Briefing Note

Breeding and Producing Seed and Propagation Material

Background

Seeds and plant propagation material are agricultural inputs, and can thus be compared to fertilisers and pesticides. At the same time they serve as important vehicles for agricultural innovation. Genetic properties make it possible to breed varieties for specific locations and growing conditions – and also help societies adapt to climate change. This amounts to 'inbuilt innovation'.

Plant breeding is the genetic modification of plants to improve desired properties. For example, breeding (along with improved fertilisation and weed control) has been responsible for wheat yields in Germany increasing from 1.8 tonnes to about 8 tonnes per hectare in the past 100 years. Today the main purpose of breeding is still to increase yields. Breeding for disease and pest resistance, too, indirectly helps to increase production. Other purposes may be to improve quality, nutritional value, taste, appearance, lodging resistance, winter hardiness, shelf life/transportability, etc. In the face of climate change, breeding programmes have increasingly been concentrating on varieties which can tolerate heat and drought, extreme weather events and high levels of soil salinity.

For more than 10,000 years farmers have been adapting the characteristics of crop plants by selection and cross-breeding. However, more systematic and scientific breeding programmes have only existed for the past 150 years. Breeding takes time: a period of 10-15 years normally elapses between initial cross-breeding and the appearance of a new variety. Newer forms of breeding are hybridisation (one-off cross-breeding of different varieties to produce hybrids) as well as mutation breeding (generating beneficial properties through artificially induced mutation, for example by applying radiation to plants). Nowadays genetic methods are also used, sometimes to reduce the time required for breeding or to transfer desirable properties across species boundaries ('transgenes') (see the GIZ Briefing Note on GMOs).

There are differing degrees of commercialisation of plant breeding and **seed production**. In informal production farmers produce their own seed. Traditionally farmers have selected and propagated their own seed and exchanged it with their neighbours. On-farm production of seed is still crucial among small-scale, predominantly subsistent farmers and those in marginal environments; for instance in India 80 per cent of seed is produced locally. On-farm seed production, in some cases by farmer groups, contributes to the preservation and development of crop genetic diversity. In most cases there are no exclusive rights of ownership to the newly-bred varieties.

The International Treaty on Plant Genetic Resources (ITPGR) was adopted in 2001 to protect these 'Farmers' Rights'. It contains agreements on the following points:

1. The right to save, use, exchange and sell their own seed
2. The protection of traditional knowledge relevant to plant genetic resources

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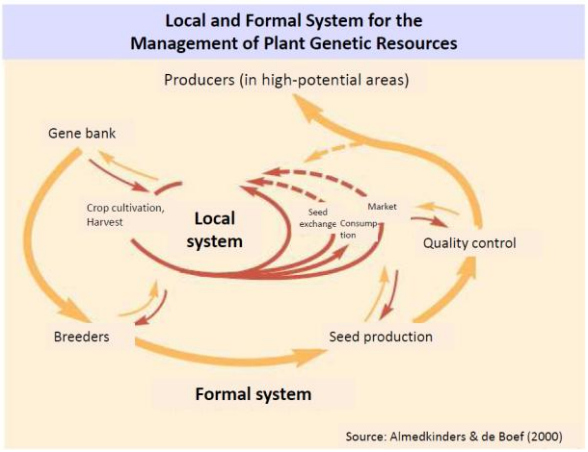
3. The right to participate equitably in sharing benefits arising from the utilisation of resources, and
4. The right to participate in making decisions, at national level, on matters related to agrobiodiversity.

Although on-farm seed is usually robust and well-adapted to local conditions, it is often of poor quality (limited germination capacity, impurities) and less productive than commercial seed when used in favourable locations. Storage conditions are frequently not ideal, limiting its shelf life. In times of crisis the seed may be consumed, leaving farmers nothing to plant for the next season. Legal frameworks can also complicate on-farm seed production; implementation of the ITPGR is sluggish.

More formal methods of seed production consist of the provision of economic services which may include variety breeding, variety registration, propagation, certification and trading. Commercial plant breeding is more efficient and improves varieties faster. The seed is usually dressed (e. g. disinfected) to improve germination, while quality control and certification ensure varietal purity is maintained. In this situation, though, ownership of the varieties is privatised. At international level breeding is protected by the UPOV (International Union for the Protection of New Varieties of Plants) agreement of 1961 (most recently revised in 1991).

Modern commercial seed often makes heavy demands on soil fertility and water availability and is unaffordable for many small farmers in developing countries. In some countries, less than 10 per cent of food cereals for personal use and the local market is grown from commercial seed. However, where smallholders are able to grow industrial crops such as cotton, tobacco and market vegetables, the proportion may be 100 per cent.

Commercial plant breeding, despite major advances, has come under increasing fire for its focus on a small number of productive species and varieties, and its concentration of ownership in a few multinational corporations. Ultimately this leads to monopolisation and a steep decline in agricultural diversity. In turn the plants become more vulnerable to new diseases and pests, and also the effects of climate change. Rights of ownership are becoming increasingly exclusive (hybridisation, prohibition of reproduction, use of terminator technology). These extend from the cultivar to the seed and in some cases to certain properties which are patented along the entire value chain. At the same time breeding concentrates predominantly on commercial agriculture, while plants for marginal locations and economically weak regions are neglected. Another point of discussion is the increasing use of genetic engineering to create GMOs (genetically modified organisms, see the Briefing Note on GMOs).



Source: Almekinders & de Boef (2000): Encouraging Diversity. IT Publications, London.

GIZ's position

The seed sector is so important to local food production and food security worldwide that we at GIZ need to renew our efforts in this area and include relevant activities in our projects. On the one hand commercial seed production should occupy a key role on account of its ability to generate fast, broad-based progress in food security and sustainable economic development. On the other, public research/breeding programmes and local production also need support. These can help to develop species and varieties which are less profitable but equally relevant for the developing countries, and at the same time retain agricultural biodiversity. This is the fundamental premise that underpins the following GIZ viewpoints:

1. **Seed production in developing countries must be formalised and commercialised in a sustainable fashion.**

Technical progress and productivity are most easily achieved in commercial seed systems. Product quality in such systems is very high, and packaging/storage systems are the most advanced. Monopolies and the resulting one-sided distribution of market power must be avoided so that technologies with broad ownership rights (e. g. GMOs, terminator technology) remain

affordable. In light of this, farmers should also receive training, to enable them to make informed decisions for or against the purchase of such varieties.

2. Breeding objectives must make greater allowance for the priorities of developing countries.

For reasons of profitability, commercial seed production has until now predominantly focused on the needs of farming and consumers in the industrialised countries. Ensuring food security and economic development in other regions demands greater consideration of the breeding aims of developing countries. Local consumption habits and taste preferences are important, for example in the context of participatory plant breeding.

3. Farmers' Rights must be respected.

The ITPGR has been ratified by numerous countries, but Farmers' Rights are still not adequately protected. Although the aim is to increase the commercialisation of seed production, these rights must not be ignored. A large proportion of people in the developing countries will continue to depend on subsistence farming in the foreseeable future, despite commercialisation. They must not suffer any disadvantage, but should share in the benefits of the greater utilisation of local agrobiodiversity as foreseen in the ITPGR (see Briefing Note: 'Agrobiodiversity').

4. Seed banks and conservation gardens are needed in subsistence farming systems.

Without seed or propagation material there can be no agricultural production. When farmers eat their seed in times of crisis, food security can be compromised. For this reason the establishment of communal seed banks should be supported, using seed supplied by local producers. This will ensure that there is seed to sow in the subsequent year. The public distribution of seed is only justified in emergency situations and after checking local seed reserves; for instance following a natural disaster when seed must be made available to allow the resumption of agricultural production as soon as possible. The seed to be distributed should come from the region. For vegetatively propagated species (plants reproduced using cuttings), conservation gardens could fulfil a similar function to seed banks.

5. The *in-situ* conservation of agrobiodiversity must be ensured.

Gene banks alone are not enough to conserve agrobiodiversity. Given the increasing focus of commercial plant breeding on a few species and varieties, the *in-situ* conservation of biodiversity must be promoted. It makes sense to support the local on-farm production of species and varieties worth protecting: this would benefit subsistence farmers in particular – many of whom are in any case unable to access commercial seed.

Action required

Promotion of the seed and propagation material sector is integral to the promotion of agriculture in general. Both GIZ and other involved players can help:

1. Development cooperation programmes on rural development should include the seed and propagation material sector.

Development cooperation should make greater provision for the commercialisation of the seed sector. This could include PPP projects with private companies. In any event market-based approaches are called for. A commercial seed sector can only function long-term if the purchasing power of the farmers increases. This requires the overall promotion of commercial agriculture to boost farming structures. In certain cases it may be necessary to temporarily subsidise the purchase of productive seed and propagation material (see Briefing Note: 'Subsidising Agricultural Inputs'). All in all, seed production should be seen as a branch of the rural economy which is supported by private seed organisations. It is important to expand the infrastructure in order to promote commercial trading and marketing systems for seed. The proximity of local dealers to the farmers is crucial here. The rapid production of disease-free plants of similar heredity calls for the promotion of the cell and tissue engineering of vegetatively propagated species. The state should be assisted in the following core areas: (1) Seed legislation/protection of Farmers' Rights, (2) Promotion of public agricultural research and (3) Promotion of on-farm production of seed when markets fail. In many countries, registration processes for new species must be accelerated in collaboration with public authorities.

2. Plant breeding must be improved in developing countries.

Public and private agricultural research facilities should improve their breeding activities in developing countries. They should concentrate on yield increases/disease resistance of species and varieties which are cultivated and consumed in the developing countries (e. g. cassava). Importantly this includes adaptation to locations where nutrient and water conditions are not ideal. Other breeding objectives, in particular in the face of climate change, should be


drought resistance and adaptation to more variable weather conditions (such as alternation between drought and flooding in a single growth period). Increasing the micronutrient content of food crops can provide a valuable contribution to food security. Participative approaches lend themselves to adaptive breeding research. Corresponding incentives may be established for the private sector by means of PPPs. Public research could also take on an important pioneer role.

3. On-farm seed production must become more efficient.

Methods of quality control (e. g. purity of variety), storage systems (e. g. vacuum packing to preserve germination capacity) and safeguarding future supplies (e. g. seed banks) must be improved for local seed production. This requires training farmers in seed propagation and selection. In particular, the spread of disease during seed production must be reduced. The regulatory frameworks for on-farm production need improvement.

4. Research, training and knowledge transfer must be improved.

Genotyping should be developed in order to make plant breeding more efficient. This calls for closer interdisciplinary networking between plant sciences (such as breeding, plant nutrition, plant physiology and molecular biology). New methods such as *smart breeding* – which uses modern biotechnological processes but does not genetically modify the plant (selection according to genetic, not phenotypic properties) – should be developed and increasingly used. Public research facilities should be equipped with user-friendly crop biodiversity and breeding informatics systems which allow them to handle increasing quantities of data. Agricultural research and development cooperation together should refine the transfer of improved species and the communication of knowledge to the private sector and farmers. In this context they should also work on cooperative models for the on-farm production of hybrid seed. Public agricultural research in general needs revitalisation to allow the production of more affordable varieties suited to conditions in developing countries: as public goods their use would not be restricted by private rights of ownership.

5. Measures must be taken to maintain agricultural diversity.

The introduction of GMOs could exacerbate current developments with respect to species and variety reduction. This is why gene banks and the *in-situ* conservation of agrobiodiversity must be supported. The best way of ensuring the latter is to promote local seed and propagation material production. Specific plant genetic resources should be tapped and utilised to adapt crops to changing climate conditions and develop new varieties. Farmers' Rights must also be respected. Seed markets facilitate the local exchange of species and thus contribute to diversity.

Contact

Alexander Schöning
E Alexander.Schoening@giz.de
T +49 6196 79-2076
I www.giz.de

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Responsible: Albert Engel

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15
E info@giz.de
I www.giz.de

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