



Food and Agriculture  
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# **A STRATEGY FOR COORDINATED DEVELOPMENT OF THE SEED SECTOR IN COUNTRIES OF THE ECO REGION**

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## Foreword

The Economic Cooperation Organization exists primarily to facilitate and promote trade between member countries. It has programs in a number of economic sectors that have a strong regional context including agriculture, communications, energy, environment, industry, tourism and transport. Among these, agriculture is one sector in which collaboration would be highly beneficial because a similar production environment extends across a very large area of Central and West Asia. National borders do not correspond with agro-ecological conditions so farmers in different countries have similar needs and face similar problems.

The seed sector is a well-defined area of potential collaboration because all countries have an established legal framework and technical procedures for dealing with seeds. Differences between national systems in these matters can lead to delays and complications in conducting trade and meeting the needs of farmers. With this in mind, FAO and ECO supported a project<sup>1</sup> from 2013-15 to promote this collaboration. Representatives of eight member countries met in a series of national and regional workshops to discuss ways to strengthen the seed sector and increase regional trade.

At a Regional Workshop held in Istanbul on 5-8 January 2015, it was agreed to prepare a draft 'Seed Agreement' that will provide a basis for future collaboration. With the support of the ECO Secretariat, governments of the member countries will be invited to sign the Agreement in order to facilitate this process, which can then be carried forward by technical experts in the specialised fields where harmonization would be most beneficial. Similar moves are under way among regional groupings of countries in several parts of the world and this reflects a global trend to improve the legitimate movement of crop varieties and seeds across national borders. Regulations that are too restrictive lead to an increase in unofficial trade (smuggling), which presents a serious threat to farmers because the quality of that seed cannot be controlled.

Discussions in the national and regional workshops revealed a wide range of experience among member countries and showed the different stages of seed industry development. It was therefore decided to prepare this 'Regional Seed Strategy' to guide the member countries of ECO along the path of harmonization by organising their seed industries along similar lines, particularly with regard to legal frameworks, institutional arrangements and technical procedures. The text of the Strategy presented here was discussed and approved at a final workshop of the project held in Antalya from 04 – 06 November 2015.

Harmonization can facilitate partnerships that bring private sector and public/regulatory authorities together to discuss, build trust, and foster collaboration on key issues. Although this will be a gradual process, participants in the Workshop believe it will bring significant long-term benefits to individual farmers, rural communities and ultimately national economies. It will also support the core objective of the Economic Cooperation Organization to increase regional trade.

It should be noted that a regional seed association 'ECOSA' was established in 2007 as an initiative of a previous FAO project<sup>2</sup> jointly implemented with ICARDA and this has

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<sup>1</sup> Seed Sector Development in Countries of the Economic Cooperation Organization

<sup>2</sup> Strengthening Seed Supply in the ECO Region

organised annual events that bring together national seed organisations and commercial companies. The constitution and objectives of ECOSA are in harmony with the proposed Regional Seed Agreement and this Strategy.

## **INTRODUCTION**

1. The member countries of the Economic Cooperation Organisation have much in common in the sphere of agriculture. With a few exceptions, they experience a cool wet winter followed by a hot dry summer. Under natural 'rainfed' conditions, the main food crop of the region is wheat, together with a number of legumes; if irrigation is available a range of summer crops can also be grown. The production environment is often harsh, with extremes of winter cold and summer heat making farming a difficult and challenging livelihood for millions of rural households across the region.

2. Agriculture remains a key part of the national economy in all countries even if they have other sources of income from natural resources. Agriculture provides employment to a significant part of the rural population and many others are involved in the processing and distribution of agricultural products. Improving the livelihood of rural people helps social stability and reduces the drift of population to urban areas.

3. For these reasons, governments of the region have a common interest in improving agriculture in order to increase food security at both local and national levels. The turbulence in international grain markets in 2007-08 has made national food security a much more urgent concern. It highlighted the risks of depending on grain imports and strengthened the resolve of many countries to enhance domestic food production.

4. Seeds play a vital role in agriculture as the starting point for each production season, and as a way to introduce new varieties from research stations to farmers. The development of a well-organised and efficient seed industry is therefore a key support to agriculture. This provides a strong technical and social justification for governments to harmonize the regulatory framework for seeds and varieties so that farmers across the region can benefit from scientific research linked to an active seed trade.

5. Among ECO member countries there is a wide diversity of experience in the organization of seed supply, reflecting differences both in their geography and in recent political history. Some countries have benefitted from large development projects, while others have managed the seed sector in their own way. Despite this diversity in organization, the basic components of the seed system are similar in all countries. For this reason, the Regional Seed Agreement has been prepared to provide a formal basis for collaboration. In particular, it will assist the exchange of information and experience between institutions and technical experts of ECO member countries. The Agreement establishes a Regional Seed Board that will provide overall coordination and will monitor the implementation of the Agreement.

6. This Strategy has been prepared to guide policy makers and key stakeholders in member countries of ECO on the steps they can take to develop their seed sectors, based on common principles and objectives. Ultimately it will assist countries to fulfil their obligations under the Regional Seed Agreement and support the goals of ECO to increase regional trade. It recommends institutional and policy approaches that are of general application and can be adapted by all countries in the region leading to the gradual harmonization of regulations. Another benefit of concerted regional action will be to align ECO countries more closely with the relevant international organizations and increase participation in the global seed trade.

7. The ultimate purpose of the Regional Seed Agreement and this Strategy is to improve the productivity and well-being of farmers in the ECO region by ensuring that they have access to good quality seed of the best available varieties for their specific production conditions. This will enable farmers to use their key resources of land, water and labour in the most efficient way so they can increase household income and contribute to the national economy.

### **SCOPE OF THE STRATEGY**

8. This strategy focuses on two closely-related areas within national seed sectors:
- i) the policy, regulatory and institutional framework for the seeds and varieties,
  - ii) the activities and procedures that are implemented throughout the 'seed chain' from breeder to farmer to ensure the delivery of good quality seed,
9. The key technical and administrative activities addressed by the strategy are:
- variety development, evaluation, registration and listing of new crop varieties,
  - seed production and marketing,
  - minimum quality standards applied to seeds that are offered for sale or trade,
  - procedures for assuring the quality of seed supplied to farmers; these are often covered by the process of certification that includes minimum quality standards,
  - administrative procedures and documents required for seed import and export,
  - phytosanitary requirements for seed import and export.
10. This strategy is concerned only with crops that are grown from true seeds including cereals, legumes, pastures, vegetables and industrial crops. However, potatoes are also included because of their economic importance in the region; the term seed as used in this document therefore includes the planting material for potatoes. Seeds of ornamental plants, medicinal plants, wild plants and forest trees are not included because they may introduce complications or may involve different Ministries. The aim of the strategy is to facilitate seed trade in the main crops of the region.
11. Although of great economic importance in some areas, tree fruits and vines are not covered by this strategy because they require different types of planting materials and present different technical challenges. A separate document may be prepared in due course to address the needs of these crops.

### **STRUCTURE AND ORGANIZATION OF THE SEED SECTOR**

12. Seed supply can be considered as a chain of activities that begins with plant breeders who create new varieties and ends with farmers who grow those varieties. (see Annex 1) In all countries, the responsibilities and activities involved in seed supply are divided between the public and private sector although the actual division of tasks may vary widely. The overall regulatory framework and key services relating to quality control rest with governmental institutions or related organizations while private companies normally undertake the more commercial functions of seed production, processing, distribution and marketing. The component activities of this organized or 'formal' seed chain are commonly referred to as the seed industry. It is the task of government to provide a policy and regulatory framework in which this industry can function efficiently while still ensuring that farmers' interests are protected.
13. Within the seed industry there are clear divisions associated with different types of crops and the quantity of seeds that are required by farmers. The major cereal crops such as wheat, barley and rice account for the bulk of the seed supply in volume terms

but they are relatively unprofitable as a commercial business. Maize is a notable exception because it is normally marketed and grown as F1 hybrid varieties that are highly profitable for seed companies to produce and supply. When hybrid maize is a significant part of the seed industry, it provides a strong stimulus for private sector participation and this generates momentum for the seed industry as a whole.

14. The other main crop groups and their characteristics from a seed supply perspective are:-

- grain legumes – despite their nutritional importance, these crops are less profitable than cereals, therefore they are of little interest to private companies; government research and extension services may need to play an active role in their promotion and distribution to farmers;
- forage and pastures - these usually require more specialised seed production techniques and the actual seed demand depends on livestock production systems; these crops are mostly perennial and this can make seed demand unpredictable;
- industrial crops – especially cotton and sugar beet, are often highly controlled and the processors may be involved in seed supply in order to ensure a consistent supply of material for processing;
- vegetables – are increasingly supplied as high-value hybrid varieties obtained from specialist breeding companies who are part of a global seed trade;
- potatoes are a unique product because of the type of planting material used (seed tubers), and the critical importance of plant health.

Because of these distinct technical and commercial characteristics, companies normally specialise in the supply of a limited range of crop seeds to particular sectors of agriculture. National policies and regulations must therefore reflect the specific technical and commercial characteristics of the different groups of crops so that regulations can be implemented in a pragmatic way.

15. The seed sector is profoundly influenced by the characteristics and production systems of the farmers it supplies. Farmers who are closely connected to a market for their crops will normally purchase seed on a regular basis because they recognise the direct linkage between quality seed and the returns from selling their produce. Conversely, poorer farmers who grow crops mostly for their own household needs, or to sell locally, may find it difficult to justify expenditure on seeds and may prefer to save their own grain for sowing in the following season. For this reason, it is much more difficult to organize a seed supply system for remote areas where farmers are not connected to markets, or for the less profitable crops like grain legumes. Likewise, farmers in irrigated areas have more reliable cropping systems and are prepared to invest in seeds, while those in more risk-prone rainfed areas are reluctant to make that commitment in case the rains fails and their expenditure on seeds is wasted. Growers of horticultural crops who produce for urban markets, or for export, always purchase their seed because product quality is of supreme importance.

16. In practice, the organized seed industry never supplies the entire sowing requirement because farmers often save seed themselves or obtain it from other sources within the community or local area. This unregulated part of the seed supply system is commonly referred to as the 'informal sector'. It works in parallel with the formal sector and in certain crops or localities it may be the main seed provider. As more farmers

become connected to commercial markets, they will require seed of higher quality and the seed industry will expand to meet these needs. The role of the informal sector is discussed in paragraph 70.

### **THE NEED FOR A NATIONAL SEED POLICY**

17. The seed industries of many countries, including those of the ECO region, are in transition from a model in which state institutions were the major players to a more diverse structure with wider participation in seed production and marketing. The guiding principle should be to create a 'level playing field' for all those wish to enter the seed industry. This process creates new challenges for governments and regulators to ensure that the seed sector develops in an efficient and coordinated way while still ensuring that farmers have access to quality seed. There is a range of experience within the region on the management of this transition and the sharing of this experience is a key element in the Seed Agreement.

18. To guide this process of change, all countries are strongly recommended to prepare and adopt a National Seed Policy or Strategy that sets out a clear vision for the development of the seed sector over a period of five to ten years. In particular, the policy should define the responsibilities of the main institutions. The policy should be prepared through a process of consultation with stakeholders so that it represents a consensus on the best way to organize the seed sector. It should reflect the actual situation of seed supply in the country and address specific problems that limit farmers' access to quality seed. For this reason, there is no standard formula for a National Seed Policy, however several examples have been developed within the ECO Region with the assistance of FAO.

19. Besides the process of preparing the policy and defining its content, the presentation of the final document is important. It should be written in clear, non-technical language and should be made widely available, for example, by placing on a website to enable access by anyone who wishes to learn more about the seed industry of a country.

20. A policy does not normally have the same force as a law; it is intended to provide guidance for all stakeholders in the seed sector and to ensure that they are working towards the same goal. The policy should be a living document that can be revised on a regular basis to take account of developments. For this reason, it is strongly recommended that an apex body is established to monitor the implementation of the policy. This 'National Seed Board' (or Committee/Council) should be composed of representatives of the major institutions and should act as a high-level advisory body for the Minister of Agriculture on all matters related to plant varieties and seeds.

21. The National Seed Board should be supported by a small secretariat within the Ministry that is responsible for coordinating all matters related to seeds and varieties and maintaining contact with the key stakeholder groups. This office would also collect statistical information about seed sector development in order to guide the Board.

### **THE REGULATORY FRAMEWORK**

22. All member countries of ECO have a Seed Law because this was one of the first aspects of agriculture to be regulated as a way of protecting farmers from poor quality seed. The detailed format of these laws reflects different legal traditions and procedures but the basic content and purpose of seed laws is broadly similar in all countries. In

addition to controlling the quality of seeds, these laws may also regulate the way in which new crop varieties enter the market or there may be a separate law for plant varieties.

23. The Law is implemented by secondary legislation such as regulations or decrees, although the format and procedures for these will depend on the legal procedures of individual countries. The detailed technical content of these regulations is one main area through which regional harmonization can be achieved if the relevant specialists from each country have a consultation forum. The Regional Seed Agreement is intended to provide the legal authority for these technical consultations.

24. The overall objective of the regulatory framework is to ensure that farmers have access to good quality seed and have confidence in what they are buying. If regulations are too strict or too costly then there will be an incentive for suppliers to by-pass the official system and to offer varieties and seed that have not been subjected to any control. The guiding principle of the regulatory framework is that it should encourage seed producers and suppliers to comply because it is in their interests to do so. Moreover, if regulations place a heavy burden on the agencies responsible for carrying out the technical work then the tasks may not be done to the required standard, or there may be delays. As the seed industry expands, it may be necessary to devolve some of the technical aspects of quality control to seed producers; this is referred to again in paragraph 64.

25. In most countries, the revision of laws is a slow process because of the need to involve the Parliament and the legal experts in the Ministry of Justice. For this reason it is important that new laws reflect the needs of a modern seed industry and take account of developments in the global seed trade so that the law remains 'fit for purpose' for the foreseeable future. ECO member countries are strongly recommended to share their current seed laws and to take these into account when re-drafting their own laws. This will be a key support to the process of convergence towards regional harmonization.

26. The relationship between policy and law gives rise to much discussion and should be made clear because these documents have quite different functions. A Seed Policy provides an overall guideline for the development of the seed sector with a medium to long-term horizon but it should be revised on a regular basis to take account of the progress made. The Seed Law and its subsidiary regulations provide legal force to certain aspects of the policy such as the minimum quality standards for seeds and varieties. The Seed Policy may also include phytosanitary and plant health issues although these are often regulated by a separate Law on Plant Protection. Therefore the Policy can be regarded as a broad umbrella covering all aspects of the seed sector, while the law(s) and regulations focus on specific elements of the policy that can be enforced.

27. It is important that the policy and the law are in harmony with each other and certainly there must be no contradictions because that would cause confusion. However, in practice these two documents are usually prepared at different times and it may be difficult to align them exactly. When a new policy is prepared, it should identify those areas of the law that need to be revised and likewise any new seed law should make explicit reference to the existence of the policy and its purpose. As noted above, the law should formally recognise the National Seed Board and its role in managing the policy. In this way, the law provides additional authority to the policy.



## **RESEARCH AND DEVELOPMENT**

28. The breeding and use of new varieties has provided the basis for increases in agricultural productivity for the past century since the science of genetics was first applied to crop improvement in a systematic way. With our increased understanding of genetics at the molecular level, this contribution will continue although these genetic advances will still be introduced to agriculture through the medium of conventional field-based plant breeding programmes. To achieve maximum impact, it is essential that improved varieties move quickly from research to farmers and with sufficient information to exploit their full potential in the production system.

29. In the major cereal and legume crops, the International Agricultural Research Centers of the GCIAR work in close partnership with national research institutions. This is a sound approach because it divides the responsibility for strategic and adaptive research in an efficient way, particularly in view of the high cost of molecular breeding techniques. Given the similarity in production environments across the region, closer integration of international and national efforts in plant breeding is strongly advocated, and this should include the sharing of trials information between national systems. The coordinated trials programmes of the GCIAR Centers facilitate the exchange of information on their new lines/varieties.

30. In the more specialised crop groups, very little breeding work is done by international centers or other public institutions so the supply of new varieties depends mostly on the private sector. This is especially true for hybrid maize and vegetables in which public breeding institutions cannot compete effectively with the large investments made by private companies who concentrate on profitable F1 hybrids. Public breeding programmes in these crops should be critically reviewed to decide if they are sustainable and competitive. They should focus on selected/priority crops in which there are varieties of special merit (e.g. melons in Central Asia) or needs that are not being properly met by the global seed trade (e.g. lucerne and esparcette).

31. In addition to national agricultural research institutes, Universities may also engage in plant breeding as part of their research programmes in genetics and agronomy. To ensure that these activities are fully utilized, it is essential that academic institutions have commercial partners with the resources and experience to carry new varieties through to the market place.

32. Successful plant breeding research depends on access to genetic resources with new traits. In the major cereal and legume crops, these resources are held in secure gene banks managed by the CGIAR centers as part of an international network of conservation. This material is freely available under procedures established by the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) using a Standard Material Transfer Agreement. All member countries of the ECO are expected to use this system.

33. Some countries maintain national gene banks to support their own breeding programmes or to ensure that traditional local materials are secure. In the case of the major crops this material will normally be duplicated within the international system while for minor or more specialised crops, such as vegetables, conservation at a national level is essential. It is therefore important that national gene banks are well-managed to ensure effective conservation of their stocks.

## **VARIETY REGISTRATION AND RELEASE**

34. For the major crops, all countries have an official trials system for evaluating new varieties to ensure that only those with real merit reach the farmer. These trials are conducted at a number of locations for two or three seasons and the results should provide sufficient data to evaluate a variety. Extending the testing period delays the release of promising new material to farmers and reduces the impact of the gains made by plant breeders.

35. The technical procedures for conducting variety trials are broadly similar in all countries but the management details for sowing rate, sowing time, irrigation and pest management will reflect normal production conditions for each crop. The use of standardised trials protocols combined with good statistical designs increases the accuracy of data more than large numbers of trials sites, which are often difficult to manage to a high standard. The standardization of trials procedures within the region will facilitate the comparison and exchange of information on new varieties.

In addition to the agronomic attributes of varieties, it is also important to take account of the quality of the end product – for example the bread-making properties of wheat. For this reason, the assessment of the overall merit of a variety for both producers and consumers is recognised in the expression ‘Value for Cultivation and Use’ (VCU).

36. The results of official variety trials conducted at research stations are never perfect because it is difficult to replicate the actual conditions in farmers’ fields within a standardized trials system. To address this concern, it is strongly recommended that additional information be collected from on-farm trials. In countries with an active private breeding sector, companies may also participate in the official trials programme and contribute data, provided that the standardised protocols have been followed.

37. A separate aspect of variety registration is the need to confirm that the variety is new and distinct from all others in the market; this has become embodied in the concept of ‘Distinctness, Uniformity and Stability’ (DUS) based on a detailed examination and description of the variety. The characteristics and procedures used for DUS testing have been established by UPOV<sup>3</sup> to serve the needs of variety protection and these have been broadly accepted for other purposes also. These tests require only small numbers of plants to be grown and usually at one or two locations

38. When sufficient data has been collected and analyzed from both VCU trials and DUS tests, it should be reviewed by an independent ‘National Variety Release Committee’ (NVRC). The status, membership and functions of this important Committee should be clearly defined in the Seed Law or its Regulations. It is important that the committee includes representatives of all the concerned stakeholders and is not controlled by public sector breeders. The NVRC may be designated as a technical sub-committee of the National Seed Board/Committee, which generally has the final authority for approving the registration and release of varieties.

39. When a new variety is approved for release, it is included in the National List of Varieties and then becomes eligible for production, marketing and certification. The variety description provided by the DUS test is used by the Certification Agency for the

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<sup>3</sup> The Union for the Protection of New Varieties of Plants (UPOV) is an international organization based in Geneva which promotes and assists the introduction of plant breeder’s rights.

purpose of crop inspection and this makes a clear link between variety registration and routine quality control. The National List should also designate an official maintainer for the variety (see paragraph 50)

40. In many countries, the process of variety evaluation and registration takes a long time and these delays reduce the impact that plant breeding can make in agriculture. There is now a global trend to streamline variety release procedures so that farmers can gain quicker access to new varieties and make their own assessment. The target should be a two-year testing period when a new variety is first introduced. Specific measures that should be taken to achieve this include:-

- carrying out DUS tests and VCU trials in parallel so that both sets of data can be presented to the National Variety Release Committee at the same time;
- allowing a provisional or conditional release of a variety if there is some uncertainty about trials data;
- allowing the pre-release multiplication and certification of promising varieties while still in the testing system so that large-scale multiplication can begin as soon as the variety is officially released/registered;
- making an obligation for breeders to have a minimum quantity of early generation seed available when they submit a variety so the multiplication programme can be launched quickly;
- allowing fast-track registration of varieties that are already on the National List of other neighbouring countries with similar agro-ecology. This would be a key step towards regional harmonization and should ultimately lead to the establishment of a Regional Variety List for the major crops, thereby making considerable savings in the resources required for variety testing by each country.

41. The main purpose of the National List is to validate those varieties that are superior in some respect and are considered useful for farmers and/or consumers. The list may also be a source of key agronomic information, for example relating to adaptation, sowing times, disease resistance. However, the list should not become too complicated otherwise it may not be kept up to date. Ideally, the National List should be available on a website so that changes can be made quickly and information can be accessed easily by any users, especially extension agronomists and others who provide advice to farmers. In this electronic format, additional information about varieties could be added as it becomes available – for example regarding disease resistance or other agronomic attributes as the variety is more widely grown.

42. To ensure that the National List remains as a useful working document there should be a process for reviewing each variety on the list on a regular basis, say every five years. Varieties that have not been adopted by farmers, or which have fallen out of the seed production system should be deleted from the list. It is recommended that this review should be a routine activity for the National Variety Release Committee.

43. Registration of vegetable varieties requires a different procedure from field crops because of the large number of crops and varieties available from the international trade. It is useful to register the names of varieties and their breeders in order to know what is being offered in the market but VCU testing is too costly. The National authorized body for variety registration should consider the use of an online system for vegetable crops so that companies could provide essential information about the

varieties they are selling. Within the framework of the Regional Seed Agreement, the ECO Regional Seed Board may consider developing a standard format for this.

44. The evaluation and release of varieties containing traits introduced by genetic modification raises special issues and may involve other Ministries besides agriculture. Although each country will make its own laws and regulations relating to biosafety, it will be advantageous for countries in the region to maintain close coordination on this topic so that information can be shared and duplication of testing avoided. Cotton in particular is a crop in which 'GM varieties' may bring great benefits in terms of reduced pesticide use and all countries that grow this crop will have to make a policy decision on the use of these varieties.

#### **PLANT VARIETY PROTECTION (Plant Breeders Rights)**

45. Plant Breeders Rights provide a property right so that the breeder of a new variety can obtain income from the use of that variety by others for a certain period. This is normally achieved by means of a licensing system, which provides for the payment of a royalty on each ton of seed produced, sold or purchased. The royalty payment is included in the final seed price (typically 5 – 10%) and is ultimately returned to the breeder. The royalty payment system works well in 'mature seed markets' where production and marketing are controlled by a strong regulatory framework. It may be more difficult to implement and enforce when many farmers save their own seed or where the seed supply system is relatively unregulated.

The legal basis for these arrangements is provided by a national Plant Variety Protection (PVP) Law. To obtain protection, a variety must be Distinct, Uniform and Stable (DUS), it must be new and it must have an acceptable name (denomination). There are no VCU requirements for a variety to be protected; it is a decision of the breeder to seek protection for his/her variety if they believe that it has sufficient merit to achieve a place in the market.

46. Breeders Rights were originally devised to stimulate investment in plant breeding by private companies so that they could obtain a return on their investment. Public breeders may also wish to protect their varieties but this is a policy decision for the government who fund those breeders. It should be emphasised that the breeder only benefits from these property rights if there is an effective royalty collection system supported by a reasonable mechanism for enforcement.

47. The Union for the Protection of New Varieties of Plants (UPOV) provides an international framework for plant variety protection by standardizing the DUS test procedures (known as Technical Guidelines) for new varieties of a wide range of crops. Countries may become members of UPOV by preparing a PVP Law that complies with the requirements and obligations of the 1991 UPOV Convention and then completing the necessary admission procedures. UPOV is able to provide guidance on the preparation of national PVP Laws and ECO countries planning such a law are recommended to contact the UPOV Secretariat at an early stage in this process.

UPOV members exchange information about the varieties they have protected and this can save on the costs of DUS testing. UPOV also maintains a comprehensive documentation system about variety protection in all its member countries.

48. It is recommended that the law on plant variety protection is kept separate from the law on seeds because these are different types of legislation. In some countries, the

law on breeders' rights also includes 'farmers rights' over their traditional varieties. However, this is a much more complex topic and it can lead to delays in the preparation and approval of the law.

## **SEED PRODUCTION**

49. The way in which large-scale (commercial) seed production is organised depends on the policies and institutions in each country. For crops such as cereals and legumes, the entire seed multiplication process will normally take place within the country because the transport of these bulky seeds is expensive. The breeding institute (or company) produces basic/elite seed and this is multiplied through two, three or four generations to meet the demand for that variety from farmers. This formal multiplication process is usually subject to control under a certification scheme as described in paragraph 62.

50. For this multiplication system to work effectively, there must be a designated 'maintainer' for each variety in commercial use. This may be the original institute/breeder or a national representative/agent of the breeder. It is the responsibility of the maintainer to manage a pure nucleus stock of the variety in its original form (as defined by the DUS test) and to generate sufficient basic/elite seed each year to meet the requirements of the seed growers who undertake further multiplication. The registration authority may request a sample of elite seed from time to time in order to confirm that the variety is being maintained in its original form.

51. The procedures used for variety maintenance in the major crops are well-known and documented. However, the production and supply of sufficient basic/elite seed is often a constraint in national programmes because breeders are reluctant to divert resources from their main task of breeding new varieties. For this reason, it is recommended that research stations establish a separate technical unit with its own resources for maintenance and elite seed production to avoid competing directly with the core breeding programmes.

52. Large scale seed production is best conducted as a commercial activity and should be undertaken by private sector entities, such as seed companies, large farms, or cooperatives. Public sector seed farms usually have a poor record in terms of efficiency, cost management and yields; this makes their seed relatively costly and may require subsidies to keep the price at an acceptable level. The use of contract growers is strongly recommended for large-scale seed production in order to achieve flexibility and good crop rotation. Contract farmers are also able to share in the financial benefits of seed production by receiving a premium price for the seed they produce. To support this process and ensure fairness for farmers, it is helpful if there is a good law on contracts.

53. The contribution made by cooperatives in agricultural production varies between countries but for the less profitable crops, such as cereals and legumes, cooperatives may provide a convenient way to supply seed to their farmer-members at moderate cost. Reduction in transport costs, better information about demand and possibility of credit for seed purchase are all potential benefits of 'internalising' seed production within a cooperative.

54. The formation of seed producer groups or other mechanisms of local seed production may enable seed to be available at a lower price that may encourage farmers

to purchase, provided they have confidence in the quality of the product they are buying. These approaches are especially relevant to the more remote or risk-prone areas where seed supply on a commercial basis is not attractive for companies. Another benefit of local seed production is that it may provide an opportunity for farmers to visit seed production sites during the growing season and make a more informed decision about varieties.

55. Seed production in other crop groups such as forages and vegetables is more specialised and has increasingly passed into the hands of larger companies that are able to organise their breeding and production on a regional or global basis. In most cases, these proprietary varieties far exceed traditional open-pollinated varieties in yield and/or quality and they dominate many segments of the market. For these crops and varieties, in-country production is impossible because the breeding companies maintain control of their inbred lines. However in maize, there may be a possibility of making a production contract with a trustworthy national company if the demand for a specific variety is sufficient. This may reduce the cost of seed and encourage farmers to use these improved varieties.

56. Besides meeting the needs of domestic and regional markets, there are many locations within the ECO region that have favourable conditions for the production of particular crop seeds and could therefore undertake 'custom seed production' for the global trade. Countries should be alert to these export opportunities and should ensure that the technical and administrative procedures for import and export are made as simple as possible in order to encourage this trade. Membership of international organizations and participation in international events will enable countries to exploit these opportunities and bring additional business to national companies and farmers.

## **SEED QUALITY CONTROL AND CERTIFICATION**

57. The most fundamental aspect of quality control is to establish minimum quality standards for all seed that is offered for sale<sup>4</sup>. The seed laws in all countries contain these standards, usually covering purity, germination, moisture content and some more specific attributes like weed seed contamination and seed-borne diseases. These quality attributes are determined on the basis of standard laboratory tests, which must be carried out on a representative sample of the whole seed lot.

For the major agricultural and horticultural crops, the actual quality standards vary only slightly between countries and these could be easily harmonized among the ECO member countries by consultation among the technical representatives. Setting very high standards may be unhelpful if it leads to less seed being available in the market.

58. The sampling and testing procedures for all important crop species are well-established and are used by most laboratories. The International Seed Testing Association (ISTA) publishes these procedures in its 'Rules on Seed Testing' and it is strongly recommended that all laboratories in ECO countries follow these rules in order

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<sup>4</sup> An alternative approach to quality control is the so-called 'Truth in Labelling' concept by which any seed can be legally sold provided that the quality standards are correctly stated on the package. There are some risks in using this approach because the deterioration of seed may accelerate at a certain stage in its life and the quality stated on the package may no longer be valid when the seed is purchased and sown.

to facilitate standardization of test results and certificates. ISTA also specifies some other related matters such as the maximum size of seed lots and these should also be respected.

59. To implement the provisions of the seed law it is necessary to identify one seed testing laboratory as having overall responsibility for seed quality control within the country. This should be designated as the 'National Seed Testing Laboratory' (NSTL) and it should have the best facilities and trained staff in order to provide the final reference point in cases of dispute or complaint. To achieve harmonization of quality control, there should be a mechanism of coordination between the senior technical staff in the National Seed Testing Laboratories of ECO member countries.

The NSTL should play a key role in training the staff of other laboratories, both public and private, within the country. If other laboratories are licensed or accredited then the NSTL would assume responsibility for monitoring their performance, for example by carrying regular inspections or random check testing of samples they have tested.

60. The National Seed Testing Laboratory should be a member of the International Seed Testing Association in order to benefit from the information, services and training opportunities they provide. The NSTL may also become accredited by ISTA so that it can issue International Certificates of seed quality. This is important if the country wishes to develop a substantial export trade although accreditation does require that a full quality management system is implemented and maintained by regular auditing.

61. One aspect of seed quality that is not easily determined by laboratory analysis is the identity and purity of the variety in the seed lot and this gave rise to the procedure known as certification under which the seed production field must be approved, the seed crop must be inspected and ideally, a post-control plot<sup>5</sup> should be grown. In practice, it is often difficult to conduct post-control plots on all certified seed lots and this is best done on a certain percentage of the lots selected either randomly, or on a 'risk-based assessment'.

62. Certification schemes have been introduced in many countries to provide a comprehensive statement of seed quality for farmers. These schemes cover both laboratory and field standards referred to above and also require that seed is marketed in a sealed, labelled package. All seed lots produced under the certification scheme are given a number to provide traceability between the generations of multiplication from breeder to farmer. Harmonizing all aspects of a certification scheme within the region will take time but this can be approached in a phased way. One key step will be to standardize the format and colour of labels used on seed sacks so that they all carry the same information and are arranged in the same way. The ultimate goal is that the certification schemes of each ECO country will be recognized in other countries so that seed can move freely across borders without the need for further testing.

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<sup>5</sup> A post control plot is grown from a sample of certified seed taken after all processing operations have been completed. It is intended to confirm that the identity and purity of the seed lot comply with the requirements of the certification scheme and in particular that no contamination has occurred during post-harvest processing of the seed lot. It is also a very useful tool for investigating complaints from farmers because the post-control plot can be compared with crops growing in farmer's fields at the same time.

63. The Organization for Economic Cooperation and Development (OECD) operates an international seed certification scheme and participation is open to any country that complies with the requirements of the schemes for different crops. The OECD schemes use a standardized system for naming generation and this is not at present used in all countries of the region. It is recommended that all ECO member countries align their certification procedures and standards with those of the OECD scheme even if they do not wish to formally join the scheme at the present time. Annex 2 shows a comparison of OECD terminology with that of the former Soviet Union.

64. As the seed industry expands, it may be impossible for official agencies and their staff to carry out all the technical operations related to seed quality control. This is a special problem where the annual cycle of crop production is highly seasonal because all field inspection work must be done within a very limited time. In these cases, it is necessary to use temporary staff who have been trained and licensed to carry out these tasks. The delegation of some certification procedures, notably field inspection, to company staff should also be considered. As with accredited seed testing laboratories, the work of all these licensed staff should be subject to random checking in order to maintain their standards.

65. Besides the routine testing of seed lots as part of the production system, there is a need to monitor what is being offered for sale to farmers by some means of market enforcement; this is done by taking samples of seed from stores or shops and sending these to the NSTL or an official seed laboratory. These enforcement procedures must be prescribed and implemented carefully because they involve rights of entry to premises and removal of property that may provide opportunities for corrupt practices by officials.

66. As the commercial seed trade expands and farmers are willing to purchase high-value hybrid seeds, there is an increasing risk of counterfeit (fake) seeds entering the market as a result of criminal activity, usually from outside the country. This may have very serious consequences for producers and it is essential that national quality control agencies exchange information if they find evidence of this illegal trade. Efforts to reduce unofficial trade are discussed in paragraph 77.

## **SEED MARKETING AND PRICING**

67. The final test of a viable seed industry is that farmers are willing to purchase seed at a price that covers all the production costs and also makes a profit for the final seller. This is easy to achieve in crops like hybrid maize and vegetables but more difficult in the self-pollinating grain crops and legumes. Awareness creation and promotional activities will help to convince farmers about the value of quality seed and will stimulate demand, providing the basis for development a viable seed industry.

The final stage of marketing should be undertaken by private companies because they are more motivated to achieve efficient use of resources throughout the production and marketing chain. Private sector entities are also more likely to engage directly with farmers and to offer the products and services that farmers require.

If large-scale seed production does not provide a viable business for companies, then the government may be obliged to intervene to support the seed system by means of subsidies to the selling price. This is a matter of policy for the government but it should be done carefully and with sufficient supervision to ensure that only good seed is



produced. If generous subsidies are provided to seed producers, there is a risk that there is an over-production of poor quality seed, which does not help farmers or the national economy. To avoid creating dependency and market volatility, the distribution of seeds free of charge or at discounted prices by public institutions is not recommended and should be limited to emergency situations following natural disasters or crop failure.

68. For self-pollinating cereal crops like wheat, barley and rice, the seed price can be related to the market price for ordinary grain with all the additional costs of seed production included. This provides a very clear cost structure in which the seed price would be significantly higher than grain, depending on the arrangement of the production system. If subsidies are used to reduce the cost of seed and stimulate purchase, it is still very important for the government to know the actual cost of production and therefore the amount of subsidy they are providing.

69. For other crops, especially hybrids, there is no direct relationship between seed and grain prices because more specialised management practices are required to produce the seed crop, usually involving control of pollination in some way. In this case the main factors that determine the price of seed is the merit of the variety and the competition in the market. This is very clearly shown in hybrid crops such as maize, tomato and cucumber where there is intense competition between companies and farmers have a wide choice of varieties. It is essential that farmers and growers in ECO countries have access to these improved varieties in order to increase productivity and quality. This will help to strengthen the seed sector and will reduce the dependence on imports.

#### **ROLE OF THE INFORMAL SEED SECTOR AND LOCAL ENTERPRISES**

70. All preceding sections of this strategy relate to the supply of seed through the organised or 'formal' seed system. However, a parallel informal channel also exists and this may be an important component of the total seed supply, particularly in more remote areas or for the less profitable crops. National seed policies should recognise that the informal sector does play an important role in some situations and it should not be regarded as an illegal activity that should be eliminated. Instead, efforts should be made to integrate the formal and informal sectors in a way that exploits their respective strengths. For example, it may be helpful to adopt semi-formal approaches by establishing seed producer groups that multiply certified seed once more to provide seed of good quality at lower cost. These groups should be provided with some official status and with support from extension services to improve their quality assurance and marketing in order to develop a reputation within the surrounding area. In this way, seed producer groups may evolve into more formal enterprises or cooperatives, making a sustainable business and assisting their client farmers.

71. Local seed enterprises or similar initiatives may have other advantages. For example, they may supply varieties that are appreciated within the area but are not produced by seed companies at a national level; these are sometimes referred to as 'pocket varieties'. In this way, local enterprises may be more responsive to farmers' real needs that would not be addressed by larger companies or organizations. Another benefit is that farmers may have the opportunity to visit seed production fields or demonstration plots within their area to view and discuss varieties, thus making a more informed choice for the following season.

72. With these possibilities in mind, ECO member countries are recommended to support alternative mechanisms of seed supply that can make good quality seed available to a larger number of farmers but without incurring the high costs of official subsidies. Countries are also encouraged to share their experiences of local seed systems, both positive and negative, which may help them to build a more diverse and responsive seed system, especially for poorer farmers or those living in remote areas.

### **PHYTOSANITARY REGULATIONS AND PROCEDURES**

73. All countries have a law to regulate plant health issues both domestically and for materials imported from other countries. These requirements are normally specified on an import permit. It is the responsibility of the exporting country to examine or test the seed lot and to issue a Phytosanitary Certificate confirming that the requirements of the importing country have been satisfied. This certificate forms part of the documentation that accompanies a seed consignment when it is shipped.

Testing procedures for seeds of the major crops and their pests are fully documented. However, the value of the phytosanitary certificate depends entirely on the capability of the testing authority and the sampling procedure they used for the seed lot. As an additional safeguard, plant health officers at the entry point will usually inspect the consignment and may also take samples for further testing to confirm that the requirements of the import permit have been met. The consignment may be placed in quarantine until the results of these tests are known and this may cause a significant delay in delivery to the importer.

74. In many countries, the list of prohibited organisms specified on the phytosanitary law was established long ago and has not been re-examined. This may lead to complications and delays in the movement of seeds even if there is no biological risk. To avoid these problems the quarantine pest lists of ECO countries should be reviewed using the revised FAO pest risk analysis procedures for listing quarantine pests.

In some cases, these phytosanitary regulations were effectively 'non-tariff barriers' which made importation difficult without any technical justification. As a consequence of the Sanitary and Phytosanitary (SPS) Agreement<sup>6</sup> of the WTO, there is now a strong pressure on countries to base their regulations on a scientific pest risk analysis so that only those organisms that present a threat to production are excluded. Given the similar production environment across large areas of the ECO region and the similar range of crops that are grown, there will be a clear advantage in carrying out a coordinated assessment of pest risks among the phytosanitary authorities of all member countries and to standardise test procedures. This will facilitate regional trade and reduce the burden of testing on individual countries.

75. The International Plant Protection Convention (IPPC) provides a framework for coordination of phytosanitary matters at an international level and most ECO countries have signed the Convention (Annex 3). In addition there are regional plant protection organisations, such as the European and Mediterranean Plant Protection Organisation (EPPO) in which several ECO countries are members. It is strongly recommended that ECO countries participate in these organizations in order to benefit from their experience and technical information. This will help to strengthen the institutional

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<sup>6</sup> The 'Agreement on the Application of Sanitary and Phytosanitary Measures' is an international treaty of the World Trade Organization, which entered into force in 1995.

capacity of national quarantine services within the region and also facilitate collaboration between them in line with international practice.

### **IMPORT AND EXPORT OF SEEDS**

76. In addition to the technical requirements for seed quality and health, there are administrative procedures relating to the movement of seeds across borders, particularly the need to obtain official permits. In some specific cases, export permits may also be required. These procedures vary widely between countries and they may be quite complicated, thus making the trade in seeds more difficult. To achieve the wider objectives of ECO, it is strongly recommended that the administrative documentation of all member countries for seeds are reviewed and compared to identify the essential elements and to move towards a standard format. It is further recommended that countries move towards a 'single door' approach so that all the procedures relating to import or export can be processed through one office.

77. Over-restrictive import procedures often lead to an increase in informal trade particularly for high value vegetable seeds that can be easily carried in vehicles or baggage. Such practices increase the risk to farmers because the quality and identity of these goods are completely unregulated and may be exploited by dishonest traders or even criminals. Member countries are recommended to adopt import regulations that are 'user-friendly' and transparent so that seed companies conduct their business through official channels and do not resort to smuggling.

78. Special procedures should be established to facilitate the importation of small quantities of seed intended for research or trials purposes. For this purpose, a standard protocol should be developed between all the national research services in the region and in consultation with the international agriculture research centers.

79. Given the complex national borders in some parts of the region, the provisions for seed in transit to a third country deserve special attention. Under the Regional Seed Agreement, there should be a clear understanding that if seeds are transported in sealed containers, and if they meet all the requirements of the destination country, they should not be subject to any additional requirements by a 'transit country'.

### **FINANCING OF THE SEED SECTOR**

80. As already noted in paragraph 12, the responsibility for activities in the seed chain are normally divided between the public and private sectors. If the private sector is able to make a profitable business in some products, then that saves the government having to spend on that work. One key purpose of the seed policy is to create an 'enabling environment' that encourages private sector participation, as far as possible on a commercially viable basis and without the need for direct subsidies. However, if the private sector does not enter a particular product area, then the government may have a social responsibility to support the seed system so that farmers can have access to improved varieties and seeds.

81. The provision of some essential services, for example quality testing and certification is one important aspect of government support to the seed industry. It is a matter of national policy if these services are provided free of charge or on a fee-paying basis. If fees are charged for certification or seed testing, it is important that the revenue can be retained by the service provider so that they have an operating fund and do not depend solely on annual budget allocations, which may be subject to delay.

82. Given the difficulty of making a profitable business from the supply of seeds of many staple crops, governments can make an important strategic contribution to the industry by providing tax incentives or relief for seed enterprises. These could include lower import duties on seed processing equipment and the inclusion of seeds in list of priority industries that are eligible for investment support or lower tax rates. However, it is essential that these schemes are monitored carefully and are not exploited by companies that wish to obtain financial benefits without producing significant quantities of seed. Such monitoring should be a responsibility of the National Seed Board.

### **ROLE OF A NATIONAL SEED ASSOCIATION**

83. As the commercial seed industry expands and the private sector plays an increasing role, it is important to have a mechanism for companies to engage in a dialogue with the government. This function is normally achieved by a National Seed Association, which should act as a representative body for all its members, providing the services and information that they require. The association should have independent legal and financial status and should be supported through annual fees paid by the members. The Association must be represented on the National Seed Council.

84. Membership of the Association should be as inclusive as possible so that all actors in the seed industry can join and be represented. To promote this objective, the Association should offer different categories of membership according to the volume and type of business carried out, and with a scale of membership fees. This will avoid the situation in which separate associations are established to represent sectional interests. The Regional Seed Association (ECOSA) can provide a forum for exchanging experience on the management and operation of national associations to ensure that they are effective.

85. National seed associations can play an important role in raising the professional standards of the industry by preparing a 'Code of Conduct' for their members and investigating those who may bring the association into disrepute through malpractice. In cases of dispute, the association should provide an arbitration service that can avoid costly legal actions. On the international stage, the association can act as a window for domestic companies who would find it difficult to make foreign contacts themselves. To further this goal, national seed associations should aim to become a member of the relevant regional associations and the International Seed Federation (ISF) and thus have access to the services and information they provide.

### **REGIONAL AND INTERNATIONAL ORGANISATIONS**

86. One key element of this regional strategy is to encourage participation in the international organisations related to plant varieties and seeds. The use of procedures and standards developed by these organisations will support the process of regional harmonization and will facilitate the integration of ECO countries in the regional and global seed trade. The key organisations already referred to in this strategy are:-

- the International Seed Testing Association (ISTA) for matters relating to seed sampling and testing procedures,
- the Seed Certification Schemes of the Organisation for Economic Cooperation and Development (OECD)
- the Union for the Protection of New Varieties of Plants (UPOV) for matters relating to breeders rights,

- the International Plant Protection Convention (IPPC) for matters relating to plant and seed health,
- the International Seed Federation (ISF) for national seed associations and/or companies engaged in the commercial seed trade.

Annex 3 summarizes the participation of ECO countries in the organizations listed above, and in other international activities related to seeds and varieties.

87. There are also regional seed associations in which ECO countries may participate. These are primarily concerned with promoting seed trade and their annual congresses attract many companies for the purpose of doing business. In addition to ECOSA which serves this region, the other two relevant associations are the Asia and Pacific Seed Association (APSA) which embraces all of Asia and the European Seed Association (ESA). Although membership of these associations may be defined geographically, companies and specialists from other regions are welcome as participants at Congresses and other events.

88. There is a lack of information on the seed sector among the countries of ECO region. There is a need to establish a platform for information exchange (varieties, availability of seed, producers, quarantine pests, etc.) to facilitate collaboration in the seed sector. ECOSA may establish and coordinate the platform.

## **EDUCATION AND HUMAN RESOURCE DEVELOPMENT**

89. In common with many other countries, the agricultural sector in the ECO region suffers from a shortage of young highly-qualified graduates. This is a serious problem given the urgency of maintaining and increasing food production to meet the needs of a growing population. The seed industry is often neglected in the curricula of agricultural universities and colleges so that graduates have little knowledge of this subject. Although seed science may be covered, this is not extended through to the more business-related aspects of production and marketing. To address this deficiency, national ministries responsible for education and training should make a concerted effort to introduce all components of the seed chain into the curriculum and explain how they are connected.

90. The development of a new curriculum is time-consuming and it is strongly recommended that institutions already teaching some aspects of seed technology or seed industry share their course content with others that may wish to develop courses in these subjects. This would also help to place seed activities in a regional context by providing information about the seed industries in different countries.

91. The Regional Seed Agreement recognises the diversity of experience within the ECO region and emphasises the benefits of sharing this experience. This applies both to the overall organisation of the seed sector and its institutions and to specific technical areas. To further the goal of regional harmonization, the exchange of young professional between countries would be of great benefit and member countries are encouraged to take steps to facilitate these contacts.

## **CONCLUSIONS AND IMPLEMENTATION**

92. The guidelines contained in this strategy are intended to assist member countries of the Economic Cooperation Organisation to fulfil their obligations under the Regional Seed Agreement. Countries are encouraged to develop the policies, laws and institutions of the seed sector in a coordinated and convergent way to support the harmonization

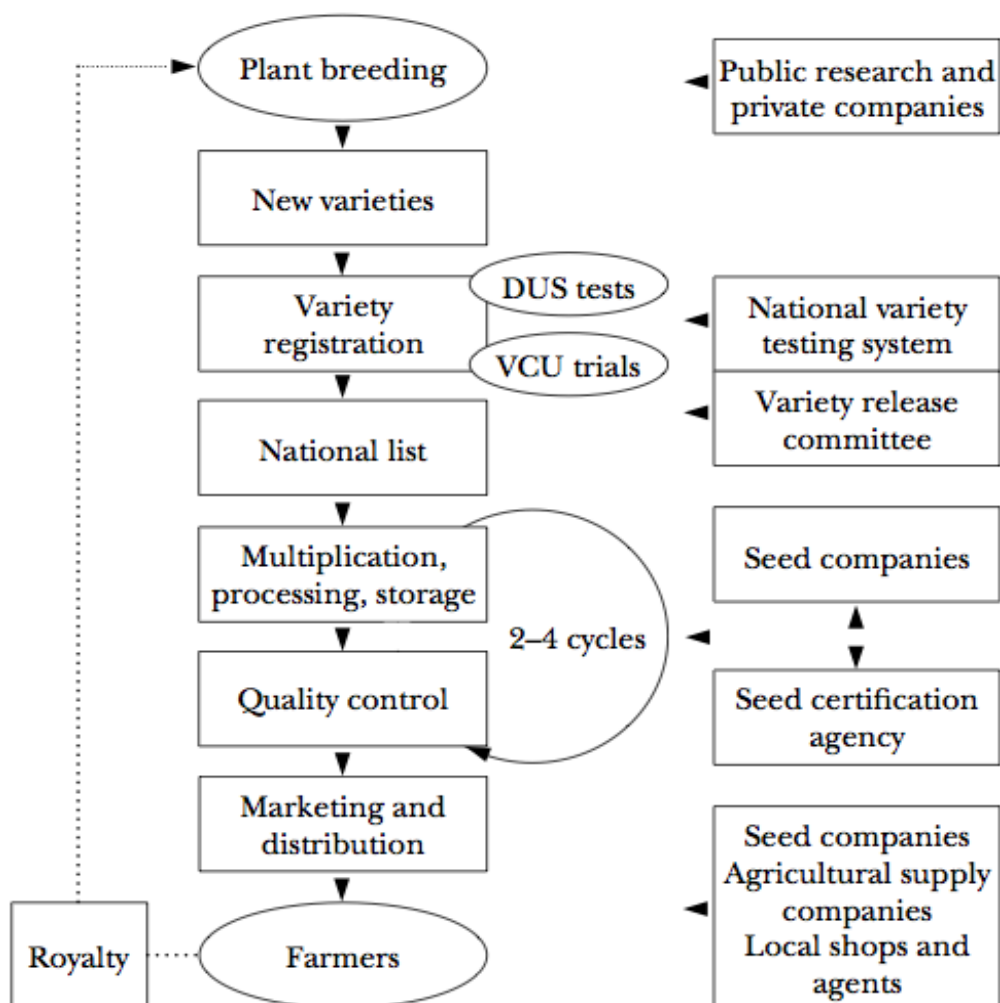
process and increase regional trade. At a technical level, the Regional Seed Agreement provides the authority for consultation between officials involved in the different disciplines to share current standards and procedures and move towards common standards and procedures.

93. It is recommended that this strategy be implemented in a stepwise way, based on priorities agreed by the Regional Seed Board in consultation with the ECO Secretariat. Once the Regional Seed Agreement is approved by the required number of countries, technical working groups should be established as soon as possible for each of the main topics discussed in this strategy and they should report their progress to the Regional Seed Board. The information and recommendations prepared by each working group should be circulated to all member states of ECO for implementation within their national regulatory frameworks.

### **List of Annexes**

1. Diagrammatic representation of the 'seed chain'
2. Comparison of different terminology used in seed certification schemes
3. Participation of ECO member states in international conventions and organizations related to seeds and varieties

**Annex 1: The Seed Chain – summarizing the activities and organizations involved in the delivery of varieties from plant breeders to farmers**



**Note:** the collection of a royalty from seed sales and the payment of this to the breeder of the variety can normally only take place if there is a national Plant Variety Protection law that gives the breeder a property right to the variety.

## **Annex 2: Comparison of different systems of seed certification terminology**

<b>Definition</b>	<b>OECD</b>	<b>USSR<sup>∞</sup></b>
1st generation seed supplied by plant breeders from their maintenance plots	Breeder	Original seed
2nd generation	Pre-basic	Super-elite
3rd generation	Basic	Elite
4th generation	Certified 1	R1
5th generation	Certified 2§	R2
6 <sup>th</sup> generation	Certified 3§	R3

OECD – is the Organisation for Economic Cooperation and Development, which operates an international seed certification scheme; the OECD terminology is also used in the European Union and is now being adopted in many countries when seed laws are revised.

§ The number of generation of certified seed allowed by national certification schemes varies between crops; normally only one or two generations are permitted but in legumes there may be three because of the low multiplication rate of these crops.

∞ Some countries of the Former Soviet Union have adopted the OECD system while others still use the terminology shown below.



### Annex 3: Participation of ECO member states in international conventions and organizations related to seeds and varieties

Organization/participation§	AF	AZ	IR	KG	KZ	PK	TJ	TM	TK	UZ
Seed lab that is a member is of the International Seed Testing Association			2	1		1			2	
Seed lab that is accredited by the International seed Testing Association				1					1	
Member of an OECD Seed Scheme#			√	√					√	
Member of the Union for the Protection of new Plant Varieties		√		√					√	√
Member of the International Seed Federation (with ordinary or associate members)			√			√			√	
Signatory to International Plant Protection Convention (IPPC)	√	√	√	√	√	√	√		√	
Member of European and Mediterranean Plant Protection Organization (EPPO)		√		√	√	∞			√	√
Signatory to International Convention on Biodiversity (CBD)	√	√	√	√	√	√	√	√	√	√
Signatory to International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA)	√		√	√		√			√	

#### Notes:

The above table is provided for information only; it is believed to be correct as of November 2015 but the details may change over time.

§ The exact status of membership or participation (such as signature, accession or ratification) varies between countries and organizations

# There are seven separate OECD seed schemes for different groups of crops; √ indicates that the country has joined at least one of the schemes

∞Pakistan is a member of the Asia and Pacific Plant Protection Commission