



भारतीय कृषि एवं खाद्य परिषद्
INDIAN CHAMBER OF FOOD AND AGRICULTURE

SEEDS WITHOUT BORDERS

The 2nd India-Africa Seed Trade Report

Scope and Opportunities for Trade, Climate Resilience, Genetic Diversity, Technology
and a Shared Roadmap for India and Africa



Published by the

INDIAN CHAMBER OF FOOD AND AGRICULTURE
(ICFA)

For the 2nd India-Africa Seed Summit 2026
Hyderabad

SEPTEMBER 2026

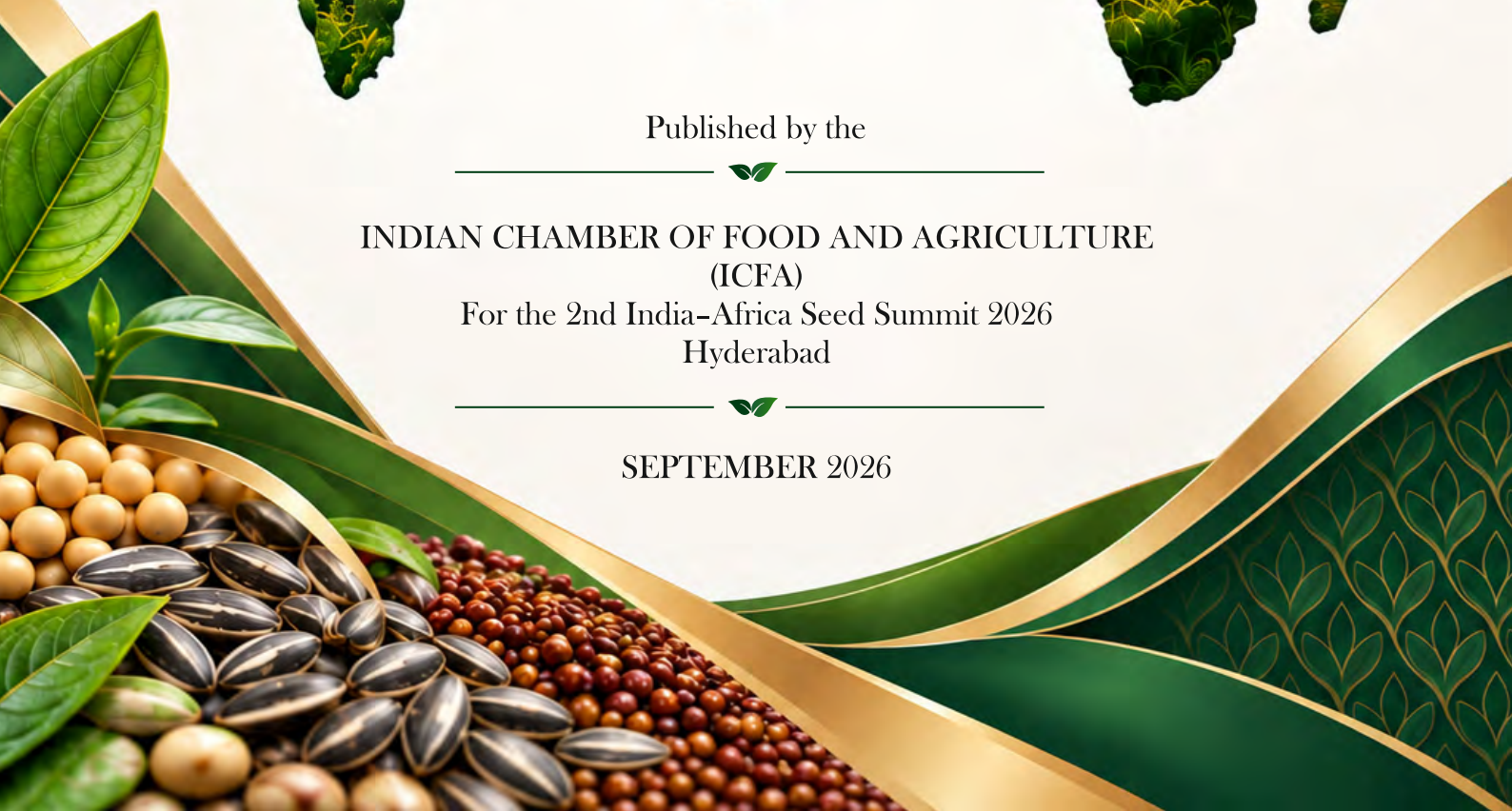


Table of Contents

Contents	1
Foreword	3
Executive Summary	4
Trade and Market Context.....	4
Different Crops, Different Pathways	4
Technology and the Next Phase of Cooperation.....	4
1. Scope, Definitions and the Global Seed Economy.....	5
1.1 Scope and Methodology	5
1.2 Understanding Seed Market and Seed Trade Data	5
<i>Main measures used in the report</i>	6
1.3 Structure of Global Seed Trade.....	6
1.4 Emerging Trends in the Global Seed Sector	7
<i>Climate resilience is becoming a major breeding priority</i>	7
<i>Breeding is becoming more data-driven</i>	7
<i>Genetic diversity is gaining renewed importance</i>	7
<i>Trade and quality systems are becoming more digital</i>	7
2. India's Seed Sector and Global Position	8
2.1 Evolution of India's Seed Sector	8
2.2 Research, Breeding and Seed Production Capacity	8
2.3 India's Seed Export Profile	9
2.4 Opportunities for India - Africa Cooperation	9
3. Africa's Seed Systems and Market Opportunity	11
3.1 Diversity of Seed Systems Across Africa.....	11
3.2 Formal and Farmer-Managed Seed Systems.....	12
3.3 Regional Seed Trade and Harmonisation	13
3.4 Seed Access, Production and Food-Security Context.....	13
4. India–Africa Seed Trade: Current Trends and Market Linkages.....	14
4.1 India's Seed Export Trends.....	14
4.2 Major African Markets	14
4.3 Crop-Specific Trade Opportunities	16
4.4 Key Barriers to Seed Trade.....	17
4.5 Opportunities for Expanding the Trade Corridor	17
5. Crop Opportunities for India–Africa Collaboration.....	18
5.1 Rice and Vegetables	18
5.2 Maize	18
5.3 Sorghum and Pearl Millet	19
<i>Industry Experience: Sorghum for Dryland and Livestock Systems</i>	19

5.4 Groundnut and Pulses.....	19
5.5 Soybean and Forage Crops.....	20
5.6 Vegetatively Propagated Crops	20
5.7 India–Africa Crop Collaboration Opportunities	21
6. Climate-Resilient Seeds and Genetic Diversity	22
6.1 Traits for Climate-Resilient Agriculture	22
6.2 Hybrids and Improved Varieties	22
6.3 Indigenous Varieties and Landraces	23
<i>Field Experience: Conserving and Using Landraces in Karnataka</i>	23
6.4 Community Seed Systems and Participatory Evaluation.....	23
6.5 Genetic Diversity for Future Breeding.....	24
7. AI, Genomics and Digital Technologies in the Seed Sector.....	25
7.1 From Conventional to Data-Assisted Breeding	25
7.2 Genomics and Predictive Breeding.....	26
7.3 Digital Tools in Seed Production	26
<i>Applied Technology: AI in Seed Production and Quality</i>	26
7.4 Seed Quality, Testing and Traceability	27
7.5 Opportunities and Risks of AI	27
8. Regulation, Standards and Market Access	28
8.1 Variety Registration and Release.....	28
8.2 DUS and VCU Testing	28
8.3 Seed Certification and Quality Testing	28
8.4 Phytosanitary Requirements	29
8.5 Plant Variety Protection.....	29
8.6 Regional Regulatory Harmonisation.....	30
9. Building a Stronger India–Africa Seed Partnership.....	31
9.1 From Seed Exports to Local Production.....	31
9.2 Local Seed Multiplication and Business Partnerships.....	31
9.3 Public-Private Partnerships in Seed Research and Innovation	32
9.4 Digital Distribution and E-commerce	32
9.5 Policy, Investment and Capacity Building	32
10. Recommendations for Strengthening India - Africa Seed Cooperation.....	34
<i>Recommendation 1: Improve Regulatory Coordination and Variety Testing</i>	34
<i>Recommendation 2: Identify Priority Crops and Traits for Joint India–Africa Work</i>	34
<i>Recommendation 3: Strengthen Local Seed Multiplication and Business Partnerships</i>	34
<i>Recommendation 4: Improve Seed-Market Information, Traceability and Digital Cooperation</i>	35
<i>Recommendation 5: Expand Joint Research on Climate-Resilient Genetics and Diverse Seed Systems</i>	35
11. Roadmap to 2030.....	36
11.1 Priority Actions.....	36
11.2 Implementation Roadmap.....	36
11.3 Key Performance Indicators.....	37
Conclusion	37

Foreword

Seed is the starting point of agriculture. The quality, availability and suitability of seed influence crop productivity, farmer income, food security and the ability of farming systems to respond to climate and market pressures. As agriculture faces changing weather patterns, rising production costs and growing demand for food, access to better seed and stronger seed systems has become increasingly important.

The 2nd India–Africa Seed Summit 2026, convened by the **Indian Chamber of Food and Agriculture (ICFA)**, provides a platform to deepen cooperation between India and African countries in seed research, production, trade, technology and innovation. The Summit focuses on stronger partnerships, climate-resilient and high-yielding varieties, regulatory cooperation, public-private collaboration, knowledge exchange and improved access to quality seed.

This report examines the opportunities for strengthening India–Africa cooperation across seed trade, crop research, climate resilience, genetic diversity, seed production, regulation and emerging technologies. It aims to identify practical areas where stronger collaboration can support commercial growth, local capacity and more resilient seed systems, while recognising that crop priorities, regulations and market conditions differ across countries.

Executive Summary

Seeds sit at the intersection of **trade, climate adaptation, genetic diversity, productivity, nutrition and technology**. As farming systems face changing climates, new pest and disease pressures and rising demand for food, the role of seed is becoming more strategic. The challenge is not only to produce more seed, but to ensure that suitable varieties can be developed, tested, multiplied and delivered in ways that respond to local conditions.

India and Africa have a strong basis for deeper cooperation. India brings experience in plant breeding, hybrid seed production, dryland crops, seed multiplication and a large public and private research base. African countries bring diverse agro-ecological conditions, important crop genetic resources, national research systems and growing demand for improved planting material. This creates opportunities that go beyond conventional trade to include **joint research, variety testing, local production, technology exchange and stronger business partnerships**.

Trade and Market Context

International seed trade is already substantial. OECD analysis estimated that around **3.9 million tonnes of seed were traded globally in 2015, valued at more than USD 10 billion**. India is part of this international market and has established seed trade links with a number of African countries. In 2024, India exported about **USD 150.6 million under HS 1209**, including exports to Kenya, Tanzania, Uganda and Egypt.

These figures represent only part of the seed trade, as several important cereal seeds are classified under separate crop-specific customs headings. The report therefore considers both broader seed-trade categories and crop-specific trade.

Different Crops, Different Pathways

The opportunity is not uniform across Africa. Maize, rice, vegetables, sorghum, pearl millet, groundnut, pulses, soybean and forage crops offer different possibilities for trade, testing, breeding and local multiplication. Vegetatively propagated crops such as cassava, yam and plantain require separate systems for clean planting material, disease management and multiplication.

Climate resilience is also becoming central to seed development. Traits such as **drought and heat tolerance, pest and disease resistance, maturity flexibility, salinity tolerance and nutritional quality** are gaining importance. Improved varieties and hybrids can be complemented by the conservation and use of landraces, genetic resources and farmer-managed seed systems.

Technology and the Next Phase of Cooperation

Artificial intelligence, genomics and digital technologies are beginning to influence breeding, field monitoring, seed-quality assessment, forecasting and traceability. In 2026, ICRISAT and CIMMYT launched a five-year initiative for dryland agriculture in Africa and India, initially focusing on **sorghum and groundnut** and using advanced breeding and data-driven approaches.

The report identifies five priority areas for strengthening India–Africa cooperation:

- 1. Stronger regulatory cooperation and variety testing**
- 2. Shared crop and trait priorities**
- 3. Local seed multiplication and business partnerships**
- 4. Better market information, traceability and digital cooperation**
- 5. Deeper joint research on climate resilience and genetic diversity**

The larger opportunity is therefore not simply to increase the quantity of seed moving between India and Africa. It is to build a more complete partnership in which **trade is supported by research, regulation, local production, technology and stronger delivery systems**.

1. Scope, Definitions and the Global Seed Economy

The global seed economy brings together plant breeding, seed production, trade, regulation, technology and farmer access. It includes commercial markets, public research, international breeding programmes and farmer-managed seed systems. International trade is one part of this wider system.

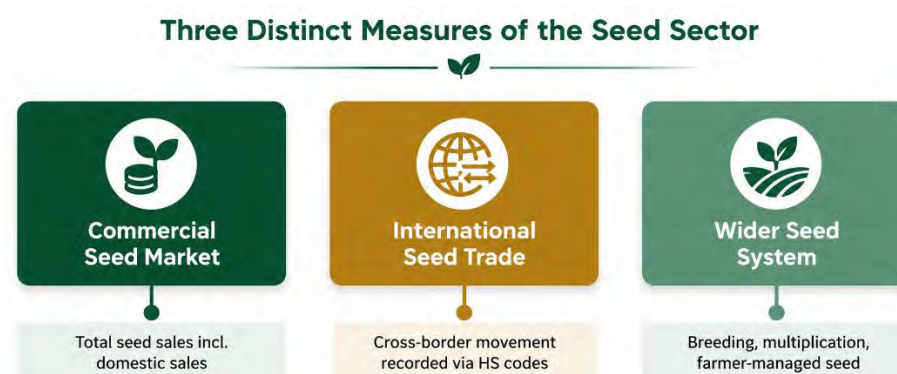
This chapter defines the scope of the report, explains how seed-market and trade data are interpreted, and provides a concise overview of the structure and direction of the global seed sector.

1.1 Scope and Methodology

The report focuses on the areas most relevant to India–Africa cooperation: **seed trade, crop opportunities, breeding, climate resilience, genetic diversity, multiplication, regulation, technology and farmer access.**

It draws on international trade databases, government and intergovernmental sources, research institutions, technical literature and sector organisations. Trade data are examined both through broader sowing-seed categories and crop-specific customs codes.

Three concepts are used throughout, and the diagram and table below set them out clearly:



Concept	Meaning
International seed trade	Cross-border movement of seed and planting material recorded through customs classifications
Commercial seed market	Seed sold through commercial channels, including domestic sales
Seed system	The wider network of breeding, multiplication, certification, public programmes, private companies and farmer-managed systems

These measures describe different parts of the sector and should not be treated as interchangeable.

Africa is also considered as a group of diverse markets rather than a single seed economy, since crop priorities, agro-ecologies, regulatory systems and farmer demand vary significantly across countries and regions.

1.2 Understanding Seed Market and Seed Trade Data

There is no single international customs heading that captures every seed used for planting.

HS 1209 is one important customs heading, covering “seeds, fruit and spores; of a kind used for sowing,” and includes categories such as vegetable and other sowing seeds. It should not be read as the complete international seed trade: several major cereal seeds are classified separately, under their own crop-specific headings. Maize seed, for example, is recorded under **HS 100510**, under which India exported approximately

USD 39.99 million in 2024 [5], and sorghum seed is recorded under **HS 100710**. Rice is a partial exception: at the international six-digit level, rice for sowing is not separated from rice traded for other purposes in the same clear way, so rice-seed trade is harder to isolate from general rice trade statistics.

A useful historical benchmark comes from OECD analysis based on International Seed Federation data. Around **3.9 million tonnes of seed were traded internationally in 2015, with a value above USD 10 billion**.

Main measures used in the report

Measure	What it shows
Commercial seed-market value	Scale of commercial seed sales
International trade value	Cross-border seed movement
HS 1209 trade	Selected categories of seed for sowing
Crop-specific seed codes	Trade in individual seed crops (e.g. maize, sorghum)

This distinction helps provide a more accurate picture of both global trade and country-level seed-sector performance.

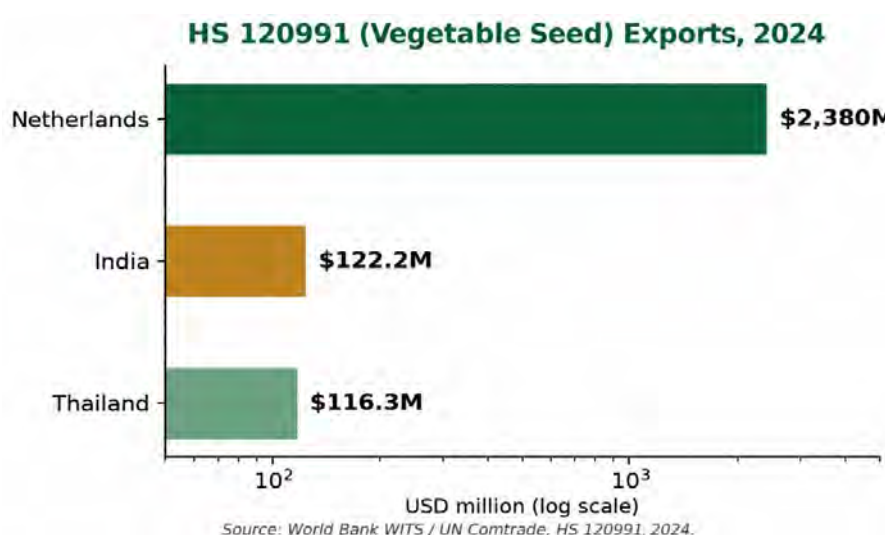
1.3 Structure of Global Seed Trade

International seed trade combines **high-volume field-crop seed with high-value specialised seed markets**.

OECD analysis found that field-crop seed represented **more than 95% of internationally traded seed volume in 2015**, while vegetable seed accounted for less than 5% of volume but about **35% of export value**.

Trade was also concentrated among established exporters. In the same analysis, **France, the United States and Germany accounted for around 40% of field-crop seed export value**, while **the Netherlands, the United States and France accounted for more than 60% of vegetable-seed export value**.

More recent data show the continued strength of specialised vegetable-seed exporters:



Seed-export competitiveness depends not only on production cost, but also on **breeding capability, multiplication, quality assurance, certification, phytosanitary compliance, logistics and established market relationships**. The OECD Seed Schemes, which include **64 participating countries**, provide common procedures for varietal certification in international seed trade.

1.4 Emerging Trends in the Global Seed Sector

Four developments are reshaping the sector.

Climate resilience is becoming a major breeding priority

Greater attention is being given to drought and heat tolerance, pest and disease resistance, maturity flexibility and performance under variable conditions. A 2024 International Seed Federation survey found that more than half of respondents identified climate change and related impacts as the leading challenge facing the sector.

Breeding is becoming more data-driven

Genomics, predictive modelling, advanced phenotyping, speed breeding and artificial intelligence are increasingly supporting conventional breeding. The five-year ICRISAT–CIMMYT initiative launched in 2026, focusing initially on sorghum and groundnut in Eastern Africa and India, reflects this direction.

Genetic diversity is gaining renewed importance

Landraces, farmer varieties and gene-bank collections remain important sources of traits for future breeding and adaptation, particularly under changing climatic conditions.

Trade and quality systems are becoming more digital

Electronic certification, digital records and traceability are improving information exchange across agricultural trade. OECD analysis published in 2025 highlights the potential of electronic sanitary and phytosanitary certification to reduce administrative costs and improve supply-chain efficiency.

Overall, the global seed economy is becoming more **knowledge-intensive**, **technology-enabled** and increasingly focused on **climate resilience**. This context frames India's seed-sector capabilities and the opportunities for stronger India–Africa cooperation, addressed in the next chapter.



2. India's Seed Sector and Global Position

India's seed sector has evolved through a combination of public research, private enterprise, farmer adoption, seed multiplication and regulatory development. Its strengths today are not limited to the size of its domestic agricultural base. India also has substantial experience in plant breeding, hybrid seed production, dryland agriculture and large-scale seed multiplication, supported by a broad network of research institutions, agricultural universities and seed companies.

This capability gives India an important position in global seed production and creates a practical basis for deeper cooperation with African countries, particularly where similar climatic conditions, crop priorities and production challenges exist.

2.1 Evolution of India's Seed Sector

The development of India's modern seed sector accelerated during the Green Revolution period from the mid-1960s. The rapid spread of improved wheat and rice varieties was supported by international germplasm exchange, public plant breeding, multi-location testing, seed multiplication, extension, irrigation and input support. Institutions such as CIMMYT and IRRI contributed important germplasm, while Indian public research and seed systems adapted and distributed varieties across different production environments.

Over time, the sector expanded beyond publicly supplied varieties. Private seed companies became increasingly important in hybrid crops, vegetables and other commercial segments, while public institutions continued to play a major role in breeding, genetic-resource management, testing and seed production.

India also became more closely connected with international seed-quality and certification systems. The country joined the **OECD Seed Schemes in 2008**, and its first OECD-certified seed consignment was issued from Telangana in 2017.

The broader lesson from India's experience is the importance of connecting research, variety development, testing, multiplication and farmer delivery — institutional coordination that is particularly relevant when considering future India–Africa partnerships.

2.2 Research, Breeding and Seed Production Capacity

India's present seed capability is supported by both public and private institutions.

The Indian Council of Agricultural Research (ICAR) operates an extensive crop-science network. Its Crop Science Division works through national institutes, bureaux, coordinated research projects and hundreds of centres located across ICAR institutes and agricultural universities. According to ICAR, this network works on **85 crops and has released around 5,800 varieties** across different crop groups, delivered through a wide agricultural-university system distributed across major production regions.

Important areas of capability include:

- **Rice and vegetables**, with extensive varietal and hybrid-development experience;
- **Sorghum and pearl millet**, supported by long-standing dryland-crop research;
- **Groundnut, chickpea and pigeon pea**, where India has significant breeding and production experience;
- **Hybrid seed production and multiplication**, supported by commercial seed companies and specialised production regions; and
- **Seed science and quality systems**, including seed production, testing, certification and genetic-resource management.

ICRISAT's headquarters in Hyderabad also gives India an important international research connection in dryland crops such as sorghum, pearl millet, chickpea, pigeonpea and groundnut. The presence of research institutions, agricultural universities and a large concentration of seed companies has made Hyderabad and the wider southern Indian seed-production belt particularly important to the sector.

The strength of India's seed sector therefore lies not in any single institution or crop, but in the combination of **breeding capability, diverse production environments, multiplication experience and a growing private seed industry.**

2.3 India's Seed Export Profile

India is an increasingly active participant in international seed trade, although its global position varies considerably by product category.

As discussed in Chapter 1, India exported approximately **USD 150.6 million under HS 1209 in 2024**. Within the more specific **HS 120991 vegetable-seed category**, India exported around **USD 122.16 million in 2024**.

Government export data provide another view of the sector. APEDA reports that India exported **USD 153.30 million of fruits and vegetable seeds in FY2025–26**, with the Netherlands, United States, Bangladesh, Thailand and the United Arab Emirates among the major destinations.

These statistics describe different product groupings and should be read separately, but together they show India's established participation in higher-value seed markets.

India's exports also extend beyond HS 1209. As noted earlier, **maize seed exports under HS 100510 were approximately USD 39.99 million in 2024**. Crop-specific classifications are therefore important when assessing India's complete export capability.

Within Africa, India already has trade links with markets in East, North, West and Southern Africa. Under HS 1209 alone, India exported seed to countries including Kenya, Tanzania, Uganda, Egypt, Ghana, Ethiopia, Nigeria, South Africa, Zambia, Senegal, Rwanda, Mozambique and Malawi in 2024.

The detailed country- and crop-level trade analysis is taken up separately in Chapter 4.

2.4 Opportunities for India - Africa Cooperation

India's relevance to Africa is strongest where its capabilities complement African crop priorities and local research systems. The objective need not be for India to become the primary source of genetics for every crop. In many cases, greater value can come from combining Indian breeding and multiplication capacity with African testing, research, local production and market knowledge.



Area	Potential basis for cooperation
Dryland crops	Joint work on sorghum, pearl millet, groundnut, chickpea and pigeon pea for drought- and heat-prone environments
Rice and vegetables	Variety evaluation, hybrid seed trade, local testing and multiplication
Maize	Joint testing and production partnerships with African research programmes and seed companies
Seed multiplication	Contract production, licensing and local multiplication partnerships
Research and breeding	Multi-location trials, germplasm exchange and collaborative breeding
Quality and regulation	Cooperation on seed testing, certification, phytosanitary procedures and regulatory information
Technology	Application of genomics, digital tools, AI-assisted breeding and traceability

Several characteristics strengthen this potential. Large parts of India and Africa operate under tropical, subtropical, rainfed and heat-stressed farming conditions. Both regions also have extensive smallholder agriculture and important dryland crop systems. These similarities can make joint testing and breeding particularly valuable when varieties are evaluated under the specific conditions of target African markets.

At the same time, the partnership should remain crop-specific. In crops such as **cassava, yam and plantain**, African research institutions have much deeper experience in vegetatively propagated planting-material systems, and cooperation should be structured around those existing strengths rather than assuming Indian leadership.

The larger opportunity is therefore to move gradually from a relationship based mainly on seed sales towards one that also includes **joint research, testing, local multiplication, licensing, regulatory cooperation and technology exchange**. Such a model can expand commercial opportunities for Indian and African seed enterprises while strengthening local production capacity and access to better-adapted planting material.



3. Africa's Seed Systems and Market Opportunity

Africa's seed landscape is highly diverse. Differences in climate, cropping systems, market development, regulation and farmer practices mean that seed demand varies considerably between regions and countries. Commercial seed companies, public breeding programmes, farmer-managed systems, local enterprises and community networks often operate side by side, with their relative importance differing by crop and location.

For India–Africa cooperation, this diversity is important. The strongest opportunities will come from matching specific crops and technologies with the needs, research capacity and seed systems of individual African markets rather than applying a single model across the continent.

3.1 Diversity of Seed Systems Across Africa

The broad regional picture reflects different production environments and crop priorities. The table below is intended to show diversity rather than rank regions by seed-sector development — even within the same region, countries can differ substantially in variety registration, commercial seed use, multiplication capacity and distribution networks.

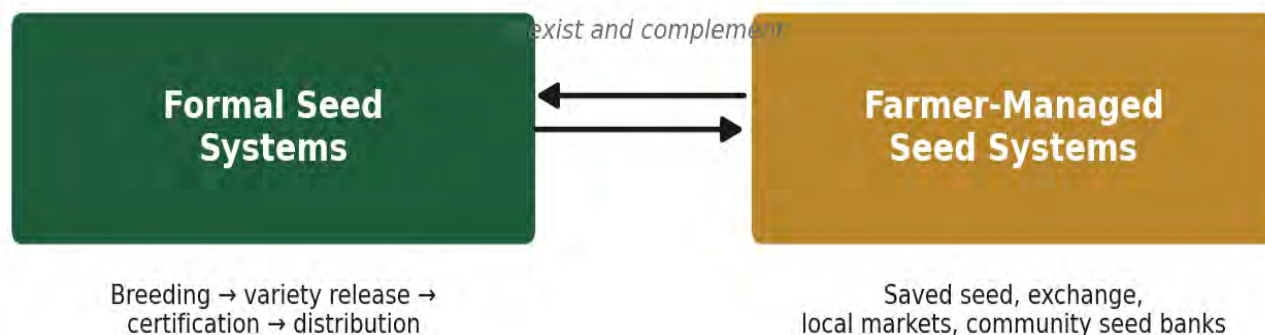
Region	Illustrative crop priorities	Seed-system considerations
East Africa	Maize, sorghum, pulses, horticulture, forage	Active public and private seed sectors in several countries alongside important farmer-managed systems; regional harmonisation initiatives are relevant to cross-border trade
West Africa	Maize, rice, cowpea, sorghum, pearl millet, cassava, yam	Formal seed markets coexist with farmer-managed systems; vegetatively propagated crops require specialised multiplication and plant-health systems
Southern Africa	Maize, groundnut, soybean, forage crops	Commercial seed markets and national research systems differ in scale across countries; SADC provides a regional harmonisation framework
North Africa	Wheat, vegetables, forage crops	Seed demand includes cereals and higher-value horticultural segments, supported by country-specific certification and import systems
Central Africa	Cassava, plantain, maize and other staples	Farmer-managed seed and vegetative planting-material systems are important in many production areas

This diversity also creates different market opportunities. Hybrid crops may support recurring commercial seed demand, while self- or open-pollinated crops may require greater emphasis on affordable multiplication and local seed enterprises. Cassava, yam, plantain and similar crops require an entirely different approach based on healthy planting material and decentralised multiplication rather than conventional true-seed trade.

3.2 Formal and Farmer-Managed Seed Systems

African farmers obtain seed through multiple channels. The **formal seed system** generally connects breeding and variety release with organised multiplication, quality control, certification and distribution through recognised public or commercial channels. **Farmer-managed seed systems** include seed retained from harvests, farmer-to-farmer exchange, local markets and community-based production.

Formal and Farmer-Managed Seed Systems



The two systems should not be viewed as mutually exclusive. FAO notes that farmers, particularly small farmers, may use both formal and local seed systems, depending on the crop, season and availability of planting material. Formal systems are particularly important for supplying new varieties, hybrids and quality-assured seed, while farmer-managed systems contribute to local availability, varietal diversity, adaptation and the continued use of locally valued crops.

A stronger African seed sector therefore needs connections between the two. Priorities include:

- expanding access to quality seed and new varieties;
- supporting local seed production and distribution;
- maintaining access to locally adapted genetic diversity;
- strengthening small and medium seed enterprises; and
- involving farmers in variety evaluation and seed-system development.

The objective is not to replace one system with another, but to improve the routes through which farmers can obtain seed that is suitable, affordable and available when needed.



3.3 Regional Seed Trade and Harmonisation

Cross-border seed trade in Africa is shaped by national regulations, but regional economic communities have developed frameworks intended to make seed movement more efficient while improving consistency in variety release, certification and quality requirements. Three frameworks are particularly important:

Regional framework	Key development	Main purpose
COMESA Seed Trade Harmonisation Regulations	Endorsed and published in the COMESA Official Gazette in 2014	Harmonisation of variety release, seed certification and phytosanitary requirements across participating markets
ECOWAS Regulation C/REG.4/05/08	Adopted in May 2008	Harmonisation of rules governing quality control, certification and marketing of seed and seedlings
SADC Harmonized Seed Regulatory System	Approved in 2008; implementation MOU became effective in 2014	Common approaches to variety release, certification, quality assurance and quarantine/phytosanitary measures

COMESA illustrates both the progress and the continuing implementation challenge. In **2019**, COMESA reported Egypt as the eighth member state to domesticate the regional seed regulations, joining Burundi, Kenya, Malawi, Rwanda, Uganda, Zambia and Zimbabwe. Because implementation continues to evolve, this historical figure should not be treated as the current total.

Regional harmonisation matters commercially because a variety intended for several neighbouring markets can otherwise face separate regulatory processes in each country. Greater use of compatible trial data, regional catalogues, common procedures and regulatory cooperation can support seed trade without removing national authority over variety approval and plant-health requirements.

3.4 Seed Access, Production and Food-Security Context

A functioning seed system is ultimately measured by whether farmers can obtain appropriate seed in **sufficient quantity**, at the **right time** and at an **affordable cost**. FAO's seed-security framework considers availability, access and quality as distinct but connected requirements.

This is particularly important in African agriculture because increasing the supply of certified seed alone does not automatically guarantee farmer access. Distribution networks, affordability, suitable varieties, local multiplication capacity and confidence in seed performance all influence adoption.

The market opportunity therefore has two dimensions. The first is **commercial**, through increased trade in improved varieties, hybrids and specialised seed. The second is **developmental and productive**, through stronger domestic multiplication, local seed enterprises, research partnerships and more effective distribution.

The African Union's broader agricultural transformation agenda, including the Malabo Declaration and the associated African Seed and Biotechnology Programme, places emphasis on agricultural productivity, access to quality seed, inclusive seed-sector development and technology use.

Africa's seed-market opportunity should therefore be understood not simply as a demand for more imported seed, but as an opportunity to strengthen the **entire pathway from breeding and variety access to local production, quality assurance and farmer delivery**.

4. India–Africa Seed Trade: Current Trends and Market Linkages

India and African countries already share an active, though still relatively modest, seed-trade relationship. The existing flow spans vegetable seeds, maize seed and other sowing-seed categories, with trade recorded across East, West, North and Southern Africa. The opportunity now is to deepen these links crop by crop, while connecting trade more closely with local testing, multiplication and distribution.

4.1 India's Seed Export Trends

India's international seed exports have shown recent growth. Under **HS 1209**, India-reported exports increased from approximately **USD 127.68 million in 2023** to **USD 150.60 million in 2024**, an increase of about 17.96%.

India's HS 1209 Seed Exports, 2023 vs 2024



India-reported exports, calendar year. Source: World Bank WITS / UN Comtrade, HS 1209, 2024.

Vegetable seed remains an important high-value component of this trade. As noted earlier, India exported approximately **USD 122.16 million under HS 120991 in 2024**. At the same time, crop-specific classifications reveal additional trade outside HS 1209. India's maize-seed exports under **HS 100510 reached approximately USD 39.99 million in 2024**.

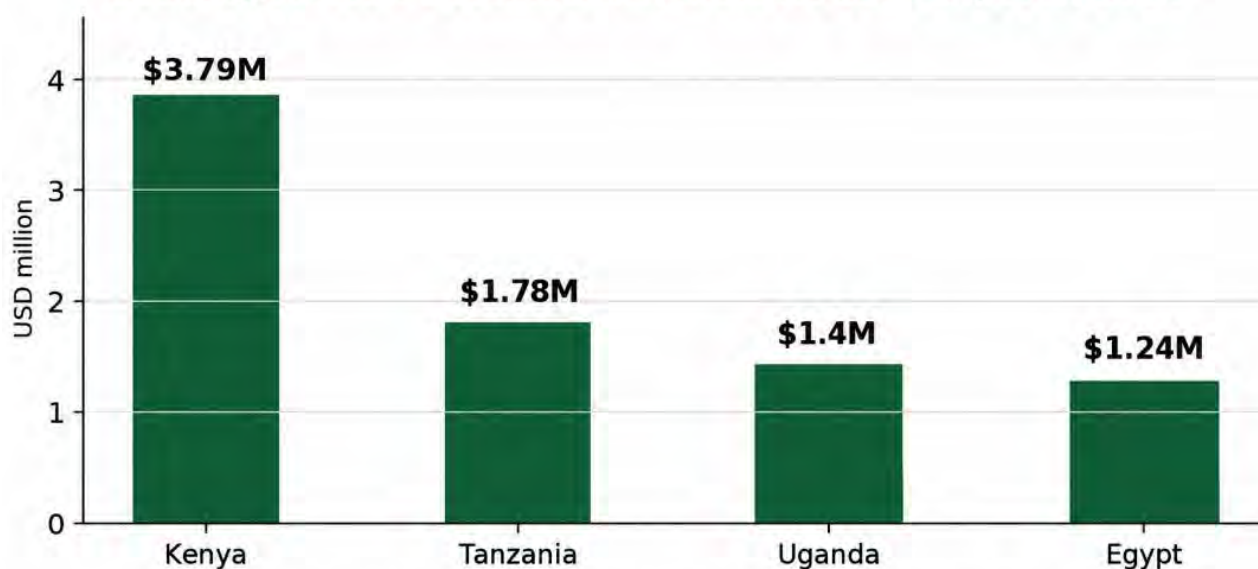
These figures show that India's export opportunity is spread across different seed categories rather than represented by any single customs heading.

4.2 Major African Markets

India-reported WITS/UN Comtrade data show an established African footprint under HS 1209. In 2024, the largest selected African destinations included Kenya, Tanzania, Uganda and Egypt:



Leading African Destinations, India HS 1209 Exports, 2024

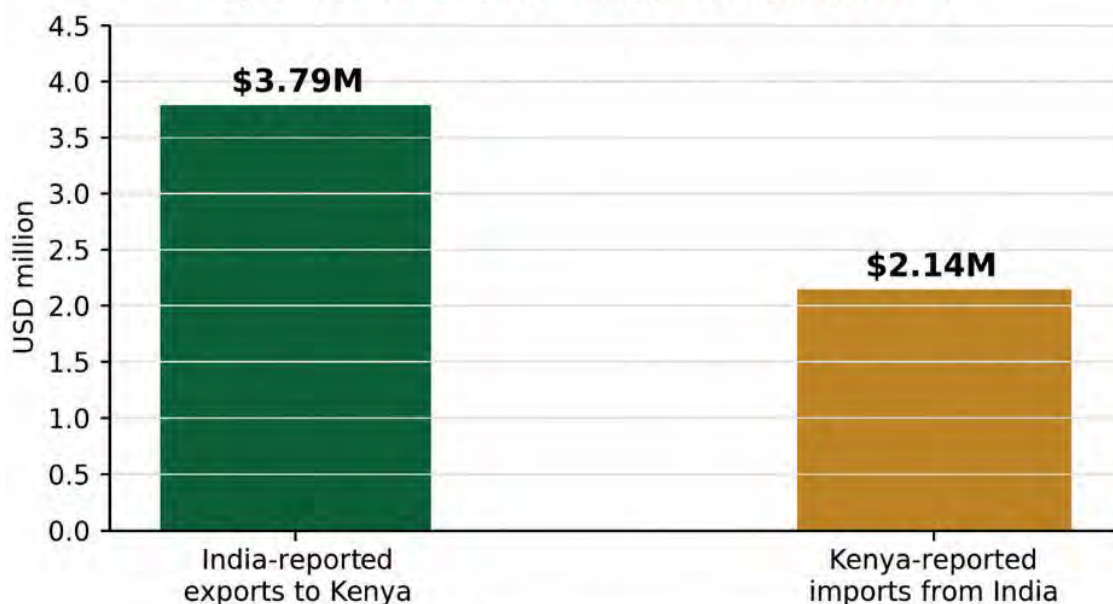


India also recorded HS 1209 exports to Ghana, Ethiopia, Nigeria, South Africa, Zambia, Senegal, Rwanda, Mozambique and Malawi in 2024. Source: World Bank WITS / UN Comtrade, HS 1209, 2024.

India also recorded exports under this category to Ghana, Ethiopia, Nigeria, South Africa, Zambia, Senegal, Rwanda, Mozambique, Malawi and other African markets.

The bilateral figures should be read as **India-reported exports**. As is common in international trade statistics, importing-country records can differ because of timing, valuation, classification and partner attribution. For example, Kenya reported approximately **USD 2.14 million** of HS 1209 imports from India in 2024, compared with India's reported exports of USD 3.79 million to Kenya.

Reporter vs Mirror Data, HS 1209, 2024



Source: World Bank WITS / UN Comtrade, HS 1209, 2024.

The geographical spread is significant because it shows that the India–Africa corridor is not dependent on a single market. East Africa currently provides some of the clearest existing linkages, while Egypt and markets in West and Southern Africa provide additional pathways for expansion.

4.3 Crop-Specific Trade Opportunities

The commercial opportunity differs substantially by crop. Existing trade provides a useful starting point, but market expansion will depend on whether varieties are suited to local production conditions and can meet national regulatory requirements.

Crop / segment	India–Africa trade opportunity
Vegetable seed	High-value export opportunity supported by India's established hybrid vegetable-seed capability; local trials and distributor networks can support market expansion
Maize	Existing export base with potential for expanded testing, multiplication and partnerships with African breeding and seed programmes
Rice	Opportunity in suitable improved varieties, testing and local seed production, particularly where market and production conditions align
Sorghum & pearl millet	Strong potential for dryland breeding, seed multiplication and climate-resilient collaboration
Groundnut & pulses	Scope for joint testing, breeding and commercial multiplication linked to food, nutrition and dryland agriculture
Soybean & forage	Opportunities linked to livestock, feed and expanding commercial production systems

Maize provides a clear example of an existing crop-specific trade link. In 2024, India exported maize seed worth approximately **USD 1.74 million to Côte d'Ivoire, USD 1.41 million to Egypt, USD 0.96 million to Ghana and USD 0.50 million to Senegal** under HS 100510.

The crop opportunities themselves are examined in greater detail in Chapter 5. At the trade level, the key point is that different crops require different routes to market. Direct export may work well for some specialised seeds, while other crops offer greater potential through local testing and multiplication.



4.4 Key Barriers to Seed Trade

Seed is a regulated biological product, so market access depends on considerably more than price and transport. Important constraints include:

Barrier	Trade implication
Variety registration and repeated testing	Can add time, cost and duplication when entering multiple markets
Phytosanitary requirements	Differences in documentation and plant-health requirements can delay or prevent shipments
Seed-quality and certification requirements	Different procedures and standards can increase compliance costs
Limited local multiplication capacity	Creates dependence on repeated imports of finished seed
Distribution and market information gaps	Make demand forecasting and last-mile supply more difficult
Finance and foreign-exchange constraints	Can restrict imports and working capital for local seed enterprises
Counterfeit or poor-quality seed	Weakens farmer confidence and legitimate commercial markets

Regional harmonisation efforts through COMESA, ECOWAS and SADC are already addressing parts of the regulatory challenge, as discussed in Chapter 3. Earlier World Bank analysis of African seed trade also identified repeated variety-release procedures, certification requirements and phytosanitary rules as important constraints to cross-border movement.

4.5 Opportunities for Expanding the Trade Corridor

The next stage of India–Africa seed trade can build on existing exports while gradually developing deeper commercial and institutional relationships. Five areas offer particular potential:

- **Expand crop- and country-specific market development** rather than approaching Africa as one market.
- **Connect exports with local variety testing and demonstration**, allowing seed companies and farmers to assess performance under target conditions.
- **Develop local multiplication and licensing partnerships** with African seed companies, SMEs and producer organisations where commercially viable.
- **Strengthen regulatory and market-information exchange** to reduce avoidable duplication and improve visibility on registration, crop calendars and demand.
- **Build regional production and distribution linkages** so that successful varieties can eventually be produced closer to the markets they serve.

The strongest long-term opportunity is therefore broader than increasing shipments from India. Direct trade can open markets and introduce suitable genetics, while **local testing, African multiplication, business partnerships and regional distribution** can create a more durable commercial relationship.

5. Crop Opportunities for India–Africa Collaboration

The India–Africa seed opportunity is strongest when collaboration is built around crops with a clear combination of **farmer demand, suitable agro-ecologies, breeding capability and workable seed-delivery systems**. The appropriate model will differ by crop. Some segments are suited to direct seed trade, while others require joint testing, local multiplication, collaborative breeding or specialised planting-material systems.

5.1 Rice and Vegetables

Rice and vegetables offer comparatively strong near-term opportunities because India has established breeding, production and seed-export capabilities in these segments.

For rice, collaboration can focus on improved varieties suited to irrigated and rainfed conditions, stress tolerance, varietal testing and local seed multiplication. Rather than transferring varieties directly across environments, promising material should be evaluated through African national research systems and adapted to local production and consumer preferences.

Vegetable seed offers a more commercially oriented pathway. India already has an established hybrid vegetable-seed industry and exported about **USD 122.16 million under HS 120991 in 2024**. Opportunities in African markets include hybrid vegetables, locally tested varieties, distributor partnerships and, where scale permits, local multiplication.

The practical model for both segments follows a clear sequence, with the balance between exports and local production determined by crop and market size:



5.2 Maize

Maize is central to food and feed systems across much of Africa and already has extensive public and private breeding networks. This means India's role should be complementary rather than based on supplying genetics alone.

CIMMYT develops and distributes improved maize germplasm and hybrids through partnerships with national programmes and seed companies across Africa, with breeding priorities including yield, drought and heat resilience, disease resistance, nutrient-use efficiency and seed-production characteristics.

For India–Africa cooperation, the strongest areas include:

- multi-location evaluation of suitable hybrids;
- seed production and multiplication partnerships;
- exchange of seed-production technology and technical skills; and
- partnerships with African seed companies and existing maize-breeding programmes.

Existing trade also provides a commercial base. As discussed in Chapter 4, India exported maize seed to African markets including Côte d'Ivoire, Egypt, Ghana and Senegal in 2024.

The opportunity is therefore to combine **African breeding and market knowledge with Indian production, testing and commercial capabilities.**

5.3 Sorghum and Pearl Millet

Sorghum and pearl millet are among the strongest areas for India–Africa research collaboration because of their importance in dryland agriculture and the experience that exists on both sides.

India and African research programmes have long worked with ICRISAT on these crops. A five-year ICRISAT–CIMMYT initiative launched in 2026 is now applying predictive breeding, genomic selection and other modern tools to dryland crop improvement in Eastern Africa and India, initially using sorghum and groundnut as proof-of-concept crops.

For sorghum and pearl millet, important areas of collaboration include drought and heat tolerance, early maturity, disease resistance, grain quality, nutritional traits and dual-purpose grain-and-fodder varieties.

Industry Experience: Sorghum for Dryland and Livestock Systems

Contributed by Advanta Seeds

Advanta Seeds illustrates how sorghum can serve both grain and livestock value chains. The company reports working with brewers in Kenya to develop contracted markets for hybrid grain sorghum, linking improved seed with a defined output market. In forage, Advanta reports the use of brown midrib (BMR) sorghum hybrids for improved digestibility and low prussic acid (LPA) multi-cut hybrids designed to improve feeding flexibility and safety.

Advanta also reports that Kenyan farmers using its Sugargraze forage sorghum have observed milk-output gains of around 30%. This is a company-reported field claim and is presented here as an industry experience rather than a general performance benchmark.

The case demonstrates a broader lesson: seed adoption can become more attractive when improved genetics are connected with clear farmer economics, livestock demand, processing or assured output markets.

5.4 Groundnut and Pulses

Groundnut, chickpea and pigeonpea offer another strong area of shared dryland interest. India has substantial breeding and production experience in these crops, while groundnut and pulses contribute to food, nutrition, income and soil-fertility systems across several African regions.

Groundnut is particularly suited to collaborative work because the current ICRISAT–CIMMYT initiative already links research systems in India, Kenya, Ethiopia and Tanzania around accelerated dryland breeding.

Priority areas include:

- drought and heat resilience;
- disease and pest resistance;
- earlier and appropriate maturity;
- grain and nutritional quality;
- aflatoxin management in groundnut; and
- local multiplication of successful varieties.

For pulses, opportunities should be guided by actual crop importance and agro-ecological suitability in each partner country rather than assuming that the same Indian pulse portfolio is relevant everywhere.



5.5 Soybean and Forage Crops

Soybean and forage crops provide opportunities linked increasingly to **livestock, poultry, dairy and feed value chains**.

For soybean, collaboration can include locally adapted varieties, seed multiplication and partnerships in markets where commercial soybean production and processing are expanding. The commercial case depends strongly on access to processing and feed markets, making value-chain assessment important before seed programmes are scaled.

Forage crops require a similarly market-linked approach. Sorghum, forage millet and other suitable crops can provide options where water availability and heat limit conventional fodder production. Advanta's Kenya experience, for example, links forage genetics with dairy productivity and repeated harvests rather than treating forage seed as a stand-alone input.

This segment therefore offers scope for partnerships connecting **seed companies, livestock enterprises, dairy systems and local seed producers**.

5.6 Vegetatively Propagated Crops

Cassava, yam, banana, plantain and sweet potato require a different approach from conventional seed crops. They are propagated through stems, tubers, vines or other vegetative material, creating distinct challenges in multiplication, disease management, storage and transport.

IITA notes that vegetative planting material is often bulky, perishable and susceptible to carrying pests and diseases, while access to quality, disease-free material remains a constraint in several African countries.

These crops are therefore not primarily an Indian seed-export opportunity. African national programmes and CGIAR institutions such as IITA have deeper crop-specific experience, and should remain central to genetics and planting-material system development.

Indian collaboration may nevertheless contribute in areas such as **diagnostics, clean-planting-material systems, digital traceability, storage, logistics and multiplication technologies**, where relevant.

5.7 India–Africa Crop Collaboration Opportunities

The crop opportunity can be summarised through three broad partnership pathways:

Three Crop Collaboration Pathways



Partnership pathway	Priority crop segments	Main form of cooperation
Near-term trade and market development	Rice, hybrid vegetables, selected maize and forage seed	Local trials, registration, distribution and seed trade
Joint breeding and multiplication	Sorghum, pearl millet, groundnut, pulses, maize, soybean	Multi-location testing, co-breeding, local multiplication and licensing
Specialised planting-material collaboration	Cassava, yam, banana, plantain, sweet potato	African-led crop systems with cooperation on disease-free material, diagnostics, multiplication and traceability

The strongest strategy is therefore not to select one crop for the entire India–Africa partnership. A portfolio approach allows **commercial seed opportunities, dryland research collaboration and locally led crop systems** to develop in parallel.

Over time, the most successful collaborations should move beyond variety introduction towards joint testing, local multiplication and, where there is clear scientific and commercial value, **joint development of varieties specifically suited to African production environments**.

6. Climate-Resilient Seeds and Genetic Diversity

Climate resilience in the seed sector is not defined by a single technology or trait. It depends on the ability of crops to perform under changing rainfall, heat, drought, salinity, flooding and shifting pest and disease pressures. For India and Africa, the most practical approach is to combine improved breeding with the conservation and active use of genetic diversity.

6.1 Traits for Climate-Resilient Agriculture

Climate-resilient varieties need to address different stresses in different production environments. Important traits include:

Trait	Relevance
Drought tolerance and drought escape	Helps reduce yield loss under water stress and shortened rainy seasons
Heat tolerance	Protects flowering, pollination and grain or fruit set under high temperatures
Early or flexible maturity	Allows crops to avoid terminal drought or late-season heat
Flood and waterlogging tolerance	Important in areas exposed to intense rainfall or poor drainage
Salinity tolerance	Supports production where soil or irrigation-water salinity is increasing
Pest and disease resistance	Helps crops respond to changing pest and pathogen pressure
Yield stability	Maintains more consistent performance across variable seasons and environments

These traits can be developed through conventional breeding, hybrids, marker-assisted selection, genomic tools and other modern breeding approaches. The most effective strategy is therefore a portfolio of complementary methods rather than dependence on a single technology.

6.2 Hybrids and Improved Varieties

Hybrids and improved conventional varieties will remain central to climate-resilient agriculture. Hybrids can provide advantages such as higher yield potential, vigour, uniformity and the combination of multiple useful traits, while improved open-pollinated or self-pollinated varieties may offer advantages in affordability, local multiplication and farmer seed use depending on the crop.

For India–Africa cooperation, the priority should be **performance under target environments**. Varieties developed in India cannot simply be assumed to perform well in African conditions. Multi-location testing, national variety evaluation and farmer-level assessment are essential before wider deployment.

Joint breeding can also combine Indian and African material to develop varieties specifically suited to heat, drought, short growing seasons, disease pressure and other local requirements. The ICRISAT–CIMMYT initiative discussed earlier, which applies modern breeding tools to sorghum and groundnut in India and Eastern Africa, provides one current example of this approach.

6.3 Indigenous Varieties and Landraces

Indigenous varieties and landraces are an important source of genetic diversity. Developed and maintained by farming communities over generations, they may carry useful characteristics related to local adaptation, stress tolerance, maturity, food quality, taste, fodder value and cultural preference.

Their value is therefore not limited to conservation. Once systematically characterised and evaluated, useful traits can contribute to breeding programmes or support direct cultivation in environments where the varieties remain competitive.

Field Experience: Conserving and Using Landraces in Karnataka

Contributed by GIZ India

GIZ India's **BioDivKA** initiative provides a practical example of linking conservation with evaluation and use. The programme, implemented with the Karnataka State Department of Agriculture and the Research Institute of Organic Agriculture (FiBL), has documented 2,164 landraces across 20 crops in Karnataka. These include 1,469 paddy landraces, 112 jowar, 80 foxtail millet, 73 finger millet, 63 green gram, **59 horsegram** and **50 redgram**, among other crops.

BioDivKA follows a “Conserve, Validate and Use” approach. Landraces are characterised for agronomic performance, stability, grain quality, nutritional attributes and adaptation, while farmers participate directly in evaluation and selection. This specific documentation and evaluation model is based in Karnataka; a related but separate community-managed seed-bank model, described in section 6.4, has also been applied by GIZ-supported programmes in Madhya Pradesh.

This approach is relevant to India–Africa cooperation because both regions retain substantial farmer-maintained crop diversity. The opportunity lies in connecting such diversity with scientific characterisation, breeding and seed systems rather than treating conservation as an isolated activity.

6.4 Community Seed Systems and Participatory Evaluation

Community seed systems can help maintain locally adapted varieties while improving farmer access to planting material. Their effectiveness depends on active multiplication, storage, exchange, documentation and community governance rather than simply conserving seed in storage.

GIZ-supported programmes provide two useful examples of how this can work in practice, without implying that either model is applied uniformly across every GIZ programme.

Under BioDivKA in Karnataka, **Mother–Baby trials** combine controlled evaluation with farmer-managed testing. Mother trials provide comparative assessment under research conditions, while Baby trials allow varieties to be evaluated under real farm conditions. Farmers assess characteristics including yield, maturity, taste, cooking quality, fodder value, resilience and marketability.

Under the **JIVA programme**, a specific community-managed seed-bank model has been documented in **Dewas, Madhya Pradesh**, and in **Chikmagalur, Karnataka**. This model covers identification of seed custodians, sourcing traditional varieties, farmer training, multiplication, storage, community seed banks, seed exchange and varietal demonstrations. It illustrates one documented approach rather than a feature common to every GIZ-supported programme.

The broader lesson is that farmers can play several roles simultaneously: **seed users, evaluators, multipliers and custodians of genetic diversity**. Participatory systems can also generate information on traits that conventional research trials may not fully capture, particularly food quality, local preference and household use.

6.5 Genetic Diversity for Future Breeding

Genetic diversity provides the raw material from which future varieties can be developed. As production conditions change, traits found in landraces, wild relatives and gene-bank collections may become increasingly important for breeding.

A widely cited FAO estimate suggests that roughly **75% of crop genetic diversity was lost during the twentieth century** as agriculture shifted towards a narrower range of cultivated varieties. The figure is best understood as an indication of the scale of genetic erosion rather than a precise global measurement.



For India and Africa, future cooperation can strengthen the connection between:

- gene banks and national breeding programmes;
- farmer-maintained varieties and scientific characterisation;
- participatory evaluation and formal variety development;
- community seed systems and local multiplication; and
- genetic-resource conservation and climate-resilient breeding.

The objective should be dynamic conservation, in which useful diversity continues to be grown, evaluated, exchanged and, where appropriate, incorporated into breeding programmes. GIZ's BioDivKA experience reflects this principle by linking landrace conservation with seed multiplication, market pathways and future crop improvement.

For the India–Africa partnership, the most resilient seed strategy is therefore one that combines **modern improved varieties with the continued conservation and use of diverse genetic resources**. This provides both near-term options for farmers and a broader genetic base for future crop improvement.

7. AI, Genomics and Digital Technologies in the Seed Sector

Digital technologies are beginning to influence the seed value chain from breeding and field production to quality testing, traceability and market planning. For India and Africa, their greatest near-term value lies in improving decisions, reducing avoidable delays and making existing production and quality data more useful, rather than replacing breeders, field trials or regulatory assessment.

7.1 From Conventional to Data-Assisted Breeding

Conventional breeding depends on repeated cycles of crossing, selection and multi-location field evaluation. These remain essential, but genomic and digital tools can help breeders identify promising material earlier and use field-testing resources more efficiently.

Conventional breeding, increasingly informed by data across the breeding cycle



Breeding stage	Data-assisted opportunity
Parent and line selection	Genomic prediction and trait-association data can help prioritise promising material
Phenotyping	Imaging, sensors and digital field records can improve the scale and consistency of trait measurement
Multi-location trials	Environmental and performance data can support better selection of trial sites and interpretation of genotype × environment interactions
Selection cycles	Predictive selection combined with speed breeding can shorten parts of the breeding process
Variety targeting	Climate, agronomic and market data can help identify the environments for which a variety is best suited

The important change is therefore from breeding based mainly on observed phenotype towards breeding informed by increasingly integrated **genetic, environmental and phenotypic data**. This does not replace field testing or breeders' judgement — it is intended to make both more efficient.

7.2 Genomics and Predictive Breeding

Genomic selection uses genetic-marker information and performance data from known populations to predict the breeding value of new material. This can help breeders narrow large populations before committing to more expensive field evaluation.

Predictive breeding extends this approach by combining information on **genetics, phenotype, environment and management** to estimate how breeding material may perform under different conditions. The quality of these predictions depends heavily on representative data and continued field validation.

A relevant India–Africa example is the five-year ICRISAT–CIMMYT initiative launched in 2026, which combines predictive breeding, genomic selection, speed breeding and advanced data integration. Its initial proof-of-concept work focuses on sorghum and groundnut, involving research partners in India, Kenya, Ethiopia and Tanzania.

For India–Africa collaboration, such approaches can be particularly valuable where breeding programmes need to evaluate material across highly variable dryland and climate-stressed environments.

7.3 Digital Tools in Seed Production

Technology also has an important role after a variety enters seed production. Hybrid seed production depends on factors such as field isolation, parental-line synchrony, crop stage, weather, harvest timing and post-harvest handling. Digital field records can make these risks visible earlier.

Applied Technology: AI in Seed Production and Quality

Contributed by Hornbill AgriTech

Hornbill AgriTech's field experience illustrates this application. The company reports using GPS-mapped field boundaries to assess isolation distances and continuously tracking flowering dates of parental lines so that emerging synchronisation problems can be identified while corrective action is still possible. Hornbill reports that changing weather patterns can disrupt parental flowering synchrony and post-harvest drying, contributing to seed-production and later germination problems. The company states that severe parental asynchrony can reduce seed set by as much as half in affected situations. This is a company-reported operational observation rather than a sector-wide performance estimate.

For India and Africa, where seed production may involve many geographically dispersed growers, some of the detailed observations that matter most — such as flowering synchrony and isolation monitoring — may be particularly well suited to relatively simple smartphone- and field-officer-based systems, rather than technology architectures dependent on expensive sensing infrastructure.

Digital production tools can support:

- plot and isolation monitoring;
- flowering and crop-stage tracking;
- weather-linked production alerts;
- harvest and post-harvest records; and
- demand and inventory planning.

The objective is to identify problems during the production season, when action may still be possible.

7.4 Seed Quality, Testing and Traceability

Digital tools can also strengthen seed-quality management by creating more consistent and retrievable records.

Contributed by Hornbill AgriTech

Hornbill AgriTech reports that its SeedAEye platform uses smartphone images to assist germination and vigour assessment. The company claims 99% classification accuracy for germinated seedlings under ISTA/AOSA-based rules, with human analysts reviewing ambiguous cases, and states that the system is deployed in ISTA-accredited laboratories in India across more than 25 field and vegetable crops. These figures are company-reported claims, presented here as an applied example rather than as an ICFA-recommended architecture for the sector.

The broader value of digitised quality testing is not limited to automation. Retaining images, test results, lot information and analyst records can provide a stronger audit trail and improve traceability when seed quality is questioned.

Across the wider seed system, digital identity and QR-based systems can potentially connect **seed lots, test records, certification information and distribution channels**. This may support quality assurance and help address counterfeit seed, provided the underlying records are reliable and accessible.

Digitalisation of regulatory documentation can also improve cross-border processes. As discussed earlier, OECD analysis of electronic sanitary and phytosanitary certification found potential benefits in faster information exchange and reduced administrative costs, while also identifying challenges around interoperability, infrastructure and legal frameworks.

7.5 Opportunities and Risks of AI

AI and digital technologies offer several practical opportunities for seed systems:

- **faster breeding decisions** by prioritising promising material;
- **better targeting of varieties** to particular environments;
- **earlier identification of production risks**;
- **more consistent and auditable quality testing**;
- **improved demand forecasting and inventory placement**; and
- **stronger traceability** across production and distribution.

However, these benefits depend on the quality of the underlying data. Models developed from narrow datasets may perform poorly when applied to different crops, climates or farming systems. This is particularly important in African smallholder environments that may be under-represented in commercial datasets.

Other concerns include ownership of genomic and farmer-generated data, protection of genetic resources, unequal access to digital infrastructure, proprietary algorithms, cybersecurity and the difficulty of explaining some automated decisions.

The appropriate principle for India–Africa cooperation is therefore **AI-assisted, evidence-validated decision-making**. Digital tools should support breeders, seed producers, laboratories, regulators and farmers, while field evidence and human judgement remain central to decisions on variety performance and seed quality.

The opportunity is not simply to introduce more technology into the seed sector, but to use technology where it can make **breeding, production, quality and delivery more accurate, timely and transparent**.

8. Regulation, Standards and Market Access

Seed trade depends on a sequence of regulatory and quality requirements that protect varietal identity, seed quality, plant health and breeders' rights. For India–Africa cooperation, the main opportunity is not to weaken these safeguards, but to reduce unnecessary duplication and improve coordination between national systems.

8.1 Variety Registration and Release

Before a new variety can be commercially marketed in many countries, it must pass the relevant national process for registration or release. Requirements vary by crop and jurisdiction, but commonly include testing of varietal identity and, where required, agronomic performance under local conditions.

This creates an important market-access issue for companies entering several African countries. A variety that has already been extensively tested elsewhere may still need additional national trials before approval. The challenge is therefore to make the process more efficient while preserving each country's authority to approve varieties for its own production conditions.

8.2 DUS and VCU Testing

Two concepts are central to variety evaluation:

Test	Purpose
DUS - Distinctness, Uniformity and Stability	Assesses the distinctness, uniformity and stability of the relevant variety characteristics, confirming that a variety is distinguishable from existing varieties and remains consistent over successive propagation
VCU - Value for Cultivation and Use	Where required, assesses a variety's agronomic performance and use value under relevant production conditions

DUS and VCU serve different purposes and should not be treated as interchangeable. DUS focuses on varietal identity and consistency, while VCU relates to performance.

For India–Africa cooperation, scope exists for **common trial protocols, concurrent multi-location testing and structured sharing of validated trial data** where agro-ecological conditions and regulatory requirements are comparable. Such cooperation can reduce repeated work without removing national decision-making.

8.3 Seed Certification and Quality Testing

Seed certification is separate from variety registration. It relates to the quality and identity of a specific seed lot and may include field inspection, varietal purity, germination, physical purity, moisture and other nationally prescribed standards.

International systems can support consistency in testing. **ISTA develops internationally recognised methods for seed sampling and testing**, providing common testing procedures and certificates used across borders, while the specific certification requirements a seed lot must meet are generally established through each country's own national system. The OECD Seed Schemes separately provide common procedures for varietal certification in international trade.

For India–Africa trade, stronger cooperation between laboratories, certification agencies and seed companies can improve confidence in seed lots and reduce the need for repeated documentation or testing where equivalent evidence is accepted.

Digital quality records, as discussed in Chapter 7, can further support traceability and auditability, but they do not replace formal certification requirements.

8.4 Phytosanitary Requirements

Phytosanitary regulation protects agriculture and ecosystems from the international movement of plant pests and diseases. Seed and planting material entering a country must comply with the **importing country's plant-health requirements**, generally under the framework of the International Plant Protection Convention (IPPC).

Phytosanitary certification is therefore different from seed-quality certification. A seed lot may meet germination and purity standards but still fail to meet an importing country's plant-health requirements.

For India–Africa trade, practical improvements can include:

- clearer exchange of import requirements;
- greater use of electronic phytosanitary documentation;
- improved laboratory and diagnostic capacity; and
- earlier coordination between exporters and importing-country plant-protection authorities.

As noted in Chapter 7, OECD analysis has found that electronic sanitary and phytosanitary certification can reduce administrative costs and improve information exchange when systems are legally and technically interoperable.

8.5 Plant Variety Protection

Plant Variety Protection (PVP) is a form of **legal intellectual-property protection** available to breeders of eligible new plant varieties under applicable national law. It is distinct from seed certification and variety release.

A functioning PVP system can encourage investment in breeding by giving breeders defined rights over the commercial use of protected varieties. At the same time, national systems may contain specific provisions relating to researchers, farmers and public interest.

For India–Africa collaboration, clarity over **ownership, licensing, germplasm use and benefit-sharing** will become increasingly important as joint breeding, local multiplication and cross-border licensing expand. This is particularly relevant where public research institutions, private seed companies and farmer-maintained genetic resources are involved.

8.6 Regional Regulatory Harmonisation

Regional harmonisation provides one of the clearest opportunities to improve seed-market access in Africa. As discussed in Chapter 3, **COMESA, ECOWAS and SADC** have all developed regional seed-regulatory frameworks covering elements such as variety release, seed certification, quality control and phytosanitary requirements.

The practical challenge is implementation. National procedures still differ, and varieties may face repeated testing and registration when entering neighbouring markets.

For future India–Africa cooperation, the most useful areas are:

- concurrent testing in India and selected African markets;
- common protocols for comparable agro-ecological zones;
- voluntary sharing or reuse of validated trial data;
- digital submission of regulatory dossiers; and
- greater regulator-to-regulator exchange.

These measures should support, rather than replace, existing African regional frameworks. Each country should retain its own authority over variety approval, seed quality and plant-health protection.

The regulatory objective is therefore **better coordination, not lower standards**. A more predictable and transparent system can shorten market-entry processes, reduce unnecessary cost and encourage seed companies to invest in testing, multiplication and distribution across more African markets.



9. Building a Stronger India–Africa Seed Partnership

A stronger India–Africa seed relationship should move beyond a buyer–seller model. Direct exports will remain important, but greater long-term value can come from combining trade with **local production, joint research, business partnerships, regulatory cooperation, investment and farmer-facing delivery systems**.

9.1 From Seed Exports to Local Production

The pathway from trade to deeper partnership can develop in stages, shown below:



This progression will not be identical for every crop or country. Hybrid vegetables and specialised seed may remain export-oriented, while field crops with sufficient local demand may support multiplication within Africa. Joint breeding does not need to wait until a market has already passed through licensing and business partnerships — in many cases, particularly for dryland cereals such as sorghum and pearl millet, research and breeding cooperation can begin in parallel with, or even ahead of, commercial multiplication, since the two tracks depend on different institutions and timelines.

Local production can reduce dependence on repeated finished-seed imports while developing African technical and commercial capacity. It can also shorten supply chains and improve the ability to respond to local planting seasons and demand.

9.2 Local Seed Multiplication and Business Partnerships

Local multiplication is one of the most practical ways to deepen commercial cooperation. Indian companies can work with African seed enterprises through **licensing, contract production, joint ventures or technical partnerships**, depending on crop economics and national regulations.

For such partnerships to succeed, local enterprises need more than access to genetics. Important requirements include:

- reliable breeder or foundation seed;
- production and quality-control protocols;
- processing and storage capacity;
- working capital;
- technical training; and
- functioning dealer and distribution networks.

African seed SMEs should therefore be treated as commercial partners in the India–Africa corridor rather than bypassed through a permanently import-based model. The objective is to create local value while maintaining agreed quality standards.

9.3 Public-Private Partnerships in Seed Research and Innovation

Seed innovation requires both public research and commercial delivery. Public institutions are particularly important in germplasm conservation, pre-breeding, trait discovery, multi-location testing and research on crops or traits where commercial returns may initially be limited. Private companies contribute breeding investment, product development, multiplication, marketing and distribution.

India–Africa public-private partnerships can bring together **ICAR and Indian universities, African national agricultural research systems, CGIAR institutions such as ICRISAT and CIMMYT, and Indian and African seed companies.**

The 2026 ICRISAT–CIMMYT dryland breeding initiative discussed earlier demonstrates how shared research can connect India and African national programmes around sorghum and groundnut using predictive breeding and genomic tools.

A practical PPP model should therefore connect public research and genetic resources, joint testing and breeding, private multiplication and commercialisation, and farmer evaluation and market feedback — allowing public science and private investment to play complementary roles rather than attempting to replace one another.

9.4 Digital Distribution and E-commerce

Digitalisation can also improve how seed reaches markets. E-commerce and digital distribution systems can make product information, dealer availability and ordering more visible, particularly where conventional distribution networks are fragmented.

However, seed is not an ordinary consumer product. Online availability must remain connected to **variety registration, seed quality, phytosanitary requirements and national marketing rules.**

Digital systems can be particularly useful for:

- connecting companies with distributors and dealers;
- providing variety and agronomic information;
- identifying where seed is available;
- improving demand and inventory forecasting;
- supporting electronic ordering and payments; and
- linking products with digital traceability and authentication.

For India–Africa cooperation, the immediate opportunity is less about creating a single continental e-commerce marketplace and more about connecting existing commercial networks with reliable digital information and traceable distribution systems.

9.5 Policy, Investment and Capacity Building

Expansion of the seed corridor will require investment at several points that private companies or local enterprises may find difficult to finance independently.

Priority areas include **multi-location trials, early-generation seed, local multiplication, processing and quality-testing infrastructure, working capital for African seed enterprises, and market development.**

Public and development finance can help reduce early-stage risk, while commercial investment should support activities capable of becoming financially sustainable. Policy support should focus on reducing unnecessary transaction costs, improving access to information and strengthening enabling infrastructure rather than displacing private enterprise.

Capacity building is equally important. Cooperation can include exchanges and training for:

- plant breeders and seed technologists;
- seed producers and quality-control personnel;
- laboratory staff;
- regulators and phytosanitary officials;
- African seed SMEs and distributors; and
- extension personnel working with farmers.

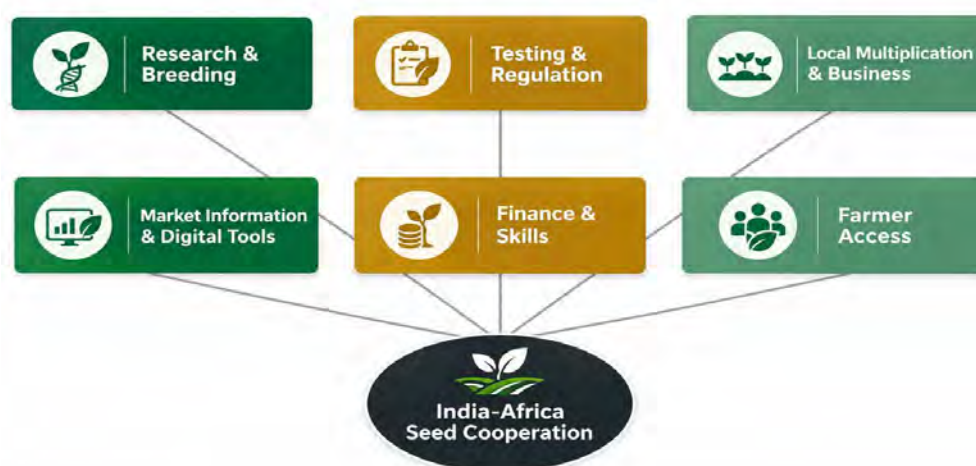
Skills and institutions ultimately determine whether research and trade translate into reliable seed supply.

9.6 India–Africa Seed Cooperation Framework

The different elements of cooperation can be brought together through a practical six-pillar framework:

Pillar	Core area of cooperation	Main actors
Research & Breeding	Joint crop improvement, germplasm evaluation and climate-resilient breeding	ICAR, African NARS, ICRISAT, CIMMYT, universities, seed companies
Testing & Regulation	Multi-location trials, information exchange and regulatory cooperation	National regulators, research institutions, regional seed bodies
Local Multiplication & Business	Licensing, contract production, processing and distribution	Indian companies, African seed companies and SMEs
Market Information & Digital Tools	Demand information, crop calendars, traceability and digital distribution	Industry, governments, research institutions, technology providers
Finance & Skills	Working capital, infrastructure investment and technical capacity	DFIs, banks, governments, universities, industry
Farmer Access	Demonstrations, extension, appropriate seed delivery and feedback	Seed companies, farmer organisations, cooperatives and extension systems

The India-Africa Seed Cooperation Framework



10. Recommendations for Strengthening India - Africa Seed Cooperation

The five recommendations below are based on the analysis presented in this report. They are intended as practical areas for discussion and action and do not represent commitments already made by any institution.

Recommendation 1: Improve Regulatory Coordination and Variety Testing

Why it matters: Varieties entering different African markets may need to undergo separate testing, registration and documentation processes, even where substantial scientific evidence already exists. This can increase time and cost for companies and research institutions and slow the movement of suitable varieties across markets.

Recommended action: Indian and African regulators should explore greater coordination through concurrent trials, compatible testing protocols and voluntary sharing of validated trial data. Existing regional mechanisms under COMESA, ECOWAS and SADC should be used wherever possible, while each country retains full authority over final variety approval and phytosanitary requirements.

Expected result: More efficient and predictable variety-approval processes, lower avoidable duplication and faster market access for suitable varieties without weakening national regulatory, seed-quality or plant-health safeguards.

Recommendation 2: Identify Priority Crops and Traits for Joint India–Africa Work

Why it matters: India–Africa cooperation can become too broad if every crop and technology is treated as a priority. Research and investment are more likely to produce results when they are concentrated on crops and traits that respond to real farmer needs, climate risks and market opportunities in specific African countries.

Recommended action: Develop a jointly agreed shortlist of priority crop and trait combinations for research, testing and commercial development. The shortlist should be shaped with African national research systems and should consider climate resilience, productivity, nutrition, local demand and the areas where Indian breeding or seed-production capabilities genuinely complement African strengths.

Expected result: A focused set of priorities that can guide joint breeding, multi-location trials, research funding and commercial partnerships, while avoiding scattered investment across too many crops.

Recommendation 3: Strengthen Local Seed Multiplication and Business Partnerships

Why it matters: Direct seed imports can support market entry, but long-term dependence on imported finished seed can limit local production capacity and increase exposure to foreign exchange, logistics and supply disruptions. At the same time, many African seed enterprises require stronger access to genetics, technical support, processing capacity and finance.

Recommended action: Encourage Indian and African seed companies to expand licensing, contract multiplication, joint production and other commercial partnerships where technically and commercially suitable. Cooperation should include access to appropriate breeder or foundation seed, production protocols, quality assurance, training, processing support and working capital where needed.

Expected result: Greater local seed availability, stronger African seed enterprises and more resilient supply chains, while creating a deeper commercial relationship between Indian and African companies beyond direct exports.

Recommendation 4: Improve Seed-Market Information, Traceability and Digital Cooperation

Why it matters: Information on registered varieties, market demand, crop calendars, import requirements, trade flows and seed quality is often spread across different institutions and databases. This makes planning more difficult for regulators, seed companies, distributors and investors.

Recommended action: Improve access to shared and reliable information on regulations, varieties, trade, demand and traceability through practical digital cooperation. Initial efforts should focus on connecting and improving existing systems, testing small-scale information-sharing and traceability pilots, and establishing clear rules on data ownership and confidentiality before considering larger platforms.

Expected result: Better-informed market and investment decisions, improved demand planning, stronger traceability and a more reliable information base for future India–Africa seed trade and digital cooperation.

Recommendation 5: Expand Joint Research on Climate-Resilient Genetics and Diverse Seed Systems

Why it matters: India and Africa both possess valuable breeding expertise, genetic resources, diverse production environments and farmer knowledge, but these strengths are not always connected through sustained joint research. Climate change also increases the importance of drawing on a wider genetic base rather than relying on a narrow set of varieties.

Recommended action: Strengthen collaboration among research institutions, gene banks, universities, seed companies and farmer organisations on climate-resilient breeding, germplasm evaluation, indigenous varieties and landraces, participatory testing and local seed access. Joint work should combine modern breeding and genomic tools with field validation and farmer knowledge.

Expected result: Stronger breeding pipelines, greater use of diverse genetic resources and more locally adapted varieties capable of performing under changing climatic and production conditions.



11. Roadmap to 2030

The roadmap below translates the report's recommendations into a simple sequence of actions through 2030. It is indicative and would require agreement among participating governments, institutions and industry partners, adapted to national priorities, commercial feasibility and regulatory readiness.

11.1 Priority Actions

The immediate priorities are to:

- identify priority countries, crops and traits for joint work;
- begin regulatory dialogue and coordinated testing in selected markets;
- expand local seed multiplication and business partnerships;
- strengthen joint research on climate resilience and genetic diversity; and
- improve market information, traceability and digital cooperation.

These actions should begin through focused pilots rather than broad multi-country programmes.

11.2 Implementation Roadmap



Period	Priority focus
2026–27	Agree priority countries, crops and traits; initiate regulatory dialogue and identify pilot partnerships
2027–28	Begin joint trials, regulatory cooperation, local multiplication pilots and research collaborations
2028–29	Evaluate pilot results; expand successful licensing, multiplication and market-access partnerships
2029–30	Scale proven approaches, strengthen regional production and distribution, and deepen digital cooperation
2030 onward	Institutionalise successful India–Africa seed cooperation models based on demonstrated results

11.3 Key Performance Indicators

Progress should be assessed through a limited set of practical indicators:

Area	Indicative indicator
Trade	Value and volume of India–Africa seed trade by relevant HS code
Research	Number of jointly tested and commercially released varieties
Regulation	Change in approval time for jointly tested varieties where measurable
Local production	Volume of seed multiplied locally and number of African enterprises participating
Farmer reach	Farmers or hectares reached by jointly developed or introduced varieties, where traceable
Investment	Public and private investment mobilised for trials, multiplication and seed-system development

Conclusion

India and Africa have a strong basis for deeper cooperation in the seed sector, built on complementary strengths in breeding, genetic diversity, research, seed production, market development and farmer knowledge. The opportunity is not limited to increasing trade, but to building a broader partnership that supports better varieties, stronger local seed systems and more resilient agriculture.

The way forward should be practical and gradual: focus on priority crops and traits, improve regulatory coordination, strengthen local multiplication and business partnerships, expand joint research, and use digital tools where they add clear value. With sustained cooperation and country-specific approaches, India–Africa seed collaboration can contribute meaningfully to productivity, climate resilience, farmer access and long-term agricultural growth.



For more details, please contact

Ms. Diplina Misra, Senior Manager

Mobile: +91 – 9289981652 | Email: diplina.misra@icfa.org.in

214-217, B-Wing, Naurang House, KG Marg, New Delhi-110001 | Ph : 011 - 41501465, 75

www.icfa.org.in