A TYPOLOGY OF COMMUNITY SEED BANKS

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Contents

Acronyms used in the text

AEZ	Agroecological zone
AS-PTA	Advice and Services for Sustainable Agriculture Project, Brazil
CDR	Complex, diverse and risky (environments)
DAREP	Dryland Applied Research and Extension Project, Kenya
DUS	Distinct, stable and uniform
FAO	Food and Agriculture Organisation of the UN, Italy
FV	Farmer variety
IARC	International Agricultural Research Centre
IIED	International Institute for Environment and Development, UK
IPR	Intellectual Property Rights
ITDG	Intermediate Technology Development Group, UK
KARI	Kenya Agricultural Research Institute, Kenya
MV	Modern variety
NARS	National Agricultural Research Station
NGO	Non-Governmental Organisation
ODA	Overseas Development Administration, UK
RAFI	Rural Advancement Foundation International, Canada
SSE	Seed Savers Exchange, USA

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EXECUTIVE SUMMARY

A momentum has developed for initiatives that allow farmers access to planting material they desire, whilst maintaining agro-biodiversity. The debate over how best to implement these initiatives has centred, to a large extent, on the issue of *in situ* conservation: the maintenance and recovery of viable populations and species in the natural surroundings where they developed their distinctive properties. This implies involving farmers as stewards of crop diversity, growing out varieties as a method of varietal conservation. Many NGOs have taken this further and developed community seed banks to facilitate these conservation activities and to allow farmers access to a wider range of material than is normally available.

Most of these NGO activities are still new and often function in parallel with, rather than build on, existing traditional seed storage and exchange mechanisms. This report reviews community seed banks and categorises them into: *de facto*; community seed exchange; organised seed banks; seed savers' networks and ceremonial seed banks. Each is considered with regard to the two primary objectives of seed banks - farmer seed security and biodiversity conservation - and their relative merits and problems indicated.

The report highlights those areas where our knowledge is still scanty and recommends future studies aimed at improving their applicability and relevance to the farming community. In particular, the issues of (a) how best to work with existing seed banking practices, and (b) how to resolve the conflicting requirements of varietal conservation and the socio-economic needs of the farmers, have to be addressed.

1. INTRODUCTION

1. Farmers need seed because without viable seed the survival of their household is endangered. In fact, the ways that farmers obtain seed are as old as agriculture, and most small-scale farmers in developing countries routinely save their seed from one harvest to the next. Nowadays, some 60-70 per cent of seed used by these farmers is still saved on-farm. Most of the remaining seed is obtained off-farm, from local sources (Louwaars, 1994; Cromwell, 1996a). This seed is usually stored in some form of seed bank, providing seed storage for farmers, and in many case *in situ*[1] conservation of plant genetic resources.

2. Nevertheless, these community systems of seed supply are increasingly coming under pressure. In the first instance, factors such as droughts, crop failure, conflict, difficult storage conditions, and poverty are eroding both the quantity of seed, and number of plant varieties available to farmers. Second, as a result of agricultural modernisation, farmers are increasingly purchasing more of their seed requirements (Berg, 1996a). Not only does this mean that local seed storage could become less important, but as this bought-in seed replaces older, local varieties, these varieties become increasingly unavailable in many communities. In consequence, interventions to strengthen informal seed supply systems, such as establishing seed banks, and seed breeding and multiplication are gaining popularity among NGOs and public sector institutions engaged in the area of seed supply.

3. Given the above, this study will examine the effectiveness of various types of community seed banks as providers of seed security and conservers of agro-biodiversity. Special emphasis will be placed on farmers operating in areas of comparatively low agricultural potential, with less fertile soils and lower and more variable rainfall, commonly known as complex, diverse and risky (CDR) areas. These farming households are likely to have limited land (of reasonable potential), limited capital resources and sometimes limited

[1] ***In situ*** conservation is 'the conservation of ecosystems and natural habitats and the maintenance and recovery of viable population and species in their natural surrounding and in the case of domesticated or cultivated species in the surroundings where they have developed their distinctive properties' (Article 2, Convention of Biological Diversity, 1994).

labour resources for on-farm agricultural production. Often, farming may be one of a portfolio of activities undertaken by the household to ensure its survival.

4. A typology of community seed banks is provided which includes five categories: *de facto* seed banks; ceremonial seed banks; community seed exchange; organised seed banks; and seed savers' networks. Each type is described in more detail and a comparison is made between them. The report then examines how these different types of seed banks contribute to maintaining biodiversity and seed security.

1.1 Terminology

5. There are a number of terms common to the debate on seeds and community seed banks that are subject to various definitions. For this report some of these common terms will be defined.

i) **Seed** is defined as the part of a plant from which a new plant can be grown. It can be:

- *generative* - such as grain or fruit seed, usually produced through sexual reproduction and consisting of an embryo and its food store within a hardened seed coat (testa); or

- *vegetative* - consisting of any propagative part of a plant such as a stem, tuber or bulb.

In this report the word 'seed' will be used when referring to generative seed, and vegetative seed will be qualified. However, seed banks refer to repositories of both types of seed.

ii) The term **modern variety** (MV), refers to the products of the formal plant breeding systems currently carried out by universities, national and international research centres and private companies. MVs are genetically distinct from each other, uniform and stable (i.e. they fulfil DUS criteria).

iii) **Farmers' variety** (FV) refer to the products of careful and extensive selection by farmers that represent a wide range of characteristics. FVs include landraces (material indigenous to the

area) and varieties that have elements of exotic material, incorporated either deliberately or by accident (Tripp, 1996; Cromwell, 1996b).

iv) **Community seed banks** usually store seed from a wide range of individuals, informal groups and NGOs who share seed among themselves, sometimes only occasionally. Seed is primarily retained from participants' own production with no formal quality control, but individual selection process and handling skills are involved. More recently, some community seed banks have been set up in partnership with the formal sector - chiefly plant breeding research institutes. This is discussed in more detail in a later section.

v) **Seed security** is defined as a state where farmers are certain, year after year, to obtain, on time, the quantity and quality of seed necessary to fulfil their production plans.

2. SEED CHARACTERISTICS

2.1 Type of seed

6. Many authors agree that small-scale farming households want seed for many different types of crops (Cromwell, 1996a; Wright *et al.*, 1994; Cromwell *et al*, 1993; de Boef *et al*., 1993). They also need seed of different varieties of each crop:

- to allow for varied physical environments;
- to benefit from the many end uses of each crop; and
- as a coping strategy for complex, diverse and risky environments.

7. Often the seed needs of men and women are different, influenced by gender divisions of labour in agriculture and their gendered local knowledge. Gender studies have shown that often women and men not only posses knowledge about different species and local varieties, but also different specialised knowledge about the same variety. In a study in Mali it was found that, in general, men cultivated a narrower range of crops than women. Likewise, womens' knowledge of sorghum and maize varieties, crops grown by both sexes, was different from mens'. In these crops womens' knowledge was mainly restricted to early maturing local varieties and five

'female' varieties of sorghum grown exclusively by women were identified. Moreover, these women were completely responsible for the maintenance of their own varieties (Gry, 1993).

2.2 Seed quality

8. Farmers want to be assured that the seed that they sow is of consistent quality. Factors that affect seed uniformity and quality are:

- varietal purity: the seed should produce plants of the desired variety (although one of the benefits of farmer varieties is their genetic heterogeneity);

- clean seed: it should be free from unwanted plant seeds e.g. weed seeds;

- germination capacity: Delouche (1982) proposes that 70% germination, rather than the higher level required for formal sector seed certification, is satisfactory for farmers' seed. This capacity is largely dependant on the way the crop is harvested, dried and stored;

- freedom from disease: saved seed should come from healthy crops and stored in appropriate conditions, to prevent disease ingress; and

- seed selection: the plant vigour of the resultant crop depends, in part, on selecting specific plants or parts of that plant (e.g. the grains from the central third of a maize cob) for seed. Farmers also select plant varieties that will perform consistently in variable growing conditions. In less than optimal growing conditions FVs will often out-perform MVs and show greater yield stability (Cleveland and Murray, 1997).

9. Most of the seed sown by small-scale farmers is of known origin, and therefore has an informal guarantee of quality. Types of quality assurance include:

- known quality: obtained from on-farm saved seed, both generative and vegetative.

- 'neighbour certification' (Singh, 1990): obtained from seed saved by family members and neighbours. Guarantees about the quality of this seed will often be taken on trust.

- commercial guarantee: obtained from purchased seed usually bought locally from known seed breeders or seed merchants. Oral, commercial and often legal assurances about the quality of this seed may accompany the sale.[2]

10. Clearly, the value of a seed lot not only depends on the innate quality of the seed itself, but also on the farmer's knowledge that accompanies the seed. This knowledge includes factors such as origin, required planting conditions and crop management skills (Heide *et al*, 1996).

2.3 Seed selection by farmers

11. The intensity of seed selection among farmers appears to vary greatly. Seed can be selected before or after harvest, and is sometimes produced in plots which get special treatment (de Brujin *et al*., 1994). A considerable body of the literature presents farmers as experts, who have extensive and sometimes complex knowledge of plant selection and seed production (de Boef *et al*., 1993). One example from this literature describes how in Sudan, during the ripening period of sorghum 'boys are posted in the fields as bird scarers keeping a watchful eye on the sorghum heads and chasing away intruding birds. They are overseen by their fathers who check on them from time to time and survey the whole fields, examining the sorghum heads for signs of bird damage. During the same period, women and girls regularly come to the fields to gather intercropped vegetables and edible weeds. They also carefully observe the sorghum plants, looking for candidates for selection. By the time of collection of planting material for the following season, the women already know from a long period of observation and family discussion the best sorghum plants' (Berg, 1993). Moreover, many authors note that it is women farmers who have responsibility for seed selection (Opole, 1993; Shiva *et al*, 1995).

12. On the other hand, there are many examples where no evidence of conscious in-field selection is carried out. For example, farmers in Maragwa, Kenya (Percy, 1996) were not

familiar with the idea of consciously trying to improve seed through selecting varieties with desired characteristics (see also Haynes, 1994; Grisley, 1993; Friis-Hansen, 1989). One possible reason is that the advantages of good seed are more obvious under favourable growing conditions than under poor ones. Research into the reasons why some farmers (both male and female) take more care over seed selection than others within, and between, communities does not appear to have been done.

13. Pre-selection of seed for sowing either at the time of storage, or immediately before planting does seem to be a fairly common practice among small-scale farmers (Wright *et al.*, 1994a, 1995; Wright and Tyler, 1994). In many cultures, seed selection at this stage is predominantly a woman's job. These practices vary, but are usually made on the basis of size, colour, grain filling, absence of insect damage, as well vigour and yield of the parent plant. In Colombia, 60% of farmers who stored bean seed considered that only the red colour was important for the seed quality and that size was normally not a problem (Janssen *et al*., 1992). On the contrary, small grains made the seed go further when planting (more seeds per kilogram). In a study in Venezuela it was found that farmers saved the worst tomatoes and the smallest, non-commercial potatoes for seed (Haynes, 1994).

3. A TYPOLOGY OF COMMUNITY SEED BANKS

14. All community seed banks store seed destined for crop production. Yet seed banks vary according to storage methods, and the institutional arrangements needed to set up and maintain these seed banks. These criteria make it possible to categorise seed banks. Seed banks are typically considered to fall into two broad categories:

- **individual seed storage**: seed is retained on-farm by millions of separate farming households throughout the world. This is by far the most prevalent method of storing seed.

[2] This category forms part of the commercial seed sector. This seed is not usually stored in community seed banks. Therefore it is not included of this review. For more information on this sector see Cromwell (1996a, Appendix 1).

- **collective seed storage**: this type of seed storage occurs when farmers, either self-organised, or assisted by outside organisations coordinate the storage of the seed they need for planting. Although, this type of seed storage does have roots in indigenous cultures or yeoman traditions, there has been an increase of NGO-led, farmer-participatory collective seed storage projects in the last decade or so (Berg, 1996a).

15. Other criteria can be employed to further sub-divide seed banks. This allows a more detailed analysis of their roles and potential to be made. These factors include:

- **type of seed**: much of the seed stored in most individual and collective seed banks is generative, but vegetative seed such as potato tubers, sweet potato vines, yam setts and cassava stakes are also found. This seed can be either MVs or FVs, or a combination of both.

- **seed exchange mechanisms**: transferring seed between individuals, households and the seed bank entails a variety of exchange mechanisms. These are mainly informal mechanisms - community seed systems - based on seed fairs, in-kind seed loans, barter and transfers based on social obligations, but also through cash sales and purchases (Cromwell, 1996a).

- **seed multiplication mechanisms:** the required quantity of seed may need to be bulked up from limited supplies either grown locally or imported. In some communities this may be the task of self-appointed individuals and in others the community may nominate or contract individuals to do this.

16. Combining these criteria, five types of seed banks can be distinguished:

Ø ***De facto* seed banks** - the sum of all seed storage in a community. They have been in existence for a long time, operate informally, and are made up of separately stored, locally multiplied, farmers' and modern varieties of seed, kept in individual households.

Ø **Community seed exchange** - organised exchange of some stored seed from *de facto* community seed banks. They operate semi-formally and are made up of individually stored,

locally multiplied, farmers' and modern varieties. Some are traditional institutions, while others have been formed recently.

Ø **Organised seed banks** - new institutions of organised collection, storage and exchange of seed. They operate formally and are made up of individually and collectively stored, locally multiplied, modern and farmers' varieties of seed.

Ø **Seed savers' networks** - new networks organised storage and distribution of seed, mainly farmers' and non-commercial varieties, between individuals and groups in a wide spread of geographical locations.

Ø **Ceremonial seed banks** - sacred groves and reserves. The seed (usually vegetative) is a common property resource, collectively managed and exchanged according to local (often religious) customs and traditions. Seed conservation is not the primary function of these systems but does occur as a consequence of their existence.

17. Clearly the boundaries between these types of seed banks are indistinct. Moreover, the factors that define these categories are not necessarily static over time. In addition, it would be possible to subsume some seed banks mentioned above into a more generalised category, or use different criteria to categorise them. However, for the purposes of this report these five types will be used as working definitions. In the next section these seed banks will be described in more detail.

4. A DESCRIPTION OF THE DIFFERENT TYPES OF SEED BANKS

4.1 *De facto* seed banks

18. *De facto* seed banks - the sum of all seed storage in a community - are by far the most numerous informal seed multiplication and storage systems maintained by farming households in the Third World. For example, nearly 70 to 90% of producers of legumes in Andhra Pradesh, India store their seed at household level (Pushpamma *et al*., 1985), 63% used their own seed in Uganda (Grisley, 1993). In addition, because the community serves as a seed bank for

individual farmers, they are assured that they can replenish at least some of their seed needs from the community if their own supply falls short. The variety and quality of this seed are usually known.

4.1.1 Crop varieties found in de facto seed banks

19. The literature suggests that when sourcing FVs, farmers prefer to obtain their seed locally, i.e. from *de facto* seed banks. For example, in a study of small-scale farmers' seed preferences in semi-arid areas of Kenya, Sutherland (1997) found that 70% of farmers interviewed preferred to source FVs, either from their own crop, or from neighbours. In Mexico it was similar, although farmers would source FVs from a wider area than their own community (Louette, 1997). In Bangladesh, the primary sources of FVs are recognised local crop producers whose resultant crop seeds always perform reliably: "this reputation within the community ensures that the seed receives the necessary care and attention during its production" (Griffiths, 1994). Some sources of non-local FVs may be available at times of marriage. In areas where the tradition of patrilocal marriage exists it is common for newly-married women to bring seeds with them along with other cultural artifacts (Juma, 1989; Zwiefel, 1995).

20. How farmers source MVs, and whether, and how much of this seed comes from *de facto* seed banks is not so clear. The problem here may lie in the misconception that a clear distinction can be made between MVs and FVs (Tripp, 1996). Bellon and Brush (1994) describe the process in which maize MVs become adapted to local systems and gradually convert to FVs in southern Mexico. Similarly Smale *et al*. (1991) relate how farmers in Malawi included certain maize MVs in their category of 'maize of the ancestors' (i.e. traditional) after having only grown them for a few years.

21. Undoubtedly, external sources such as the formal sector (IARCs, NARSs and Ministries of Agriculture), NGOs and the private sector (to a lesser extent, for small-scale farmers), have a large role to play in supplying MVs, which then enter *de facto* seed banks (Machado, 1996). Sutherland (1997) found that 75% of farmers interviewed preferred to buy MV seed from outside the area, in this case through the Dryland Applied Research and Extension Project (DAREP) and other dryland farming projects in Kenya. This bought-in seed is then used for

several seasons. In Nepal, a study examined the role of mini-kits, consisting of one or two improved rice varieties, and fertiliser if appropriate, in variety testing and the distribution of proven improved seed (Cromwell and Green, 1992). It was found that a few key individuals were very important as diffusers of MVs to the rest of their communities. The study concluded that they had 'a personal commitment and interest in promoting development in their community'. In semi-arid areas of Zimbabwe, 'good' farmers are important seed sources for the informal distribution of MVs (Commutech, 1996). Likewise, recent developments such as decentralised farmer participatory plant breeding programmes are responsible for distributing MVs to local communities. Another way that MVs become part of *de facto* seed banks is through the distribution of relief seed in times of stress.

22. Understanding that the type of seed found in *de facto* seed banks will be influenced by gender relations is also crucial in any analysis of community seed banks. However, it must be remembered that neither mens nor womens' knowledge is uniform; what they know often depends on their age, socio-economic strata, ethnic identity and culture.

23. There are many examples of a variety of storage practices. Cereal seed is commonly hung up in smoky areas of the homestead to minimise insect damage and also reduce the moisture content (Wright *et al*., 1994a). It is stored in sisal sacks, synthetic sacks, brown paper bags, containers such as wooden boxes, clay pots, gourds, tins, glass jars, or left loose in a room, or granary (which collectively represent the *de facto* seed stores). Many farmers will treat the seed, some with chemical insecticides and others with natural products (leaves, ashes, fine sand, vegetable oil). Some farmers who do not treat their seed check it periodically, placing it in the sun, removing insect pests by hand or letting hens and chickens eat them (Janssen *et al*., 1992). Sometimes farmers mix seed with sand, spent sump-oil, manure and other substances to reduce the temptation to consume the seed stock in times of food shortages (Commutech, 1996; Percy, 1996a; RAFI, 1986).

4.1.2 Seed quality

24. As stated above, farmers value seed of physical purity and reasonable germination percentages, but uniform seed size and varieties conforming to DUS criteria are often irrelevant

(Cromwell, 1996a). Farmers often do know when their seed is of poor germination quality and compensate by using higher seed rates. In Merida, Venezuela one farmer explained that 'he took three beans at a time for sowing together, and if one happened to be no good then it served as compost for the others' (Haynes, 1994).

25. On the other hand, few farmers have the necessary skills to determine whether their home produced seed is free of either viral, bacterial, or fungal diseases, and, to a lesser extent, insect and weed infestations all of which can be readily transmitted through contaminated seed. This is because observation alone is usually not sufficient to determine if seed is disease contaminated. Drill-box surveys carried out over a three year period on farmer saved wheat seed in Haryana, India showed that seven insect pests were associated with the seed samples. Only 13.2% of samples were free from insect pest infestations (Kashyap and Duhan, 1994). Likewise seed of 20 weed species were found contaminating farmer-saved rice seed in Nueva Ecija, Philippines (Fujisaka *et al*., 1993). Selective roguing of diseased plants in the field helps to reduce disease pressure on potential seed material but this is probably an uncommon practice. In Uganda, for example, only 7% of farmers regularly pulled out diseased plants to limit the spread of diseases to other plants in the field (Grisley, 1993).

4.1.3 Quantity of seed stored in de facto seed banks

26. Small-scale farming households often aim to save sufficient seed to last two seasons, to allow for the risk of complete harvest failure, or the need to replant (Cromwell, 1996b). Yet most small-scale farmers who use their own seed will bring in new seed stocks from time to time. Farmers generally obtain seed from other sources if:

i) they want to plant a bigger area;

ii) they wish to grow crops for which they cannot adequately store the seed. For instance, storing groundnuts and soya beans in monsoon climates is difficult, because seed stored at high ambient humidity soon deteriorates. In addition, some vegetables do not produce seeds in certain environments (Linnemann and Bruyn, 1987);

iii) they perceive that the quality of the seed has degenerated, i.e. the plants fail to develop and produce well under normal growing conditions;

iv) the quality of the seed harvested is bad (excessive moisture content, discoloration, high disease presence);

v) the seed is eaten or sold; or

vi) insufficient seed is available due to adverse climatic conditions, or other natural or man-made phenomena.

27. As a rule, the quantities which small-scale farmers seek to acquire from sources other than their own are small, usually dependent on the previous years' harvest. Cromwell (1996a) reports on a survey that she and other colleagues carried out in Malawi. Typical total quantities needed were 5kg for maize, 14kg for groundnuts and 6kg for beans. Even so, liquidity constraints often strongly define small-scale farmers' strategies for renewing their seed. Often, they only partially renovate their seed stock, or replace seed less frequently than recommended by seed technologists. In one case in Colombia, farmers selected an amount of grain for sale, equal to their bean seed needs, with more than usual care. They were able to sell this grain at a premium and supplemented their receipts with some additional money to purchase seed (Janssen *et al*., 1992).

4.1.4 Home gardens

28. Home gardens, defined as a supplementary food production system under the management and control of the household members (Cleveland and Soleri, 1987) can also be considered as a special case of *de facto* seed bank. Home gardens have played an important role in the domestication of grain and root crops as well as serving as an avenue for the introduction and adaptation of new crops. Since these gardens provide supplementary food, the crops grown in them are usually different, primarily consisting of fruits, vegetables and herbs. Crops often thought of as field or staple crops may also be grown in small quantities in the gardens, although the varieties of a given crop grown in the home garden may be different to those in the main

fields. They are often a supply of the crop in the off-season, or are used to produce seed. For example, in the Philippines *dor-ans*, a small area of 20 to 200 square metres, are found very close to the house or rice store. *Dor-ans* are usually maintained by women who grow different traditional, and highly prized varieties of sweet potatoes as a source of planting material (Mula, 1993). The indigenous people of the Mek group in the Highlands of Irian Jaya source vegetative planting materials for crops such as sweet potatoes, taro, bananas and sugarcane and some vegetables from their home gardens (Damania, 1996).

4.1.5 Equity of access to seed from de facto seed banks

29. Very little is known about issues of equity of access to seed in community seed systems. Many studies only mention farmers as an undifferentiated category. Perhaps this lack of analysis is due to the assumption that precisely because this informal system is in local farmers' hands, then it must be relatively equitable. Some newer studies are beginning to examine this issue, although the information is often partial and incomplete. More work is needed in this area.

30. Sutherland (1997) in his study of seed practices and preferences of small scale farmers in semi-arid areas of Kenya used criteria such as age, draft animal ownership, agro-ecological zone and wealth category to examine their influence on the type of crop varieties grown. These factors were examined in isolation, however. There has been no comparative analysis (so far), nor have the factors which make up the wealth categories been described. Nevertheless, he found that the poorer households were slightly more inclined to plant MVs than the medium and richer ones; that hand-hoers depended more on MVs; and the use of MVs increased with the dryness of agro-ecological zones. Combining these factors it appears that poorer households have limited access to *de facto* seed banks for either MVs or FVs and depend on other sources, particularly relief seed, local markets and the project (DAREP). As for age, the older households relied more on their own saved seed (60%) than the younger ones (47-52%). Conversely, a Commutech (1996) study in Zimbabwe which analysed baseline data on the introduction of seed packs in the districts of Tsholotosho, Chiredzi and U.M.P. districts notes that in Chiredzi, which is one of the hottest and driest parts of the country, farmers' reliance on their own saved seed is higher that the other

two districts. It is suggested that this greater reliance might be 'a reflection of a lower economic status on the part of the Chiredzi householders'.

31. A few studies explicitly examine the movement of seed between wealth and/or ethnic strata. In Nepal, Cromwell and Green (1992) found that the spread of a new variety (through the distribution of mini-kits) between ethnic groups was slow. Only 27% of the total transactions were between different ethnic groups. The Commutech (1996) study from Zimbabwe found that better-off farmers were more likely to receive new varieties of seed for on-farm trials from local extension agents. Even if this variety turned out to be a good one, the poor living within the same village would often not get to hear about it, and/or try it out, although their better-off counterparts would. The authors concluded that better-off farmers use a different seed distribution and exchange network from poorer farmers. In two case studies from Midlands and Matabeleland North in Zimbabwe (Grohn-Wittern and van Oosterhout, 1996), a discussion among farmers revealed that the poorer farmers clearly were at a disadvantage in the community seed system. The richer farmers can share seeds between themselves and average-wealth farmers. Yet if they want seeds from poorer farmers they have to use an average-wealth farmer as a go-between. Similarly, poorer farmers cannot contact a rich farmer directly but also have to use a go-between unless (s)he uses friendship ties, which is rare. The farmers themselves concluded that poorer farmers always received the poorer quality seed and the rich always the best. Farmers in the Maragwa location, Kenya were asked if there were any problems associated with borrowing seeds. They came up with the following list of problems: the farmer cannot get enough seed for the whole farm; the farmer has no choice in the type of seed to plant; most of the time the farmer gets low quality seeds; most of the time the farmer ends up sowing late, as farmers only give seeds to their neighbours after they have planted enough for their own farm (Ithalii, 1997). Organised religion may have a role to play in the redistribution of seed to the poor. For example, in the Orthodox church of Ethiopia, the poor are offered a quantity of the best selected local seed during the celebrations for St Mary. Because these seeds are considered blessed, they are more than likely to be sown rather than eaten (Berg, 1992).

32. Several studies in Africa mention the fact that the payment for seed exchange is changing, as most farmers are at least partially integrated into the market economy. Formerly,

the exchange of small grains seed was generally free of charge, or bartered for labour, an axe or beer but now it is on a cash basis. A report from the ITDG Chivi Food Security Project, Zimbabwe (Mugedeza, 1996) notes that selling seed to other farmers has become the most prevalent form of exchange. It adds that extension workers claim that some farmers are earning substantial sums of money selling seed to farmers in their locality. The traditional 'keepers of diversity' may be disappearing as seed storage becomes less important, especially for farmers who have access to cash. Moreover, as food and food aid becomes more readily available in shops, on-farm seed storage may no longer be a matter of survival for a growing number of farming households.

33. Gender relations can also play a considerable role in seed exchange. In the Maragwa location, Kenya, it was found that women farmers depend more on their own saved seed than men. While women borrow seed from their immediate family and neighbours and rely on relief seed, men have a wider range of sources for seed and depend more on borrowing and buying all types of seed (Percy, 1996).

34. The examples above suggest that there is a hierarchy of access to seed from *de facto* seed banks. This hierarchy is often mediated by factors such as gender, wealth, social status and ethnicity. In fact, it may be more productive to assume that a number of *de facto* seed banks, containing different combinations of quantities and varieties of seed, co-exist within a community. All this results in complex patterns of seed sourcing, with individuals using different sources of seed over time.

4.2 Community Seed Exchange

35. Community seed exchange - the organised exchange and sale of local stored seed (from *de facto* seed banks) - has been in existence for many centuries in some parts of the world. One of the best known examples are the seed fairs of the Peruvian Andes. These are regional fairs, usually held once a year, often during religious festivals, where people from different agro-

ecological zones congregate. The date of the fairs normally coincides with the end of harvest. They act not only as commercial markets, but are an opportunity to exchange seeds and knowledge between local communities. In the last decade, a group of researchers and NGOs have used seed fairs in the Cusco region of Peru as a vehicle to organise successful competitions, for promoting local seed diversity and support to *in situ* conservation of genetic material (Tapia and Rosas, 1993). Through community leaders, farmers are invited to participate in the competitions. Prize winners are those who exhibit the most diverse crop materials and display the most local knowledge. The winners are both men and women, as well as groups such as Mothers' Clubs.

36. Similarly, NGOs in other parts of the world are promoting local seed shows and competitions. Many aim to encourage farmers to 'share information and exchange seed within the locality, giving them access to a wider choice of varieties and maintaining a higher level of biodiversity' (Percy, 1996). For instance, at the 1995 Maragwa Seed Show, organised by ITDG Kenya, 119 farmers (70 men, 49 women) from 19 nearby villages, displayed 134 varieties of seed from 7 crops. In addition, MV seed from the local research station (KARI) was exhibited. Although farmer to farmer seed exchange could not be directly monitored, farmers were heard to express interest in the seeds and some found seed that they hadn't seen since childhood. Interestingly, the report notes that 'confidence in the value of local seeds was boosted, although interest and attention by farmers to the KARI seeds was greater'. On the whole, women exhibited more types of crops, as well as crop varieties, than men. In this way they gained recognition and prestige for their local knowledge. It is hoped that the fair will continue as an annual event (Percy, 1996). Similarly, the Alternative Agriculture Network, a coalition of NGOs in South-East Asia, and Navdanya, a 'people's network for conservation of indigenous genetic resources' in India are organising seed exchange to promote more use of traditional seeds (Berg, 1996a; Navdanya 1994).

37. Ingredients for successful local seed shows appear to be:

- build on local activities wherever possible;
- coordinate with local indigenous structures;
- involve other agencies working in agriculture;

- announce the event well before time;
- ensure that the potential competitors understand the criteria for different classes, and the overall rules for exhibiting;
- ensure that the judges command the respect of the local population; and
- give attractive prizes.

38. No socio-economic data could be found examining who participates in these fairs, and why. This is an obvious gap in the literature. Nevertheless, some anecdotal evidence exists to suggest that seed fairs are potentially providing a vehicle for more equal access to local seed for all farmers, and for women in particular, especially where they are not restricted by cultural norms concerning their mobility.

39. Seed fairs, initially promoted by NGOs, can become self-financing. For example, the Chivi Seed Fair in Zimbabwe which started in 1993 with NGO help, is now planned and organised by the local community and is also getting 'bigger and better' (Lloyd-Laney, 1996).

4.3 Organised seed banks

40. It is generally agreed that formal seed supply systems, including national projects to supply MVs have had limited success in meeting the seed needs of small farmers (ACTIONAID / University of Edinburgh, 1995). Therefore in the search for alternative approaches to address this gap, different types of seed banks have been established. These seed banks, usually organised by a combination of public sector institutions, NGOs and grass roots movements, are primarily developed for seed multiplication and/or seed storage, while some also explicitly promote *in situ* conservation of plant genetic resources. The seed comes from *ex-situ* gene banks, local FVs, outside plant breeding programmes or relief seed supplies. It is stored in individual granaries, or purpose-built stores and may serve just one community or several. Using these criteria, organised seed banks can be divided into four main types (which often overlap):

- seed banks storing and/or multiplying FVs;
- seed banks multiplying *ex situ* seed from gene banks;

- seed banks multiplying MVs; and
- seed banks established to distribute relief seed.

41. Examples of each of these is given below. A large proportion of these organised seed banks have been established in the last 10 years or so and are still evolving. Many are expanding their role to become semi-commercial.

4.3.1 Seed banks storing and/or multiplying FVs

42. The establishment of this type of seed bank has usually been facilitated by NGOs and/or grass roots level groups promoting genetic resource conservation. The basic features of these seed banks are: first, they only store and/or multiply FV seeds; second, they are organised as community undertakings; and third, they are owned and managed by community assemblies. The communities identify the best traditional seed growers and selectors, and purchase their seed. This seed is then distributed to other farmers, in some cases for cash or in-kind payment, or they may be loaned as part of a seed credit scheme. Berg (1996a) states that these seed banks "do not 'save' or 'conserve' seeds, but like banks they put their capital to work through lending". In this model, conservation is not separated from production and seed supply and FVs are maintained and improved. In many cases a strong training element accompanies the establishment of these seed banks, especially in the areas of seed selection and storage practices. There are numerous examples of this type of seed bank, including the Tigray Community Seed Bank Project, Ethiopia (Berg, 1996b) and AS-PTA in Brazil (David, n.d.). In some cases these seed banks are moving towards establishing *in situ* gene banks by investigating the history of local plant varieties, documenting existing biodiversity and the collection and storage of local plant varieties etc. (Navdanya, 1994; Reinjtjes *et al.*, 1992).

43. In terms of social equity, the Community Seed Bank Project in Tigray, Ethiopia gives priority to poorer farmers. Female headed households (considered to be particularly vulnerable) constituted 35% of the beneficiaries of the project (Berg, 1996b). In fact, all the reports reviewed for this study mention targeting women beneficiaries. It is not clear whether project planners are truly taking issues of social equity into account when planning and implementing their projects or whether they are simply paying lip service to the idea of equality.

4.3.2 Seed banks multiplying ex situ seed from gene banks

44. The Biodiversity Institute (formerly the Plant Genetics Resource Centre/Ethiopia), established in 1976 from previous holdings of crop germplasm at various crop breeding and scientific institutions, was probably the first gene bank to assign an active role for farmers in genetic resource conservation. This was organised by the 'On-farm Landrace Conservation and Enhancement Project' started in 1988 (Worede, 1992). Previously collected landraces stored in the gene bank were returned to selected communities who then multiplied and further improved them through mass selection. Some of this seed has gone back to the gene bank. To date, most of this work has been undertaken by women farmers who are given training in improvement selection. They are encouraged to grow samples of the original seed stock alongside selected materials so that they can critically evaluate the results of their own selection. Results of these experiments have not been published so far (Berg, 1996a) so it is not possible to establish how much 'improvement' has actually taken place.

4.3.3 Seed banks multiplying MVs

45. Often these organised seed banks are one element of plant breeding programmes run by researchers and scientists usually financed by the public sector. Their main objective is to speed-up the diffusion of promising new varieties through on-farm testing and farmer evaluation. These varieties can be identified and released in a much shorter period than normal, because the time needed for additional cycles of selection to achieve uniformity required for official release is not necessary in this case.

46. Although the detail may differ, depending on the context, the basic steps for setting-up this type of organised seed banks are as follows. First, researchers and farmers involved in on-farm trials programmes jointly select the varieties to be multiplied. Then a few farmers, nominated by their peers, multiply these varieties, following guidelines laid down by researchers who monitor the crop through all its growing stages. After harvest the quality of seed and storage is assessed by the researchers who certify the seed as either acceptable quality for sale, or it is rejected. These farmers then sell the seed to local farmers at an agreed price. Examples

of this type of organised seed bank are the Narenda Dev University of Agriculture, Andhra Pradesh (Maurya *et al*., 1988) and the Farming Systems Research Team - Western Province, Zambia (Lof and Nchemba, 1994).

47. As these organised seed banks have only been in existence for a few years it is difficult to evaluate their effectiveness. Most reports describe the operation of these seed banks as satisfactory. In Zambia for example, after the first season in operation, 50% of the seed banks produced seed of acceptable quality for sale. Only one financial and economic appraisal could be found. This is for the Small-Scale Seed Development Project in Malawi (ODA / Malawi Government / ACTIONAID, 1995). A cost benefit analysis exercise was undertaken, calculating an internal rate of return of 43.3%. The report states 'even allowing for the possibly that benefits have been overestimated, the project can be considered as highly beneficial to the Malawian economy'.

48. Nevertheless there are many hidden assumptions that undermine the viability of this type of organised seed bank. For example, it is assumed that there is a local unmet demand for MVs of the major staple crops and that they do present real advantages to small-scale farmers, who will want to adopt them. However, in many marginal farming areas MVs are not substantially better than FVs. In addition, many programmes assume a reasonable availability of the basic seed and farmers willing to multiply it. Also, as many of these programmes are located in semi-arid areas where the risk of drought or poor rainfall is always high, the success of this type of project is somewhat threatened. Other considerations are systems of land tenure, and quality and size of land holding. For example, small-scale farmers who have traditional/customary land tenure rights might find it difficult to multiply seed in quantities that can be securely retained either for the next season and/or for sale because of insecurity to land titles and limited suitable land and soil sites for favoured crops.

4.3.4 Seed banks delivering relief seed

49. In the past, these seed banks were set up mainly by NGOs (e.g. ACTIONAID, ACORD, CARE, pers. comm.), after emergencies such as wars and droughts, to distribute relief seed through community organisations. Much of the literature has been highly critical of these

interventions, citing that totally inappropriate seeds were often distributed free of charge year after year, both displacing FVs and removing the incentive for farmers to save seed (Grohn-Wittern and van Oosterhout, 1996; Richards *et al*, 1995). Moreover, most NGOs either ignored or didn't understand local community seed systems, consequently undermining them, and at the same time creating a dependency syndrome among the farmers.

50. Although some NGOs still hand-out seed via community organisations, others have evolved their programmes to promote seed multiplication schemes. For example, ACTIONAID - The Gambia began their work in 1983 as a response to seed shortages due to drought. Their original intervention provided seeds and other production inputs on a part-grant, part-credit basis. However, it was soon recognised that they were encouraging dependency and stifling entrepreneurial opportunities for potential seed growers. They are now promoting organised seed banks in conjunction with the Seed Technology Unit of the Ministry of Agriculture, in ways similar to the previous category (organised seed banks for the multiplication of MVs) (Aube, 1995).

4.4 Seed Savers' networks

51. In several countries groups of small farmers, hobbyists, gardeners and like-minded people have come together to form what are collectively known as 'seed savers'. These grass roots groups share resources, information, seeds and plant materials for mutual benefit. The Seed Savers Exchange (SSE) is one of the largest NGOs that conserves plant genetic resources in North America. It is based at a small farm in Iowa and depends on individuals who maintain seeds of numerous heirloom varieties of subtropical vegetables and other crops. The SSE keeps a large collection of about 16,500 entries (Damania, 1996). The Heritage Seed Library run by the Henry Doubleday Research Association in the UK has become a thriving enterprise with more than 5,000 members. Their collection numbers more than 1,000 different varieties, each of which is grown out as necessary. A cadre of 'Seed Guardians' help by taking responsibility for other varieties, bulking up the seed so that it can be distributed to other members (Cherfas *et al*., 1996). In Australia, the Seed Savers Network has focused on endangered vegetables, fibres, fruits, nuts, beverages and medicinal plants. To date they have initiated the setting up of three networks: in the Solomon Islands, Tonga and the Caribbean. They have delivered Community

Seed Bank training to government and NGO personnel, agriculture teachers and lecturers, women's groups and farmers (Seed Savers, 1997).

4.5 Ceremonial seed banks

52. Sacred groves are found in many parts of the world, ranging in size from a few trees to dense virgin forests of hundreds of acres (Mitra and Pal, 1994; Shepherd, 1991; Dorm-Adzobu and Veit, 1991). Since they are dedicated to a deity and therefore sacred, the community protects them. All forms of vegetation, including shrubs and climbers belong to this deity and the removal of plants is strictly controlled. Consequently, these groves are sanctuaries for rare endangered species, many of which have disappeared outside the grove. Besides being indicators of forests that might have once flourished in the locality, these groves are a bank of plant diversity and germplasm. These resources can be used to return vigour to crops grown in the vicinity, either by deliberate introduction of material back into the production system, or through the natural crossing of cultivated plants and plants conserved in these groves.

53. For example, the Omotic Ari people in south western Ethiopia cultivate ensete (*Ensete ventricosum)*, a multi-purpose, banana-like plant. Although propagated by seed in natural conditions, cultivated ensete is propagated vegetatively and rarely flowers because most plants are consumed before the flowering stage. But in certain areas called *kaiduma,* wild populations of ensete grow, flower and set seed, this is because it is taboo to enter these areas. In this way the conservation of wild ensete is backed by firm ritual beliefs. Landraces are seldom lost, and the presence of the *kaiduma* can increase the genetic diversity of cultivated ensete populations (Shigeta, 1990).

54. Sacred groves are one example of how traditional religious or socio-cultural practices lead to environmental preservation and sound resource management. However, these groves are rapidly disappearing throughout the world, and those that still do exist are vulnerable to the pressures of human population growth, livestock herds and people looking for ways to secure fuelwood and other forest products. But, as the coverage of visible forest declines, some governments, notably in sub-Saharan Africa and India are beginning, once again, to take notice

of these practices which have (in the past, at least) help to preserve and manage the forests (Dorm-Adzobu and Veit, 1991).

4.5.1 Sacred seeds

55. When special seeds varieties play a spiritual role within a local culture, they are usually conserved separately. For example, even though most farmers of the Shangwe people of Zimbabwe have shifted towards growing short season varieties of sorghum, a long season variety called Rongwe is unlikely to become lost. This is because it is used for brewing a beer drunk only by spirit mediums when they want to consult their ancestors. No one else is allowed to use the grain unless they have the permission of the medium, but if they do, (s)he will be affected by bad luck (Grohn-Wittern and van Oosterhout, 1996).

5. A COMPARISON OF THE DIFFERENT TYPES OF COMMUNITY SEED BANKS

56. Despite the rapid pace of change in many rural communities, traditional seed banks are by far the most important method of seed supply and seed multiplication for small-scale farmers. Numerically speaking, they probably account for around 70% of all seed stored by small-scale farmers, principally in *de facto* seed banks. To date, sourcing seed from *de facto* seed banks has offered clear advantages to many farmers. First, most of this seed is the farmers' own seed, and is of known quality. Second, small quantities of seed can usually be obtained from neighbours, if necessary. Third, seed is usually readily available at the required time. Fourth, payment can often be made by a variety of means other than cash. And fifth, they can be a good source of less common, but locally adapted varieties of seed. It is important to remember however, that for some farmers *de facto* seed banks are not always the preferred source of seed. Seed quality (purity, germination capacity, freedom from disease etc.) may be variable as compared to bought-in seed. They can be less than egalitarian, with restricted access for the poor, especially women and marginalised ethnic groups - traditional seed fairs are likely to improve this access. Moreover, many traditional seed banks (especially *de facto* seed banks, and ceremonial seed banks) are increasingly coming under threat from factors such as population pressure,

agricultural modernisation, droughts, conflict etc. Indeed, the availability of less common varieties of seed from traditional seed banks is threatened in many parts of the world.

57. In the last decade or so, NGOs, grass roots organisations and the formal sector have essentially created a parallel system of organised seed banks, albeit with community involvement. Some outputs of these interventions (though not necessarily common to all) are:

- training in seed selection, seed quality control and storage methods;
- encouraging farmers and/or communities to produce and distribute their own seed (either to achieve self-sufficiency, or to prevent loss of local genetic resources as represented by FVs); and
- satisfying the seed needs of particular categories of farmers, such as vulnerable groups.

58. As most of these initiatives have only been in existence for a few years, it is difficult to evaluate their effectiveness. Nevertheless, in Table 1 an attempt to compare traditional seed banks with their newer counterparts has been made, on the basis of whether they achieve their desired outputs.

59. Table 1 shows that the newer organised seed banks have the potential to improve the physical quality, seed security and equity of access to seed, as compared to traditional seed banks. These improvements will not be equal across all four types of seed bank, however and depend on the individual objectives for setting-up each seed bank. Moreover, assessing improvements in seed quality may be somewhat contentious. For example, in the case of organised seed banks multiplying MVs, the physical quality of the seed may improve greatly through farmer training, but the suitability of the varieties supplied by these seed banks can be questioned. This is discussed in more detail in the next section.

60. Although, it appears that these new types of seed bank may improve local seed supply, little is known about their impact (either in detail or magnitude) on traditional seed systems. Moreover, the economic sustainability of most of these interventions is perhaps doubtful. It is somewhat ironic that although the literature on organised seed banks often states that interventions in informal seed supply systems should be based on careful analysis and a proper

understanding of the target communities, these parallel systems have either generally ignored *de facto* seed systems, or failed to understand them.

6. COMMUNITY SEED BANKS AND *IN SITU* CONSERVATION OF PLANT GENETIC RESOURCES

61. It is widely known that using MV seed along with the promotion of modern agricultural practices has the potential to increase crop yields, and for this reason many governments have promoted the use of MV seed for all types of farmers (Cromwell, 1996a). It is also known that the depletion of plant genetic resources, in particular in their centres of diversity, can be associated with the spread of modern agricultural practices (Damania, 1996). Therefore, does a conflict exist between increasing productivity by using MV seed and supporting plant genetic diversity in agriculture? And can community seed banks play a role in resolving this conflict by supporting diversity?

62. The evidence presented so far suggests that although traditional systems of community seed banks are not explicitly designed to conserve FVs in an unchanged form, this does occur to some extent. Some authors have described this type of conservation as '*in*

Table 1. A comparison of the different types of community seed bank

Type of seed bank	Rationale	Antecedents and institutional actors	Dominant type of seed	Physical quality of seed	Seed security	Equity of access	Economic sustainability
De facto community seed bank	Seed security/ production	Traditional; indigenous institution	FVs	Variable	Good but under threat	Somewhat limited access for poorer, women and ethnic groups	Good
Community seed exchange							
- traditional seed fairs	Seed security/ production	Traditional; indigenous institution	FVs	Variable	Good	Majority have access	Good
- seed shows/competitions	Improve seed exchange mechanisms	New; NGO/community	FVs	Variable	Good	Idem	Good if it can be self-financed
Organised seed banks							
- multiplying FVs	Seed multiplication/ conservation	New; NGO/grass roots group/community partnership	FVs	Potentially improved	Improved	Access for all?	Good if it can be self-financed
- multiplying *ex situ* seed	Seed conservation	New; scientist/NGO/ community partnership	FVs	Idem	Improved	Idem	?
- multiplying MVs	Seed multiplication	New; Scientist/farmers group partnership	MVs	Idem	Improved	Mainly benefits participating farmers	?
- relief seed	Survival	New, NGO	MVs	Idem	Improved	Poorest benefit most?	Poor
Seed savers' network	Conservation	NGO	FVs	Good	Good	Good	Good
Ceremonial seed banks	Religious	Traditional; indigenous institution	FVs	Good	Good but under threat	Controlled by community leaders	Good

situ conservation by default' (Berg, 1996a; Haynes, 1994). However, underpinning the establishment of the newer types of organised seed banks are a range of activities affecting the conservation of plant genetic resources. These activities generally fall into two camps; those that have explicit conservation objectives, promoted by NGOs and the genetic conservation movement; and those that may help to erode plant genetic resources as they are part of modern agricultural production systems. These activities are detailed below and in Table 2.

63. Activities which support conservation *through* utilisation, allowing for the development of seeds over time, in response to physical, economic and social pressures, using *ex situ* gene banks as a back up, and activities which use *in situ* conservation as a complement to *ex situ* gene banks, especially for the purposes of regeneration, may conflict: it is sometimes expressed as a tension between conservation and socio-economic objectives.

64. However, even if varieties develop as a result of these activities, the alleles or gene complexes that are adapted to the specific ecosystem may not be lost: they may simply be incorporated into the new varieties (Louette, 1994; Maxted *et al*, 1997).

65. More research on gene flows within a farming system is needed. The value of the seeds that the community conserves *in situ*, is hard to estimate. As the FAO Report on the State of the World's Plant Genetic Resources for Food and Agriculture states: 'formal economic methods of valuation do not take into account local people's perspectives, priorities, value concepts, and so on' (FAO, 1996, Annex 1-4). Attempts to value similar genetic resources have been made by IIED in assessing the value of wild resources in agricultural systems (Hinchcliffe and Melnyck, 1995). However, the way that this value may be realised in monetary terms depends either on its market price or on benefits returned to the community through the enhanced use of the seed or its genetic material by plant breeders. Such benefits would be determined through Farmers' Rights and access agreements, IPR or Patent legislation or through specific contracts (FAO, 1996).

6.1 Activities that potentially maintain FVs

66. These activities contribute to the conservation of FVs and their development through utilisation and 'natural' crossings with material in the 'wild'. Through selection and other pressures there may be emphasis on developing or maintaining varieties. For example, positive selection for ear colour in maize may favour the maintenance of a local variety whereas greater emphasis on increased ear size may favour development of the variety.

6.1.1 Conservation of FVs

67. Conservation without modification can only be effected in *ex situ* gene banks, usually located outside of the community, where regular regeneration, in conditions which minimise opportunities for crossing with other material. However, many *ex situ* gene bank accessions are in danger of being lost because of unsatisfactory physical conditions in the gene bank, and the need for seed regeneration (FAO, 1996). In some cases, the gene bank will return seeds to seed banks for local *ex situ* multiplication and storage (Worede, 1992). According to this typology, Seed Savers Networks and organised seed banks multiplying *ex situ* seed from gene banks (both new types of seed bank) perform this type of explicit conservation of plant genetic resources.

6.1.2 Conservation with 'natural' development

68. Most types of seed bank will allow for some ‘natural’ development i.e. evolution of plant genetic material. Ceremonial seed banks are the ones most likely to provide this type of natural development, though it is not an explicit function of the seed bank. The infusion of genes through crossing with wild relatives, that grow in protected and marginal areas, into generatively propagated crops, is also a source for 'natural' development of crops. However, there needs to be subsequent selection by farmers for further propagation.

6.1.3 Conservation and development through utilisation and selection

69. Most FVs have been developed through utilisation and selection, and are stored in *de facto* seed banks. Although conservation is not an explicit objective of these traditional seed banks they have, historically, been responsible for conserving the majority of the world's plant genetic resources. Recent initiatives such as organised seed banks storing and/or multiplying FVs are now explicitly promoting this type of conservation (Marques and Macedo, n.d.).

6.2 Activities that potentially erode FVs

70. The impact on erosion of FVs depends on the relative area sown to improved FVs and MVs. This is the primary cause of genetic erosion (FAO, 1996). Community seed banks, especially Organised Seed Banks, may exacerbate this.

6.2.1 Development of FVs

71. Deliberate introduction of different genetic material may happen informally by local farmer breeding (Soares, 1996) or more formally in Participatory Plant Breeding schemes (Witcombe *et al*, 1996). This is not static conservation but deliberately develops and improves varieties, incorporating new material sometimes from within the local agroecosystem, but often from outside. Thus they may have a slight negative impact on the conservation of plant genetic resources, at a local scale. Most types of community seed bank may be used to store this improved seed, particularly *de facto* seed banks and organised seed banks storing and/or multiplying FVs.

6.2.2 Development of MVs

72. This may be done by formal sector and commercial plant breeders with on-farm testing of pre-release seeds. Some bulking of seed may be carried out and the seed stored in organised seed banks multiplying MVs. The impact of these seeds on the conservation of FVs depends on the extent to which these varieties are adopted and whether genes from these varieties spread to FVs.

6.2.3 Provision of relief seed

73. This is most common in post-disaster conditions where external agencies, often NGOs, source seed without reference to its suitability to the locality (Richards *et al*, 1995). The impact of such introductions, through organised seed banks established to distribute relief seed, can be very negative. On occasions, appropriate seed may be available in the area but may need bulking up by local organisations.

6.2.4 Replacement of local varieties by Modern Commercial Varieties

74. The dissemination mechanisms for these varieties may be through commercial, formal or informal routes. Community seed banks may form part of the distribution system and, as such, may contribute significantly to the erosion of FVs.

6.3 A comparison of the impact of type of community seed bank and type of seed activity on the conservation of FVs

75. Table 2 indicates that traditional seed banks (*de facto*, community seed exchange and ceremonial) both promote and check the maintenance of plant genetic resources depending on the type of agricultural production system. As they principally store FVs, they make a positive (albeit default) contribution to the overall maintenance of plant genetic resources.

76. Likewise, some of the newly organised seed banks maintain FVs while others erode them. Seed Savers' Networks, organised seed banks multiplying FVs, and organised seed banks multiplying *ex situ* seed will, to a greater or lesser extent (Table 2), maintain and possibly enhance local plant resources. On the other hand, organised seed banks multiplying MVs and supplying relief seed will generally erode FVs. As little quantitative data exists (either in aggregate or individual form) it is difficult to estimate whether they are collectively more likely to maintain plant genetic resources, or not.

Table 2. The impact of type of community seed bank and seed activity on the conservation of FVs

Seed activity / Type of community seed bank	**Activities that potentially maintain FVs**			**Activities that potentially erode FVs**			
	Conservation of FVs	**Conservation with 'natural' development**	**Conservation and development through utilisation**	**Development of FVs**	**Development of MVs**	**Provision of relief seed**	**Dissemination of modern commercial varieties**
***De facto* seed banks**	+	++	++	-	--	n/a	---
Community seed exchange	+	++	++	-	--	n/a	---
Organised seed banks							
-multiplying FVs	+	++	++	-	n/a	n/a	n/a
-multiplying *ex situ* seed	+++	+	+	n/a	n/a	n/a	n/a
-multiplying MVs	n/a	n/a	n/a	n/a	---	n/a	---
-relief seed	n/a	n/a	n/a	n/a	n/a	---	---
Seed Saver networks	+++	++	++	-	n/a	n/a	n/a
Ceremonial seed banks	++	+++	n/a	n/a	n/a	n/a	n/a

Key: Greater conservation of FVs +++ ++ + - -- --- greater erosion of FVs
n/a Not applicable

77. Both the traditional and newer types of community seed banks highlight the conflict between productivity and the maintenance of plant genetic diversity (Wright and Kameswara Rao, 1997). Perhaps flexibility in seed storage itself is the best way to support diversity. Partnerships between plant breeders and communities can promote the multiplication and storage of MVs, while NGOs, grass-roots organisations and communities support the maintenance and storage of FVs. However, the latter will only work to support plant genetic diversity if there is no economic penalty attached to maintaining diversity. For example in Africa, many governments promote hybrid maize through price support and import subsidies; this makes it very difficult to work for a more diverse agriculture (Cromwell, 1996a).

7. CONCLUSIONS

78. This report has distinguished five types of community seed banks that make up the informal seed sector. In terms of the total quantity of seed stored, traditional seed banks, and *de facto* seed banks in particular, supply the vast majority of the seed produced and saved by small-scale farmers in developing countries. In the last decade or so, there has been an increase in collective seed storage projects promoted by NGOs and some formal sector institutions that have, by and large, been set up in parallel to traditional seed banks, albeit with community participation.

79. It is interesting to note however, that although NGOs etc. have taken scant notice of traditional seed supply systems when establishing seed bank projects, many of these interventions are in general attempting to improve the perceived 'weaknesses' of traditional seed banks - variable physical seed quality and inequitable access to seed. For example, many projects are trying to improve the quality of seed stored, by training farmers in plant breeding techniques, pre-harvest selection and post-harvest storage. In some projects, the issues of seed exchange and distribution are being addressed through, for example, the promotion of Community Seed Fairs or the specific targeting of beneficiary groups within the community.

80. In terms of the conservation of agro-biodiversity, traditional seed banks have been, and continue to be, the mainstay in preserving FVs. Whether they continue in this role, depends largely on the farming systems in their locality. It is likely that they will only continue to

support plant genetic diversity if there is no economic penalty to maintaining this diversity. With regard to the new types of seed bank, some have been explicitly set up to conserve biodiversity, but others definitely erode plant genetic material. One situation in which particular care needs to be taken not to jeopardise plant genetic diversity is that of post-emergency seed distribution.

81. Finally, as stated in the text, there are considerable gaps in our knowledge about the workings of all types of community seed banks. In particular, it is recommended that work be carried out to address the following identified issues:

- detailed research into the functioning of different types of seed bank, in both technical and socio-economic terms;

- research into the contribution that different types of seed banks can, or do, make towards the conservation of agro-biodiversity;

- what are the social and economic cost-benefits of seed banks that use farmers as seed producers, as opposed to centralised systems?

- what are the impacts of seed banks on traditional systems?

- what are the impacts of seed banks on the maintenance of plant genetic resources?

- examine if seed banks can provide both seed security and conserve agro-biodiversity at the same time, or do these outputs conflict?

- examine best practice in NGO and others implementation strategies for establishing and maintaining seed banks;

- who benefits from, and contributes to, Seed Fairs, and why?

- how much 'improvement' takes place during Landrace enhancement programmes and what effect does this have on overall genetic diversity?

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