



# Review of Challenges and Opportunities of Formal and Informal Seed Systems in Ethiopia

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## *Abstract*

*Review of challenges and opportunities of formal and informal seed system in southern Ethiopia. Review shows how the physiological aspect of seed quality has influenced the agricultural process for the most diverse crops. Informal and formal seed systems play a dominant role in Ethiopia's economy. In this respect, legislations and practices that hinder the development of the sector should be reviewed with the aim of removing the hindrances and replacing them with enabling policies and strategies. In addition to this for a sustainable national seed industry development, it is necessary that private seed sector participation flourishes. Thus, government should collaboratively work with the non-governmental organization and private sector. Thus, coordination and linkages among all actors and stockholders is need strengthening to foster rapid, orderly and effective growth. Supporting farmers in on-farm seed production suggests a role for formal, informal and intermediary seed sector in seed supplying within the country.*

*Key words- Informal seed system, formal seed systems*

## **Introduction**

The seed, or whole ovary, is the most crucial tool for replacement from generation to generation. Following the union of the egg and sperm to form the zygote, the ovary zygote cell divides several times to produce an embryo. The most important tool for renewing itself from one generation to the next is based on seed, which is the full ovary. Throughout human history, seeds have been essential to the advancement of different people's expanding agriculture since the earliest days of agriculture Bhale, et al (2018).

Its significance has been associated with the ability to domesticate the most varied plants in the past and, in the present, with the production of several innovations in biotechnology exemplified by the most varied cultivars and hybrids brought to the market. All of its abilities, however, are dependent upon the quality of this supply, which exists in the combination of an individual's physical, genetic, sanitary, and biological traits. This review

explains how the agricultural process for the most diversified crops, including vegetables, forages, and main crops, has been impacted by the physiological aspect of seed quality.

It highlights its central role in fulfilling the growing demands of a growing world population. We emphasize the preoccupation of research, development, and innovation actions in the sense of recognizing the factors that influence the physiological quality of seeds, developing and enhancing methods to estimate, preserve, and increase it, and how the adoption of high physiological quality seeds has influenced the development of the major crops.

Seeds have played a fundamental role since the beginnings of agriculture, propelling the agricultural development of different people in different ages of human history. Its importance has been linked to the possibility of domesticating the most diverse plants in the past and, nowadays, of providing many biotechnological advancements represented by the most diverse cultivars and hybrids introduced into the market. However, the expression of all its capacities depends on the quality of this supply, represented by the sum of physical, genetic, sanitary, and physiological attributes. This review shows how the physiological component of the quality of seeds has influenced the agricultural process for the most diverse crops, particularly major crops, forages, or vegetables. It highlights its central role in fulfilling the growing demands of a growing world population. We emphasize the preoccupation of research, development, and innovation actions in the sense of recognizing the factors that influence the physiological quality of seeds, developing and enhancing methods to estimate, preserve, and increase it, and how the adoption of high physiological quality seeds has influenced the development of the major crops.

Ethiopia's informal and formal seed systems play a dominant role in the country's economy, as the agricultural sector represents about 45 percent of gross domestic product (GDP) and 85 percent of export earnings and provides livelihoods for 85 percent of the population (Alemu, 2011). Both systems are operating simultaneously in the country, and it is difficult to distinguish between the two. Both systems are operating simultaneously in the country, and it is difficult to distinguish between the two. There is, however, a fact that the formal system is the original source of improved seeds in the informal system. The development of intermediate seed systems might bridge the gap between formal and informal seed systems, improving access to quality seed in the informal sector at lower costs, ultimately improving productivity and food security (Otieno *et al.*, 2017).

## 1. THE IMPORTANCE OF SEED ON AGRICULTURAL PRODUCTION AND FOOD SECURITY

Limited availability and access to quality seed is often regarded as one of the main obstacles to increasing production and productivity levels (Ojiewo *et al.*, 2015). The use of good-quality seed of adopted and improved varieties, which have genetic and physical purity, health standards, high germination, and a high

moisture percentage, can increase farmers productivity by 20–30%, ensuring food security and improving livelihoods (Mula, 2012). According to a study by Abebe and Alemu (2017), having access to seed together with other inputs and services is crucial for boosting crop yields and agricultural production, which in most cases ensures food security for households.

The importance of seed as the carrier of the most important characteristics for crop production has been recognized since the early days of agriculture. Starting from 10,000 years ago, harvesting seed from preferred plants has been the basis of crop domestication and, consequently, of present-day agriculture (Louwaars and Gam, 2009). Seed and other planting materials are the farmers' most precious resources, especially for smallholder farmers in sub-Saharan Africa, where agriculture is characterized by much risk and uncertainty. So investments in crop improvement can potentially reach a wide range of farmers. While many other areas are also important for agricultural development, such as markets, credit supply, support institutions, and policies, access to appropriate seed is clearly the first step (Sperling and McGuire, 2010).

## 1.1 THE SEED SYSTEM

The seed system in Ethiopia represents the entire complex of organizational, institutional, and individual operations associated with the development, multiplication, processing, storage, distribution, and marketing of seed in the country (Abebe and Alemu, 2017). Farmers, particularly smallholder ones, are involved in multiple kinds of seed systems, which can guarantee them the quantity and quality of seeds they need and the ability to market their produce (Atilaw, 2016). Seed systems in Ethiopia can be divided into two broad types: the formal system and the informal system (Alemu, 2015).

However, the seed system development strategy prepared by the Ethiopian Agricultural Transformation Agency (ATA) has recognized the three seed systems: formal, informal, and intermediary (ATA, 2015; Sisay *et al.*, 2017).

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## 1.2 Formal Seed System

The formal seed system is called formal because it is mainly a government-supported system, and several public institutions are also involved in it. Formal systems are externally regulated through the application of rules and regulations governing both the production and distribution of seed, which is largely controlled by public seed enterprises but is increasingly being undertaken by specialized companies operating along commercial lines (Jones *et al.*, 2017). It is comprised of established and formally recognized state and commercial institutions engaged in seed research, development, and distribution. This system largely includes several interrelated components such as variety development, release and registration, seed multiplication, processing, seed quality control, certification, and diffusing modern varieties in the form of quality seed, ultimately with the aim of promoting higher yields, increased incomes, and food security (Santos, 2023; Ojiewo *et al.*, 2020).

The major actors in the formal system are the National Agricultural Research Systems, the Ministry of Agriculture, Ethiopian Seed Enterprises, and private seed companies specializing in specific crops like Pioneer. Recently, regional seed enterprises were also established as public seed enterprises, such as Oromiya Seed Enterprise, Amhara Seed Enterprise, and Southern Nations nationalities and Peoples Region Seed Enterprise, and entered into the formal system. All actors have interdependent roles in the system, and the inefficiency of one actor will automatically negatively affect the performances of the rest of the actors. There are also some licensed seed traders that import and market vegetable seed of exotic varieties (Gemedo *et al.*, 2012; Tesfaye *et al.*, 2018).

## 1.3 Informal Seed System

The informal seed system in the Ethiopian context is defined as seed production and a distribution practice where there is no legal seed certification process and lacks quality control mechanisms that cannot guarantee minimum quality standards (Alemu, 2010). It can also be described as a larger mass of seed of both local and improved crop varieties produced in a way different from the formal certification system, or any different improved seed, saved or received from a source produced beyond the formal certification or branding process (Tesfaye *et al.*, 2018). Moreover, the whole seed production and distribution process is not monitored or controlled by government policies and regulations but rather by local standards, social structures, and norms (McGuire, 2013).

The informal system is traditional, semi-structured, operates at the individual community level, uses a wide range of exchange mechanisms, and usually deals with small quantities of seeds often demanded by farmers (Gemedo *et al.*, 2001; Atilaw, 2016). This sort of sector also has complex mechanisms of delivery, dispatch, and business schemes. Muigai (2021) has put possible existing functional sources of seed transactions

that farmers can access under different scenarios, like farmers' own saved seeds, farmer-managed seed production, direct sales, cooperatives, farmer dealers, grain merchants, crop buyers, retail store dealers, consumer outlets, research centers, and exchange between farmers, NGOs, and relief organizations. The important attributes of this system include relative advantages through ease of accessibility, simplicity, affordability, diversity, decentralized nature, adaptability, manageability, and offer immediate and flexible access during times of uncertainty (Sisay *et al.*, 2017).

#### 1.4 Intermediary Seed System

Locally demanded crops and varieties are often ignored by large private and public seed companies because the demand and profit margins are too small for private seed companies to justify investment (Thijssen *et al.*, 2023). According to Sisay (2017), the newly recognized intermediary seed system has overlapping features with both the formal and informal seed systems. The intermediate sector is specifically defined as business-oriented community-based groups (producer cooperatives or unions) that are engaged in the multiplication and distribution of non-certified seed of either modern or local varieties (ATA, 2017). The intermediary seed system includes the production and marketing of seed by local farmers under financial and technical support from NGOs and breeding centers, which has been referred to as the alternative seed system by Hirpa *et al.* (2014). Their contribution is also particularly important for crops where there is less investment interest from private seed companies and for crops that are covered to a lesser degree by public seed enterprises. (Sisay *et al.*, 2017)

## 2. SEED SYSTEM DEVELOPMENT IN ETHIOPIA

The formal seed supply sector started in Ethiopia five decades ago as an extension activity by academic and crop research institutions. In 1942, Jimma Agricultural College was the first to start improving seed production and distribution (Zewdie *et al.*, 2015). As early as 1954, the Alamaya College used to distribute seed to farmers, and then the Institute of Agricultural Research was made responsible when it was established in 1966. Later on, and the Chillalo Agricultural

Development Unit (1967) was some of the precursors of the organized seed sector in the country (Zewdie *et al.*, 2015). While in the late sixties and early seventies, many private large-scale commercial farms flourished, which were eventually nationalized by the socialist Dergue Government (Zewdie *et al.*, 2015), during which, in some parts of the country, the then government established new state farms based on socialist principles. Farmers' producer cooperatives were also organized, and farmers' resettlement projects were launched. Those developments led to an increased demand for modern agricultural inputs, particularly improved seeds. Until the government established the Ethiopian Seed Corporation, later renamed Ethiopian Seed Enterprise, in 1979, there was no organized system responsible for seed supply in the country (Zewdie *et al.*, 2015) to produce,

process, and distribute seed for the entire country. After its establishment, the enterprise solely remained the key player in the multiplication, processing, and dissemination of improved seeds to the vast agriculture. Initially, the ESE was given responsibility for seed supply to the entire farming community through local production or imports from abroad. Although its activities skewed toward state farms and cooperatives at the expense of small farmers, the establishment of the Ethiopian Seed Enterprise did lead to the beginning of an organized seed production and supply system (Sisay *et al.*, 2017). The ESE was the only seed-producing organization responsible for supplying seed to the entire farming community through local production and/or imports from abroad until 1993. In 1993, a national seed industry policy and strategy were formulated to guide seed sector development. The National Seed Industry Council (NSIC) was established under Proclamation No. 56/1993 and became responsible for advising the government on policy and regulatory issues that would help improve and build a sustainable national seed supply system. Pioneer Hybrid entered Ethiopia and later the establishment of regional seed enterprises in 2008/09 (Sisay *et al.*, 2017).

Even Since 1992, both agricultural research and the seed sector have gone through several policy and regulatory reforms and institutional and structural changes to respond to the developmental challenges of economic growth and development (Bishaw and Atilaw, 2016). Currently, the Ethiopian seed system is characterized by a mix of federal and regional public seed enterprises, small to medium domestic private seed companies, large-scale foreign private seed companies, and a wide range of semi-informal licensed or non-licensed small seed enterprises of different shapes and scales operated by cooperatives or farmer associations that are involved in seed supply (Bishaw and Atilaw, 2016).

### 3. THE ROLE OF THE FORMAL SEED SYSTEM

Food security and poverty reduction are increasingly given policy priority in developing countries. One major step towards achieving food security in developing countries is to improve their ability to achieve seed security. In Ethiopia, the formal seed sector is promoted by state governments and comprises both public and private organizations, including the Institute of Biodiversity Conservation, the Ethiopian Institute for Agricultural Research, regional agricultural research institutes, universities, the Ethiopian Seed Enterprise, Pioneer Hybrid Seed Ethiopia, several small-to-medium-scale private seed farms, and farmers. Other relevant stakeholders are the Ministry of Agriculture and Rural Development, the Bureaus of Agriculture and Rural Development, farmers' cooperative unions, and NGOs (Zewdie *et al.*, 2020).

#### 3.1 The Role of the Ethiopian Agricultural Research System

Enhancing rural household's income and food security through improved access to improved agricultural technologies is a key development strategy in Ethiopia. Agricultural research in Ethiopia has a relatively long history and is carried out by a number of institutions that are doing their level best to generate and promote

agricultural technologies, contributing to the national demands of transforming Ethiopian agriculture. This research system consists of federal and regional agricultural research institutes and higher learning institutions.

The institutions are continually improving various agricultural technologies through breeding of improved varieties (high yielding, better adaptation, resistance to biotic and abiotic stresses, and better seed quality), maintenance of released varieties, and the production of breeder and pre-basic seed production methods by coordinating their research activities through various work processes and coordination offices, with the ultimate goal of ensuring food security and reducing poverty in the country in line with the government's development direction. Improved seed is one of the most important inputs for improving crop production and productivity. Its contribution is high when it is available in the desired quality and quantity at the right time and for the right price (Louwaars and De Boef, 2021). The development of improved varieties and technologies by those institutions continues to equip farmers with tools that improve productivity and livelihoods (Fikre, 2020).

### **3.2 The Role of the Ethiopian Biodiversity Institute**

Ethiopia, as a center of diversity, would face the biggest consequential challenges if this priceless resource were lost, as it is already experiencing from other agricultural sector activities. Without efforts in conservation and general support through seed banks or other seed conservation institutions, this places genetically diverse landraces in a vulnerable position, and as a result, food security is in danger (Otieno *et al.*, 2022). Consequently, the Ethiopian Biodiversity Institute is responsible for the collection, conservation, characterization, and utilization of Ethiopia's germplasm. It is a major source of germplasm for crop breeding in the national agricultural research system in the country. Crop biodiversity also provides means for adaptability to a fluctuating environment while also enabling stability in crop yield and supply. Promotion of genetic diversity is critical for climate change adaptation, short-term food security, and long-term heightened productivity as it fosters resilience and availability of food crops through improving soil quality and increasing productivity (Tura *et al.*, 2022; Teklewold *et al.*, 2017).

### **3.3 The Role of the Federal Ministry of Agriculture and Regional Bureaus of Agriculture**

The Ministry of Agriculture and Rural Development is an umbrella organization that coordinates and leads the various activities of the seed industry, like national seed policy, variety registration and release, seed import and export, seed certification, quarantine, and extension (Tesfaye *et al.*, 2018). Moreover, the ministry also provides guidelines and standards to enforce internal quality control for all seed producers, delineate and enforce roles and responsibilities among seed producers, support private sector producers to meet needs for commercially attractive crops, enable seed producers to build capacity for internal quality control, and strengthen national seed demand estimation and local market assessment (ATA, 2017).

Bureaus of Agriculture and Rural Development in regional states play a vital role in seed distribution, while credit is offered by various financial institutions through farmer cooperative unions. Farmer's cooperative unions share in seed supply to small farmers is now growing very rapidly (Zewdie *et al.*, 2020). In Ethiopia, demand assessment for certified seed is carried out by the Ministry of Agriculture and Natural Resources (MoANR) through the regional Bureaus of Agriculture (BoA) based on the area sown by different crops and the seed replacement rates achieved in each regional state (Atilaw *et al.*, 2016). After the information is aggregated into woreda, regional and national demand statistics, improved certified seed is supplied to Ethiopian smallholders primarily through regional, state-run extension, and input supply systems.

### 3.4 The Role of Seed Policy

Ethiopia's seed systems are being driven by political decisions that are seen to enable the continued upward trend of the country's sustainable agricultural growth (Alemu, 2019). Seed policy is a declaration of intent of the government on which direction to take in a complex seed sector, in areas such as public-private relationships, private sector development, regulations of foreign trade, taxes, subsidies, public and private breeding, compulsory or optional certification, etc. (Ojiewo *et al.*, 2020). To continue to promote the conservation and use of agro-biodiversity in a country, there will be important roles for policies that promote genetic diversity and strengthen both formal and informal seed systems (Otieno *et al.*, 2022). The critical policy areas where change could help are seed legislation, seed pricing, coordinated seed policy, plant breeding, seed technology research, and institutional linkages (Cromwell *et al.*, 1993). The national seed policy and regulatory framework provide an enabling environment for the seed sector's development. Hence, it provides incentives for the public and private sectors to assume command of the commercial components of the seed industry (Atilaw *et al.*, 2016).

### 3.5 The Role of Public Seed Enterprises

Formal seed production is mainly in the hands of the public seed enterprises, which are one of the public enterprises involved in the production, seed quality control, distribution, and marketing of both foundation and commercial seeds (Zewdie *et al.*, 2020). The public seed enterprises have the mission to deliver high-quality seeds of cereals, fruits, vegetables, forages, spices, and other crops to farmers and other end users on a commercial basis by multiplying and processing seeds from breeder seeds acquired from the national research centers and imported from abroad, helping to enhance the production and productivity of the agricultural sector in Ethiopia. The enterprises are also playing a leading role in the advent of organized seed production and supply large volumes of improved seed to the country. (Sisay *et al.*, 2017). Hence, public seed enterprises introduced a flexible pricing policy in which a 15% premium was paid on the current grain price. The enterprises also supplied basic seed at lower prices, allowing farmers to keep 10% of the seed produced for planting next season (Zewdie *et al.*, 2020).



### 3.6 The Role of Private Seed Companies

The Ethiopian government has long had a commitment to boosting the role of the private sector in agriculture (Spielman *et al.*, 2021). With the gradual move of the country toward a market economy, the private sector is getting more and more involved. This also applies to the agricultural domain, including the seed sector. Until 2015, there were more than 50 national companies and some multinationals operating in the country, contributing to the seed business development in Ethiopia. Private producers, in aggregate, provide 32% of the total formal seed supply in the country (Atilaw and Korbu, 2016). Again, it has become mandatory to produce a concise business profile among the seed chain actors in the country so as to promote their products at national, continental, and global markets (ESA, 2015). Partnerships with public organizations, such as research institutes, bureaus of agriculture, and some cooperatives, play a significant role in variety demonstration, scaling out farmer-based quality seed production, and out-grower schemes. The scale of production, processing, and distribution of quality seed of improved varieties from those sectors has increased over the last ten years (Tesfaye *et al.*, 2016).

### 3.6 The Role of Non-Governmental Organizations and International Development Programs

An NGO can play a great role in enhancing the seed production capacity of smallholder farmers, which in turn contributes to the well-being of the people (Beyene, 2022). NGOs programs mainly focus on intermediary systems with a community-based and local seed business approach. These NGOs support the establishment of primary cooperatives and unions to achieve local seed security and, consequently, food security. NGOs offer support for establishing community seed banks and provide emergency or relief seed. NGOs have been responsible for organizing farmers' groups and seed producer cooperatives by liaising with the cooperative promotion offices of the government. Other NGOs and international development programs, like ISSD Ethiopia, aim to strengthen different seed systems and support the development of a vibrant, pluralistic, and market-oriented seed sector (Ojiewo *et al.*, 2020).

Thereby, the ISSD Ethiopia program contributes to food security and economic development through agriculture. ISSD proposes to build upon the strengths of informal (i.e., farmers and community-based) and formal (i.e., public and private) seed systems. ISSD also considers a range of seed entrepreneurs among the different seed systems (Ayana *et al.*, 2019). The program supports local seed businesses, strengthens regional and national seed companies, and develops links with international seed companies.

### 3.7 Role of Community-Based Seed Systems

A community-based system is an informal arrangement wherein a group of farmers has established a system of producing, exchanging, or selling quality seed. This can include both local and improved seeds. (Sisay *et al.*, 2017). A community-based system is also called an intermediary system (Bishaw and van Gastel, 2012), which is considered to be an important strategy to increase farmers' access to diversified crop varieties in rural areas by bridging the gap between the formal and informal sectors (Ojiewo *et al.*, 2020). The concept of community seed production as a market-oriented LSB provides potential for sustainable, quality seed production and enhanced food security (Ojiewo *et al.*, 2020). The major actors in this system are groups (of farmers) and cooperatives, which were licensed in community-based seed production and marketing (ATA, 2015).

The farmer-based seed production and multiplication scheme has been operational in seven high-crop-producing potential regions of Ethiopia since 1997. In Ethiopia, a recent seed survey found that between 25 percent and 50 percent of small farm households borrow or buy seeds every year, but most transactions take place between neighbors and relatives; farmers say they prefer this system because they can see the crop stands from which the seed is taken (Singh, 2015). For small-scale farmers, the development and maintenance of a sustainable community-based seed supply system is essential to improving their food security, especially in conditions where their seed stocks have been severely affected. (Ojiewo *et al.*, 2020).

Seed producer cooperatives in Ethiopia are enterprises established by a group of individual farmers from a given locality (Sisay *et al.*, 2017). Seed producer cooperatives fall under the intermediary seed system in Ethiopia (ATA, 2015).

Seed producer cooperatives engage in diversified production of crops and varieties (Walsh and Thijssen, 2016). The crops and varieties that the SPCs produce have increased both in number and type. They address the niche market for crops where there is limited investment interest (i.e., financial attractiveness) by private seed producers and for crops that are addressed by public seed enterprises to a limited extent (Sisay *et al.*, 2017). Farmers are encouraged and supported to organize themselves in seed producer cooperatives to produce and sell quality seed (Ayana *et al.*, 2019).

Seed producer cooperatives make the seed affordable, available, and accessible to the community because they reduce transaction costs. Some well-performing seed producer cooperatives produce the same type and quality of seed as public and private seed enterprises do, but they can deliver it to farmers at lower prices than big seed enterprises (Sisay *et al.*, 2017). The cooperatives are also very instrumental in technology promotion and further scaling up processes through the provision of inputs (seed and fertilizer) and distribution, credit, improving bargaining power for farmers, and market access.

#### 4. THE ROLE OF THE INFORMAL SEED SYSTEM

In Ethiopia, the informal system is extremely important for seed security. The bulk of seed supply is provided through the informal system, implying its importance to national seed security (McGuire, 2013). According to Thijssen (2008), 90% of the seed used by Ethiopian smallholder farmers is saved or exchanged with others through traditional means such as gifts, bartering, labor exchange, cash transactions, or social obligations accessed from friends, relatives, and local markets, and the remaining 10% is improved seed. Hence, these informal sources have been the primary sources of new planting material for smallholders.

The majority of Ethiopian farmers show a tendency to depend on the informal system due to the following key reasons: primarily, it is relatively cheaper and readily available in the farmer's villages just when seed is needed. Secondly, it allows the use of seeds after testing on primary adopter farmers, and lastly, it is more reliable and its sustainability is more guaranteed than the formal system (Atilaw, 2016; Ojiewo *et al.*, 2020). Informal seed systems are also key for smallholder farmers in relation to food security and promoting resilience in the face of increasing uncertainty (Ojiewo *et al.*, 2020). Farmers' practices for reproducing and multiplying seed can accelerate or slow down the degeneration process, and thereby the need for replacing their own seed with other healthier material (Almekinders *et al.*, 2019). Informal systems are short, simple, and less externally regulated and are particularly important in serving the needs of smallholder farmers who use their own saved seed from the previous harvest and/or seed accessed from friends, relatives, and local markets (Ojiewo *et al.*, 2020).

#### CONCLUSION

Increasing the production and productivity of the crop subsector is one of the measures taken in Ethiopia to assure the food security of more than 110 million people and escape the long-lived poverty that persists in the country. This improvement can only be realized if modern technologies are utilized, from which seed takes the first priority due to its nature. Access to and use of seeds is critical factors for the ability of smallholder farmers to increase agricultural production and productivity, ensuring food security and improving livelihoods. However, in order for seed to be a key factor in agricultural productivity, it must be channeled into a system.

In Ethiopia, the formal and informal seed systems have been operating for several decades and have played a lion's share in supplying seeds for the entire crop production. Both seed systems are distinct but intersect. Interaction between these two supply sectors provides important ways of combining formal and local knowledge and plant materials, which can lead to the creation of site-specific solutions (Louwaars, 2017).

In countries like Ethiopia, where the formal seed supply is inefficient, the informal system is extremely important for the seed security of the nation. The majority of Ethiopian smallholder farmers are largely dependent on this system, mainly through farm-saved seed exchange. Thus, national seed policies should

recognize the role of smallholder seed producers and the informal seed sector as a whole. In this respect, legislation and practices that hinder the development of the sector should be reviewed with the aim of removing the hindrances and replacing them with enabling policies and strategies.

In addition to this, for sustainable national seed industry development, it is necessary that private seed sector participation flourish. Thus, the government should collaboratively work with non-governmental organizations and the private sector. Thus, coordination and linkages among all actors and stockholders need strengthening to foster rapid, orderly, and effective growth. Supporting farmers in on-farm seed production suggests a role for the formal, informal, and intermediary seed sectors in seed supply within the country.

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