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Integrated Seed Sector Development in Africa: 
A Conceptual Framework for Creating Coherence Between Practices, Programs, and Policies

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Public sector seed programs in most sub-Saharan African countries targeted the dissemination of quality seed of improved varieties in the 1970 and ‘80s, assuming that the informal seed system would disappear. The orientation in 1990s shifted toward withdrawal of the public sector, promoting privatization and liberalization of the seed market. The informal seed system remained dominant. Integrated seed sector development aims to better link informal and

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formal seed systems, and balance public and private sector involvement. It explores variation among seed value chains, with the aim of making seed programs and policies more coherent with farmers’ practices and more effective at reaching food security.

KEYWORDS Sub-Saharan Africa, seed systems, food security, integrated approaches

INTRODUCTION

Seed and other planting materials form the basis of crop production. Key issues in analyzing the contribution of seed to agricultural output are availability, quantity, quality, and affordability, which means physical access to the right seed at the right time for the right price. Throughout the world, it is the farmers themselves who produce the largest quantity of seed of most crops. This farm-saved seed is used for both locally and scientifically bred varieties.

The public sector supports seed sectors in different ways, notably by carrying out research in breeding and developing varieties; by arranging (and subsidizing) seed quality controls or seed promotion; and by protecting breeders’ rights. The public sector can also stimulate investments in the seed sector by introducing tax measures and by subsidizing certain seed products. Furthermore, the public sector may participate, directly or indirectly, in the production and distribution of seed for crops considered essential for national food security.

To a large extent, the quality of seed determines the success of crops in terms of yield (and yield stability) and product quality, and thus its contribution to food security and the value of crop products in the market. The quality of seed has several aspects: its genetic properties, i.e., the inherent genetic makeup of the variety, and the germination rate, seed health, and purity of the seed. This genetic diversity provides options to cope with adverse conditions and risks, whether seasonal, short term, or related to climate change in the long term.

There are a number of diverse initiatives for increasing the availability and quality of seed in Africa, including those that aim to:

- Strengthen the public functions of seed quality control and varietal registration;
- Support multinational, commercial seed companies for producing and trading their seed;
- Strengthen national or local entrepreneurship in the seed sector;
- Provide support to farmers for producing better quality seed; and
- Supply seed as part of emergency supplies.
This diversity of interventions responds to variations in demands, crops, and settings that characterize agricultural development.

Seed sector development gains attention when seed security and food security are linked together with agricultural economic development in sub-Saharan Africa. Good-quality seed is essential for any food production; it is also a technology transfer agent crucial for increasing productivity and production. Furthermore, seed is a potential commodity for stimulating local and national economic development and entrepreneurship, and is an important component of agricultural biodiversity. A diversity of practices and realities exist in seed sector development. Many of these practices have been created based on a linear approach to seed sector development, thus with the assumption that one particular seed sector or system exists. These practices have been supporting the public seed sector since the 1970s and primarily the private seed sector since the 1990s. Likewise, seed policies have been designed and implemented within such a linear approach. These have resulted in seed programs that are incoherent with the practices and variations that exist in agriculture in Africa.

As a result of the increasing global interest in agriculture, in a context of rising food prices and concerns about food security and climate change adaptation, seed sector development in Africa has regained the attention of governments, donor communities, civil society, and other stakeholders. At local level, farmers and entrepreneurs seek opportunities in the seed market. Within this context, this paper elaborates the concept of integrated seed sector development (ISSD), initially formulated as way to integrate formal seed systems and farmers’ seed systems at the technical (Louwaars 1996a) and institutional levels (Louwaars 1996b; De Boef, Louwaars, & Almekinders 1997). Subsequently, the seed system perspective has been used for on-farm management of genetic resources (Jarvis et al. 2004; De Boef et al. 2010; Jarvis et al. 2011), participatory plant breeding (Almekinders, Thiele, & Danial 2007), and seed security and support of on-farm seed production (Almekinders & Louwaars 1999; Latournerie-Moreno et al. 2006). The institutional bottlenecks that hamper the implementation of on-farm management of genetic resources have been recognized and have led to the inclusion of integrated seed systems in the debate on seed and variety legislation (Tripp 1997; Louwaars, 2002; Louwaars, 2007; Bragdon et al. 2009).

The objective of the current paper is to outline ISSD as a useful conceptual framework for creating coherence among seed practices, programs, and policies. The focus of this paper is on sub-Saharan Africa; it addresses the variation in agriculture and practices in seed sector development and characterizes informal and formal seed systems, emphasizing their structure and limitations. The facilitation of interactions between the two seed systems is considered the first ISSD principle. Subsequently, the differentiation between development and market-oriented seed value chains is addressed
as a basis for a line of reasoning that no single public-, private-, community-, or NGO-based intervention can support seed sector development. The individual farmers themselves use different seed systems for different crops, such as (international) commercial seed for exotic vegetables; seed from national commercial chains based on international or public research for maize; local semi-commercial sources for groundnut seed produced for the city market; and farm-saved seed for mainly home-consumed crops like sorghum, finger millet, and beans. This leads to the second ISSD principle, which is that seed sector development needs to be approached in a pluralistic manner, including public, private, community-based, or NGO stakeholders, each of them assuming specific responsibilities in dissimilar seed value chains. In conclusion, the paper underlines the key principles for ISSD and shares some final remarks.

**VARIATION AND COMPLEXITY IN AGRICULTURE AND SEED SYSTEMS**

Farming and cropping systems vary along agro-ecologies. They also vary in their objectives for agriculture: livelihood, food supply, and/or income generation. This variation defines the structure of the seed system. The diversity in seed systems is also associated with the type of farmers, subsistence or commercial, or any variation in-between. Another differentiation in seed systems is associated with the crops, whether these are food or feed crops produced for home consumption and/or the market (cereals, pulses, vegetables) or produced as cash crops within a specific value chain (oil crops, vegetables, tobacco, cotton). The system of reproduction has a major effect on the structure of seed systems, and the variation becomes evident when comparing selfing cereal and pulse crops with hybrid maize varieties, and vegetatively reproduced crops such as potato, cassava, and banana. Another key element is the orientation of the seed sector, which is organized either according to the principles of agricultural development (food security), the principles of the market (profit), or a mixture of these. These variations have great implications on the structure of seed value chains. A diversity of organizations operate in seed supply, varying from public and private organizations to NGOs, farmers’ cooperatives, and informal farmers’ groups. The objectives and opportunities determine to a large extent which of these stakeholders take the lead and which cooperate in these seed systems. In return, the mixture of stakeholders has implications for the type of programs and policies that aim to strengthen the seed sector.

Given the different functions of seed in food security, entrepreneurship, technology transfer, and biodiversity, the objective for supporting seed sector development is not solely embedded in policies that target each of those four
areas of attention. The multiple objectives create a complexity in which no single strategy for agricultural development, and therefore seed sector development, exists. ISSD as a concept embraces these multiple objectives and this complexity. It uses a system approach to better understand complexity and, consequently, applying a value chain approach identifies different seed systems that operate in parallel, in a dynamic model. These sectors are characterized as the basis for the development of programs and policies aimed at vibrant and pluralistic seed sector development.

INFORMAL SEED SYSTEM

The first distinction can be made between the formal and informal systems. Informal seed systems cover methods of seed selection, production, and diffusion by farmers, including the exchange of seed. Farmers obtain seed and varieties through informal networks based on exchange with, or gifts from, relatives and neighbors, or through bartering with other farmers or purchasing from local markets. Key issues in determining the use of seed by farmers are availability, quantity and quality, and price. Seed has to be available, which means that there has to be physical access to the right quantity of seed of the right variety at the right time, and it needs to be affordable. Farm-saved seed is the most prominent source since farmers are familiar with the seed they grow themselves and know that the variety is adapted to local conditions and preferences. Informal seed systems are also referred to as farmer-managed seed systems (Bal & Douglas 1992), traditional seed systems (Cromwell, Friss-Hansen, & Turner 1992), and local seed systems (Almekinders, Louwaars, & de Bruijn 1994). We refer to the informal seed system as to distinguish it from the formal system; it is illustrated in Figure 1 (Almekinders, Louwaars, & de Bruijn 1994; Almekinders & Louwaars 1999; Thijssen et al. 2008; Dalton et al. 2010).

The informal seed system has several limitations (Louwaars 2007). The most common one is the assumption that seed is usually readily available in informal systems. In such situations, farmers are not well prepared when facing shortages. Such shortages can be acute, for example, owing to drought or civil unrest, or chronic, basically as a result of poverty and because farmers are unable to put seed aside from the harvest as a result of low productivity (Sperling, Cooper, & Remmington 2008; Lipper, Anderson, & Dalton 2010).

![Informal Seed System](image_url)
The consequential dependence on seed relief may lead to loss of genetic resources (Richards, Ruivenkamp, & van der Drift 1997; Sperling, Osborn, & Cooper 2004).

The fact that seed supply of major crops is anti-cyclical when compared to crop production creates another serious limitation to the performance of informal systems. Plenty of seed is available after a highly productive season and, consequently, seed demand is low. This is because most farmers have been able to combine saving seed with their consumption needs. However, seed availability after a poor season is inadequate not only for the individual farmers who rely on farm-saved seed, but also for their social networks. Seed shortages may occur when contacts with communities in areas that have experienced better cropping conditions during a previous season are limited, and farmers may have to rely on poor-quality planting materials, such as food grain obtained in the market and whose varietal characteristics and seed quality are unknown (David, Mukandala, & Mafure 2002; Louwaars 2007; McGuire 2008).

The seed of some crops is more easily produced than that of others. Germination capacity and vigor are at stake during processing and storage (e.g., soybean in the humid tropics). Diseases can be transmitted by seeds and may also build up over time (e.g., beans). Varieties may “degenerate” because of insufficient or inadequate selection (notably cross-fertilizing crops like mustard, maize, and sunflower). The ability of farmers to produce quality seed may be limited by such factors.

Farmers tend to possess good knowledge of their major crops, and selection is likely to be more precise and intense for those crops than for others. The availability of modern varieties of crops may trigger a wider use of variation and a stronger interest in selection by farmers. In several cases, this practice has led to the development of “new farmers’ varieties” that can be fairly uniform and well adapted to advanced mono-crop production (Almekinders & Louwaars 1999; Salazar, Louwaars, & Visser 2007).

The improvement and adaptation of crops, in times of changing farming conditions, will continue to be slow as long as farmers’ selection depends on natural ways to create diversity. Adaptation may be necessary, for example, to contend with a gradual decrease in soil fertility or the presence of new diseases or strains of diseases; to meet the needs of farming systems in the process of change because of expanding population; to deal with the introduction of new technologies or radical changes in food and agricultural markets; or to cope with climate change. Many of these changes are substantial and can neither easily be met by existing genetic diversity, nor by farmers’ capacity to select and exchange materials. However, movement of materials that have the potential to cope with change has been widely reported, although these movements within informal systems and associated exchange mechanisms and markets remain limited (Louwaars 2007; Lipper, Anderson, & Dalton 2010).
Despite the extensive local knowledge base of those communities that depend on their own varieties and seed, the knowledge system and practices associated with the informal seed system maintains a certain lack of awareness. This lack of awareness often relates to diseases or processing and storage practices, but also to the maintenance of varieties. Interestingly, with regards to this last point, there are also contradictory examples of situations where farmers have an insightful understanding of crop reproduction systems, as can be seen in the case of sorghum in Cameroon (Alvarez et al. 2005), maize in Mexico (Louette, Charrier, & Berthaud 1997), and cassava in Brazil (Emperaire & Peroni 2007).

Despite the limitations that informal seed systems exhibit, their advantages are significant both in developing and industrialized countries. In those countries that are agriculturally advanced, there is widespread recognition that “good farmers can produce good seed for themselves and their neighbors” (CGN 2007). An estimated 80% of all seed used in Africa is produced in the informal systems (Byerlee et al. 2007), and for many crops the estimate is closer to 100%, which means that informal seed supply is the main source of seed for most crops and farmers in developing countries, and is likely to remain so for the foreseeable future (FAO 2010). Therefore it deserves recognition by, and the attention of, scientists, development partners, and policy makers.

FORMAL SEED SYSTEM

The formal seed system provides tested seed of uniform varieties that have been evaluated for their adaptation to certain farming systems. The structure of the formal seed system is guided by scientific methodologies for plant breeding and controlled multiplication operated by public or private sector specialists. Significant investments have been made throughout the developing world to improve varieties and to produce and promote quality seed for some major food crops. The formal system is illustrated in a simplified format in Figure 2.

Within the formal seed system, commercial seed production and marketing is only possible for a limited number of crops. The private sector concentrates on hybrids (notably maize) and high-value horticultural crops that can guarantee that all the overheads, including transportation and quality-management costs, will be covered, and that can offer some profit. Profit margins on self-fertilizing crops like most cereals and legumes are generally low due to competition with farm-saved seed. In some countries (e.g., Brazil, India), commercial companies produce such crops when they can generate enough profits from large quantities or when supplying large commercial farmers only. The private sector generally operates at country-wide and international levels, and involves cash transactions and a profit.
FIGURE 2 Formal Seed System.

orientation that results in the production of large quantities of seed and the marketing of just a few varieties with wide adaptation.

The public sector supports seed systems in different ways, notably by conducting research in breeding, by carrying out varietal development, by organizing (and subsidizing) seed quality control, or by promoting quality seed and improved varieties. Policy and legal frameworks facilitate investment in breeding and seed production, providing access to plant genetic resources, protecting breeders’ rights, and ensuring seed quality control. The frameworks may follow international standardization and regional harmonization of methodologies that address genetic resource access, intellectual property rights, varietal release, seed certification, and phytosanitary measures for import and export.

The limitations of the formal seed system can be seen at the level of the individual components in the chain and in terms of the connections between the components. Consequently, formal seed chains, as with any value chain, are as strong as their weakest link. A formal seed chain where the breeding component is weak has “nothing to sell” that farmers do not already have and tends to lose impact, since many farmers purchase seed primarily to access new varieties. Similarly, the chain will break when seed production is poorly organized and seed quality is low, or when the delivery system fails and seed does not reach the farmers in the right quality and quantity at the right time and price (Gregg & Van Gastel 1997). In such situations, “farm-saved seed” of the informal system outperforms, or is more competitive than, “formal” seed. The interdependence of the different components is a challenge for the organization of formal seed chains (Louwaars 2007).

VARIATIONS IN VARIETY AND SEED REPLACEMENT

Despite the prominent assumption in the 1970s and 1980s that local varieties would rapidly and completely be replaced by modern varieties (Frankel & Soulé 1981), informal seed systems, with their traditional and local varieties,
have remained vital for many major crops in the developing world. For food crops, adoption of modern varieties varies. Over the past decades, the area planted with modern varieties of maize has increased significantly in sub-Saharan Africa. In 2006, modern maize varieties (including both hybrids and open-pollinated varieties) covered 33% of the area in Eastern Africa and 38% in Southern Africa, excluding South Africa (Mason et al. 2011), and it reached 60% in 2005 in Western Africa (Alene et al. 2009). In the early 2000s, adoption rates for modern varieties reached up to 60% for wheat and 40%–50% for rice (Evenson & Gollin 2003). Variety replacement for those major (non-African) food crops is estimated 40%, while variety replacement of food crops such as sorghum stays as low as 10% (Byerlee et al. 2007).

It is evident that the situation for maize is different than for other crops. Modern variety adoption and yearly purchase of formal quality seed of maize hybrids has increased through an emerging commercial maize seed sector (Kenya), public maize dissemination systems (Ethiopia), a strong association between NGOs and private companies in seed marketing (Ghana), and public subsidized input programs (Malawi, Zambia) (Scoones & Thompson 2011). The increase is the result of major initiatives that foster market-led technology adoption (Toennissen, Adesina, & Devries 2008). The “maize model” boosts technology use and is enforced by favorable institutional and policy frameworks. International donor and philanthropic programs have promoted market-oriented seed sector development. In several countries (Malawi, Zambia), the maize model is embedded in national subsidized input programs targeting national food security and enterprise development; however, in both countries these programs take a major share of the government budget available for agriculture (Chinsanga 2011; Nakaponda 2011), which indicates limited sustainability. Smale, Byerlee, and Jayne (2011) and Scoones and Thompson (2011) question whether the maize model is economically viable and institutionally sustainable, and point out that it is not applicable to other seed systems or food crops. Alternative approaches are required, for example, upgrading or strengthening ‘fragile’ public breeding and seed systems (Scoones & Thompson, 2011), supporting local seed business (Thijssen et al. 2008; Neate & Guei 2011), and strengthening national seed companies (MacRobert 2009; O’Connor Funk 2009). The primary focus on maize is an illustration of the limited picture dominant in seed sector development, varietal replacement, and adoption of modern varieties in sub-Saharan Africa; it only addresses part of a much more robust reality of food and seed markets (Lipper, Anderson, & Dalton 2010; Sperling & McGuire 2010).

INFORMAL SEED SYSTEM AND LOCAL VARIETIES

Variety replacement is not a sole indicator for the performance of the formal and informal seed systems. More than 80% of the seed planted by
African farmers remains to originate from informal systems (African Union 2008; Byerlee et al. 2007). Farmers to a large degree rely on informal seed sources, independent of whether they cultivate local or modern varieties. Despite all investments in technology, dissemination, and marketing systems, the continued importance of informal seed systems in any region or production system is by a large degree defined by the fact that most small-scale, poor farmers operate in complex, risk-prone, and diverse environments. Poor farmers in those environments are difficult to cater to in formal research and technology development systems (Chambers, Pacey, & Thrupp 1989; Pretty 1995). Local varieties from informal sources do remain to meet the needs of many farmers and communities (Jarvis et al. 2011). Farmers continue to use farm-saved seed of both local and modern varieties for a number of reasons (Lipton & Longhurst 1989; Tripp 2001; De Boef et al. 2010; Lipper, Anderson, & Dalton 2010); those most frequently stated include: (i) inadequate access to markets; (ii) the structure and functioning of market channels often unfavorable to those farmers living in remote areas; (iii) limited access to financial resources or credit to buy or produce seed; (iv) the limited effectiveness of the formal system in providing timely and adequate access to quality seed of improved varieties; and (v) the lack of interest or capacity of the research system for developing genotypes that are specifically adapted to their production environment, owing to economic and organizational considerations.

The structure of the formal seed system and its organization through existing policy and regulatory frameworks widely ignore, and to some extent undermine, the value of the informal systems. They can even result in a distortion or dismantling of such traditional and often valuable systems. The methodologies for seed regulation frequently result in barriers for potential interactions between the formal and the informal systems, other than those at the stage of germplasm collection and the commercialization of varieties (Tripp 1997; Louwaars, 2007; Jarvis et al. 2011).

**ISSD PRINCIPLE: THE TWIN TRACK APPROACH TO SEED SYSTEMS**

One of the fundamental principles of the integrated seed sector development (ISSD) concept is the need to develop a twin track approach where the effectiveness of both the informal and formal seed systems can be improved through a concerted effort ensuring that proper integration is promoted at every component of the seed value chain. The seed value chain between the formal system (genebanks, breeding, multiplication, and marketing) with the informal system is promoted. The integration between formal and informal seed systems in the conventional setting is visualized in Figure 3.
The interactions between the formal and informal systems can be characterized as follows:

- Conservation and development organizations recognize community biodiversity as a means to contribute to in situ conservation and on-farm management of plant genetic resources for food and agriculture, and to enhance the resilience of farming systems (Sthapit et al. 2008; Jarvis et al. 2011). These types of interactions foster the use of local and traditional varieties, and thereby may result in strengthening the informal seed system (De Boef et al. 2010). However, they may also result in the use of local varieties in participatory plant breeding by identifying the criteria and materials for breeding programs as illustrated in Andean countries (Almekinders, Thiele, & Danial 2007) and at a global level (Ceccarelli, Guimarães, & Weltzien 2009), improvement of local varieties in response to market opportunities such as illustrated in Nepal (Gyawali et al. 2010), or promotion of local varieties in local seed business development as illustrated in Ethiopia (Abay, de Boef, & Bjørnstad 2011).

- An increasing number of international and national breeding programs involve farmers in various stages of the breeding cycle (Witcombe et al. 1996; Almekinders & Elings 2001; Ceccarelli, Guimarães, & Weltzien 2009), with further implications for varietal release (Witcombe & Virk 1997), as well as for production and marketing of seed of varieties (Bishaw & Turner, 2007; Aw-Hassan, Mazid, & Salahieh 2008) and structure of formal and informal seed value chains (Almekinders, Thiele, & Danial 2007).

- Farmer participation in release committees and the inclusion of participatory varietal selection in variety testing procedures are examples of further integration at the level of variety release (Almekinders & Elings 2001; Louwaars 2002; Witcombe & Virk 1997).
Enhanced technical knowledge can improve on-farm storage of seed (Almekinders & Louwaars 1999; Latournerie-Moreno et al. 2006).

Farmers are increasingly recognized as strategic partners for reaching seed security and an increasing number of farmers buy commercial seed of their food crops from emerging small-scale seed enterprises. As such, farmers are supported in commercial seed production and marketing (MacRobert 2009; De Boef & Thijssen 2010; Neate & Guei 2011), with implications for the structure of the seed value chain, for example, addressing the supply of early-generation seed, seed quality-control mechanisms and structure of seed marketing promotion programs driven by the government, donors, or NGOs (African Union 2011).

The role of agro-dealers and marketing networks is increasingly being recognized in seed sector development, thereby enforcing market forces for dissemination at a local level (MacRobert 2009). Voucher systems can be instrumental in transformation from relief to market-orientated system of seed and variety dissemination (Longley 2006).

Figure 4 outlines interactions between formal and informal seed systems and provides some examples.
based on the availability of quality seed of modern varieties; rather it could only become successful when technology introduction was embedded in a broader programme investing in agricultural infrastructure and farmers' capacities in entrepreneurship, and enabling policies for input and output prices. In sub-Saharan Africa, as with the rest of the developing world, the orientation of the formal system originally was primarily public. The justification for public investment was that seed was regarded as a crucial agent for technology transfer, ensuring farmers would benefit from one of the major technologies becoming available: high-yielding varieties. Consequently, quality seed of such varieties was produced and distributed to farmers. The Seed Industry Development Programme, led by the Food and Agriculture Organization of the United Nations, assisted many countries in setting up seed farms, contract grower schemes, and seed conditioning and processing plants for their major food crop seed (Feistritzer 1984).

The Green Revolution, with its initial focus on development, stimulated the building of centralized seed production units in many countries as public institutions or state enterprises. Their structure was along the lines of the successful private seed industries of Europe and North America. Formal seed systems subsequently developed specialized in-house and, later, independent seed quality-control institutions to create quality awareness among both seed producers and customers, and to safeguard the interests of farmers. These were also similar to the official seed certification agencies in North America and Europe. However, a crucial difference between private seed industry in the north and the public seed systems in sub-Saharan Africa was that the seed value chain in the latter was development oriented rather than profit oriented; seed was primarily distributed and not marketed. Varieties were developed within (international) public institutions, released through public research institutions, and then seed was produced and disseminated through public (extension) organizations. Consequently, the breeding component was driving the chain (see Figure 5, left-hand side).

In the 1980s and 1990s, however, seed policies followed the general economic trends of structural adjustment, which forced the transformation of public seed units into private or public market and profit-oriented seed enterprises. Such private orientation resulted in a shift in focus toward just a few commercially interesting crops and a more exclusive client base, notably (hybrid) maize seed for commercial farmers. The private-sector interest in the maize seed and breeding sector has shown major weaknesses in public research and seed systems (Setimela et al. 2009). Remaining and often weakened public breeding programs that are responsible for other major food (non-maize) crops are unable to disseminate their varieties to farmers upon release. The seed value chain for major food crops (other cereals, pulses, and oil crops) lacks the seed production component, as shown in Figure 5 (right-hand side). In many cases, NGOs began operating in this vacuum; in other cases, research centers chose to work directly with farmers in
disseminating their varieties. Emerging small-scale seed enterprises, or local seed businesses, aim to fill this gap in the seed value chain for many food crops (Thijssen et al. 2008; De Boef & Thijssen 2010; De Boef et al. 2010; Neate & Guei 2011).

The transformation from development to market orientation proved much more difficult than expected, largely because of the shift in “driver” needed for such a transition. In development-oriented seed chains, as highlighted above, it is the breeding component that drives the chain. Seed production and marketing are necessary to take new varieties to as many farmers as possible. In commercial seed systems, the marketing component takes primary lead in the chain (MacRobert 2009; O’Connor Funk 2009). Even though the basic components are the same (breeding, seed production, marketing), developmental and commercial seed systems are fundamentally different, as illustrated in Figure 6. Insufficient appreciation of this difference is an important reason for the fact that many attempts to commercialize the public seed production infrastructure have failed (Louwaars 2007). Consequently, plural pathways to (Scoones & Thompson 2011) or integrated approaches for seed sector development are advocated that create room for both development and market orientation, and thereby create space for multiple approaches better matching the multiple seed systems, instead of one single approach built primarily on the “maize model” (Smale, Byerlee, & Jayne 2011).

**ISSD PRINCIPLE: DEVELOPMENT AND MARKET ORIENTED SEED CHAINS**

The second ISSD principle is to accept and work with both public-(development) and private-oriented (market) seed chains, ensuring that the
comparative advantages and interactions of each are used to their full advantage for achieving an integrated seed sector, thereby contributing to the overarching objectives of food security, economic development, the promotion of agricultural entrepreneurship, and biodiversity conservation and use. The development- and market-oriented chains are the same; however, flows of information and decision-making processes are distinctively different. In addition, while the public system focuses on seed production to meet national targets, private production is based on sales figures and predictions. Figure 6 shows the clear distinction between the types of crops promoted by the public system (major food crops) and the private system, which focuses on profitable seed products (high value crops, hybrids). The ISSD principle is to accept that each chain has to play an important role in seed sector development, i.e. instead of taking a linear approach (Douglas 1980) adopt a pluralistic approach and promote complementary seed sector development pathways in response to the variation, as is characteristic of agriculture in Africa (De Boef et al. 2010).

In an ISSD framework, different types of entrepreneurship can be supported. It avoids making a priori choices for any type of seed value chain.

- Large-scale seed companies, which operate internationally, promote the most commercial crops by providing their varieties and their business skills, including the development of distribution channels. These companies mainly deal with just a few commercial crops (hybrids, vegetables, and GMOs) and target customers who are farmers that can manage their environmental variation well through the use of mechanical land preparation, fertilizers, pesticides, etc.
Seed companies that operate nationally target highly commercialized and medium-level farmers as primary customers, initially by providing good seed of varieties bred by the public research system, possibly with some level of exclusivity. Their product range includes some food and industrial crops. These companies may be privatized public enterprises or seed companies established by local investors.

Local seed businesses, developed by advanced farmers or farmers’ groups, emerge at different levels of proficiency, bridging the divide between advanced informal and emerging formal. These farmers’ groups may initially produce seed for their own use or for larger enterprises as contract farmers, or they may develop their own seed marketing organization. Because of lower overheads and transport costs, such local seed businesses are able to provide farmers with a broad range of seed products that would not be profitable enough for larger companies.

Finally, agro-industries, such as oil mills, breweries, cotton ginneries, and flower traders, interfere and, in most cases, control seed business in order to make sure that their main operations are fed with the right type of produce. This kind of involvement develops into rather closed-value, chain-based seed operations that focus on the producers supplying the chain.

All these different types of seed entrepreneurship can contribute to providing the total amount of seed needed in the country, and public policy needs to find ways to support and regulate them based on their needs and limitations.

ISSD GUIDELINE: GENERAL OVERVIEW

The final consideration of the ISSD concept is to understand and define the systems in each country, or specific area, using the following guidelines:

- Recognize the existence and consequent relevance of the informal seed system.
- Facilitate the integration of informal and formal seed systems.
- Endorse and support a pluralistic approach to seed sector development involving private and public systems and civil society, and create room for a diversity of international, national, and local seed businesses to contribute their strengths and operate in their specific niches.
- Recognize the driving forces as being food security, economic development, promotion of agricultural entrepreneurship, and biodiversity management.
- Define a range of seed systems and structure them for the seed value chain.
• Design programs built upon a variation of seed systems.
• Design enabling policies that foster pluralistic approaches in seed systems evolving in response to the dynamic nature of seed sectors in development.

ISSD provides an integrated view of the roles of seed in agricultural development in the widest sense. It avoids blueprint solutions and simplistic one-directional ideas about what an ideal seed sector should look like and how to achieve it. Such linear approaches have been dominating seed policies and programs for the last 50 years. ISSD basically provides a framework in which countries can fit in their own particular situations and into which evolving developments can be fitted. As such it also provides guidance to development partners in public, private, and civil society to identify gaps and opportunities for strengthening the diversity of seed systems in parallel. ISSD can help circumvent clashes between those who promote the development of the international private system, those who focus on promoting local-level seed entrepreneurship, and those who focus their efforts on promoting agro-biodiversity to enhance resilience. ISSD-based seed policies allow governments to channel their investments and those of their partners, and provide a basis for regulatory frameworks that support diversified seed systems in their country, notably through seed laws, breeders' rights, and biodiversity laws, and within each create several options for implementation. In this way, the ISSD concept provides an important basis for the African Seed and Biotechnology Program, headed by the African Union (2008; 2011), by promoting coherence among practices, programs, and policies for seed sector development at a continental level.

REFERENCES


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