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STRENGTHENING SEED SYSTEMS: GAP ANALYSIS OF THE SEED SECTOR

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I. CONTEXT

1. At its Eleventh Regular Session, the Commission on Genetic Resources for Food and Agriculture (Commission) "encouraged FAO to continue its work to strengthen seed systems at national, regional and global levels and reiterated its recommendation in paragraph 32 of the Report of its Tenth Regular Session, that a gap analysis of the seed sector be prepared. This would be reviewed by the Working Group on Plant Genetic Resources. The analysis should consider in a balanced way both the formal and informal seed sectors, as well as the relationship between breeding and seed systems".[1]

2. In business and economics, a gap analysis is a tool that helps a company to compare its actual performance with its potential performance. To apply this tool to the seed sector as a whole, FAO compiled information from different sources on the state of the main elements of the seed sector (mainly in developing countries) and analysed the overall strengths and weaknesses. From this analysis, gaps were identified as well as priority areas to be addressed.

3. In this paper, the term "seed" is used in the agronomic sense, to include any type of planting material intended for use in producing a crop, i.e. either generative or vegetative, such as roots, tubers, bulbs, cuttings, rhizomes and apomictic seed. Seed is not only a carrier of the genetic resources for food and agriculture, it is also a basic element of any crop production system and thus fundamental for food security and rural development. In this sense, seed has to be physically available at an affordable price, at the right time, in the right place and in the right quantity, and with the right genetic attributes and quality (purity, physiological and sanitary conditions) for it to have the desired impact.

II. INTRODUCTION

4. Out of more than 50 000 edible plant species in the world, only a few hundred contribute significantly to food supplies. As few as only 30 crops provide 95 percent of human dietary energy needs with just four of them – rice, wheat, maize and potatoes – providing more than 60 percent[2] of the world's food energy intake.

5. Dependence on such a small number of species and the fact that within those species breeding is mostly done on modern genetically related varieties makes the world's food and forage supply vulnerable. Increasing the use of agriculture biodiversity, both intra and interspecific, to ensure steady germplasm conservation and utilization is one of the primary strategies to meet the evolving needs of our time. FAO considers that the sustainable use of genetic resources for food and agriculture will be the foundation for many of the adaptation strategies required in food and agriculture, especially in the face of climate change.[3] Most of the world's genetic diversity *in situ* lies in natural areas and in the hands of subsistence farmers, who maintain this diversity within their farming systems, i.e. in a "pool" that constitutes a source of seed diversity.

6. Germplasm conservation and use is fundamental for maintaining and increasing food security, especially because it is the basis for the development of improved varieties that will produce increased yields and have higher tolerance to abiotic and biotic factors, as well as other important characteristics beyond those attainable from varieties currently used by farmers. However, improved varieties *per se* will not give the desired impact if seed of these varieties cannot be made available to farmers. In many countries, improved varieties with high genetic potential do not have impact on food production because seed systems are not in place. It is for

[1] CGRFA-11/07/Report, paragraph 34.

[2] http://www.fao.org/nr/cgrfa/cthemes/plants/en/

[3] FAO. 2008. High-level Conference on World Food Security: the challenges of climate change and bioenergy, Rome, 3-5 June 2008. *Climate change and biodiversity for food and agriculture*. Technical background document from the Expert Consultation, 13-14 February 2008 (HLC/08/BAK/3).

this reason that the germplasm conservation/crop breeding/varietal development complex needs to be properly integrated and synchronized into seed systems, so that the desired effect on crop production/productivity can be obtained.

7. Among all inputs for agriculture, whether commercial or subsistence, seed has a unique feature, as it is a means for delivering technology to farmers. Value in agricultural genetic resources lies in the diversity within a crop and seed is the vehicle for carrying this genetic diversity over time and space. Regardless of the scale of agriculture, seed quality, particularly its genetic attributes, determines the level of crop productivity in the presence of other crop-production inputs. An estimated 50 percent of the global increase in yields over the past fifty years has been derived from genetic progress and seed quality, in addition to agronomy improvement and phytosanitary product uses. For the last 20 years, some studies indicate that the percentage link to genetic progress is increasing and around 90% for wheat and barley with a sustainable agricultural production management.[4] Hence seed security is a *sine qua non* for food security.

8. Unlike other agricultural inputs such as fertilizer and pesticides, the specific characteristics of seed make its delivery to farmers complicated. Seed is a living organism and requires appropriate handling, processing and storage operations in order to ensure that its viability is maintained until it is sown in the field. Seed quality is an essential element of seed systems: when provided to farmers seed should have high germination and vigour, high levels of genetic and physical purity and be free from pests and diseases. Multiple cycles of production are necessary to generate quality seed and in order to obtain the quantities required to meet market demand. Thus, the seed supply chain generally differs greatly from that of other inputs.

9. While the availability of quality seeds is no longer a critical issue for farmers in the developed world, most developing countries still face serious fundamental problems related to farmers' access to quality seed and improved varieties of crops species suited to their needs and adapted to their agro-ecological conditions. There are major constraints, related to a lack of efficient and sustainable conservation and utilization of agricultural biodiversity, for the eventual development of effective seed delivery systems. Consequently, member countries regularly request FAO's technical and policy support to address some of the deficiencies in the complex seed production and supply system.

10. The present document aims to review seed systems' development issues particularly as they relate to facilitating access of all farmers to good quality seed at all times. It first looks at prevailing relationships among seed systems and in particular, describes the links with plant breeding and seed systems, the formal and informal systems and the public and private sectors. The methodology used to identify gaps within these seed supply systems is then described. The document finally highlights the main gaps in seed systems for those subregions where data were collected and potential areas of activities to overcome these gaps.

III. MAJOR ELEMENTS OF THE SEED SYSTEMS

Breeding and seed systems

11. Plant genetic resources are the raw materials for plant breeding and the development of new varieties. These resources are vital for the sustainable intensification of agricultural production and to ensure the livelihoods of a large proportion of women and men who depend on agriculture. However, this impact can only be felt if seed of improved varieties is increased from a mere handful to large quantities, for use by farmers. On the other hand, new, improved varieties are fundamental to support the development of the seed sector. For seed enterprises to be successful, a steady stream of new varieties into the market is needed.[5] These strong interactions

[4] NIAB / Mackay and al. 2010.

[5] FAO. 2010. *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Commission on Genetic Resources for Food and Agriculture, FAO, Rome.

among conservation of plant genetic resources for food and agriculture (PGRFA), plant breeding and seed systems has led FAO to consider the "PGRFA continuum" as its strategic framework for action. The *Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture* (SoW-PGRFA) indicated that, from 1996, a key change has been the increasing interdependence among countries with respect to their needs for access to material held by others. This is especially true in the light of climate change and the need to develop new varieties that are adapted to new environmental conditions and challenges and resulting pest and disease spectra.

12. To ensure a favourable correlation between plant breeding and seed systems, various components need to be in place namely: i) a variety release system; ii) varietal development and extension; iii) variety maintenance and early generation seed multiplication; and iv) an intellectual property rights system.

Variety release system

13. Variety release procedures are implemented in most countries to evaluate and regulate the varieties for which seed can be produced and traded. The purpose of this system is to ensure that varieties made available to farmers are superior in their performance and diverse in their characteristics than existing varieties on the market. It can also prevent the use of varieties that might have a negative impact on agriculture, such as those susceptible to major diseases that could create the risk of significant production loss. Variety release procedures usually encompass performance testing through multilocational trials as well as administrative registration procedures. They can be either mandatory or voluntary, depending on the country. To fulfil its role properly the variety release system must be operated in an efficient manner. Unduly long procedures for the release of new varieties are one of the factors that can delay farmers' access to the benefits of plant breeding. National variety release systems are also challenged by the need to provide farmers' access to a diversity of varieties that are adapted to various agro-ecologies and to a range of end uses.

Variety development and extension

14. When new varieties are to be used, farmers must be adequately informed about their performance. Systems therefore need to be in place to provide this information to farmers and/or to offer them the opportunity to test the varieties. Throughout the world, these systems are operated by public sector extension services, private seed companies, NGOs or directly by farmers' organizations. Serious malfunctioning of extension seed services, either public or private, experienced in many countries, is a major barrier to the adoption of varieties by farmers and use of PGRFA.

Variety maintenance and early generation seed multiplication

15. The production of quality seed and especially the preservation of the characteristics of varieties throughout generations require that the breeder maintain a quantity of very high-quality seed, often called nucleus seed. The multiplication of subsequent early generations of seed, pre-basic and basic seed (also known as breeder and foundation seed), which requires high technical expertise and specific equipment and infrastructure is generally carried out under control of the breeder. In many developing countries, these functions are often undertaken by the public sector's breeding institutions. Issues relating to delays in timely availability of adequate quantities and quality of early generation seed can cause major bottlenecks for the production of improved seed in many developing countries.

Intellectual Property Rights (IPR)

16. IPR for plant varieties provide a means for plant breeders (either from the public or private sector) to obtain a return on the investment in research required to develop new performing varieties. Thus, IPR provide incentives for investment in the development of new varieties. Legislation on plant breeders' rights has played an important role in making new

varieties more accessible to farmers in many member countries of the International Union for the Protection of New Varieties of Plants (UPOV)[6] both in developing or developed countries.

17. The connection between breeding and the informal seed system is in general more fragile than that with the formal sector. The weak position of research systems in generating new varieties and inefficient extension systems in developing countries contribute to the irregularity of the injection of improved varieties into the informal seed supply system. However, the informal sector can play a crucial role in the diffusion of new varieties among farmers, especially in countries where the formal sector cannot produce the large quantity of seed necessary to satisfy farmers' needs. It has been documented that the informal sector was a key player in the rapid diffusion of improved varieties in Asia during the Green Revolution.[7] In addition, in order to improve the acceptability of varieties by farmers and the adaptation to their needs, breeders have developed methodologies that involve farmers in the plant breeding process. The SoW-PGRFA indicates that farmers' participation in plant breeding activities has increased in some regions over the past decade through participatory plant breeding (PPB) approaches.

Formal and informal seed supply systems

18. An understanding of how farmers gain access to seed is impossible without an awareness of the type and nature of arrangements for supplying the seeds which are needed for planting crops. Formal and informal seed supply systems are the two terms used to describe the systems of seed delivery to farmers and both are operational in developing countries and to a lesser extent in developed countries. These two seed supply systems have their distinct characteristics, the synergies of which could be tapped to create a more robust seed supply system. The comparative features of the formal and informal seed sectors are shown in Appendix 1. A description of the typologies of each seed delivery system is outlined below.

Formal seed supply system

19. The formal seed supply system is highly regulated and involves a chain of activities leading to clear products which are certified seed of verified varieties. The chain usually starts with plant breeding and selection, resulting in different types of varieties, including hybrids, and promotes advanced fixed germplasm materials leading to formal variety release and maintenance. Guiding principles in the formal system ensure that varietal identity and purity are maintained throughout the various generations of seed multiplication(Breeder or Prebasic→ Foundation or Basic→ Registered and/or Certified→ in some cases Commercial), with optimal physical, physiological and sanitary quality. Conscious efforts are made to ensure that the appropriate documented multiplication process and procedures are followed and that quality control measures are taken at various stages of the operation.

20. Private seed enterprises (private sector) and public seed sectors are in the domain of the formal seed supply system and the bulk of seed generated through this system covers economically viable crop species with good recurrent seed demands, such as vegetables, hybrids and some cross-pollinated crops (maize for example) and to a lesser extent some self-pollinated crops (wheat, barley for example) or some vegetative propagated crops (mainly potato). The system has been referred to by other names including: a) organized seed system; b) conventional seed system; c) commercial seed system and d) regulated seed system.

Informal seed supply system

21. The informal seed supply system (or informal seed system) refers to the traditional arrangements used by farmers to supply the seeds they need to plant in the following season. Other names given to informal seed supply systems include: a) farmer-managed seed system: b)

[6] FAO. 2010.Op.cit

[7] Mehra, K. 2002 *Entrepreneurial spirit of the Indian Farmer*. AI & Society, Vol. 16: 112-118; Reddy, C.R., Tonapi, V.A., Bezkorowanjnyi, P.G., Navi, S.S. & Seetharama, N. 2007. *Seed system innovations in the semi-arid tropics of Andhra Pradesh*. International Livestock Research Institute (ILRI), ICRISAT, ICRISAT, Patancheru, Andhra Pradesh, India. 224 pp.

farm-based; c) local seed production and supply; d) traditional seed system; and e) farmers' seed system. Activities tend to be integrated and locally organized and embrace most of the ways in which farmers produce, disseminate, and access seed: directly from their own harvest; through exchange and barter within the community; and through local markets. It is a flexible system and varieties of seed may comprise landraces or old or new improved varieties; however the seed is of variable quality. The same general steps or processes take place in the informal seed supply system as in the formal sector (variety choice, variety testing, introduction, seed multiplication, selection, dissemination and storage) but they take place as an integral part of farmers' production systems rather than as discrete activities. While some farmers treat "seed" as special, there is not always necessarily a distinction between "seed" and "grain". The steps do not flow in a linear sequence and are not monitored or controlled by government policies and regulations. Instead, they are guided by local technical knowledge and standards and by local social structures and norms.

22. The relative importance of these two systems varies depending on the state of development of the agricultural system and the crops. About 80 percent of food production reportedly comes from farmers with smallholdings[8] and the majority of farmers in developing countries use seed from the informal seed system. Most of the seed covered by this system falls within crop groups that are not of commercial interest to the private sector but the bulk of which constitute important food security crops. Contrary to conventional views, the formal and informal seed delivery systems coexist in large part in developing countries and in some cases in developed countries; farmers will usually resort to either or both of these systems for different crops and for different seasons.

Comparative roles of public and private sectors in seed supply

Public and private sectors

23. Both public and private seed enterprises operate within the ambit of the formal seed supply system. However, since the first SoW-PGRFA, it has been reported for some countries that there is a new distribution of tasks on the basis of the commercial prospects of different crops, with the public sector more involved in self-pollinated and in some cases, open-pollinated food crops and underutilized species, while the private sector concentrates on hybrids, horticultural crops, major crops, such as wheat, rapeseed, sugar beet, potatoes …. The distribution of task between the public and the private sector is mainly linked to the possible return on the research investment required for developing new varieties.

24. Private seed sector activities are geared towards successful marketing of their crop and variety portfolios, including germplasm resource management, breeding, seed production and distribution. In some countries, where regulatory frameworks allow, the private sector also draws from public sector genetic resources and plant breeding activities. The success of the private seed sector has led to the development of diverse seed industries, from a various range of small and medium seed companies to multibillion dollar industry, associated with chain businesses, specialized in the production of seed equipment, packaging materials, seed treatment and warehousing. The seed industry is influenced by a number of instruments, procedures and international conventions, namely the International Plant Protection Convention (IPPC), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the International Union for the Protection of New Varieties of Plants (UPOV), the International Seed Testing Association (ISTA), the Organisation for Economic Co-operation and Development (OECD) and the Convention on Biological Diversity (CBD). In order to gain access to germplasm or seed trade in the global domain, nations are obliged to become members of pertinent organizations or ratify necessary conventions.

[8] Swaminathan, M.S. 2009. Need for an Ever-green revolution. Keynote speech at the Second World Seed Conference. Responding to the challenges of a changing world: the role of new plant varieties and high quality seed in agriculture, 8-10 September 2009, FAO, Rome.

25. Despite the efficiency and apparent success of private sector seed production and delivery, the range of crops covered and their genetic base are not very broad. For instance, the bulk of global multimillion dollar seed businesses invest in only a limited number of crops: Maize, Vegetable seeds, Wheat, Rice, Sorghum, Barley, Soybean, Sugar Beet, Rape seed, Sunflower, Rapeseed, Bean, Groundnut and Potato. Thus, the bulk of food security/orphan crops is not included.

26. Substantial investments were made in developing countries in the 1980s and 1990s to strengthen public seed production; however this proved to be very costly resulting in curtailed donor support, which led to countries' disengagement. Countries such as India considered seed production as a strategic component of food security and maintained a strong public seed production system. For crops like hybrid maize, some countries phased out seed production and the private sector took over this activity. However, elsewhere, and for crops with less market opportunities, such as orphan crops, seed production has essentially collapsed. Although public sector involvement in the formal seed system has declined over recent years, there are indications that this situation may now become reversed in some regions, especially as a result of increased donor interest.[9]

IV. GAP ANALYSIS OF THE SEED SECTOR

Methodology

27. In order to identify seed sector gaps, FAO used a series of studies on national seed systems in Africa, Central Asia, Central and Eastern Europe that were undertaken in the framework of the following FAO regional or national seed programmes: a) the formulation/review of national seed policies in many countries; b) the development of a continent-wide African Seed and Biotechnology Programme (ASBP), established in collaboration with the African Union, to provide a strategic framework for the development of the seed sector in Africa; c) the establishment of a regional association for countries of the Economic Cooperation Organization (ECO) region, comprising countries of the Central Asia and the Caucasus subregion; d) the development of a regional seed programme in Central Africa and e) the harmonization of seed rules and regulations in western, central and southern Africa. These studies were carried out in collaboration with national governments, seed associations and regional economic communities[10]. The results obtained from these studies are summarized in Appendix 3.

28. In order to identify the gaps, the characteristic elements constituting an efficient seed supply sector (Appendix 2) was used as a framework for evaluating seed sectors of the selected countries. The aim of this exercise was to pinpoint the missing/weak links in seed systems and to highlight the critical gaps between germplasm conservation and the seed sector continuum so that effective action could be taken to address the problems. The analysis focuses on the main regions in which FAO has had activities over the last five years. The geographical coverage of the study is therefore limited but provides a good vision of gaps in the seed sector in developing countries.

Results of the gap analysis

29. The results in Appendix 3 reveal different seed gap scenarios, and that within and among countries these are diverse in nature and in scale. While gaps vary from region to region, there are also intraregional variations. It was also observed that these gaps vary with regard to crop species and the characteristics of prevailing agriculture (subsistence, semi-commercial or commercial). In many developing countries, farmers' access to quality seed of a diverse range of adapted varieties

[9] FAO. 2010. *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Commission on Genetic Resources for Food and Agriculture, FAO, Rome.

[10] a) Sub-Saharan Africa - The Economic and Monetary Community of Central Africa (CEMAC), Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS), the West African Economic and Monetary Union (WAEMU), The Economic Community Of West African States (ECOWAS) and the Southern African Development Community (SADC); b) Region of Economic Cooperation Organization of Central Asia (ECO).

is impeded by weak technical capability and capacity for varietal development and/or effective delivery of improved seed to farmers, coupled with inappropriate seed policies and regulatory frameworks.

Policy and regulatory gaps

30. A seed policy is the guiding principle by which seed systems can be developed. It expresses government philosophy and intentions regarding key areas of the seed industry and signals its collaborative role and that of its partners. In those countries where there is a defined national seed programme, there is a guiding principle, often entrenched in national agricultural plans or policies. But only in a few countries is there a purposeful, registered seed policy document, formulated to serve as a guiding instrument for seed industry development. National seed policies and regulatory frameworks have a major impact on the success of the seed sector. This is due to the fact that, even in the presence of reasonably sufficient infrastructure, capacity and technology, a lack of or inappropriate policy and legislation may create barriers to seed sector development. Such is the case with restrictive legislation that can prevent the free flow of germplasm and seed among country's seed sector partners as well as across a national boundary or throughout a region.

31. The studies revealed that most countries do not have a well-documented seed policy, nor appropriate flexible legislation, to facilitate the smooth take off and growth of the seed sector. In countries of the ECO region, the seed industry has been constrained by a centrally-controlled economic system, and overly dominated by the public sector. Few African countries have formulated and passed a comprehensive seed policy. Policy and regulatory gaps are more evident in West African countries, compared to those of North, South and East Africa. The Central and East European Countries (CEEC) region are rather advanced in the development of seed policies. Formulation or review of seed policies are needed in ECO countries.

Variety development

32. Countries display wide variation in variety development efforts - the first step in the seed multiplication chain. In both CEEC and ECO regions, varietal development is greatly enriched by past heritage and the relative availability of technical expertise. In CEEC, most countries showed advanced variety development activities, but most of the work is based in the public sector. In spite of abundant germplasm resources in the ECO region, it lacks regular injection of new varieties into the seed production cycle. This is partly due to limitations imposed by low to average levels of varietal improvement activities. Apart from Turkey, the level of prevailing activities is low because of outdated equipment, low levels of modern technology and the lack of opportunity for private sector participation in the seed industry. Access to foreign partnerships as well as links between the private and public seed sectors are constrained by restrictive legislation and absence of Plant Variety Protection (PVP).

33. While several countries in Africa have only rudimentary research programmes and partner-assisted variety introduction efforts, others have an applied research set-up, through which they source advanced lines from cooperating programmes for adoption through national trials and screenings; still others have elaborate research and variety development efforts in which they are self-sufficient in all basic stages. A few countries, such as Kenya, Morocco, South Africa, Tunisia, Zimbabwe and Zambia, have private sector involvement to varying degrees, leading to more dynamic programmes compared with those obtaining in other parts of Africa.

34. The achievements of the private sector in variety development have lately encouraged many countries to signal their intentions to involve more private sector participation in these activities and this is reflected in some of the recently formulated seed policies. Evidence to support the benefits of this strategy can be found in South Africa, Kenya, and Zimbabwe, where the relatively long history of private sector investment in variety development has not only relieved governments of the otherwise heavy investments needed for variety development but has also led to huge benefits for farmers and national economies. It is also noteworthy that the CEEC countries have accelerated their accession to the UPOV convention as a means of facilitating

private sector participation in their respective seed industries thereby enhancing farmers' access to improved novel varieties.

35. In a minority of African countries, there exist well-defined systems of variety release backed by a properly established variety release agency. This situation prevails in those countries where the seed industry has progressed. In the majority of countries, however, the agencies charged with variety development are themselves the authorities for releasing varieties. In a majority of African countries, the variety release system is haphazard, ad hoc and spasmodic. In all cases, there is no effective variety release agency. In western Africa (ECOWAS countries), a common harmonised regulatory framework for variety registration has been adopted, including a common variety catalogue. However, efforts are still needed in order to implement effectively the harmonized regulatory framework. In CEEC, varietal evaluation and release mechanisms are well developed but fully controlled by the public sector. The level of development of facilities and appropriate equipment for multilocation variety trials and demonstrations vary from country to country. In the ECO region, with the exception of Turkey, Pakistan and Iran, activities related to variety evaluation, registration and release are exclusively managed and controlled by the public sector. Varietal release mechanisms are more complicated, stringent, and hinder speedy access to superior varieties bred outside countries, as well as to improved technology, particularly biotechnological products.

36. The level of cooperation among countries' variety development efforts needs to be enhanced so that their collective efforts become more productive and beneficial. Networks for the exchange of germplasm are weak and need to be strengthened if they are to play their proper roles. For example, regional and country-to-country cooperation could reduce the lengthy period of variety development. The adoption of regional applied research approaches would allow countries to import advanced lines and finished varieties from similar agro-ecological zones into their national trials for screening and adoption. The studies showed that in spite of the critical role that variety development must play in any credible seed programme, allocated resources are grossly insufficient. In most cases facilities are outdated and unserviceable, human resource development has reached a low ebb and budgetary allocations have dwindled. This situation was most serious in countries where variety development efforts were entirely or predominantly public.

Seed Production

37. Some arrangements to provide seeds to farmers are present in all countries, attesting to governments' recognition that provision of seeds is critical for food security. In spite of good intentions, several of the seed production programmes do not meet the needs of modern agriculture.

38. In southern and eastern Africa, early efforts to support the seed sector have been expanded with private sector participation, resulting in very advanced seed production industries, even if only for a few selected and commercially attractive crops. In the rest of Africa, the rapid pace of seed development with donor support in the 1970s and 1980s seems not to have led to sustainable seed programmes, as most of these concentrated on state farms, parastatals and other publicly-funded and operated seed activities. Although to their credit, it must be observed that such public programmes were more sensitive about catering to the requirements of traditional farmers, they were not economically sustainable as public budgets dwindled and donor support waned. Currently, the trend is for the public sector to disengage from seed production[11], although responsibility for pre-basic and basic seed production continues to be entrusted to some public-funded agency or to the originators of the varieties. This trend is also favoured by development partners and donors who wish to see a reduction in public funding of the commercial stages of the seed industry. Apart from a few countries in eastern, southern and northern Africa, where the private sector is active either at corporate level or at least through the participation of private

[11] Louwaars, Le Coënt, Osborn, 2010. *Seed Systems and Plant Genetic Resources for Food and Agriculture.* Thematic background study for the Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Commission on Genetic Resources for Food and Agriculture, FAO, Rome.

farmers as seed growers, most countries currently operate at the informal seed system level and have only recently been facilitated to develop along the lines of the private seed sector.

39. In CEEC, all categories of seed, except for certified seed, are produced by the public sector, yet the latter suffers from the absence of modern seed production/processing facilities and equipment, as well as from support in the application of new seed technologies. There is also a shortage of the critical complement of trained staff for all phases of the seed production and supply chain.

40. Similarly, in the ECO region, with the exception of Turkey and Pakistan, seed production systems are still centralized and production and handling equipment is outdated. Moreover, prevailing policy and regulatory frameworks are not open to private sector participation in important areas of the seed industry, nor for stakeholders' access to new seed production technologies.

41. As the private sector becomes increasingly dominant and the public sector withdraws, the degree of abandonment of seeds of food security crops becomes even more pronounced, as do those of vegetative crops such as cassava, plantains, yams etc. Indeed, this is the present situation in most countries where seed development is following modern trends. It is clear that some innovative ways need to be found to establish stronger public-private sector partnerships in seed production for major food security crops.

Seed quality assurance and certification

42. Basic tenets of seed quality assurance guarantee, through seed generations, varietal identity by means of appropriate crop field inspection techniques and appropriate laboratory checks for seed quality attributes. In almost all the countries studied, it was noted that arrangements were in place to ensure that seed production and other activities in the seed chain adhere to established rules and regulations. In several countries these rules and regulations are contained in formal seed legislation or seed laws and their ensuing regulations. In others, it was noted that legislation had been proposed but not yet formally passed, but in the latter cases, administrative arrangements were in place to ensure that all players conform to the tenets of the proposed rules and regulations.

43. An appropriate seed quality assurance programme, however, needs more than legislation; it also requires an implementing and enforcing body and adequate facilities and resources, such as seed laboratories and trained staff, all at public expense. Only a few countries completely lack these facilities and resources. The majority of countries have a seed quality control agency, some level of seed testing arrangements and trained staff. But only in a few countries seed quality control arrangements were considered satisfactory. A large number of countries, though starting well, have floundered as public funds have dwindled. Laboratories lack essential equipment, mobility is grossly insufficient, staff training has come to a halt and the credibility of entire programmes has fallen into decline. Perhaps in countries where private sector participation is advanced, a cue can be taken from the trend, for instance, in southern and eastern Africa, where quality control licensing arrangements with seed companies have reduced the burden on public seed quality agencies. In addition a judicious levying arrangement could possibly attract some funding from commercial activities into the seed quality control effort. Fully-fledged seed certification exists only in a few African countries, such as Kenya, Morocco, Tunisia, Zimbabwe, Zambia and South Africa and even there, it is confined to a prescribed list of crops for which certification is compulsory. In other countries, such as Ghana and Nigeria, there is a shorter list of crops where certification is an option. In western Africa (ECOWAS countries), a common harmonised regulatory framework has been adopted for seed certification for the main agricultural and vegetable crops, which are consistent with international standards. In a few countries yet to advance their seed programmes, the Quality Declared Seed (QDS) concept[12], which enables seed quality to be achieved in good measure with minimum resources, has been opted for or exists side-by-side with the minimum standards programme.

[12] FAO. 2006. *Quality declared seed system*, FAO, Rome.

44. In CEEC legal frameworks as well as physical and technological facilities for seed quality control are mostly adequate. Apart from Turkey, some countries of the ECO region lack necessary legal frameworks and appropriate physical and technological facilities for modern seed quality control assurance.

Seed conditioning and storage

45. Modern seed conditioning equipment, such as cleaners, graders and dryers, as well as appropriate storage systems, are necessary for the efficient preparation and storage of the large quantities of seed that are produced.

46. In the early days of African seed programme development most countries invested in huge seed plants, which today are found to be obsolete in view of shrunken public sector seed production programmes. In some countries, satisfactory arrangements have been made to turn these over to the private sector but elsewhere these plants are completely abandoned as they do not fit into current schemes. In almost all countries, small (and in some cases mobile) plants are needed, first to equip the needs of breeders and public foundation seed agencies; beyond this further efforts would be required to assist the private sector with incentives and soft credits to design and procure seed plants suited to their own commercial needs.

47. In the ECO region seed conditioning and storage facilities are outdated and opportunities for acquiring modern equipments is greatly limited owing to a lack of necessary public funds. Moreover, the absence of private sector participation in seed production arrangements deprives the countries from investment in equipment and technology transfer which the former could infuse into the seed sector if provided with the necessary incentive.

Seed distribution and marketing

48. Seed distribution and marketing determine, to a great extent the effectiveness of the seed industry and its success. They connect the lengthy process of crop improvement, seed multiplication and conditioning to the demand and use of the finished product by farmers.

49. In the past decades of publicly-operated seed programmes in most African countries, seed distribution was largely in the hands of seed parastatals and extension agencies, etc. Although this strategy ensured reasonable and affordable seed prices and relatively wider coverage in terms of locations and crops, it was characterized by very high public budgets, quality deterioration, leading to heavy losses; it also led to unplanned carryovers. The current picture of seed marketing and distribution throughout Africa is somewhat different. Along with the other pillars of seed reforms which are being established with the introduction of the private sector, seed marketing and distribution have become prime areas for the private sector. It is widely known that the latter is already deeply involved in marketing, with advanced seed industries in eastern and southern Africa. Governments there have virtually no role in the business of selling seeds except to ensure quality control and monitor general trade ethics via the statutory institutions which have been put in place.

50. Seed distribution and marketing is better organized in CEEC because of the private seed sector's involvement. Prices of inputs are generally lower than those usually obtained in developing countries, and thus stimulate demand. Apart from Turkey, Pakistan, Iran and Afghanistan, where the private sector boosts seed marketing and distribution activities, in other ECO countries these activities are carried out through centralized marketing with all its drawbacks.

51. In-depth studies of market size in all countries will be a major contribution towards obtaining better estimates for the potential of the seed sector's development. Detailed market studies will help seed companies/cooperatives in planning their production strategy for marketing and sales. It will also help breeders, starting their activities in the private sector, to identify species and regions where private breeding will be rewarded.

Seed promotion

52. In the era of public sector seed development, seed promotion, as a component of seed marketing, was a public extension activity via radio, newspapers, and television. Currently, much less of that occurs, and where the private sector has not become well-established and profitable, it has hardly undertaken any responsibility for seed promotion.

Transboundary seed trade

53. While cross-border trade in seeds has continued in eastern and southern Africa over a long period, in other areas such as West and Central Africa very little of such trade takes place. For example, in SADC region, cross-border seed trade has increased from 7.5 million € in 2004-2006 to more than 32 millions € in 2007-2009; during the same period, in ECOWAS region, cross-border seed trade remained stable around 750 thousand €[13]. Of course, the types of emergencies which have fuelled seed exchanges throughout the south and east have not occurred in the west. Furthermore, superiority in varieties of one national programme over another has not been so marked as to attract farmers to those varieties across the border. In addition, restrictive laws and procedures, particularly in relation to plant quarantine and customs requirements, and in a few cases seed legislation, hinder seed exchange among countries. Countries in different regions of Africa have recently embarked on harmonization efforts with a view to aligning their seed trade protocols in order to enhance free movement. Countries of the Southern African Development Community (SADC), and the Economic Community of West African States ECOWAS) and the West African Economic and Monetary Union (WAEMU) have already adopted an harmonised regulatory framework. Countries of the Common Market for Eastern and Southern Africa (COMESA) and the Economic Community of Central African States (CEMAC) have embarked on this circuit. Strong efforts are however still needed for the concrete implementation of these harmonized regulatory frameworks.

54. In CEEC, particularly in countries that have adopted the OECD seed schemes, transboundary seed movement is facilitated. Movement of seed among ECO countries is constrained by various barriers, especially strict plant quarantine requirements. Recent initiatives by FAO have laid the foundation for harmonized seed regulations that will facilitate seed movement within the region, and between the region and other parts of the world.

55. Transboundary seed trade is also a relief tool in the event of seed shortages. When harmonization of rules is in place and varieties are recognized in different countries of a given region, export/import alleviates seed insecurity.

Extension services

56. Extension is expected to play a leading role in the promotion of seed and to assist farmers in all aspects of seed use in order to engender crop productivity, but many extension activities have been unable to succeed due to gross budget limitations. In addition, human resources have seriously dwindled, mobility is a major constraint and methodologies are in some instances unclear or ineffective. In most countries, governments recognize their responsibility to ensure that the message of improved varieties is transmitted to farmers. The degree to which governments are able to deliver this message effectively varies widely and is dependent on available government resources. Therefore, in countries facing acute economic problems, variety dissemination efforts are rather low key. Private sector involvement in extension and variety dissemination is increasingly important. This trend is already under way in CEEC and some countries of northern, eastern and southern Africa.

Private seed sector development

57. In spite of great advancements made by the private seed sector at a global level, there is a large vacuum of crop species not covered. The so-called orphan crops (e.g. millet, root crops, etc.), most of which are of great importance for food security, are generally covered by the

[13] UN-COMTRADE.

informal seed system. In most cases, the absence of private sector participation in the seed sectors of the countries studied has been due to the absence of effective demand for seed. This is caused by the ease of seed-saving by farmers (as in self-pollinated crops), the limited commercial perspective for crop output and the absence of value-adding activities, resulting in limited capacity to invest in high quality inputs such as seed. The absence of plant variety protection in many countries has also reduced private sector interest to invest in plant breeding activities without assurance of returns on investment.

58. The studies showed that almost all countries wish to incorporate the private sector into the commercial areas of the seed industry. But in the majority of cases the level of development achieved to date falls far short of the goal.

The informal seed sector

59. The contribution of the informal seed sector to overall seed supply is highest in West Africa (90-98 percent), followed by North, South and East Africa (70-95 percent) and least in the ECO region. Interestingly, information obtained through the workshop conducted for CEEC countries revealed that the informal seed sector contribution to total seed supply is even higher in some countries of CEEC region (Armenia, Albania and Bosnia and Herzegovina) than in the ECO region.

60. Considering the remaining importance of the informal sector in some countries, it is unfortunate that it has not been accorded the recognition it requires and consequently, not received the necessary attention and support that would enable it to enhance its role. The informal seed sector has been crucial in meeting the needs of food security, especially for traditional crops that have been abandoned by the formal sector, and has remained the source of seeds for farmers who cannot afford to buy seeds in the formal sector. Moreover, high-yielding improved varieties do not necessarily satisfy the needs of farmers that are seeking other attributes such as yield stability, cooking quality etc. The extent to which the informal seed sector has been assisted in Ethiopia, the Gambia and Zambia and a few other countries, and the benefits that have accrued from such assistance to the overall benefit of the national agriculture, should encourage other countries to rethink their approach to this huge potential source of good seeds to supplement what the formal seed source can offer. Needless to say, a lot of further action needs to be taken before that can happen.

61. In the area of variety development, farmer-based plant breeding programmes will need to be strengthened with inputs from conventional breeding to upgrade the genetic base of traditional cultivars and ensure uniformity. In seed multiplication, farmers will need assistance to streamline their methodologies in line with approved modern concepts to ensure that seed quality is produced. In seed conditioning and storage, it should be possible to merge traditional methodologies suited to small-scale endeavours with simple, mechanized systems which are affordable, easily operated and not dependent on modern energy sources.

62. Although most governments would like to see improvements in community-based seed initiatives and village-level seed entrepreneurship, in reality in most country those efforts are at best rudimentary.

63. Overall, the introduction of entrepreneurship into the ranks of willing informal seed sector practitioners could be an excellent step towards bringing the informal sector closer to mainstream seed industries and set the stage for an integrated seed system in which both subsectors, together, can contribute to their mutual advantage.

Technology and capacity

64. The gaps in activities ranging from variety development to seed production and quality assurance are determined largely by the level of technology and the availability of requisite expertise. It was noted that modern technologies, such as biotechnology tools for marker-assisted breeding were generally not in use in the subregions that were considered. Technologies available for seed production, conditioning and storage are limited for several reasons, including cost of

equipment, availability of local expertise as well as facilitative policy and legislation that constrains the collaborative participation of the private and public sector in the seed industry, thereby limiting incentives for the introduction of new technologies. In addition, information showed that recent advancements in technology for the delivery of the seed and crops, as well as corresponding price incentives, have a tremendous influence on the relative acreages and the number of crops species cultivated in countries. In this context, certified crop acreages were noted to have varied within and among countries since the first SoW-PGRFA. A similar trend was observed regarding the narrow genetic base of varieties used in countries with modern high-technological packages.

65. Human resources and technical capacities are fundamental to ensure the present and future development of the seed sectors. In the last 20 years, in countries where the private seed sector has flourished, human resource development has kept pace with the needs of the industry. The wave of public sector staff training undertaken with donor assistance in the decades from the 1960s has ceased. Senior leaders of national seed programmes trained during that period who remained in their countries, have since retired. In almost all emerging seed industries, human resource skills are therefore found to be inadequate. It should be pointed out that the specialist nature of seed technology aspects requires a pool of adequately trained staff, able to service the private sector, as well as capable local or regional institutions to impart such skills. Overseas fellowship awards have dwindled and expertise in plant breeding, seed technology, agronomy etc, is now hard to come by.

V. POTENTIAL AREAS OF ACTIVITIES

66. In order to address the gaps identified in the analysis, the following potential areas of activities are needed. The importance of public/private partnership and the need to undertake integrated approaches for the development of formal and informal sectors ate cross-cutting issues that are taken into account in the proposed areas of activities. Governments, FAO, technical partners and donors should consider putting their efforts in implementing these activities, in a collaborative manner, in order to facilitate the development of the seed sector in developing countries.

Policy and regulatory gaps

1. Review/formulate appropriate seed policy and legislation, facilitating the development of the seed sector by promoting collaboration between public and private sectors and taking into account the specific needs of the formal and informal sectors. Policy approaches should also be tailored to the different types of crops.
2. Harmonize seed and phytosanitary regulations at regional level in order to facilitate cross-border seed trade.
3. Strengthen collaboration among genebanks, plant breeders, seed producers and farmers to ensure wider germplasm utilization.
4. Develop appropriate schemes for plant breeders' rights to facilitate the participation of the private sector in the seed industry
5. Develop appropriate measures to protect and promote farmers' rights.

Variety development

1. Strengthen plant breeding programmes and public/private partnerships for major food security crops, including the so-called "orphan crops".
2. Increase farmers' participation in crop improvement activities in order to ensure that new varieties are appropriate to farmer practices and experiences.
3. Facilitate private sector access to improved germplasm of the public system.

4. Strengthen cooperative subregional/regional breeding networks that will facilitate the flow of improved germplasm among countries.
5. Streamline variety release procedures to ensure that improved varieties are rapidly made available to farmers.

Seed Production

1. Strengthen seed production programmes, including early generation seed multiplication, taking into account comparative advantages of the public and private seed sectors.
2. Support the emergence of local, private sector seed enterprises through capacity building activities and adequate credit schemes.
3. Improve the organization of the private seed sector by strengthening national and regional seed associations.
4. Strengthen farmers' capacities in seed multiplication in order to improve quality of seed produced in the informal sector.

Seed quality assurance and certification

1. Develop seed quality control schemes adapted to the level of development of national seed sectors.
2. Strengthen capacities and infrastructure of public institutions in order to ensure seed quality control in the laboratory and field inspections.
3. Develop public/private partnership for the implementation of seed quality assurance systems.

Seed conditioning and storage

1. Assist the private sector with adequate credit schemes to acquire seed storage infrastructure and seed processing equipment adapted to their own commercial needs.
2. Explore possibilities for the public sector to facilitate the private sector's use of available infrastructure.
3. Assist farmers to improve traditional methods of seed conditioning and storage.

Seed distribution and marketing

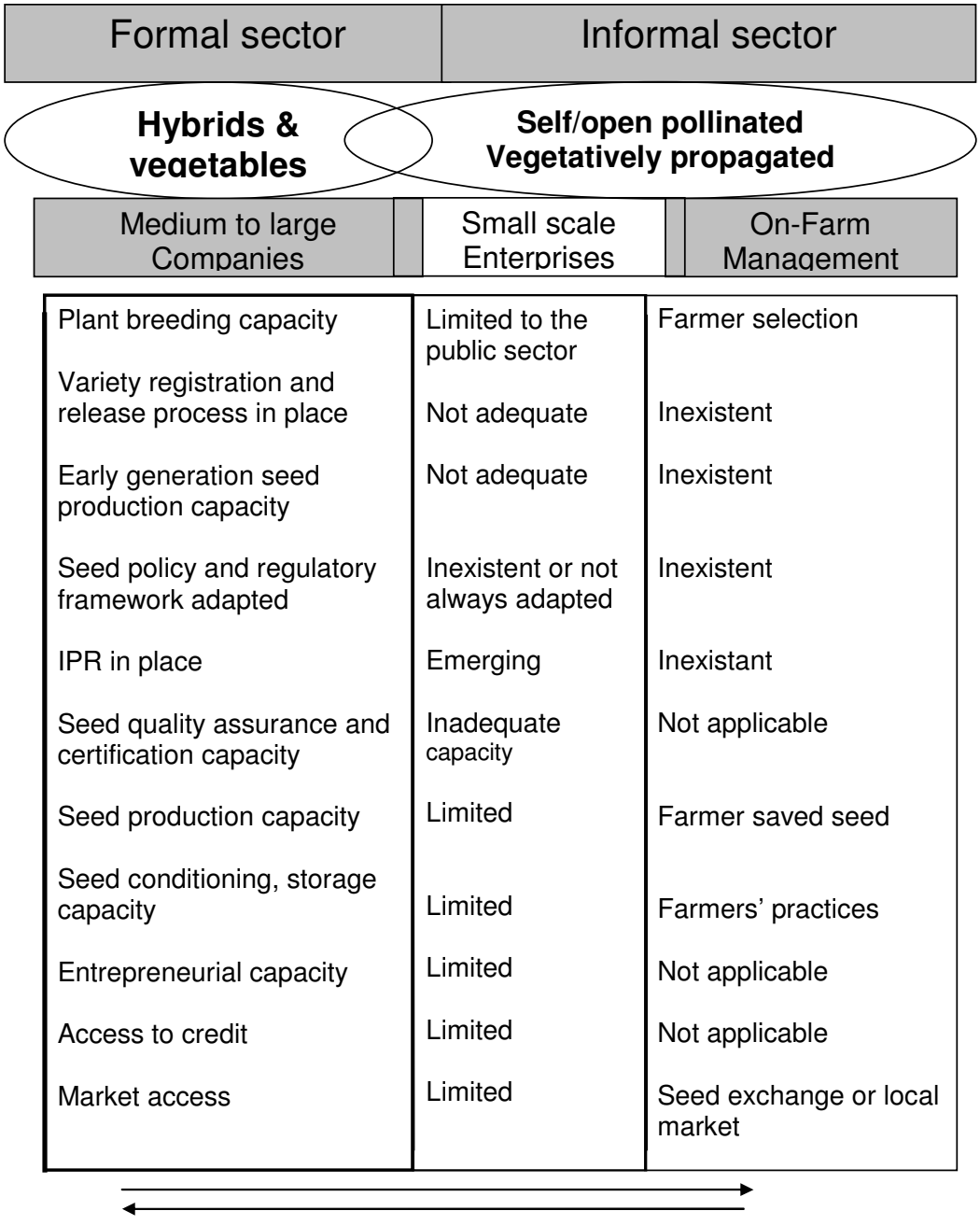
1. Implement seed market studies in order to improve business planning of seed enterprises.
2. Link the crop production and the seed supply chain, also through contractual agreements in order to ensure a better match of seed supply and demand.
3. Promote value adding activities at local level in order to increase farmers' investment capacity and seed demand.
4. Facilitate the development of local seed distribution networks.
5. Strengthen seed promotion programmes and implement efficient methods to improve farmers' and seed producers' knowledge and skills related to varieties and seeds

Technology and education

1. Create platforms to facilitate technology transfer among countries with advanced seed sectors and countries with seed sectors in development, also through south-south collaboration.
2. Develop plant breeding and seed technology curricula in universities at national and/or regional level and facilitate access to graduate fellowship opportunities in order to train future technicians and scientists needed in the private and public sector.

APPENDIX I

RANGE OF SEED SECTOR DEVELOPMENT



Continuum

Sources: FAO. 2010. SoW-PGRFA, Chapter 2 Gaps & Needs; Country level assessments; Seed trends papers; Africa seed review papers; Countries' requests; Electronic consultations; FAO/OECD/UPOV/ISF/ISTA World Seed Conference, 8-10 September, 2009.

APPENDIX II

COMPONENTS OF A FUNCTIONAL SEED SYSTEM

Components of seed programme	**Possible problems (barriers) affecting progress**
1. Seed policy and regulatory framework	❖ Legal instrument ❖ Seed policy ❖ phytosanitary ❖ Intellectual property rights and in particular Plant breeder's right (PBR) ❖ Biosafety ❖ PGRFA and ABS policies
2. Varietal improvements/develop-ment	❖ Source of materials germplasm materials ✓ Access to /control of germplasm by formal (public and private) and Informal sectors ✓ Seed regulatory framework ❖ Level of technology ✓ Access to expertise in plant breeding ✓ Modern facility for plant breeding ❖ Partnership for access to private sector germplasm ✓ Lack of appropriate partners ✓ lack of UPOV-compliant legal protection for breeding technology
3. Variety evaluation, registration and release	❖ Facility for multi-location varietal demonstration ❖ Linkage between farmers (commercial and subsistence) ❖ Availability of dynamic variety release mechanism for ✓ Number of varieties released every year (every five years) • Number of hybrid crops varieties • Number of transgenic crops • Number of OPV crops ✓ Seed intended for the commercial system ✓ Seed for subsistence farmers ❖ Capacity for technical and administrative examinations for variety testing (DUS, VCU) and PBR ❖ Existence of national catalogue ❖ Regional harmonisation
4. Extension	• Technology transfer mechanism • Seed extension
5. Seed production ✓ seed multiplication ✓ Seed processing ✓ Seed storage	❖ Facility for seed production ✓ Appropriate land and equipment ✓ Organizational setup for production of seed classes (breeder, foundation and certified seeds) ❖ Facility for conditioning ✓ processing equipment ✓ seed storage facility
6. Seed quality control	❖ Seed certification ❖ National seed quality system developed ✓ Field inspection ✓ Laboratory seed testing ❖ Laboratory facility ❖ Regional harmonisation ❖ Technical expertise ✓ Membership of ISTA ✓ Membership of OECD

7. Seed marketing and distribution	❖ Availability of National Seed Association (NSA) ❖ Membership of regional or global seed association ❖ Technical and managerial capacity of local seed enterprises
	❖ Seed promotion ❖ Incentives for use of good quality seed ✓ Hidden subsidies (free consultation services by extension) ✓ Differential price incentive for produce of certified seed users
8. Value adding activities at rural level	

APPENDIX III

SEED GAP ANALYSIS

Components of Seed Programme	North, South and East Africa	West African Countries	Central and Eastern European Countries (CEEC)	Economic Community Organization countries of Central Asia [ECO]
1. Seed policy and legislation	More than 60 percent of countries have functional seed legislation. However, only half of these have good seed policies. In general, biosecurity is at a rudimentary stage, except in Kenya and South Africa. PBR is at a rudimentary stage except in Morocco, Tunisia, Kenya, South Africa, which are UPOV members. ARIPO (African regional intellectual protection organisation), gathering English speaking countries and other, is currently working on the development f a regional framework for PVP.	Policy and legislative frameworks are advanced. Harmonization of seed regulations is adopted but implementation strategies are still needed. French speaking member countries of the African Intellectual Property Organization (OAPI) have UPOV-compliant regional legislation.	Seed legal frameworks are generally advanced. Seed policies are being formulated by member countries to facilitate the development of the private sector. However, there is limited advancement in the area of biosafety regulation.	Policy and legislative frameworks are not very advanced. Exceptions are Turkey, Pakistan, Iran and Afghanistan. Nevertheless, four of the countries are members of UPOV (Azerbaïdjan, Kirghizstan, , Turkey, Uzbekistan) Exceptions are Turkey, Pakistan, Iran and Afghanistan.
2. Varietal improvement and development	More than 75 percent of countries studied had above average activities. Half of these have functioning to well advanced genebanks. However, with the exceptions of South Africa and a few east African countries, the germplasm is mainly controlled by the public sector. Also, the public sector is mainly responsible for the production of pre-basic seed, except in Zimbabwe, Kenya, South Africa and Swaziland, Tunisia, Morocco where seed regulatory arrangements allow the	Only two of the countries studied showed any high-level of active work on plant germplasm. Seed regulatory frameworks create a barrier for easy access of the nascent private sector to germplasm material, which is controlled by the public sector. Also, a lack of facilitative seed regulations limits countries' access to modern facilities and to technology for plant breeding that the private sector could provide. Access to expertise and	More than 75 percent of countries studied had above average activities. Variety development works well but most of it is based in the public sector. The role of the informal seed sector in three of the countries – Armenia, Albania and Bosnia and Herzegovina – is highly significant.	In spite of abundant of germplasm resources of ECO countries, the subregion lacks regular injection of new varieties into the seed production cycle. This is partly due to limitations imposed by low to average levels of varietal improvement activities. Level of technology, apart from Turkey, is low, owing to outdated equipment and low levels of modern technology. resulting in a lack of opportunity for the private sector to participate in these activities.

	private sector to play a major role in this activity. Access to expertise and modern tools for plant breeding is highly enhanced in these countries because of facilitating seed regulations, including plant variety protection that facilitates collaboration between the public and private seed sector. However, biotechnology applications' issues are at rudimentary stages.	modern tools for plant breeding is highly impeded in these countries because of lack of implementation of PBR legislation to safeguard the interest of foreign private seed companies that may wish to establish businesses in the country.		Access to foreign partnership as well as links between private and public seed sectors are constrained by restrictive legislation and absence of adequate plant variety protection (PVP). The seed sector is more public –based and there is no clear-cut facilitative seed policy to encourage the private seed sector to play an important role in the seed industry and thereby bring in the much-needed capital investment and technological innovation.
3. Variety evaluation, registration and Release	Varietal release mechanism is more stringent and approval time prolonged for externally developed varieties, hence slow untimely access to newly developed varieties, including biotechnological products. Around 70-95 percent of the seed sector comprises the informal seed supply arrangements but there is little linkage of this vital sector to the varietal release activities, hence the low yield of most non-commercial crops compared to the world's average. More than 60 percent of countries have well established varietal evaluation, registration and release mechanisms. Exceptions are Eritrea, Namibia, Mozambique,	These activities still need to be strengthened. The regional catalogue in ECOWAS/WAMU regions is a starting point. This is reflected in farmers' lack of awareness of a number of improved varieties stacked in the shelves of many NARs. Lack of expertise and appropriate varietal release mechanisms contribute to low turnover of crop varieties used by farmers. In addition, lack of collaboration between public and private seed sectors, coupled with the monopoly of most publicly-bred varieties and lack of credible extension systems to link researchers with non-commercial farmers, have reduced the possible impact of limited varietal development activities on the predominant	Varietal evaluation and release mechanisms well developed but fully controlled by the public sector. Technical work required for varietal release considers procedures of the OECD seed schemes, of which most countries have become members. Level of development of facilities and appropriate equipment for multilocation varietal trials and demonstrations vary from country to country. In the countries in transition, facilities and equipment for essential work are limited.	With the exception of Turkey, Pakistan and Iran, activities related to variety evaluation, registration and release are exclusively managed and controlled by the public sector. Varietal release mechanism is more stringent and impedes speedy access to superior varieties bred outside of the country, as well as improved technology, particularly biotechnological products.

	Chad and Cameroon.	informal seed sector. Capacity for the implementation of DUS, VCU and PBR is highly reduced.		
4. Extension	Seed extension and seed technology transfer is slowed down by a lack of critical mass of knowledgeable personnel and suboptimal mechanism for collaboration between personnel of the private and public seed sectors.	Credible extension systems to link researchers with farmers, particularly the pre-dominant subsistence farmers, are lacking.	Seed extension and seed technology transfer is mainly in the public domain but is more recently being expedited by the involvement of the private seed sector in certified seed production.	Apart from Turkey and Pakistan, seed extension services and technological transfers associated with it are highly limited owing to governments' limited financial resources.
5. Seed production ✓ seed multiplication ✓ Seed processing and Seed storage	Pre-basic and basic seed productions are predominantly carried out by the public sector although the private sector is strongly involved in basic seed production. A large majority of certified seed is produced and marketed by the private sector, with exceptions of Eritrea, Namibia and Chad. Seed conditioning facilities are moderately available, the bulk of the seed conditioning being taken up by the private sector.	All activities related to pre-basic and basic seed production are carried out by the public sector while responsibility for production of certified seed classes are equally shared by the public and private sector – except for a few countries like Nigeria, Ghana and Côte d'Ivoire, where the private sector is fully carrying out this responsibility. There is a lack of appropriate modern equipment for seed production, conditioning and storage in most countries	Pre-basic and basic seed productions are predominantly carried out by the public sector while certified seed classes are produced jointly by public and private sectors, except in Armenia. Facilities for seed production, conditioning and storage are inadequate and outdated.	All activities related to pre-basic and basic seed production are dominated by the public sector while the downstream certified seed classes are jointly produced by both the public and private sectors. Facility for seed production, conditioning and storage is outdated and availability of modern equipments is highly limited.
6. Seed quality control	Sixty percent of countries have good certification systems. Only five of these countries are members of ISTA.	Physical and technological facilities for seed quality control are seriously lacking. ECOWAS/WAEMU adopted regional legislation on seed certification which is a good starting point to improve these activities. Only Ghana is a member of ISTA, and Burkina Faso a member of OECD for seed trees.	Physical and technological facilities for seed quality control are fairly adequate. The lesser advanced of these countries are: Armenia, Belarus, Georgia, the former Yugoslavia Republic of Macedonia and Montenegro.	Physical and technological facilities for seed quality control are highly limited while five countries are members of ISTA. Turkey, which is the most advanced country in the group, is a member of ISTA and OECD seed scheme.
7. Seed marketing and distribution	Only five of the of the countries–Zambia, Zimbabwe, Kenya, South Africa and	Many countries have national seed associations and are all members of African	There are some private seed companies in this subregion but only	National Seed Associations (NAS) are present in the majority of countries and more

	Swaziland - have well developed private seed sectors with strong seed distribution and marketing. Crop producer price incentives for use of good quality seed are very limited owing to weak seed demand for crops, particularly non-commercial food security crops. Many countries have national seed associations and are all members of African Seed Trade Association (AFSTA).	Seed Trade Association (AFSTA). Seed promotion is lacking in non-commercial crops. Demand for certified seed remains limited.	Serbia and Croatia are members of the European Seed Association. Technical and managerial capacities for the seed industry are well developed in a few countries such as Croatia and Georgia. Seed campaigns and incentives for use of good quality seed is entrenched in the promotional activities of the seed companies operating in these countries. Differential price incentives for produce of certified seed users are facilitated by consumer awareness and premium prices paid for produce from good agricultural practices (GAP) of Europe.	recently a subregional seed association – ECOSA – was formed with the assistance of FAO, to bridge the regional Seed Association vacuum between Asia and Europe. Turkey is member of ESA. Few countries are members of APSA. Apart from Turkey, Pakistan and Iran, the technical and managerial capacity of local seed enterprises is inadequate. Incentives for use of good quality seed is lacking in most countries, as seed distribution is carried out as a government service to subsistence farmers.
8. Value adding activities at rural level	In general, value-adding post-harvest activities are still at primordial stage. Consequently, there is a dearth of marketable value-added products from raw agricultural produce.	In general, value-adding post-harvest activities are at rural level and have not been facilitated by modern technologies to enhance commercial feasibility. Therefore, there is little or no influence of these activities on seed demand.	In general, the value adding activities in this subregion are higher than those of Africa and ECO countries.	Apart from Turkey, Iran and Pakistan, there is limited transformation of primary agricultural products.