Varietal development and seed system in west Africa: Challenges and opportunities

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Abstract
Population growth and changes in human diets have helped make rice an important staple food in both urban and rural areas. Despite tremendous efforts made by many countries in west Africa, the sub-region still imports rice. With the progress in varietal development combined with the will of many states to promote rice production, reversing current trends in the near future is on track provided that inputs and, more specifically, quality seed can be delivered in a timely manner. However, west African seed systems are complex with many non-professional intermediaries and numerous stakeholders (NGOs, technical and financial partners, public sector, etc.). Formerly, governments were in charge of regulating production and marketing, but most governments no longer do so. Could the emerging private sector take over these responsibilities in an efficient manner? The private sector is very diverse. There are producers organized within groups and associations that produce and distribute seed, retailers in urban areas, government services (extension, national seed services) and private seed companies that, depending on the situation, produce their own or purchase producers' seed and package it for sale. They also ensure control and certification of the production. Which seed system should be promoted when seed markets are scarce or being built in some sectors? In most countries, the most common supply pattern for producers is self-supply — relying on one's own harvest to supply seed for the following season. Thus, it would be very difficult to plan for an annual seed demand. Another constraint is related to the lack of organization in the agricultural produce markets. These markets should encourage producers to request for technological innovations. Many traders in west Africa are more interested in imports than in promoting local products (rice, maize, millet). Since 2000, associations, government services and seed companies have been established by either technical and financial partners or the public sector without prior market survey. With the common practice of self-supply of seed among most farmers, the exclusive trade of seed by these bodies might not be viable. Considering the low technical and organizational capacity of the sector producers, a public–private partnership should improve its performance. Harmonizing seed legislation in the sub-region should also offer new opportunities to the sector.

Introduction

In west Africa, the development of rice production has always been a public concern. Various surveys of the agricultural sector have presented rice as a promising crop (GRiSP 2010; USAID, 2009). Meeting the increasing national needs that largely depend on imports has always been and remains the main objective.

With the population growth and increasing urbanization in most countries, rice has gradually become a strategic product for most sub-Saharan African (SSA) countries. Agricultural policies aim for full water control and the development of the rice sector to achieve food security and control poverty.

According to the USAID (2009) surveys, rice is a high-potential development commodity. However, observed performance is below expectation. The gap between production potential and actual production is wide and this is attributed to poor operation of the rice sector. However, until the crisis of 2008, a number of specialists were asking whether African local rice could compete with rice from south-east Asia.

Conventional plant breeding systems have been established throughout the world. The development of NERICA varieties by Africa Rice Center (AfricaRice) has opened real opportunities for rice production systems (upland and lowland).

Producers' access to quality seeds is a major constraint in the sub-region. Some seed systems established by technical and financial partners, NGOs and public services operate in parallel in most countries of the sub-region with the same objective of supplying rural populations with certified seeds. However, most of them face various structural, technical and financial problems.

Agro-food challenges in west African countries

Based on the United Nations' projection (Dembélé and Staatz, 2010) of the evolution of the world population, global rice demand will increase from 439 million tonnes (Mt) in 2010 to 496 Mt in 2020 and 553 Mt in 2035 — a 26% increase in 25 years. According to AfricaRice (Diagne, 2010), paddy rice production in the sub-region grew from 6.7 Mt in 1990 to 9.3 Mt in 2006.

With the high urbanization and increase in purchase power, west Africa is experiencing a significant increase in rice consumption in urban and rural areas (Table 1). Consumption increased from 1.3 Mt in 1960 to nearly 6 Mt in 1990, and is attributed to two main factors: increased incomes and urbanization. With the

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Table 1. Evolution of production, import and consumption of rice in west Africa (average totals per year)

	1961–1974	1975–1984	1985–1994	1995–1998
Production ('000 t)	1 335	2081	3456	4567
Import ('000 t)	424	1340	1982	2423
Consumption ('000 t)	1336	2852	4688	6234
Per-capita consumption (kg)	26	33	39	43

Source: WARDA (2000).

possible impact of climate change on agricultural production in the sub-region, it is essential to double rice production by 2050.

In this context, timely provision of performing varieties resistant to biotic and abiotic constraints, as well as provision of other production factors (fertilizers, pesticides) needs to be improved. Seed associations and cooperatives have been created and contribute to improved seed production and commercialization. Unfortunately, in many cases, there are often unsold seeds because many producers do not renew their seeds regularly.

Overview of seed production: Productivity from 1961 to 2008

Rice production in west Africa covers only about 60% of the population's needs. This has resulted in increasing rice imports from Asia. Senegal alone imports the equivalent of US$ 150 million worth of rice each year (ROPPA, 2009). With the current trends, according to FAO estimates (Dembélé and Staatz, 2010), rice imports in west Africa will increase from 6.4 Mt in 2008 to 10.1 Mt in 2020.

Thanks to the significant progress achieved in some production areas of the Senegal River valley (SRV) and the Office du Niger, west Africa could fully meet the rice demand of its populations if conducive production conditions were created.

In addition to land availability, rice producers have acquired significant know-how thanks to national and international research. Yield levels of 6–7 t/ha are regularly achieved in irrigated cultivation in some production areas (SRV and small village irrigated perimeters). Considering the potential of improved varieties disseminated by research institutions, and the low level of production intensification (especially in rainfed rice), it is still possible to significantly improve rice productivity and quality.

To avoid riots in their cities during the world food crisis of 2008, most governments of the sub-region were obliged to increase local rice production through input subsidies (fertilizers, seeds, pesticides) with the objective of selling rice produced cheaper than the cost of imported rice. Thus, actions to promote local rice were initiated in most countries. The major issue remains the competitiveness of locally produced rice compared to rice imported from Asia.

Innovation in varietal creation

Thanks to the progress in molecular biology and genetic engineering, varietal development methods are being transformed in all crop breeding programs. These innovations, together with the decoding of the rice genome, mean that varietal development can be directed toward specific environments and markets. Progress is becoming faster thanks to marker-assisted selection. New high-yield-potential varieties continue to improve rice productivity. Harnessing hybrid vigor in rice is a reality in Asia and Egypt. We can therefore expect the development of a new generation of hybrid rice varieties with better yields and good quality for west Africa.

As part of capacity-building of African scientists in these new tools, many financial partners have contributed to establishing research platforms in molecular biology. For example, Biosciences for Eastern and Central Africa (BeCA) in Kenya, and Centre d'etude et de recherche pour l'amélioration de l'adaptation à la sécheresse (CERAAS) in Senegal.

All these initiatives reinforce the establishment of a well-organized and efficient seed system in the countries of the sub-region.

Seed system in west Africa

Traditionally a government-managed sector, supported by some projects and NGOs, the seed sector has interested few private-sector stakeholders. The private sector has mainly intervened in the market gardening seed sector, where seeds are mostly imported.

From the 1980s, the seed sector was liberalized in most countries following structural adjustment. But in some countries, the sector is still owned by the government. However, in rural areas where the government is not present, NGOs become involved; NGOs also become involved where the private sector shows no interested in developing business (e.g. if the target crop is self-pollinated, there will not be a regular demand for seed, because farmers can use seed from the harvested grains).

An estimated 120 Mt of seeds are used annually in the world. In developing countries, about 80% of food crop seed comes from farmers' production. Thus, the majority of seeds used in west Africa are produced by farmers and distributed through traditional systems (barter, donation, etc.) (Table 2). Farmers are therefore producers as well as users of seeds. The market rarely plays a major role in seed distribution.

Table 2. Sources of millet and groundnut seed in Niger and Senegal (%)

Source	Niger		Senegal	
	1996	1997	1996	1997
Millet				
Personal production	93	82	66	57
Family and friends	2	7	0	1
Village market	5	9	31	39
Seed sector	0	2	2	3
Groundnut				
Personal production	89	82	54	36
Family and friends	3	4	0	1
Village market	8	14	28	38
Seed sector	0	0	18	25

Source: WCA-ICRISAT Survey 1997 (Ndjeunga *et al.*, 2010).

However, the liberalization process undertaken following structural adjustment programs led to partial disengagement of states from this key sector for agricultural production. Unfortunately, despite some sectoral interventions of certain private stakeholders in commercial crops such as cotton (in Burkina Faso, Chad and Mali), groundnut (in Senegal) and rice (in Mauritania and Senegal), the gap thus created has not been bridged by the private sector. This is a worrying situation for food crops for which seed produced by the formal sector does not always meet required standards and for which quantities sold on markets are insufficient and generally not accessible to small producers (because of their remoteness from urban markets).

Demand for quality seed is generally better met when the seed is distributed where it has been produced and where the private sector can play a significant role in this distribution (Rohrbach, 1997; PRECAD, 2009). But the private sector only intervenes when it is sure to make a profit. Therefore, randomness of seed purchase by producers does not encourage them to invest in hazard-prone zones. This is evident in sectors like dry cereal crops, where poor farmers are constantly faced with climatic risks and are therefore unlikely to invest in seed, so the private sector does not get involved.

The seed trade flourishes only when there is a market to absorb surplus production at producers' level. For want of attractive markets for agricultural products, there is no incentive to intensify production. How can economic operators be encouraged to invest in seed production under these conditions?

It is understandable why NGOs (with support from certain technical partners) have promoted a lot seed self-supply instead of having confidence in the private sector. However, there are attempts to use this self-supply mechanism to develop seed trade, the management of which seems very difficult with regard to seed regulation. AfricaRice, through a community-based NERICA seed production and distribution system, has developed an approach to ensure quality seed production and distribution to the community. This approach has contributed a lot to the wide dissemination of NERICA rice varieties in Guinea (Brossier, 2007).

Overview of the seed system in west Africa

Seed is the most important production factor and the cheapest input for production systems in SSA. In most of the countries of the region, two seed systems exist in parallel: a formal system established by the state and its technical partners, and a traditional or informal system based on a tradition of exchanges and mutual support among producers within any one zone.

The quality of seeds has an important multiplying effect at the household level (PRECAD, 2009; Initiative Riz Mali, 2008). But seed industry cannot thrive where there is no appropriate seed legislation or incentive market. Only appropriate seed legislation can encourage private stakeholders to create enterprises likely to boost the seed sector by favoring high-quality seed production and commercialization.

Although clear provisions relating to intellectual property rights are not yet established in all countries, the legal environment and the institutional context are mostly conducive to the establishment of such systems. In some countries, seed monitoring and certification systems have yet to be established.

Whatever their environment, producers should always ensure their seed supply to avoid shortages. That is why they take their seeds from their own production. Moreover, given their socioeconomic situation, seed traders are rarely interested in them.

The conventional or formal system

The conventional system is based on a regulated process with stakeholders whose roles and responsibilities are well defined, supplying the market with certified seeds for production. These seeds should be previously registered in an official catalog of seeds and varieties. Certified seeds should meet the standards of quality seeds (germination capacity, varietal purity, etc.).

Established in almost all countries, this system was not generally satisfactory, although the state and its partners have invested a lot of money in it. Based on the Western model of seed production and distribution, it operated well in very few countries. This situation is attributed to many factors: the difficulty of estimating the seed demand and supply; low purchasing power of farmers; low yield of varieties proposed by research; lack of qualified staff to ensure quality control and certification; lack of market to sell the surplus production generated by seeds, etc. The potential demand is high compared to current availability (Table 3).

Table 3. Potential demand (20% of area) and current (2000) seed availability (in tonnes)

Country	Maize	Rice	Sorghum	Millet	Cowpea	Groundnut
Ghana (potential)	11 223	6733	1139	461	1990	17 833
Ghana (20% target)	2245	1347	228	92	398	3567
Ghana (actual)	2653	696	4	0	38	48
Nigeria (potential)	50 629	120 775	35 101	12 952	57 070	117 780
Nigeria (20%)	10 126	24 155	7020	2590	11 414	23 556
Nigeria (actual)	5184	4439	948	558	372	190
Mali (potential)	5329	19 594	4961	4124	4729	17 358
Mali (20%)	1066	3919	992	825	946	3472
Mali (actual)	714	2592	85	66	36	11
Niger (potential)	127	597	12 799	16 833	61 389	28 417
Niger (20%)	25	119	2560	3367	12 278	5683
Niger (actual)	0	0.2	109.6	2561	388	42.4
Senegal (potential)	2336	5434	972	2273	2744	65 081
Senegal (20%)	467	1087	194	455	549	13 016
Senegal (actual)	25	2255	0	2	5	1066
Burkina Faso (potential)	7217	3648	7830	3480	1347	21 537
Burkina Faso (20%)	1443	730	1566	696	269	4307
Burkina Faso (actual)	9492	864	500	139	578	161
Benin (potential)	9836	4840	1831	326	5179	21 530
Benin (20%)	1967	968	366	65	1036	4306
Benin (actual)	1922	176	0	0	0	0
Togo (potential)	6422	1915	978	187	2486	3344
Togo (20%)	1284	383	196	37	497	669
Togo (actual)	195	90	3	0	0	0

Source: WASA (2010).

The traditional or informal system

The traditional system is present almost everywhere in the sub-region. In this system, farmers harvest the best heads (ears, panicles, pods) from their fields to keep as seed till the next season. Each farmer therefore ensures his or her seed supply with seeds produced on his or her own farm. It is only in case of disaster (drought, flood, war) that seed demand is high. Farmers sometimes exchange seeds among themselves. Seed trade is not significant.

There is no formal quality control; 'the receiving farmer' controls the quality before using the seeds. If the seeds are of poor quality (germination problems), the farmer will no longer ask for seeds from the same source. In this system, farmers give less importance to varietal purity — homogeneity is not a quality criterion: they often mix different varieties, if not different species to reduce the risks.

Conclusion

The seed system in west and central Africa was not given sufficient attention in relation to its importance compared to other sectors such as agricultural research and extension (INRAN, 2004; IER, 2008; INSAH, 2000). Seed demand is very high in Kenya, Malawi, Zambia and Zimbabwe. The market is flourishing and the private seed sector is well developed. But in west and central Africa, farmers only ask for seed under the following circumstances: following a disaster; when their own varieties are not performing well; when they want to test new varieties following an advertisement or a research day. Demand is not always predictable.

The participation of the private sector is very weak, because of low prices and lack of organization of the seed supply. In west and central Africa, production systems are highly diverse. Almost every zone has its own

varieties. This situation, added to the uncertainties of rainfall, can push any zone to change its varieties at any time. It is therefore extremely difficult to plan seed demand in advance.

The many private companies that supply pesticides in west and central Africa have had little involvement in seed distribution, except for market-garden crops. Seed companies are much more in evidence in southern and eastern Africa, especially in South Africa and Zimbabwe, where the production and dissemination system and use of hybrids is highly developed.

Key stakeholders of the seed sector

Many stakeholders (private and public sector) are involved in the seed system in most production zones as in Office du Niger (Fig. 1).

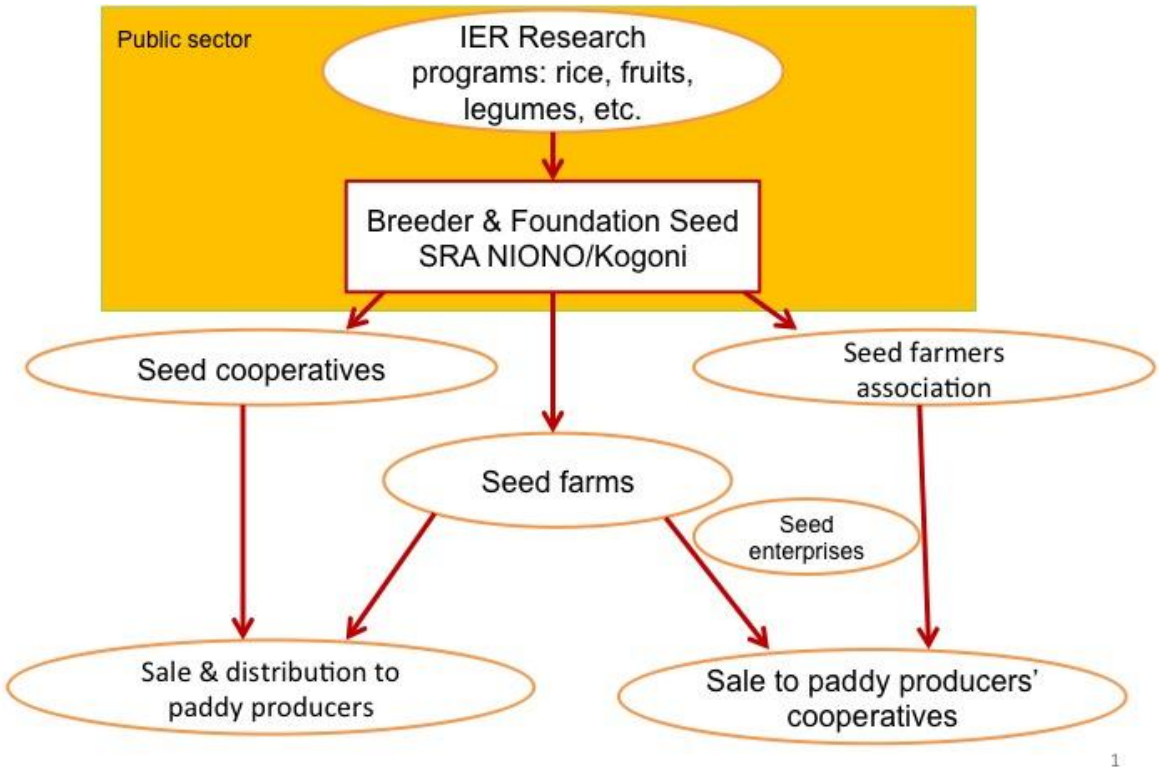

Figure 1. Seed production and distribution in the Office du Niger.

In the Office du Niger, for example, there is a seed producers' association as well as seed cooperatives producing and selling certified seeds. In the same zone, there are also seed farms alongside seed enterprises producing and distributing seeds. Research, through its structures, ensures the availability of breeder and foundation seeds.

Despite the co-existence of these structures, these stakeholders do not collaborate enough. Many producers continue to use their harvest as seeds beyond the 3 years advised by the seed policy. So, everywhere in west Africa, the conventional seed system is made up of stakeholders from the public and private sectors, as elaborated below.

Public sector

- **Research tasks related to varietal development** (prospection, introduction, selection), and breeder seed and foundation seed production. This is the 'poor relation' of the system due to its lack of resources. The lack of regular availability of breeder and foundation seeds is a major constraint in many countries. Once a variety is registered in the variety catalog, breeders no longer feel obliged to meet the needs with breeder and foundation seeds. There is no budget for this activity in most research institutes. Moreover, needs are not always known in time to meet them.
- **Seed quality control and certification service**, an independent specialized service of the research, is tasked with ensuring that seeds sold on the market meet the seed quality standards.

Private sector

- **Certified seed producers–distributors**, organized in an association or a cooperative that ensures seed production, certification and distribution.
- **Seed enterprises, economic interest groupings**, which often produce on contract with the certified seed producers–distributors, but also buy their production and package it for distribution. To these stakeholders, we can also add NGOs created following governments' incapacity to correctly supply producers. These NGOs also give advice.
- **Agro-dealers** who, originally located in urban areas, have expanded into rural areas thanks to the support of the agro-dealers' capacity-building program (Agrodealers Strengthening Program for Mali, ASPM) that has trained people and set up shops to sell inputs in many production zones.
- **Farmers, potential buyers of certified seeds**, well organized in some sectors such as cotton and irrigated rice. Determining demand is generally easy. For the sectors that are not organized, such as millet, sorghum, cowpea and maize, it is not easy to estimate the demand which is not often regular.

Most of these stakeholders do not have strong skills in finance and business management and seed technology (techniques, organizational and financial, etc.). Access to credit is difficult for most of the stakeholders, leading to low levels of mechanization.

Only the imposition of regulation on the seed actors and the organizations, and empowerment of the value chain actors, are likely to improve the system.

The seed market in west Africa

As noted previously, except for market gardening, the seed market is not well developed in west Africa. It was with the disengagement of the state from the seed business that private seed enterprise started to emerge with the support of donors. Before state disengagement from the seed sector, seed supply was ensured through extension services. Except for years of extreme drought, there were no seed problems. Extension services (such as the national seed service in Mali) took foundation seeds supplied by research and produced certified seeds to be sold to commodity extension services, which distributed them alongside other inputs (fertilizers and pesticides). The commodity extension services also bought the entire production in certain cases, especially cotton in Mali (Compagnie Malienne de Développement du Coton, CMDT), rice in Office du Niger, and groundnut in Sengeal (Société nationale de commercialisation des oléagineux du Sénégal, SONACOS).

Under these conditions, technological innovations were continually sought to improve productivity. Seeds should respect homogeneity and purity criteria to meet the standards established by governments.

In the case of nonorganized sectors such as dry cereals (rainfed rice is in this category), the seed demand and supply is extremely difficult to estimate. Very often, there is no distributor nearby. It is difficult, if not impossible, for a seed company or an association to undertake production without predictable demand. Production and commercialization are therefore planned on an uncertain basis.

Many seed associations, cooperatives and enterprises have difficulty selling their seed production for lack of demand, while producers in other regions experience seed shortage. This shows an absence of communication among stakeholders and the non-functioning of the distribution system — distributors being located mainly in or close to urban areas. With governments' disengagement, access to seeds has become much more of a problem for producers of dry cereals (millet, sorghum, maize, rainfed rice) than for producers of cash crops such as cotton. Especially in irrigated perimeters, seed production is generally well organized. However, seed dealers and paddy producers are not linked so that seeds can be sold easily.

Figure 2 shows that there is no private seed sector for rice in west Africa (if community-based sector [seed associations and cooperatives] is not considered as part of the private sector). Conversely, in southern Africa and Tanzania, there is a very active seed sector. In west Africa, there is a private seed sector for maize in Ghana and Nigeria (Fig. 3).

Conclusion

The seed system in west Africa is highly diverse, with multiple stakeholders supported by technical and financial partners with visions and objectives that are not always the same.

Governments and certain technical and financial partners want to strengthen the conventional system with an emerging private commercial seed system by putting in place a control and regulatory system to ensure the quality of commercial seeds.

On the other hand, NGOs and other partners wish to promote self-supply of farmers with more responsibility for farmers who are producers and users of the seeds produced.

It is difficult to choose between these two systems because they seem to be complementary at the country level. The conventional system works well with cash crops, while the traditional system continues to be practised by the producers of certain food crops and in the areas not well linked to market. It is likely that these

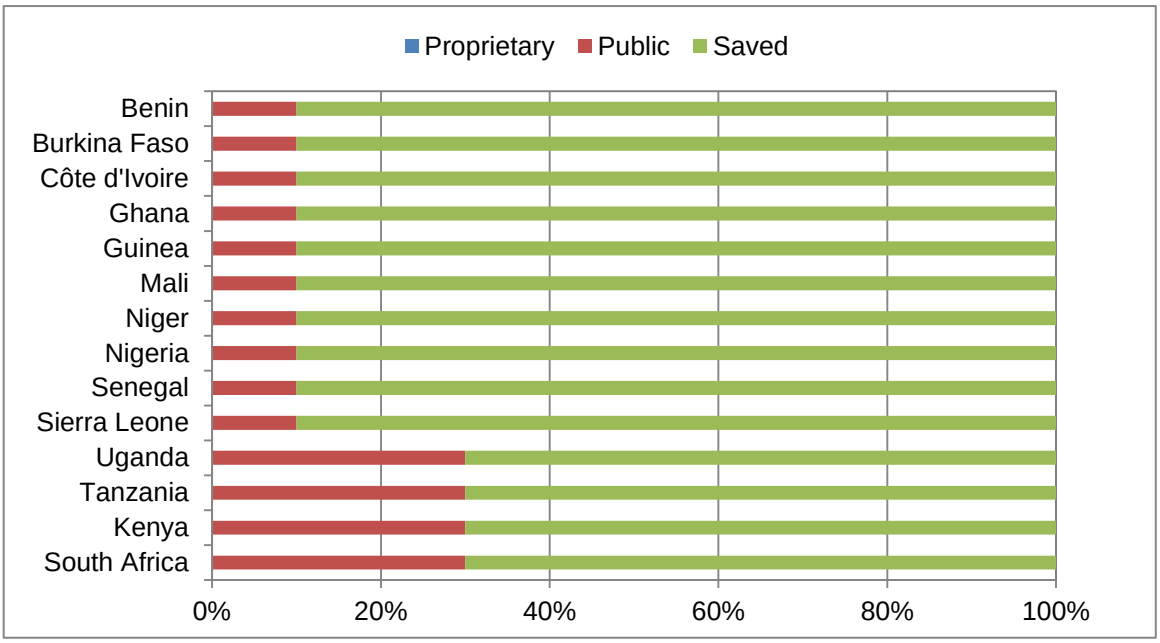

Figure 2. A seed market where the private seed sector is absent (e.g. most of west Africa) (Context Network, 2009).
Key: Proprietary, Share of the private sector; Public, Share of the public service; Saved seed, Producers take grain from their harvest to be used as seeds.

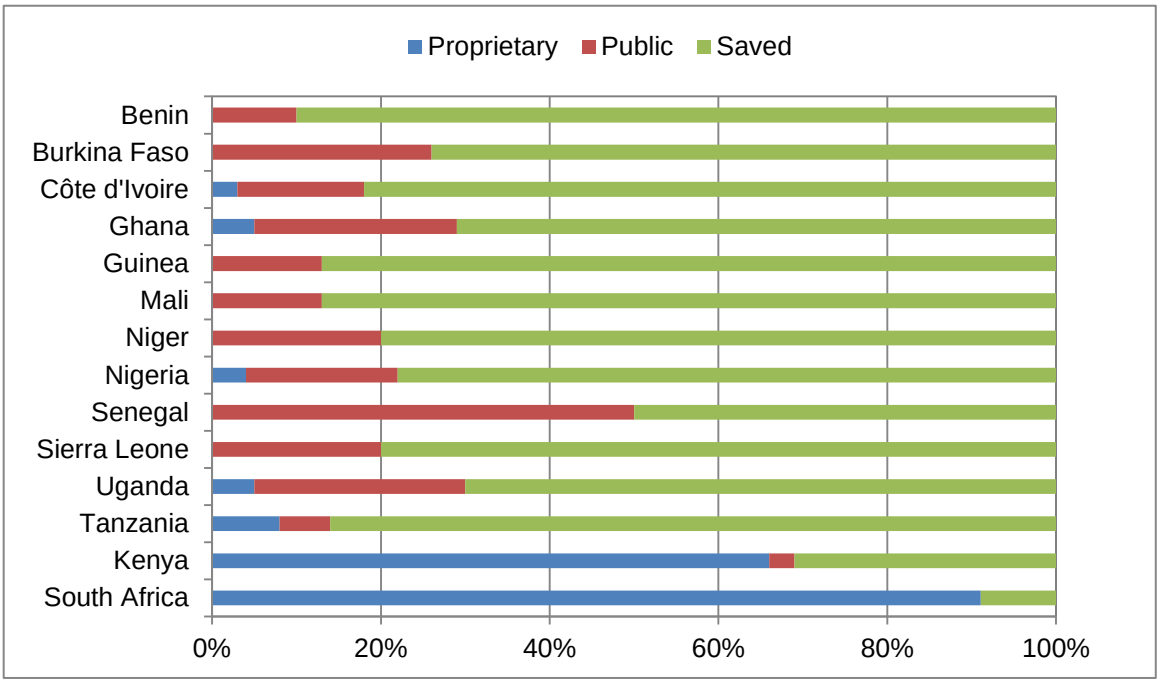

Figure 3. Emerging maize seed sector (e.g. Côte d'Ivoire, Ghana, Kenya, Nigeria, South Africa, Tanzania, Uganda) (Context Network, 2009).
Key: see Figure 2.

two systems will continue to work side by side for a long time, until the market is attractive enough to make producers insist on certified seeds.

Despite this situation, many conditions are in favor of the emergence of a viable seed industry in the sub-region. With the disengagement of the state and the political will of the countries to ensure food security in the region, there are opportunities to develop an efficient and profitable seed sector.

However, a prerequisite for this emergence lies in promoting a value chain with all stakeholders and the development of relatively sure outlets for products. In this context, meeting food needs through an integrated

regional market could play an attractive role to stimulate the seed sector and lead to the emergence and booming of self-governing seed production and distribution structures in the value chain. It is the evolution of agriculture and agricultural markets that will determine the evolution of the seed system in the sub-region: we need to produce beyond household food security and supply local and regional markets.

Many opportunities are now in place — such as initiatives to intensify cereal production in the region (e.g. GOANA in Senegal, Rice Initiative in Mali); agriculture is (once again) a priority of technical and financial partners; the emergence of new better-qualified stakeholders in the seed sector; more promising new varieties (e.g. NERICA, F_1 hybrids); the establishment of new seed policies taking into account seed harmonization and legislation in the sub-region.

However, several constraints need to be removed in order to establish a dynamic and profitable seed system. Among the numerous actions required, I mention just three:

- stakeholders' capacity-building in the different segments of the seed sector;
- linking the different stakeholders in order to ensure a joint planning of supply and demand;
- access of stakeholders to credit in order to be better equipped and face operating costs of their enterprises.

In this context, the closeness of seed producers' and distributors' cooperatives and associations to producers could enable them to play a big role in improving the use of improved seeds and change producers' habits.

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