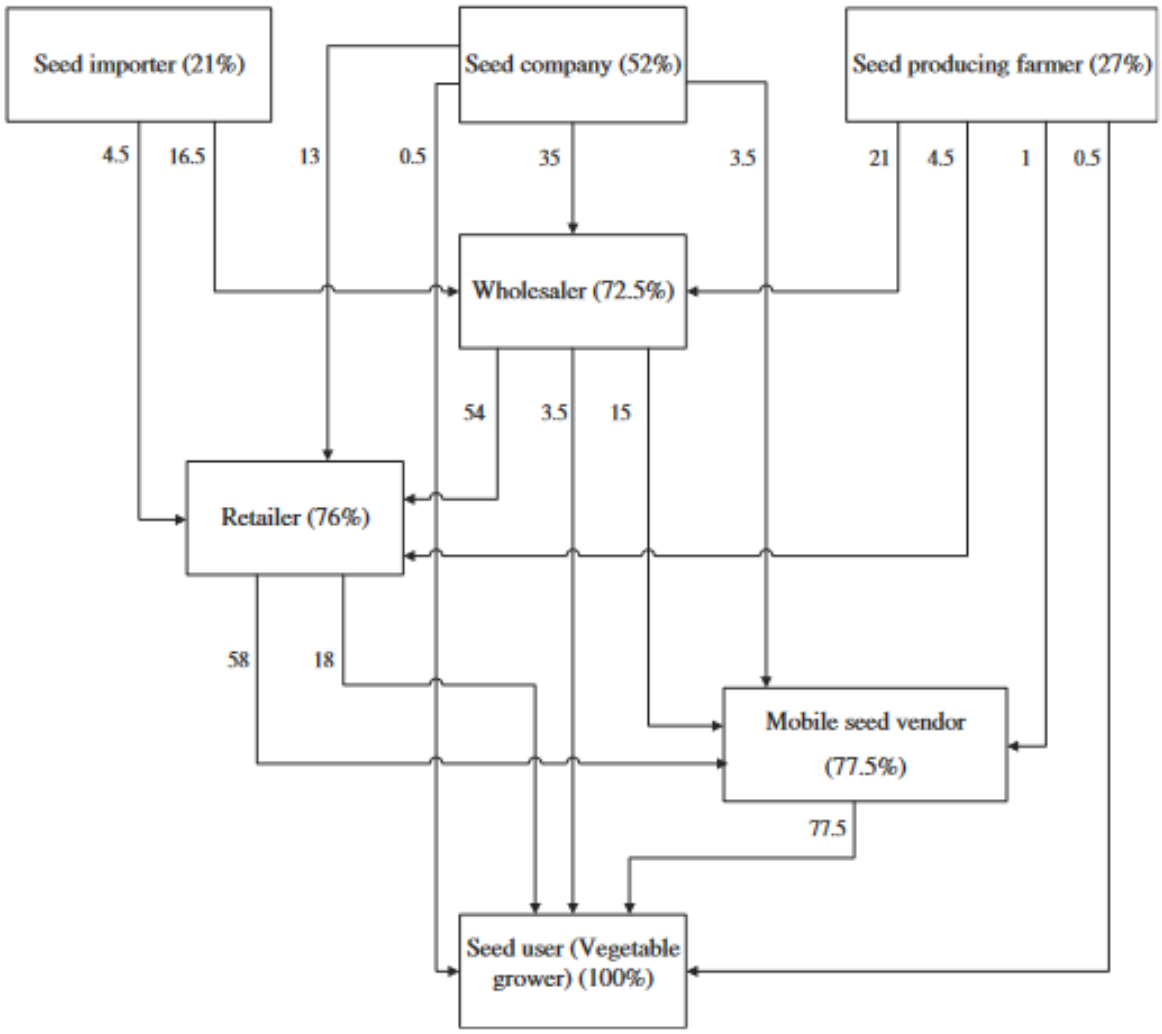

Figure 16 *Vegetable seed production and marketing system in Bangladesh. The numbers alongside the lines are the '%' of seed distributed through the respective channels (Mallick, 2018).*

Vegetable seed demand and supply

Notwithstanding the difficulties in determining the exact statistics, there is growing acknowledgement that the utilization of quality seed of improved varieties of vegetables has increased in Bangladesh, triggering productivity improvements across the sector. The value of the vegetable seeds market in Bangladesh is estimated at USD 80 million, of which the import value is estimated at USD 20 million (BSS, 2022a).

According to a study commissioned by RVO (2021), given the increasing utilization of quality OP and hybrid varieties, the potential market is at least double that size. Also, for some crops, farmers use more hybrid varieties than for others. For example, currently 100% of farmers buy cauliflower seed from the formal market while only 37% of farmers buy formal brinjal seeds (RVO, 2021). The share of farmers using registered tomato and chilli seeds is 88% and 41% respectively. Overall, the study concluded that horticultural farmers in Bangladesh are well aware of the range and benefits of improved (OP and hybrid) seed, yet counterfeit seeds have been a persistent problem in the Bangladesh market, given the weak control and limited awareness of both farmers and seed retailers (RVO, 2021).

The Ministry of Agriculture estimates the current sales of quality vegetable seeds in Bangladesh (formal sector) at 2,400 tons (Table 8). Private companies are the main supplier of seeds for vegetable farming. Clear data figures on the demand for quality vegetable seed is still missing and the total quantities of currently supplied seeds are difficult to determine (Foysal, 2022). Recent studies of the Bangladesh seed sector argue that the total demand for vegetable seed in the country amounts to 4,500 tons (RVO, 2021). Similarly, according to the Seed Producers Association and the Department of Agricultural Extension, 4,500-5,000 tons of vegetable seeds are needed in the country every year (The Business Standard, 2021). This figure is much higher than the one of 2400 tons as it includes seed supplied through the informal seed system.

Table 12 *Demand and supply of vegetable seeds 2015-16 to 2021-22 (BBS, 2022a).*

Year	Demand (tons)	Supply (tons)
2015-16	2137	1083
2016-17	2266	1883
2017-18	2291	1927
2018-19	2307	1359
2019-20	2433	1977
2020-21	2473	2001

The gross demand for vegetables is 4500 tons. Of this, the local private seed sector supply is around 2160 tons (48%); imported seed, 900 tons (20%); public sector contributions are limited to around 70 tons (67 tons BADC, 3 tons BARI), corresponding to 2%; and the rest is met by the informal seed system, which stands at about 1350 tons, or 30% of the overall figure (FGD, 2023) (FGD V. 2023a). Therefore, it can be concluded that quality vegetable seeds produced in the country can meet 50% of the total demand.

Vegetable seed value chain service providers

The key seed value chain service providers are illustrated in Table 13 below.

Table 13 *Vegetable seed value chain service providers.*

Seed services	Service providers
Regional Yield Trials (RYT)	Seed Certification Agency (SCA)
DUS testing	Seed Certification Agency (SCA)
Variety Release and registration	Seed Wing
Seed quality assurance in production	Self-certification or self-declaration. The SCA does the market monitoring only.
Seed quality assurance in marketing	SCA, DAE, BADC monitor the seed shops
Seed quality assurance in seed import	Plant Quarantine Wing
Seed quality assurance in seed export	Plant Quarantine Wing
Marketing information and promotion	Department of Agriculture Marketing (DAM), DAE, NGOs, private seed sector
Financial services and management	Bangladesh Krishi Bank (BKB), Rastriya Krishi Union Bank, all other government banks, private sector banks
Seed extension	DAE, BADC, private seed sector, NGOs

Vegetable seed extension work is carried out both by private and public sector actors. Vegetable seed-producing companies have invested substantially in bringing quality vegetable seeds to farmers through demonstrations, field days and training sessions. Several companies have completed integrated operations in the country, from breeding to extension; they customarily involve in their extension efforts both seed dealers and farmers (Access to Seed, 2023). Concerning the public extension efforts, DAE's horticulture wing is actively involved in vegetable seed extension. The wing primarily deals with three activities: education, technology, and research and technology transfer. These activities range from promoting floating vegetable cultivation, safe (organic) production, and post-harvest management. HRC also is involved in technology transfer.

Imports of vegetable seeds

Import permissions for vegetables are quite straightforward and require an import permit. For obtaining the import permit the dealer requires a phytosanitary certificate and business registration documents. The phytosanitary certificate is supplied by the DAE (the type of standard varies from one vegetable seed to another). For variety testing for registration, as vegetables are not designated as notified crops the registration process is rather simple. A one-location trial suffices, with supporting documents from trials implemented elsewhere (MOA, 2020).

Challenges of vegetable seed systems

Several scholars highlighted multiple challenges hindering the sector. These are as follows; limited availability of quality seeds of improved varieties (OP and hybrid); a substantial counterfeit market (seed retailers offering expired seeds, fake seeds, etc.); lack of capital for seed imports; high research and development costs for new varieties; inadequate storage facilities; inadequate supply of good quality seed in the peak season; the high purchase price of seed; and lack of collaboration among stakeholders (RVO, 2021; Mallick, 2018, 2019; Biwas, 2017; Dadon, 2012).

3.3 Flowers

Flower crop data and projections

Bangladesh' floriculture industry is dynamic and fast-growing. It has achieved significant growth during the past few decades (Amin et al., 2017; Tazuddin, 2021 Hajong et al., 2022). Despite the participation of 25,000 smallholder farmers, the flower industry in Bangladesh remains in its nascent stages, offering substantial potential for production and business opportunities. The climate (between 15^0 C and 34^0 C through the year), and the availability of water, fertile soil and cheap labour are attractive conditions to grow the sector. At present, flowers are cultivated on 5-6 thousand hectares of land in 24 districts including Jashore, Jhenaidah, Chuadanga, Dhaka (Savar), Gazipur, Panchagar, and Manikganj. About 1.5 to 2 million people earn their living in floriculture.

Bangladesh produces different type of flowers. However, about 90% of the domestic flower industry's is derived from five varieties of flowers (gladiolus, rose, marigold, chrysanthemum and gerbera). See Table 14.

Table 14 *Flower varieties popular in Bangladesh per volume and market size (RVO, 2023).*

Flower Varieties	Distribution of flower varieties according to volume %	Distribution of flower variety according to market size %
Marigold	30	7.18
Tuberose	10	15.96
Rose	20	18.62
Gladiolus	10	26.59
Gerbera	10	18.62
Chrysanthemum	3	0.80
Others (lily, tulip)	17	12.23

The present market size of the flower sector is estimated to be close to USD 179 million annually and expanding at a rate of 10-15%. Recent research argues that the domestic market can for example easily absorb three times the current supply of gladiolus and twice the supply of chrysanthemum (RVO, 2023). There are 3000 flower traders, and around 2,000 flower shops, of which 1,000 are located in Dhaka. Flower-processing centres and flower markets are flourishing in Panisara, Jhenaidah and Jashore with the support of USAID and the Bangladesh Government.

Import and Export

Domestic flower production currently meets 70% of local demand, with the remainder imported from China(10%), India (10%) and Thailand (10%) (The Business Post, 2022; Rayhan, 2016). This is a big improvement from a decade and a half ago, when Bangladesh was highly reliant on the global market to meet domestic demand and 80% of its demand was met by imports (The Business Post, 2022; Rakibuzzaman et al., 2018). The export market is still nascent and formal data are not currently available.

Flower seed systems

We found three seed systems for the flower sub-sector in Bangladesh (Table 15). At the moment there is no formal organization in Bangladesh that manages seed supply. But there are leading farmers, that produce, aggregate (at times importing the seeds), and distribute seeds, very often through informal channels.

Table 15 *Flowers seed systems configurations.*

Characteristics	Entrepreneurial farmers	Public	Farmer-managed
Domain	Formal-informal	Formal	Informal
Use of flowers	Cash, domestic	Cash, domestic	Cash, domestic
Major flowers	Gerbera, lilium, orchid, marigold	Gladiolus, tuberose, lilium, marigold	Rose, gladiolus, tuberose, marigold
Type of varieties	Foreign private (imported), local private	Local public	Local indigenous and recycled improved high-yielding varieties (HYV)
Type of seed quality	Quality seed	Quality seed	Farmer-saved seed
Type of marketing and distribution	Local exchange	Distributed directly by flower division	Local exchange
	25%	Negligible	75%

Therefore, the farmer-managed system is prominent in the flower seed system - according to the stakeholders engaged during the FGDs carried out for this assessment, it counts for the 75% of the overall system (FGDF, 2023). Typical to this system is that farmers get their flower seed inputs from local seedling producers, start growing the flowers (in open conditions), and then save cuttings, tubers or rootstocks (or get them from neighbouring farmers) for the next planting. Several researches conducted in Bangladesh floriculture sector support this claim. For example. Rayhan, (2016) conducted a survey with 500 flower farmers in 10 major flower-growing districts of Bangladesh and found that the majority of farmers (71.20%) used own-produced seeds and/or own-grafted seedlings. Similarly, Mannan (2007) carried out a research involving 101 flower farmers in Jessore districts and found that 64% collected the seeds and seedlings from their own plants. In another study Hajong (2022) found that across 100 farmers surveyed in Jashore district, 62% used their own seeds for flower cultivation.

Seed demand and supply

No official data is currently available depicting the exact figures on seed supply and demand in the flower sector. This is also because of the nascent stage of the industry and the informal characteristics that typify this seed system. What is currently reported is that at present only a few farmers import seeds and seedlings for their own commercial production, or they aggregate and distribute it to other fellow producers. The main source of imported seed in the Bangladesh floriculture sector, predominantly through informal channels, originates from neighbouring India (50%). This trade specifically caters to flower growers, primarily in the Jashore area, which is close to the Indian border. Informal imports of flower seed are unreliable in quality and supply is rather ad-hoc and quite expensive. Varietal impurity and logistics challenges are also indicated as main concerns (RVO, 2023; FGDF, 2023). The small amount of certified seeds of hybrid varieties are

imported from the Netherlands, Thailand, China and Singapore. In particular, hybrid seedlings of orchids are mainly imported from Thailand; marigold seed is imported from Thailand, the Netherlands, China and India; and lily seed is imported from the Netherlands.

No local private companies are currently engaged with any flower breeding programme. However, it is important to note that tissue culture-based flower seed production in Bangladesh is rapidly developing. Several organizations (among which the more prominent ones are Tishan Botani, Apex, and Agrobet Pran) are engaged in gerbera production through tissue culture. Government (BADC), NGOs (RRF) and other private sector organizations (Getco, Ispahani, ACI, Lal Teer) have indicated their intention to start a tissue culture lab for the production of flower seeds and seedlings in the near future (RVO, 2023). In the current gerbera tissue culture production scheme, customarily, the mother plant is imported from India, and the comb is used as planting material. Most of the mother plants come from KF(Kumar and Florist) Bioplant, an Indian-Dutch joint venture.

The public sector role in the flower sector is very limited. The public sector emphasizes its priority on seed sector development for food crops rather than flower seed (Wittstock & Quinto, 2008). The limited engagement of the public sector is through the floriculture division of HRC, the research branch of HRC responsible for varietal development of flowers. The floriculture department became operational only in 1998 although HRC had been set up two years previously. Since then, some efforts have been made in flowers' varietal development. Presently, the floriculture division of BARI is conducting research on gladiolus along with other flower varieties. 25 varieties of 15 flower crops have been currently developed by BARI. These comprise gerbera tuberose, gladiolus, red ginger, orchids, cactus (2 varieties), chrysanthemum (4 variety), marigold, and rose. The floriculture division is also carrying out small-scale seed multiplication and direct distribution to the farmers, but the amount of seeds distributed is negligible. It is important to underline that the capacity of the floriculture division is very limited. There is only one plant breeder within HRC and variety development for flowers is very cumbersome process, taking on average 6 to 7 years to develop.

Seed imports

On April 24, 2018, the Ministry of Agriculture issued the Plant Quarantine Rules 2018 to protect domestic plants and plant products from foreign invasive insects and pests (MOA, 2018). The rules shared formats for import permits, phytosanitary certificates, and import permit applications. For any first consignment, seed/bulb need to quarantine for full one season; after that, further consignments do not need any such type of quarantine. On the other hand, if the supplier declares/ certifies that the product is free from concern diseases or pests, it needs no quarantine. Under this rule, schedule-2, serial 74-104 is considered for flower plant and inputs (bulb/ tuber/ seed/ corn/ cutting/ bud etc). For the major details on requirements for imports specific to seed and bulbs, see Appendix 5.

Challenges to flower seed systems

Several constraints in the floriculture seed sector have been highlighted in several researches. Tazuddin (2021) foregrounded the limited availability of domestically-produced seed, lack of necessary research on flowers' seeds, and a lack of any national floriculture development policy. Prodhan et.al., (2017) highlighted a lack of variety of flowers to meet the demand of the local and global markets and a weak system of supplying variety of flower seeds to farmers. He also highlighted that more research on flower seeds should be undertaken by the BARI (floriculture division) scientists to develop disease and insect-pest resistant HYV varieties of flower seed in the near future. Haque (2012) also highlighted that high-yielding varieties are locally unavailable to the farmers at the proper time. For this reason he recommended that the government should encourage researchers and private seed companies to produce high-yielding varieties of flowers. He also especially recommended a national guideline on floriculture and suggested that senior officials of DAE should be designated for extension, coordination, and monitoring of floriculture, especially for flower activities. Other challenges faced by the sector include inadequate production facilities, marketing constraints, lack of cold-storage facilities, low-quality propagation material, farmer education in GAP, and losses reported because of insects, birds, diseases, tough weather and shorter seasons (only dry season, 7-8 months) (FGDF, 2023).

4 Policy and regulatory framework

Context

Bangladesh has established a comprehensive seed policy and regulatory framework to develop a competitive national seed sector. Key aspects of seed policies and regulations include new variety development, variety release and registration, seed quality control and certification, seed business and trade (import and export), conservation of genetic resources, utilization and exchange, protection of intellectual property rights, and institutional arrangements for decision-making and implementation mechanisms. The primary policy and regulatory framework governing the seed sector in Bangladesh includes the National Seed Policy (1993), the Seed Ordinance (1977) and its amendments, the Seeds Amendment Act (1997, 2005), the Seed Rules (2020), the Plant Quarantine Act (2011) and the Plant Variety Protection Act (2019).

It is important to recognize that the Government of Bangladesh initiated a series of reforms in the early 1990s, transitioning from a state-controlled seed sector to promoting private sector involvement in seed marketing and distribution, regulating seed quality for domestically produced seed, and facilitating seed imports into the country. This reform has led to significant growth in the private sector and contributed to the development of the Bangladesh seed sector, particularly the vegetable seed sector which is predominantly managed by the private sector.

While the seed policies and regulatory framework and their reforms mainly focus on food-security crops, there is a lack of specific policy or regulation to support the flower seed sector. The following sections provide important regulatory provisions or constraints observed mainly for food-security crops, with a specific focus on potatoes and vegetables.

Variety release and registration

The National Seed Board (NSB) is the statutory policy body responsible for making decisions on variety releases or registrations in Bangladesh (Kolady & Awal, 2018). Any variety, whether imported or domestically developed, must be registered with the NSB. The Seed Certification Agency (SCA) is the institution which administers the value for cultivation and use (VCU) test and distinctness, uniformity and stability (DUS) test for proposed new varieties on behalf of the Technical Committee and the NSB (MOA, 2022; SCA, 2023). While all new varieties need to be registered with the NSB, the regulatory procedure differs between notified and non-notified crops (Table 16).

Previously, variety registration for notified crops (including potato) could take up to two years, but recent policy changes have significantly reduced the registration period to just three months. This was viewed as a positive development for the seed sector, as it allows for a more rapid response to market demands and enhanced competitiveness. For non-notified crops, the registration process is not a stumbling block.

Table 16 *Key differences in variety release or registration requirements for notified and non-notified crops.*

Regulatory provision	Notified crops (controlled crops)	Non-notified crops (uncontrolled crops)
Crops	Rice, wheat, potato, sugarcane, jute, kenaf and mesta	All other crops (for example, vegetables)
Crop with temporary de-notification		Potato (for the period 19 September 2019 to 31 December 2023)
Variety release or registration	New varieties developed by private or public agencies require VCU and DUS testing for variety release or registration and subsequent approval required by NSB	Varieties imported or locally developed by a private person, company or agency must be registered with the NSB prior to being sold by giving prescribed cultivar descriptions, but there will be no requirement for prior testing and approval. Varieties developed by public research agencies in Bangladesh will be subject to an internal review and approval by each respective agency and must be registered with NSB before being released.

Seed Certification and Seed quality control

The Seed Certification Agency (SCA) is the statutory body responsible for seed certification and seed quality control for controlled/notified crops in Bangladesh. Breeder and foundation seed produced by the public sector in Bangladesh require mandatory certification from the SCA. However, for non-notified crops (such as all vegetable crops), seed certification by the SCA is not applicable. In such cases, seed producers are responsible for seed quality control and are required to implement an internal quality control system similar to the certification scheme. These seeds are labelled as 'truthfully labelled seed' by the operator. Not all seed producers or traders have the facilities to conduct relevant seed tests, and the private sector cannot utilize public laboratory facilities. The SCA conducts post-market quality control inspections for both publicly-produced and privately-produced seeds sold in the market.

The SCA maintains a well-structured network of seed laboratories at one central and seven regional levels. Additionally, it operates 26 mini seed laboratories and seed certification offices in 64 districts. While the SCA does not possess an International Seed Testing Association (ISTA) accredited seed laboratory, ISTA seed testing protocols are utilized for seed laboratory testing. Similarly, the SCA adheres to OECD standards in field inspections, although Bangladesh is not yet a member of the OECD. On the other hand, the MNT Seed Testing Laboratory, a division of Lal Teer Seed Limited, has obtained ISTA accreditation, the first of its kind in Bangladesh.

The SCA faces key challenges, including high staff turnover and a shortage of skilled personnel. There has been a rise in counterfeit seed cases, particularly in the vegetable crops seed. Currently, there is a vision for institutional change wherein the SCA will become a separate entity, independent of the Department of Agricultural Extension (DAE). This transition is expected to enhance capacity, provided that the agency is adequately funded and staffed.

Seed import and export

The Plant Quarantine Wing serves as the official National Plant Protection Organization (NPPO) of Bangladesh in accordance with the International Plant Protection Convention (IPPC), implementing international standards as stipulated by the Plant Quarantine Act of 2011. Bangladesh operates an import permit system whereby importers must seek permission to import seed through one of the 30 plant quarantine stations situated at the port of entry. The Wing is equipped with a national reference laboratory and 15 plant quarantine laboratories utilized for pest diagnostics during import inspections. Additionally, the majority of these stations issue phytosanitary certificates for export purposes, indicating a well-functioning export system compared to seed imports. Despite these efforts, the Plant Quarantine Wing faces constraints because of a limited number of well-trained inspectors specialized in seed inspection. Addressing this constraint is essential for maintaining effective quarantine measures and ensuring the quality of imported seeds.

Import permissions for non-notified crops, such as vegetables, are relatively straightforward and necessitate an import permit. To obtain such permits, dealers must furnish a phytosanitary certificate from the government agency of the exporting country, along with business registration documents.

Seed importers mentioned problems with seed import, including vegetable seeds, seed potatoes, and flowers. Lengthy seed import permit requirements and the need for authorization from different departments delay the issuance of letters of credit (LCs). Changes in phytosanitary requirements and regulated pests are not timeously notified to seed-exporting countries, and not all regulatory procedures/information are available in English, limiting access to necessary information.

Plant variety protection

The Government of Bangladesh promulgated the Plant Variety Protection Act in 2019 (MOA, 2019) with the aim of contributing to agricultural development and food security through the protection of breeders' intellectual property on new plant varieties, by granting breeders' rights. However, the establishment of the National Plant Variety Protection (PVP) Authority and PVP office, which are crucial administrative requirements for implementing the PVP system, has not yet been realized in Bangladesh. Furthermore, the technical capacity required for distinctness, uniformity, and stability (DUS) testing needs strengthening to ensure competence in assessing breeders' rights applications. At the same time, the private seed sector's business is affected by the illegal copying of original seed company varieties, which are sold in the market under different brand names.

5 Seed sector challenges and ambitions

This chapter elaborates the challenges and ambitions for the three crop groups considered in this assessment. The challenges and ambitions highlighted in this chapter emerged out of the consultative process with key stakeholders. The key steps which have been pursued in the synthesis process (of both challenges and ambitions) follows in full the standard methodology utilized by Thijssen et al., (2023) in the assessment of the Egypt seed sector. Here below are described more in details the key steps we followed:

Challenges
In this SSA, we collected primary and secondary data with different data collection methods. In particular, we employed desk study and stakeholder consultations. We identified and grouped a number of challenges that negatively impact the performance of the seed sector. We used the integrated framework for seed sector and food system transformation (see Figure 2 in Chapter 2) to cluster these into eight key seed sector functions: (i) production, (ii) value addition and distribution, (iii) service provision, (iv) utilization, (v) stakeholder organization, (vi) regulation, (vii) coordination, and (viii) funding.

These challenges are further elaborated in eight sections below. Besides highlighting the challenge, we indicate whether these challenges are: crop group-specific or crop-specific (vegetables, potatoes or flower), and to which stakeholders these challenges are of major concern. These stakeholders are marked as follows: local private (Bangladesh seed producers and seed companies), international private (mainly international or Dutch seed companies), and public (various government departments of Bangladesh, mainly the Ministry of Agriculture). Challenges are further grouped into topics.

Ambitions
Each of the eight seed sector performance functions has its own ambition. Together these ambitions contribute to the vision of a well-functioning seed sector in Bangladesh, that is innovative, competitive, resilient and inclusive. 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.

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

Topics	Challenges	Ambitions	Crops	Major concerns
Access to climate-resilient new varieties	Limited availability of new varieties that are adaptative to Bangladeshi climate conditions (salinity-tolerant, waterlogging-tolerant and resistant to emerging diseases and pests)	Climate-resilient varieties tolerant to salinity, flood and new diseases/pests are available to local private seed sector	Potato, Vegetables	Local private
Access to new varieties for market processing	Limited availability of new varieties that are suitable for the processing industry	New varieties suitable for processing industry are available to the local private seed sector	Potato	Local private
Access to new varieties for export market	Limited availability of new varieties suitable for the export market	New varieties suitable for the export market are available to the local private seed sector	Potato	Local private
Access to pre-basic seed	Limited access to pre-basic seed of foreign varieties	Pre-basic seed of foreign varieties are available to the local private and public seed sector	Potato	Local private, public
Unprotected cultivation technology	Majority of seed production is carried out in open-field conditions, making it more vulnerable to climate impacts such as floods, higher temperatures, and increased occurrences of diseases and pests	Protected vegetable seed production technologies are promoted in partnership with the international private seed sector	Vegetables	Local private, public
Diversity of flowers varieties	Limited choices of different varieties of flowers to meet the growing demand of the local markets	New varieties of flowers are made available in partnership with the local and international private seed sector	Flowers	Local and international private
Capacity on tissue culture technology	Limited capacity on tissue culture-based flower seed production	Capacity is developed for the local private sector in partnership with the international private sector	Flowers	Local and international private
Access to basic seed of flowers (mother plants)	Lack of high-quality basic seed (mother plant) of flowers within the country (mainly imported from India)	Basic seeds of flower varieties are made available to the local private seed sector	Flowers	Local private
Small landholding	Vegetable growers with limited small landholding have difficulties in establishing varietal trials /demos	Lease-based systems of land are in place. Variety trials are performed in government-owned lands in favourable and accessible locations	Vegetables	International private

5.2 Value addition and distribution

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

Table 18 *Topics, challenges and ambitions related to seed value addition and distribution.*

Topics	Challenges	Ambitions	Crops	Major concerns
Low profit margin for contract growers	Contract growers employed by the government are often discouraged by low profit margins and late payments	Price set for contract growers must be routinely checked and must follow market-based conditions	Potato	Public
Trained seed dealers	Limited number of trained seed dealers, affecting the marketing of quality seed	Seed dealers are trained in handling, distribution and marketing principles of quality seeds	Vegetables, potato	Local private
Seed packaging materials	In some instances Dutch exporting countries are obliged to ship seed potatoes in wooden crates, increasing overall costs	Farmers are aware about the benefits of seed potatoes sent in jute bags, and welcome shipments in such packaging materials	Potato	International private

5.3 Service provision

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

Table 19 *Topics, challenges and ambitions related to service provision.*

Topics	Challenges	Ambitions	Crops	Major concerns
Gene bank	Lack of gene banks is affecting the development of new varieties	Dedicated gene bank for vegetables, potatoes and flowers developed within BARI	All	Public, local private
Breeders capacity	Lack of skilled plant breeders with new breeding tools (e.g. speed breeding)	Plant breeder capacity developed in new breeding tools, in partnership with international knowledge institute	Potato, Vegetables	Local private, public
Accelerate new variety development	Lack of tools and infrastructure to accelerate new variety development	New tools and infrastructures for variety development are available in the country	Potato, Vegetables	Local private, public
Higher education courses	Lack of higher education courses on advance breeding tools (speed breeding)	Higher education institutes offering courses on advance breeding tools	All	Public
Cold storage conditions	Absence of separate cold storage chamber for storing seed potatoes (Table potatoes and seed potatoes are stored together in the same chamber)	Cold storage with separate chamber for seed potatoes is available	Potato	Local private
Information on seed storage space demand	Lack of coordinated system of data forecasts on the space required for seed potato in existing cold storage facilities	Information/data forecasting system developed for space required for seed potato cold storage	Potato	Local private
Access to credit	Lack of credit facilities to flower growers such as for the establishment of tissue culture labs, greenhouse-based production, and building cold storage facilities	Credit policy which allows flower-seed producers to access credit under favourable conditions	Flowers	Local private
Internal seed quality control	Most of the seed producers and small companies do not have an internal seed quality control system, thus affecting seed quality	Capacity for internal quality control system is developed through public-private partnership	Potato, Vegetables	Local private
Seed certification human resources	Seed Certification Agency (SCA) is lacking in human resource capacities (only 55% staff positions are filled) and has high staff turnover	Develop SCA's capacity as an independent seed certification authority to address the challenges of high staff turn-over	Potato, Vegetables	Public
Digitization of seed certification	Limited digitization of seed certification operations, hindering efficiency of services	Digitalized seed certification operations	Potato, Vegetables	Public
Plant quarantine wing capacity	Lack of well-trained inspectors at various plant quarantine stations, including at the ports of import, hindering the quality of inspection service delivery	Develop plant quarantine wing capacity as an independent national plant protection authority to address the challenges	Potato, Vegetables	Public
Issuance of import permit	Import permit requirements are lengthy and authorization needed from different departments delaying the issuing of letter of credit	Import permit requirements are reviewed and simplified as well as digitalized	All crops	International and local private
Notification of phyto requirements	Changes in the phytosanitary requirements are not timeously notified to the seed exporting country	A digital system is in place to increase coordination and ensure timely notification of changes in phytosanitary requirements	All	International and local private
Export delay	Late shipments of seed potato from exporting countries affects the potato production in Bangladesh (shipments should arrive in Bangladesh at least one month earlier than the current time-scale)	Quicker trade route system (Netherlands/Europe-Bangladesh) explored	Potato	Local and international private

5.4 Utilization

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

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

Topics	Challenges	Ambitions	Crops	Major concerns
Trials of new varieties	Limited new-variety trials, resulting in few adoptions of new varieties by farmers	Increase number of new-variety trials for farmers	Potato, vegetables	Farmers
Quality seed demos	Limited quality seed demos to the farmers, resulting in a low uptake of quality seed	Increase number of quality seed demos organized for farmers	Potato, vegetables	Farmers
Training on GAP	Lack of farmer knowledge on good agricultural practices such as improved agronomy practices, and use of fertilizers/agrochemicals	Farmers are aware of and apply good agricultural practices	Vegetables, Flowers	Farmers
Improved seed storage technology	Lack of farmer knowledge on improved storage facilities and techniques such as diffuse light storage technology	Farmers are aware of and apply improved storage techniques	Potato, flowers	Farmers
Farmer-saved seed	Farmers reuse potato seed for several seasons, impacting farm productivity	Farmers are aware of the value of using quality seed	Potato	Farmers
Seed quality in the informal seed system	Seed available through the informal system (farm-saved, local market, illegally imported, counterfeit etc.) is often of poor quality	Quality of seed traded through the informal seed system is improved	All	Farmers
Awareness on new variety	Farmers' unwillingness to adopt new varieties	Farmers understand the benefits of new varieties and adopt them	Potato, vegetables	Farmers
Quality seed of flowers	Lack of certified/quality flower seed for farmers	Quality/certified flower seed is available to farmers	Flower	Farmers
Access to quality inputs	Farmers have limited access to quality seeds, fertilizers, pesticides etc.	Farmers have increased access to quality seeds, fertilizers and pesticides etc.	All	Farmers
Access to finance	Farmers have poor/limited access to finance	Farmers have increased access to finance	All	Farmers

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 21 *Topics, challenges and ambitions related to stakeholder organization.*

Topics	Challenges	Ambitions	Crops	Major concerns
Public-private collaboration	Limited public –private collaboration in variety development research	Public-private partnerships are-established for variety development research	All	Local private, public
Private sector representation	Seed potato price is affected by table potato minimum price set by the government, but the private seed sector is not represented in the committee	Private-sector involvement in setting table potato price	Potato	Local private
Representation of private sector in national seed board	National Seed Board membership could be more inclusive, to increase the private sector participation (currently 25 members, one from the private seed sector (BSA) and one from farmer organizations)	Private seed sector is well represented in the national seed board	All	Local private
Seed producers platform	Currently there is a lack of any potato seed producers' platform or similar structure to coordinate the sector (although it is the second largest crop after rice)	Potato-seed producers' association/platform well established	Potato	Local and international private
Flower Association capacity	The Bangladesh Flower Society and Bangladesh Nurseries Association are relatively underdeveloped	The capacity of the Bangladesh Flower Society and Bangladesh Nurseries Association is strengthened	Flower	Local private
Bangladesh Seed Association (BSA) capacity	BSA capacity is relatively underdeveloped. It has very low capacity to organize itself or to conduct a constructive dialogue with the public sector around problems affecting the seed industry. There is no regular dialogue between the various seed subsector stakeholders around seed policy and regulatory issues	BSA is recognized within the sector as an institution improving policy formulation, analysis, advocacy and reform. It pools experts on different areas of seed industry. It runs advocacy campaigns with the government on behalf of member/BSA concerns	Potatoes, vegetables	Local private

5.6 Regulation

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

Table 22 *Topics, challenges and ambitions related to seed sector regulation.*

Topics	Challenges	Ambitions	Crops	Major concerns
Incentive for plant breeders	Lack of incentive structures to attract and retain skilled breeders (e.g. royalty system, higher education, advanced training)	Plant breeders are incentivized through royalty policies, higher education and advanced training	All	Local private, public
Non-notified crops status	The private seed sector views lifting the de-notification as counter-productive for the seed business and advocates for the permanent de-notification of the potato crop	Potato de-notification process is sustained	Potato	Local and International private
Subsidized seed	BADC subsidized seed potato price affecting the market competition	Increased coordination/dialogue between public-private sector in setting the seed potato price	Potato	Local and international private
Counterfeit seed	Increased cases of counterfeit seed (mainly of popular varieties when there is high demand and seed supply is low being sold to farmers. Seed Certification Agency is limited in its control of counterfeiters. Lack of data on the impact of counterfeit seed on the vegetable seed sector	Halting counterfeit seed traded in the market through risk-based inspection and a strong market-monitoring system	Vegetables	Local and International private
Flower seed production	Seed imports from the Indian border are largely unchecked and informal	Strengthen the Plant Protection Wing capacity on seed inspection at border	Flowers, potatoes, vegetables	Local and international private
Seed certification standards	Lack of seed certification standards and guidelines for flower seed production	Flower seed certification standards and guidelines developed	Flowers	Local private
Phytosanitary certificate	Phytosanitary certificates require declaration of pests that are not present in the seed-exporting country lists, resulting in delay to the seed import	Effective coordination mechanism developed between the NPPOs of the seed exporting countries and Bangladesh NPPOs.	All	International and local private
Plant Variety Protection	The Plant Variety Act (2019) is not being implemented, hindering the introduction of better technologies/new varieties from the international market and the local private breeding sector	Capacity developed of the implementation of the Plant Variety Protection Act (e.g. establishment of PVP rules, PVP Board and DUS testing capacity)	All	Public, International and local private
Royalty collection	Collecting royalties is challenging for international and local seed companies	Enforcement of the PVP Act to facilitate the royalty collection process	Potato, flowers	International and local private
Breeders Rights Protection	Breeders take varieties along when they join a new seed company; as a result local seed companies face challenges that their varieties are being stolen by other seed companies	Enforcement of the PVP Act to protect breeders' rights	Vegetables	Local private
Harmonization of seed laws and regulations	Seed laws and regulations are not compatible with international standards such as the OECD seed scheme; the plant variety protection (PVP) system is not compliant with the International Union for the Protection of New Varieties of Plants (UPOV) system	Bangladesh seed-related rules, regulations and guidelines are harmonized with international standards	All	Local and International private, public
Flower sector policy	The lack of floriculture development policy in Bangladesh is impacting sector development. Existing seed policies and regulations do not cover the flower seed systems, so the needs and challenges are not addressed	Floriculture development policy and floriculture seed policy developed	Flower	Local and international private, Public

5.7 Coordination

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

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

Topics	Challenges	Ambitions	Crops	Major concerns
Seed data	Reliable data on seed production by the contract growers is missing. This makes difficult to predict demand, especially for BADC, which has difficulty in predicting and selling the originally-planned stock	BADC seed growers share their seed production data transparently	Potato	Public
Seed data	Reliable data on hybrid seed production is not accessible	The private seed sector routinely share their seed production data with BSA	Vegetables	Public, Local private
Independent authority for seed certification	The establishment of SCA as an independent authority for seed certification is not yet implemented (so far there has only been a change in the name, Agency to Authority)	SCA is an independent seed certification authority	All	Public, local and international private
Independent authority for plant quarantine	The establishment of an independent Plant Quarantine Authority is not initiated yet	The Plant Quarantine Wing becomes an independent Plant Quarantine Authority	All	Public, local and international private
Seed data	Lack of a system which coordinates the data on seed production and supply	The Bangladesh Seed Portal is well established	All	Local private, public

5.8 Funding

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

Table 24 *Topics, challenges and ambitions related to seed sector funding.*

Topics	Challenges	Ambitions	Crops	Major concerns
Agricultural credit from private banks	Private banks get a higher budget from government for agricultural credit than publicly-owned banks, but private banks have limited branches in rural areas resulting in difficulties in providing credit to farmers	Criteria of budget allocation for agriculture credit is revised	All	Local private
Credit to flower-seed production	No credit or finance for flower production facility or storage because of non-eligibility within the current scheme (loans can only be made as an industrial loan, not as an agricultural loan)	Flowers growers benefit from agriculture loans	Flowers	Local and international private

6 Way forward

This seed sector assessment (SSA) provides an in-depth examination of the Bangladesh seed sector, focusing on three crop groups: potatoes, vegetables, and flowers. Through extensive desk research and consultations with key stakeholders we have highlighted the current state of the different seed systems of these crop groups. Our analysis has also allowed us to identify key challenges affecting the advancement of the Bangladesh seed sector, categorizing them into specific seed sector functions. This has enabled us to determine areas requiring significant attention, such as in seed production, service provisions, or regulations, where major bottlenecks have been identified. We have also specified the crop groups affected by these challenges and which types of stakeholders are most affected by these challenges (for instance, farmers, local or international private organizations, or public organizations). This has enabled us to reflect on the relevance - for the advancement of Bangladesh seed sector as a whole - of certain issues, and reflect on whether challenges are sector-wide or crop-specific. In other words, we provide valuable insights into the current state of the Bangladesh seed sector, addressing the question: *Where are we now*?

In addition to identifying challenges, we have also outlined specific ambitions for the seed sector, aimed at addressing these challenges and driving future progress. This allows us to address the question: *Where do we want to go*? However, formulating these ambitions proved to be a complex task due to conflicting interests and priorities among stakeholders. Despite these challenges, through extensive consultations, we have developed and validated ambitions that provide future directions for the seed sector's transformation. We have clustered these ambitions into three different areas of opportunity. The first cluster of opportunities contribute significantly to the advancement of seed systems for all three crop groups and for the Bangladesh seed sector as a whole; the second cluster of opportunities are specific to potato and vegetables; and the third cluster of opportunities are specific to flowers. The three clusters are described in detail below.

Sector-wide opportunities

- Establish a national genetic resources centre in Bangladesh with a specific focus on vegetables, potatoes and flowers.
- Strengthen public-private partnerships to promote variety development and research.
- Strengthen capacity in advanced plant breeding methods and tools (hands-on training, higher education courses and programmes).
- Establish five ISTA-accredited laboratories in the public and private sector, and strengthen the partnership with ISTA.
- Establish an independent seed certification authority under the Ministry of Agriculture and develop its capacity-building potential.
- Establish an independent national plant quarantine authority under the Ministry of Agriculture and develop its capacity-building potential.
- Implement the Plant Variety Protection Act (2019).
- Establish a fully digitized and automated Bangladesh seed portal as a one-stop-shop to facilitate seed regulatory services, seed businesses and trades, and support increased coordination on national seed data.
- Review seed import and export regulatory procedures, amend existing rules or regulation that cause delay, and develop online automation of processes.
- Review and harmonize seed rules and regulations that are compatible with international standards.
- Strengthen the capacity of the Bangladesh Seed Association.
- Support private sector-led seed extension and improved cultivation practices for farmers.

Potato and vegetable-specific opportunities

- Formalize potato seed producer cooperatives in order to professionalize existing seed contract growers.
- Strengthen the local production of potato seed in Bangladesh.
- Promote improved potato seed storage technologies/practices to the farmers.
- Strengthen internal seed quality control capacity for local seed producers and seed companies, including the development of policy guidelines and SOP development.

- Organize training programmes on protected seed production practices (polyhouse, net-houses and greenhouse).
- Strengthen the market inspection system to control counterfeiting in seeds.
- Strengthen the patrolling system and inspections at the border to curb the dissemination of poor-quality seed to farmers.
- Promote new and high-yielding varieties of vegetables and potatoes that are adaptive to Bangladeshi climate conditions (salinity, waterlogging).
- Promote new and high-yielding varieties of vegetable and potato that are suitable for the export market.

Flower specific opportunities
- Develop floriculture sector policy.
- Develop flower-seed multiplication and seed certification standards.
- Strengthen the capacity of the Bangladesh Flowers Society and Nursery Association.

We are confident that this assessment offers a comprehensive overview of the Bangladesh seed sector for potatoes, vegetables, and flowers, providing stakeholders in both Bangladesh and the Netherlands not only valuable insights to support collaboration and improve sector performance, but also key insights concerning the ambitions and prioritization of the latter.

As part of our objectives, we have also identified opportunities for partnerships between Bangladesh and the Netherlands. In a separate document, we have outlined detailed seed investment opportunities with pathways for implementation of ambitions based on current gaps, and stakeholders' interests and priorities, addressing the question: *How to get there*?

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Appendix 1 Stakeholder consultations

A total of 63 different organizations and over 104 experts have been involved in the Seed sector assessment. They participated through meetings on policy and regulatory environment studies in Bangladesh (24-27 September 2023), crop-specific focus group discussions in Bangladesh (9-12 October 2023), crop-specific bilateral meetings with Dutch/international seed companies (November 2023-January 2024), multi-stakeholder validation workshops in Bangladesh (12 December 2023), and validation meetings with Dutch seed companies in the Netherlands (6 February 2024). Below is the list of organizations that participated in various events of the SSA.

Public sector -Bangladesh
Bangladesh Agricultural Development Corporation (BADC-Seed and Horticulture, CDP corps, Seed Division, Seed processing and preservation division), Bangladesh Agricultural Research Council (BARC -Crops division, Planning and Evaluation division), Bangladesh Agricultural Research Institute (BARI -Vegetable Division, Flower Division, Horticultural Research Center, Seed Technology Division, Tuber Crop Research Center, Planning & Evaluation Wing), Department of Agricultural Extension, Plant Quarantine Wing, Seed Certification Agency, Seed Wing (Ministry of Agriculture), Bangabandhu Sheikh Mujibur Rahman Agricultural University and Sher-e Bangla Agriculture University.

Private Sector -Bangladesh
A.R. Malik Seeds private limited, ACI Seed, Agri Concern Limited, Bangladesh Flower Society, Bangladesh Cold Storage Association (BCSA), Bangladesh Seed Association (BSA), Bayer crops limited, Bondhon Genetics limited, BRAC Seed & Agro Enterprise, Delta Desh, DuPont Bangladesh limited, East Bengal Seed company, First Farmer Agro Industries Ltd, Globex (Exim) private limited, Kishan Seed International, Krishibid Seed limited, Lal Teer Seed Ltd, Metal Agro Limited, Mollika Seed Company, Supreme Seed Company limited, Syngenta Bangladesh Limited and Winall Hi-Tech Seed company limited.

Farmers organisation/Association -Bangladesh
Potato seed producers, farmers growing vegetables, potatoes and flowers.

Development partners and INGOs
Asian Development Bank (ADB), Cordaid, Food and Agriculture Organisation (FAO), International Fund for Agricultural Development (IFAD), Netherlands Development Organisation (SNV), PUM Nederlands, Solidaridad, The Netherlands embassy in Dhaka, Bangladesh, World Bank.

Dutch/International seed companies, Association
Agrico, Bakker Brothers, BASF Nunhems, Bayer, Bejo Seeds, East West Seed, Enza Zaden, EASI Seeds, HZPC, International Association of Horticultural Producers (AIPH), Limagrain/Hazera, Plantum, Rijk Zwaan, SEPIA, STET Holland, Syngenta.

Appendix 2 Vegetables produced in Bangladesh

Vegetable Production Bangladesh

Crop	2019-20			2020-21			2021-22			
	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	%
VEGETABLES (Winter)										
Rabi Brinjal	83	4496	373	83	4621	385	85	4838.16	409	11
Rabi Pumpkin	43	4705	204	44	4910	216	45	5140.81	229	6
Cauliflower	54	5219	283	56	5259	294	56	6066.39	342	9
Cabbage	55	7013	384	55	6888	380	53	7435.57	395	10
Watergourd	49	5105	251	50	5019	252	51	5547.87	284	7
Tomato	70	5897	415	73	6144	448	73	6046.35	442	12
Radish	65	4423	287	67	4693	316	67	4831.77	322	8
Beans	62	2754	170	55	3080	170	57	2986.74	170	4
Carrot	5	3906	21	06	4805	28	06	5036.39	31	1
Palongsak	28	2442	59	25	2454	61	25	2523.87	62	2
Lalsak	31	1996	61	32	2062	65	32	2255.06	73	2
Lausak	17	1849	31	18	1848	32	18	2010.95	36	1
Shallgam	3	2701	9	03	2747	09	03	2758.39	10	0
Uthche	14	1951	28	14	2012	29	15	2110.93	32	1
Other winter vegetables/Beet	-	-	-	.098	2.56	.202	0.29487	3071.29	01	0
Total Winter Vegetables	575	448	2576	581	462	2.685	586	4843	3838	
VEGETABLES (Summer)										
Kakrol	13	2476	32	14	2504	34	13	3003.09	40	2
Pumpkin, Kharif	34	4019	136	30	4692	140	30	4813.84	145	7
Brinjal, Kharif	49	3766	185	49	4109	202	49	424.13	210	10
Patal	26	3471	91	26	3778	98	26	4282.30	110	5
Lady's Finger	29	1961	56	30	2332	70	30	2811.04	85	4
Jhinga	25	2096	53	26	2169	56	26	2311.00	61	3
Karala	27	2160	59	27	2212	59	29	2274.66	65	3
Green Banana	29	5712	167	29	6185	179	29	6404.93	183	8
Chalkumra	25	3226.08	81	26	3408	88	26	3601.57	94	4
Cucumber	24	3398	83	25	3752	95	26	3898.69	100	5
Khirai	14	3342	47	17	3588	62	17	3760.91	64	3
Puisak	27	3240	88	27	3591	98	28	3647.49	102	5
Chichinga	20	2171	43	19	2371	46	20	2442.80	48	2
Danta	27	2856	77	27	3156	86	28	3167.75	89	4
Barbati	17	1646	28	18	1882	33	18	2228.48	40	2
Dundal	11	1981	21	11	2143	24	11	2410.51	27	1
Kachur lati			2481	42	18	2641	19	2563.41	49	2
Shajna	15	26.27	28	07	26.12	29	07	26.47	30	1
Katcha Papya	20	43	391	26	31	292	22	30.46	308	14
Maan Kachu	6	3104	18	05	3411	16	05	3451.11	17	1
Mura Kachhu	10	3465	34	10	3438	33	09	3691.96	34	2
Kachhu shak	4	1524	6	04	1354	05	04	1556.19	07	0
Owl Kachhu	2	7368	16	02	7675	17	02	8183.34	18	1
Mukhi Kachhu	23	4317	98	24	4655	110	24	5129.43	123	6
Pani kachu	14	4458.04	62	14	4415	62	14	4599.42	65	3
Kachu	0	0	0	0	0	0	0	0	0	0

Crop	2019-20			2020-21			2021-22			
	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	Area '000' Acres	Per acre Yield (Kg)	Production '000'M. Tons	%
Pat Shak	7	1903	13	07	1819	13	07	1946.30	14	1
Data Shak	14	2065	29	14	2163	30	14	2265.23	32	1
Kalmi Shak	5	1899	10	05	1995	11	06	2025.19	12	1
Other summer vegetables	-	-	-	-	-	-	-	-	-	
Total Summer Vegetables	535	3738	2000	540	3781	2042	539	4029	2172	
Total Vegetables (Winter & Summer)	1110	4121	4575	1121	4110	4587	1125	5342.22	6010	100

Appendix 3 Import-export data indicator crops

Brinjal

	2018	2019	2020
Import volume (x1000 tons)	0.39	0.14	0.29
Export volume (x1000 tons)	3660.94	1522.45	241

	2018	2019	2020
Import Value (million USD)	1	0.1	1
Export Value (million USD)	5192	2139	463

Tomato

	2018	2019	2020	2021
Import volume (tons)	1294	33392	42677	45572
Export volume (tons)	123	64	2	139

	2018	2019	2020	2021
Import Value (million USD)	485	14623	18840	19526
Export Value (million USD)	81	35	4	86

Onion

	2018	2019	2020	2021
Import volume (x1000 tons)	262555.9	259253.9	687183.6	571290.9
Export volume (x1000 tons)	66	15	44	68

	2018	2019	2020	2021
Import Value (million USD)	63497	108773	191782	172321
Export Value (million USD)	19	12	22	37

Appendix 4 Registered varieties

This table provides the number of varieties released by BARI (TCRC). For each variety is indicated ownership (whether has been developed by the public sector or by the private sector) and released year. The list is not complete, as it is missing several varieties introduced in late 2022 and 2023.

Name of the variety	Released year	Applicant ownership
BARI Alu-1 (Heera)	1990	BARI
BARI Alu-2 (Morene)	1990	Blue-Moon International
BARI Alu-3 (Origo)	1990	Blue-Moon International
BARI Alu-4 (Ailsa)	1993	Blue-Moon International
BARI Alu-5 (Patrones)	1993	Blue-Moon International
BARI Alu-6 (Multa)	1993	Blue-Moon International
BARI Alu-7 (Diamant)	1993	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-8 (Cardinal)	1993	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-9 (Mondial)	1993	Blue-Moon International
BARI Alu-10 (Kufri Sinduri)	1993	BARI
BARI Alu-11 (Chamak)	1993	BARI
BARI Alu-12 (Dheera)	1993	BARI
BARI Alu-13 (Granola)	1994	Agriconcern
BARI Alu-14 (Cleopetra)	1994	Blue-Moon International
BARI Alu-15 (Binela)	1994	Blue-Moon International
BARI Alu-16 (Arinda)	2000	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-17 (Raja)	2000	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-18 (Baraka)	2003	Blue-Moon International
BARI Alu-19 (Bintje)	2003	Blue-Moon International
BARI Alu-20 (Jaerla)	2003	Blue-Moon International
BARI Alu-21 (Provento)	2004	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-22 (Saikot)	2004	BARI
BARI Alu-23 (Ultra)	2005	Agriconcern
BARI Alu-24 (Dura)	2005	Agriconcern
BARI Alu-25 (Asterix)	2005	Blue-Moon International
BARI Alu-26 (Felsina)	2006	Blue-Moon International
BARI Alu-27 (Esprit)	2008	Agriconcern
BARI Alu-28 (Lady Rosetta)	2008	North Pole & South Pole
BARI Alu-29 (Courage)	2008	Blue-Moon International
BARI Alu-30 (Meridian)	2009	Lai Teer Seed Ltd.
BARI Alu-31 (Sagitta)	2010	Blue-Moon International
BARI Alu-32 (Quincy)	2010	Blue-Moon International
BARI Alu-33 (Almera)	2011	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-34 (Laura)	2011	Agriconcern
BARI Alu-35	2012	BARI
BARI Alu-36	2012	BARI
BARI Alu-37	2012	BARI
BARI Alu- 38 (Omega)	2012	Farm Fresh Enterprises
BARI Alu- 39 (Bellini)	2012	Blue-Moon International
BARI Alu-40	2012	BARI
BARI Alu-41	2012	BARI
BARI Alu-42 (Agila)	2012	A. J. Enterprise
BARI Alu-43 (Atlas)	2012	Global Agro Resources Incorporation
BARI Alu-44 (Elgar)	2012	Dion International Company Ltd.
BARI Alu-45 (Steffi)	2012	Dion International Company Ltd.
BARI Alu-46	2013	BARI
BARI Alu-47	2014	BARI

Name of the variety	Released year	Applicant ownership
BARI Alu-48	2014	BARI
BARI Alu-49	2014	BARI
BARI Alu-50	2014	BARI
BARI Alu-51 (Bellarosa)	2014	M/S Kabirajhat Associates
BARI Alu-52 (Labadia)	2014	Euro Bangla Agriculture Ltd.
BARI Alu-53	2014	BARI
BARI Alu-54 (Musica)	2014	M/S Purple Pluse
BARI Alu-55 (Red Fantasy)	2014	Farm Fresh Enterprises
BARI Alu-56	2014	BARI
BARI Alu-57	2014	BARI
BARI Alu-58 (El Mundo)	2014	M/S Euro Bangla Agriculture Ltd.
BARI Alu-59 (Metro)	2014	M/S Kishan seed International
BARI Alu-60 (Vivaldi)	2014	M/S Blue-Moon International
BARI Alu-61 (Volumia)	2014	M/S Blue-Moon International
BARI Alu-62	2015	BARI
BARI Alu-63	2015	BARI
BARI Alu-64 (Folva)	2015	Giant Agro Processing Limited
BARI Alu-65 (Rosagold)	2015	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-66 (Pamela)	2015	Global Agro Resources Incorporation
BARI Alu-67 (Gorgina)	2015	Farm Fresh Enterprises
BARI Alu-68 (Atlantic)	2015	Farm Fresh Enterprises
BARI Alu-69 (Flamenco)	2016	M/S Blue-Moon International
BARI Alu-70 (Destiny)	2016	A.R. Malik and Company (Pvt.) Ltd
BARI Alu-71 (Dolly)	2016	Global Agro Resources Incorporation
BARI Alu-72	2016	BARI
BARI Alu-73	2016	BARI
BARI Alu-74 (Bercelona)	2017	M/S Tanvir Traders
BARI Alu-75 (Montecarlo)	2017	M/S Tanvir Traders
BARI Alu-76 (Caruso)	2017	Farm Fresh Enterprises
BARI Alu-77 (Sarpo Mira)	2017	Giant Agro Processing Limited
BARI Alu-78	2017	BARI
BARI Alu-79	2017	BARI
BARI Alu-80	2018	BARI
BARI Alu81	2018	BARI
BARI Alu82	2019	BARI
BARI Alu83 (Cimega)	2019	Giant Agro Processing Limited
BARI Alu84 (Memphis)	2019	Eastern Trade Corporation
BARI Alu85 (7 four 7)	2019	Agriconcern
BARI Alu86	2019	BARI
BARI Alu87	2019	BARI
BARI Alu-88	2019	BARI
BARI Alu89 (Fortus)	2019	Estren Trade Corporation
BARI Alu90 (Alouette)	2019	A.R. Malik and Company (Pvt.) Ltd
BARI Alu91 (Carolus)	2019	A.R. Malik and Company (Pvt.) Ltd
BARI Alu92	2021	BARI
BARI Alu93	2022	BARI
BARI Alu94 (Sunred)	2022	Eastern Trade Corporation
BARI Alu95	2022	BARI
BARI Alu96	2022	BARI
BARI Alu97 (Alverston Russet)	2022	Eastern Trade Corporation
BARI Alu-98 (Arizona)	2022	A.R. Malik and Company (Pvt.) Ltd
BARI Alu99 (HZD-1249)	2022	Eastern Trade Corporation
BARI Alu100 (Ottawa)	2022	Agriconcern
BARI Alu101 (Blackberry)	2022	BARI
BARI Alu102 (Spartan red)	2022	BARI
BARI Alu103	2023	BARI
BARI Alu104 (Hind)	2023	Dion International Co. Ltd.
BARI TPS-1	1997	BARI
BARI TPS-2	1997	BARI

Appendix 5 Import rules flower seeds and seedlings

Category of Commodity	Plant Species	Use		Country of Origin	Requirement of Additional declarations	Special Conditions of Import
Flower bulbs	Dahlia (Dahlias pp.	(i)	Tubers for planting or propagation	Any Country	Freedom from: Virus affecting dahlia except dahlia Mosaic virus	(i) Post-entry quarantine for one growth season. (ii) Freedom from soil
		(ii)	Seed(ling)		Not Applicable	Freedom from quarantine weeds seeds.
Flower bulbs	Chrysanthemum (Chrysanthemum spp.)	Seed(ling)			Freedom from: Bacterial leaf blight of tomato (Pseudomonas viridiflava)	Freedom from quarantine weeds seeds.
Flower bulbs	(b) Gladiolus spp.	Corms/ Cormlets for planting or propagation			Freedom from: (a) Smut (Urocystis gladiolicola) (b) Rusts (Uromyces gladioli and U.transversalis) (c) Cormrot (Fusarium. Oxysporum f.sp. gladioli) (d) Hard rot (Septoria gladioli) (e) Scab and neck rot (Burkholderia sp.)	(i) Post-entry quarantine for one growth season. (ii) Freedom from soil.
Flower bulbs	Rose (Rosa spp.)	Grafts/ Bud wood/Saplings for planting			Freedom from: (a) Crown gal (Agrobacterium tumefaciens) (b) Hairy root (A. rhizogenes) (c) Brand canker (Coniothyrium wernsdorfiae) (d) Brown canker (Cryptosporella umbrina) (e) Downy mildew (Peronospora sparsa) (f) Rust (Phragmidium spp.) (g) Rose streak virus	(i) Post-entry quarantine for a period of 18 months except budding for 90 days. (ii) Freedom from soil for rooted cuttings.
Flower bulbs	Lily (Lillium spp.)	(i) Bulbs for planting			Freedom from: (a) Fusarium wilt (Fusarium oxysporumf.sp.lilii) (b) Anthracnose (Colletotrichum lilii) (c) Bacterial leaf spot(Burkholderia gladioli pv. Gladioli) (d) Lily viruses (lily rosette, lily symptom less, tulip breaking and lily curl stripe)	(i) Post-entry quarantine for one growth season. (ii) Freedom from soil.

Category of Commodity	Plant Species	Use	Country of Origin	Requirement of Additional declarations	Special Conditions of Import
Flower bulbs	(h) Tulipa spp.	Bulbs for planting or propagation		Freedom from: (a) Bulb and stem nematode (Ditylenchus dipsaci) (b) Yellow pustule and hellfire (Curtobacteriumflac cumf aciens pv.oortii) (c) Tulipa viruses viz. band breaking, chlorotic blotch, virus and other seed borne viruses.	(i) Post-entry quarantine for one growth season. (ii) Free from soil. (iii) Hot-water treatment of bulbs at 45°C for 4hrs followed by suitable fungicidal treatment and the treatment shall be endorsed on the Phytosanitary Certificate. Or Treatment with Phosphine at recommended or equivalent any other treatment.
	Gerbera (Gerbera jamesonii)	(i) Seed(ling)			Freedom from quarantine weed seeds.
			Netherlands	Freedom from: (a) Frankliniella occidentalis (Western flower thrips) (b) Otiorhynchus sulcatus(Vine weevil) (c)Thripsangus ticeps(Field thrips) (d) Phytonemus pallidus (Strawberry mite) (e) Phytophthora cryptogea (Tomato root rot)	Post-entry quarantine growing for a Period of 45 days.

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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, 7,600 employees (6,700 fte) and 13,100 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.