1.

Seed diversity of crops and varieties

The diversity of crops and varieties has been identified by the LinKS studies as a key element in people's livelihood strategies and is crucial to their ability to adapt and survive in unfavourable environmental conditions (FAO and ICRISAT 2004; FAO 2007). The studies clearly demonstrate the importance of crop diversity in counteracting the effects of droughts and other environmental hazards, and in ensuring family food security. Farmers cultivate early- and late-maturing varieties of the same crops to increase the period of food availability and to spread out the amount of work required at harvest time. Participants' responses and field observations show that the range of crops planted in specific agro-ecological conditions is determined by a careful selection process. By planting different varieties of cereals and legumes, farmers benefit from more productive but less hardy varieties, while at the same time hedging this risk with varieties that are less productive yet more tolerant to drought (FAO and ICRISAT 2004). Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) (2006e) summarizes the advantages of crop diversity in that "crop diversity enables people to mitigate climate- and market-related risks, cope with the varying availability of labour, or secure a harvest even if they cannot sow at the normal time."

Crop diversity is therefore an essential part of the FAO definition of seed security, which includes "timely availability of seed of improved variety and ecotype of staple crop kinds to farmers, especially after a disaster, and its efficient distribution at the right place and at an affordable price" (FAO 1997). Farmers interviewed by the LinKS projects defined seed security as "having enough seed for the season to plant the crops required by the household or the ability of the household to access the required seed for the season through purchase" (FAO 2007). This definition ascribes two dimensions to seed security: availability and access. While the dimensions of quality and stability were not directly addressed in the studies, the focus on careful seed selection and storage processes shows the important role seed quality plays for farmers.[3] Moreover, other FAO reports have emphasized the importance of quality seeds as a major requirement for food security (Larinde 1997).

Food security was defined by the farmers as the availability of staple crops, such as maize, throughout the year. There was a marked difference in staple crop availability for the different socio-economic

[3] Sources for seed security framework are Remington, 1998, Remington et al, 2002, Sperling et al 2003, Sperling 2004.

groups. The data obtained in the Southern Highlands and Central Zone of Tanzania demonstrated very strongly the importance of neglected and collected crops for food insecure households. The studies show that during the months of staple crop shortage, these crops can cover up to 80 percent of the food intake of food-insecure groups. Wild resources are particularly important for the food and livelihood security of poor rural women and children, especially in times of ecological stress or change, such as drought. These groups generally have less access to land, labour and capital and thus need to rely more on the wild biodiversity available locally (Pimbert 1999).

1.1 SEED DIVERSITY AND FOOD SECURITY

Seed diversity has always been a cornerstone of people's livelihoods in rural Mozambique and Tanzania. The historical timelines developed in the studies show the range of crops grown. There is evidence that crop diversity has changed over time mainly due to governmental projects and the introduction of high-yielding varieties and cash crops. The Mozambique study found an overall drop in crop diversity in the last decade. Previously 90 percent of the study participants grew more than six different crops, while today only 73 percent report growing the same number. The main observations derived from the LinKS case studies can be summarized as follows:

- As cropping systems become more commercialized, there is a reduction in crop and varietal biodiversity.
- Cash crops provide income that can be used to supplement family food needs during staple crop shortages.
- There is a clear tendency to manage traditional crops and cash crops at the same time to broaden livelihood options. Many farmers maintain traditional crops on a reduced scale.
- Women take a leading role in conserving and managing traditional crops and varieties.

The collection of wild plants and minor crop species is another strategy to achieve food security, which has not been affected or replaced by the introduction of new crops and varieties. Wild plants such as *mlenda* (okra), wild fruits, greens and vegetables are consumed throughout the year as farmers are knowledgeable about how to process and conserve them. Women favour minor crops such as pumpkin, cucumber, sponge gourds and watermelon as they are easily available, not labour-intensive and provide healthy food during staple crop shortages, usually between February and June (FAO 2007). Wild plants are especially important for food-insecure households, which rely on them throughout the year. Food-secure households and medium-secure households rely on them after bad harvests but also use them as regular food supplements.

Managing seed diversity is key to increasing biological and cultural diversity. Vernooy (2003) points out that in their struggle to survive with poor soils and limited resources, small farmers continue to allow plant varieties to evolve. Plant genetic diversity is crucial to breeding food crops and is thus one of the central preconditions for food security. It is also vital to modern plant breeding, as it provides the genetic traits required to address crop pests, diseases and changing climate conditions. Thus, plant genetic diversity is an indispensable factor in the fight against poverty (Andersen 2006). Experts from 25 nations have stated that conservation and sustainable use of diverse cultivated plants and domestic animal breeds are key to attaining the first Millennium Development Goal (MDG): to eradicate extreme poverty and hunger (IPGRI, GFU, MSSRF, 2005).

1.2 SOCIO-ECONOMIC AND GENDER PERSPECTIVES

Socio-economic differences

The LinKS studies identified differences in seed diversity and security within different socio-economic groups. Identifying and understanding these differences is important to better target future seed interventions. This is a particular concern, since there is growing evidence that specific groups are more likely to benefit from seed technologies than others. The LinKS studies made the following observations:

- Better-off households manage fewer diverse crop systems since they are more market-focused and grow a larger share of improved varieties of cash crops. At the same time, these households grow local crops for food consumption.
- The use of neglected and wild crops is a common practice in all socio-economic groups and has continued despite the introduction of new crops and crop varieties. However, lower socio-economic households depend more heavily on these resources than better-off households.
- Improved and hybrid varieties are commonly used by better-off farmers, while these varieties are less used in poorer households. However, even resource-poor households try to obtain improved crop varieties and may have access to them through local seed distribution channels.
- Wealthier households were more likely to conserve and control their own seed, while poorer households more often supplemented their limited seed stock with whatever was available to them, which was often seed of poor quality or varieties unsuitable for the local environment. (FAO and ICRISAT 2004).
- Households categorized as “better off” have better access to physical resources such as irrigation systems and larger plots, which in turn has a positive impact on the amount of seed harvested and the potential to save self-produced seed. They also have more access to improved seed through purchase and better mobility to access markets and other seed sources outside their village. They can hire labour in exchange for seed during the cropping season and can therefore plant earlier than other groups.
- Medium-level farmers’ seed security largely depends on self-produced seed. Seed shortages among this socio-economic group are largely the result of crop failure due to bad weather or pest outbreak. Households in this category access seed through exchange and gifts, but access to improved seed is very limited (FAO and ICRISAT *2004;* Mkucha et al 2004*).*
- The poorest households are the most seed insecure, since they generally fail to produce enough crops to keep seed throughout the year. They access seed largely through the exchange of labour for seed and occasionally they acquire small quantities as supplies at no cost. (Lazaro and Bisanda 2004).

Gender differences

The LinKS studies revealed a clear difference between men and women's responsibilities with respect to crops and seeds. Women are involved in producing subsistence food crops such as beans, peas, potatoes, cassava, finger millet, and vegetables, while men are more concerned with producing crops for cash. However, both men and women produce maize because of its dual role as a household food and a cash crop (Lazaro). Additional findings include:

- Seed selection is mainly done by women, while men are responsible for constructing adequate seed storage structures (such as *tsala* for maize or *dhule* for beans) (FAO and ICRISAT 2004).

The Tanzanian studies revealed that men take an active role in seed selection and storage for cash crops, which include maize, groundnut, millet and sorghum. This differentiation can change depending on external circumstances; in years of good harvest, some crops (e.g. groundnut) may become cash crops as well as food crops.

The LinKS studies demonstrated a striking relationship between gender and seed security. Female-headed households were, on average, poorer than male-headed households and therefore were likely to be less seed-secure in terms of their ability to purchase and access seed from external sources (ICRISAT, FAO 2004). This observation concurs with the generally accepted findings that place women and children among the poorest globally (IFAD 1998, DFID 2006).

It is important for future studies to explore differences in female and male farmers' perception of seed and food security. For example, the report from the Southern Highlands mentions that farmers' beliefs about their seed and food security was based on the availability of maize, the main staple crop in the region. However, further research may show that women might also consider other food crops which are important to supplement family food needs. Understanding gender differences in these contexts would help better target seed management interventions and support women in achieving greater seed and food security.

1.3 SEED DIVERSITY AND LOCAL KNOWLEDGE

Women play a central role in managing agro-biodiversity and the knowledge of seed selection, production and supply. As women are mainly responsible for seed selection and management of traditional food crops, they also hold a higher level of knowledge about these crops than men (FAO and ICRISAT 2004). For example:

- Nutrition and health needs are most often women's responsibility. Therefore, it is usually women who are knowledgeable about the plants and animals that serve these needs, their culinary, nutritional or curative properties, and their agronomic and environmental characteristics. There is a greater variety of plants and animals contributing to subsistence than the range of products sold in the markets.
- Women often use a broader set of selection criteria than men, since they use plants in more diverse ways (Howard 2003). Whereas men generally focus on criteria related to agronomic characteristics and market value, women apply additional criteria related to food consumption, such as palatability, taste and cooking qualities. Furthermore, men and women share criteria related to the quality of seed, such as seed size and freedom from pests. (FAO 2007)

The current research shows the importance of reaching women, in particular when addressing agro-biodiversity conservation issues (GTZ 2006c). However, this remains a significant challenge in many seed management interventions.

The Mozambique study revealed that crop diversity and local knowledge also vary based on age. Fewer than 30 percent of farmers under the age of 45 grow more than 10 crops while nearly 50 percent of those over 45 do so. The fact that younger adults grow a narrower range of crops may be partially associated with the loss of knowledge about traditional crops. Interviewees were asked to identify the number of traditional seed varieties they knew for the following crops: maize, rice, groundnut, cowpea, cassava and pumpkin. In all cases except cowpea a significantly higher percentage of younger adults were unable to identify a single traditional variety when compared with older adults. This is illustrated in Table 1 below. The LinKS data from Mozambique coincides with data collected from Ethiopia that examined local knowledge related to durum wheat varieties. In Ethiopia it was found that only men over the age of 50 were familiar with the old varieties and knew how to cultivate them (GTZ 2006a).

Table 1. Percentage of interviewees unable to identify any traditional varieties of seed

	Maize	Rice	Groundnut	Pumpkin	Cassava	Cowpea
Under 45 age group	8%	13%	25%	27%	33%	10%
45 years and over	2%	5%	12%	10%	19%	12%

Source: Mozambique study (FAO and ICRISAT 2004)

The LinKS studies show that traditional knowledge is practical knowledge, applicable on a day-to-day basis. This practical knowledge links closely with seed management issues. When a certain seed disappears, the knowledge of indigenous peoples and local communities about these biological resources often disappears too, since it is usually transmitted orally. Local knowledge is not transferred into formal systems: it is still not recognized by decision-makers, despite the growing discussion about its value and potential contribution to policy. Additionally, there are limitations at community and inter-community levels, where the knowledge is not always accessible to all socio-economic groups.

1.4 WHAT WE HAVE LEARNED SO FAR

This section synthesizes the main observations about seed diversity and suggests a number of key issues to include in a check-list when assessing or planning seed interventions in the future.

Key lessons learned include the following:

- Seed diversity is important to cope with environmental and socio-economic stresses and is a cornerstone of farmers' livelihood strategies.
- Seed diversity encompasses traditional staple crops, neglected crops, market crops and wild plant species, which are managed in a complex system.
- There are important socio-economic and gender differences when it comes to seed diversity, seed security and food security which need to be understood to effectively target any seed intervention.
- Seed diversity and local knowledge are closely linked and need to be considered and understood from a gender-specific perspective.
- Local knowledge is based on practical experimentation and is therefore vulnerable to permanent loss if crops and varieties lose importance in the farming system.

Socio-economic issues

To understand seed diversity in the local context, the following questions should be asked of different socio-economic groups[4] (better-off households, medium and resource-poor households), taking into account the perspectives of men and women[5].

Which crops are cultivated in the fields? Who is responsible for cultivating which crops? Are these responsibilities delegated according to gender, age, capability? Are wild or collected crops included in the diet? Are wild or collected crops used for other purposes (e.g. medicinal qualities, beauty products)?

Which crops are the staple crops, which are cash crops, which are traditional and which are the introduced crops? Who takes the lead in cultivating these crops – men or women?

Is the seed of these plants available for men and women in sufficient quantity, within reasonable proximity and in time for planting?

Do men and women have adequate income to access these seeds or other resources to purchase or barter for them?

Is seed supply stable over time or do people experience acute or chronic seed shortages?

How do local men and women define seed security?

4 More detailed description of these socio-economic groups can be found in the original project documents.

5 Tools for socio-economic stratification and gender analysis are available in FAO SEAGA material.

Gender issues

To explore the different knowledge within communities and among household members (and especially between women and men), questions should include the following:

Who takes decisions about the management and resource allocation of different crops?

Who is responsible for seed selection, treatment and storage, and for seed multiplication and exchange?

What are traditional practices related to seed selection, treatment and storage, and for seed multiplication and exchange?

2. Understanding seed systems

The LinKS studies revealed that local and formal seed systems co-exist, and that local seed systems are important for seed and food security. All three studies agree that over 95 percent of the seed used by farmers derives from local systems. This finding is substantiated by many other sources. Most of the seed planted in Tanzania is obtained through the local system (Friis-Hansen, 1999; Mtenga, 1999; Mbwele et al., 2000; Rohrback et al., 2002). Mbwele et al. (2000) estimate the figure at 96 percent of the seed sown, while Rohrback et al. (2002) estimate that only 10 percent of farmers have access to improved seed of maize, sorghum and pearl millet. Despite the recognition of the importance of local seed systems and the diversity maintained in them, the formal seed system has received more attention and financial resources over the past decade, with the aim of producing high-yield crop varieties (Vernooy 2003).

2.1 LOCAL SEED SYSTEMS

The case studies show that traditional crops and local varieties of staple crops are maintained by local people as part of their customary practice. For small-scale farmers, seed and food production are not separate objectives, but are part of the same livelihood strategy (FAO 2007). Seed collection may even start in the field during the harvest (FAO 2007), while seed selection is carried out at the homestead for the majority of crops, such as cereals, pulses and legumes (FAO and ICRISAT 2004).

The findings emphasize that farmers have developed local coping mechanisms to acquire seed when there are shortages. One mechanism is to exchange seed within the village or between villages; another is to be paid in seed instead of cash or to exchange small livestock or livestock products for seed. Sometimes seed is also given or received for free between relatives or neighbours.

Local markets or local seed traders are another source of seed as they sell it in small quantities at affordable prices (FAO 2007; GTZ 2006e). When farmers turn to the markets for seed, they look first for seed they recognize but eventually they focus on other criteria, including availability – “you can find it on the market” – and access – “you can pay for it” (FAO and ICRISAT 2004).

The reports also show differences in seed sources among different socio-economic groups. The report from Tanzania shows that better-off households acquire seed from up to 19 different sources compared with only nine different sources in the poorer households. Furthermore these findings show that men and women access equally diverse sources for seed, although the sources themselves differ between genders (FAO 2007).

Vernooy (2006) confirms that access to resources and knowledge varies between groups of different social status, leading to inequities. To a large extent, resource-poor households rely on resource-endowed farmers for genetic materials through farmer-to-farmer networks, which often extend beyond the village boundary (Subedi et al. 2001).

Nodal farmers

Most community members grow different cultivars, but some farmers maintain a wider range of diversity than others. These farmers, referred to as "nodal farmers," play a significant role in the flow of genetic materials and occupy a relatively central position in the local network of on-farm biodiversity management.

Nodal farmers are those who:

- grow more cultivars, including important and rare landraces, and are perceived as the diversity-minded farmers of the community;
- constantly search for new diversity from within or outside the village and select for best adaptation of plants to diverse/variable farm environments; and
- acquire or distribute genetic materials.

Source: Conservation and Sustainable Use of Agricultural Biodiversity (2003); published by CIP-UPWARD in collaboration with GTZ, IDRC, IPGRI and SEARICE; Paper 33

In the LinKS studies, nodal farmers play an important role in conserving local landraces. Nodal farmers were described as men and women with a strong interest in conserving traditional crops and who were not in a higher socio-economic group. In both Tanzanian studies, nodal farmers were recognized as the guardians of local diversity. Their role in seed distribution within and between communities and different socio-economic groups is not yet fully understood.

2.2 FORMAL SEED SYSTEMS

The LinKS studies emphasize the ineffectiveness of formal seed systems and the limited role they play. (FAO 2007). The participants from the Southern Highland case study in Tanzania stressed that the formal system had failed to meet their demand for seed. Similar concerns were expressed in the Central zone study. The main reasons stated for the ineffectiveness of the system were the following:

- Prices of improved varieties are often not affordable.
- Seed is offered in large quantities.
- Quality of seed is not always good.
- Seed may reach the villages at times unsuitable for sowing.
- Focus is on improved crop varieties of selected staple and cash crops.

On the other hand, farmers have expressed an interest in obtaining improved varieties and new crops and would like improved access to the formal system. Currently, this interest is often satisfied through other channels, such as private seed traders, stockists in town and non-governmental organizations (NGOs). (FAO 2007).

The formal system focuses on farmers who are more market-oriented and who have the resources to purchase not only the improved seed, but also other inputs required to cultivate it. Therefore, male farmers, who enjoy greater wealth, education and socio-economic power, are more likely to make use of the formal system. The formal system also promotes improved staple crop varieties to improve food security through high-yielding crops. However in naturally disadvantaged regions, such as deserts and mountainous areas, the improved seeds do not produce well and therefore these areas have seen very little improvement in yields over recent decades. It is in these very areas that local plant species and animal breeds are often advantageous, since they have adapted optimally to the local conditions (GTZ 2006d).

As Tripp (2006) points out, identifying these sorts of biases does not imply that the particular technology is inappropriate or should be abandoned. Rather, the results argue for more efforts to understand patterns of uptake and distribution and to work toward improving the various aspects of the process – technology, targeting, project management and policy – so that a wider range of farmers can take advantage of the innovations. In seed management interventions, particular attention should be given to women's access to new technologies and to potential biases towards and against different socio-economic groups. Creating an environment to allow all groups to better access new technologies should be a development priority.

2.3 INTERACTIONS BETWEEN THE LOCAL AND THE FORMAL SEED SYSTEM

The LinKS studies show that the local seed system has been influenced by the formal system through the introduction of new crops or improved varieties of local crops. Improved crop varieties were introduced and seed was provided through the extension service. The impact of these interventions on local seed systems has not been monitored or analysed in a systematic fashion. However, there is accumulating evidence elsewhere that unplanned and badly targeted interventions are weakening existing seed management processes and organizations (Timsina and Upreti; Dominguez and Jones 2003; Musa 1998; Tripp 2001).

In Tanzania, Quality Declared Seed Systems (QDS) and the selection of contact farmers are two mechanisms that have been established by the formal system to improve integration on the local level. The QDS system is a seed quality control mechanism developed by FAO to provide a more easy-going approach to seed certification in areas where seed markets are not functional and government resources are too limited to effectively manage comprehensive certification systems. Under QDS, seed producers (contact farmers) are responsible for quality control, while government agents check only a very limited portion of seed lots and seed multiplication fields. Innovative farmers are selected by the formal system and trained in seed production and management. The aim is to produce improved seed at the local level by empowering farmers to multiply seed at reduced cost for their communities under the supervision of agricultural extension officers. A weakness of this system is that the livelihoods and farming systems of the QDS farmers are very different from those of most villagers. Innovative farmers are usually the wealthiest farmers, so they have large fields and use tractors; they do not use the same cultivation techniques as small farmers. QDS and contact farmers were also reported to be very busy in their own fields and not to voluntarily allot time to sharing knowledge with other farmers. Only if other farmers directly approached them to seek information would they share their knowledge. As a result, QDS and contact farmers make up part of the male-dominated national seed system (Kessy 2006) and focus mainly on improved varieties of selected staple crops (FAO 2007).

The LinKS studies recommend that the formal and local systems be complementary. This position has been promoted by a range of different development organizations. GTZ and the Centre for Genetic Resources in the Netherlands (CGN) (2000) stated the following: “The complementarity of the formal and local sector offers multiple opportunities to develop a well-integrated seed sector in which both formal and local actors play a significant role. Farmers’ capacities and knowledge regarding local conditions, seed selection, and traditional mechanisms of seed exchange are valuable elements in the functioning of the local seed sector. Instead of replacing the local sector, the formal sector can build on these elements to address more effectively the seed demands of small-scale farmers. The local system can be significantly strengthened, for instance, by introducing improved genetic materials and adapting improved seed technology to local conditions. The limitation of the formal sector lies in its incapacity to address widely varying agro-ecological conditions or the needs and preferences of small-scale farmers. Farmers’ knowledge and capacities and farmer-based organizations can play an important role in this respect. This knowledge and these capacities can be mobilized through participatory approaches.” Participatory Plant Breeding (PPB) is one strategy that would make use of this knowledge (FAO, DFID, IDRC, etc.). The aim of PPB is to ensure that the research undertaken is relevant to the farmers’ needs. Researchers work directly with the farmers, and much of the testing takes place on the farm. (IDRC http://www.idrc.ca/in _ focus _ seeds/ev-30549-201-1-DO _ TOPIC.html)

2.4 WHAT WE HAVE LEARNED SO FAR

Key lessons learned so far include:

- Farmers make use of local and formal systems for seed management.
- The local seed system covers the majority of seed needs in communities.
- Seed sources and access to information differ among socio-economic groups and between women and men.
- Nodal farmers play an important role in conserving a wide variety of traditional crops.
- Access to the formal system is limited due to a number of different factors including price, quantity, quality and timeliness of delivery.
- Linkages between the local and formal systems are limited.
- Complementary strategies could enhance the functioning of both systems.

Before planning any seed management intervention, it is important to understand the differences in seed demand and the flow of genetic materials for different socio-economic groups (better-off, medium and poor households) and between men and women[1].

[1] Source: Adapted from Key sheets for Development in the Natural Environment, Seed Supply, DFID ODI, 1997

Questions to be asked include:

Are men and women farmers searching for new varieties that may simply require an initial introduction of seed?

Are men and women farmers purchasing hybrids that can be supplied by a commercial enterprise?

Do men and women farmers have seed quality or management problems that require specialized seed enterprises or extension advice?

From whom do men and women usually get seed?

To whom do men and women usually provide seed?

What are the difficulties of obtaining seed from other people and what are the benefits?

Another important aspect to explore is the impact felt by farmers of past and present interventions from the formal system. As with the questions above, it is crucial to include men and women from different socio-economic strata.

Additional questions to be asked to understand the local system include:

Are there notable differences in crop and variety diversity within the community and between men and women?

Who are the farmers with the largest crop and variety diversity? What is their gender, age, socio-economic position, etc?

What type of knowledge do men and women hold about their crops?

How does this knowledge differ between men and women and between different socio-economic groups?

Are these farmers recognized as seed and information sources in the community (e.g. nodal farmers)?

Questions to ask about the functioning of the formal system include:

Which organizations promote or introduce seed in the community? Do they target men and/or women?

Where do men and women obtain seed outside the community?

What are the constraints to accessing the formal system for men and women?

What are the benefits of accessing the formal system?

Does the public research system have appropriate links with the rest of the seed system to ensure the effective delivery of its varieties?

Do men and women farmers have access to appropriate information on seed characteristics before planting?

Can men and women farmers afford access to the plant varieties they need and can they save, re-use and exchange them according to their customary practice?

3.

The main drivers for change in crop diversity

The LinKS studies sought to understand what causes change in crop diversity. To achieve this, they tried to establish links between major political and environmental events and changes in seed diversity and food security. The information was collected by developing timelines with key informants from the study villages. Three main drivers for change were identified by this method:

- introduction of new crops and varieties;
- natural climate events;
- changes in household structure as a result of HIV/AIDS.

The introduction of new crops and varieties was brought about by policy changes from pre-independence to post-independence and the economic reform era (FAO 2006), which introduced several different agricultural development programmes.

Natural climate events such as droughts and floods were identified as another driver for change. Repeated incidents of drought led to complete crop failures and the need to look for new seed elsewhere. New, better, drought-resistant crops were introduced (e.g. Bambara nut) and new varieties were acquired from a range of sources, including labour-seed exchanges (FAO 2006). At the same time, heavy rainfall events led to some temporal improvement for the cultivation of certain crops such as rice and vegetables, but also led to the increase of pests and diseases.

An additional suspected driver for change is the increased incidence of HIV/AIDS. As HIV/AIDS leads to major changes in livelihood, its effect can be observed in agricultural practices and crop diversity.

3.1 IMPACT OF IMPROVED CROPS AND VARIETIES

Two main characteristics of the last economic reform era were the orientation towards markets and the introduction of high-yielding crops and varieties. Market orientation often shifts women's traditional control over land- and plant-based resources to men as these resources become more valuable (Howard 2003). It can also stimulate over-exploitation in the absence of strong systems of indigenous resource control (Price 2003; Wooten 2003). The introduction of new crops and varieties has an impact in several areas:

- Agro-biodiversity: In several cases, the studies conclude that agro-biodiversity has increased with the introduction of improved crops and varieties. This is true in the short term but over a longer period of time it is likely that the new varieties will displace traditional crops and landraces, as the findings from several other cases indicate. Furthermore, this analysis does not take into account the genetic diversity contained in the different varieties. Whereas local crop varieties are usually based on a wide range of genetic material, improved varieties are known to have a narrow genetic base.
- Food security: Although many policy programmes studied by LinKS introduced new crops and varieties with the aim of improving food security, there is no evidence from the data that this was actually achieved. Nor is there any analysis of the equity of improved agricultural technologies, such as improved seed and fertilizer. While these interventions may have been beneficial for some households, they may have increased the gap between the better- and less well-off in that community (Tripp 2006).
- Seed management: The introduction of new crops and varieties through the formal system offers the potential for farmers to experiment with new seed material and to broaden their choice of seed supply. However, it may also undermine existing local structures as the formal system often distributes seed as part of subsidized programmes, which come with other external inputs and may bias farmers' selection of seed. The negative impact of seed distribution on local seed systems has been reported by a wide range of authors in different contexts (Dominguez and Jones 2003, Sperling et al. 2003).

3.2 INCREASED CLIMATE VARIABILITY

While climate variability was not directly addressed by the LinKS studies, climate events were identified as having played an important role in crop diversity changes in the past and influencing farmers' decisions to use mixed-farming systems at present. Zhao et al. (2005) suggest that increasing climate variability (e.g. extreme climate events) is likely to be more important than the more gradual changes in average climate. All assessments conducted by the International Panel on Climate Change (IPCC) suggest that climate variability and climate change (primarily droughts) will generally have significant impact on almost all farming systems in Africa (Thornton 2006).

In light of this, agro-biodiversity and its decline acquire new significance. Agricultural genetic resources are not only falling victim to climate change; they are also of fundamental importance for adapting to this change and coping with the problems it poses. Plants and animals that have had little economic value until now, but which can cope with the changing climatic situation will become more important.

Plant resistance to environmental stress (e.g. drought tolerance) is a multi-genetic characteristic. It is difficult to achieve this through genetic engineering and best developed through classical breeding under *in situ* conditions (GTZ 2006b). At the World Social Forum (2007) in Nairobi, Kenya, African civil society organizations made the following statement which emphasizes the importance of diversity:

> *"The future of agriculture for Africa and the world will have to build on this biodiversity and farmers' knowledge, especially in the current context of climate change. The diversity of seed varieties continually developed by African farmers will be vital to ensure that they have the flexibility to respond to changing weather patterns. With the challenges that climate change will bring, only a wealth of seed diversity maintained by farmers in Africa can offer a response to prevent severe food crises."*

3.3 THE IMPACT OF HIV/AIDS ON SEED DIVERSITY AND FOOD SECURITY

HIV/AIDS has a negative impact on seed diversity and food security, as it further reduces the labour resources and economic capacities of affected households (FAO 2007; FAO and ICRISAT 2004). Female-headed households and households caring for orphans were found to cultivate less diverse crops and as a consequence were more likely to be food-insecure. They also depended more on collected and minor crops as a major portion of their diet (FAO 2007). These findings are supported elsewhere. For example, Gari (2002) concludes that HIV/AIDS causes severe labour and economic constraints that disrupt agricultural activities, aggravate food insecurity and undermine the prospects of rural development.

The HIV/AIDS pandemic in southern and eastern Africa is not just a human health crisis; it also threatens biodiversity. Farming parents may not live long enough to pass on knowledge about local plants to the next generation (Bioversity International website 2007). Biodiversity is a casualty of the HIV/AIDS epidemic, but it can also be harnessed to help those who have become infected and are suffering the debilitating effects of the virus. Most farming communities in the region have almost no access to anti-retroviral medication, so proper nutrition may be the only means they have to boost their immune system. All over the continent, people are turning to plants for treatment, putting pressure on biodiversity and threatening several species. Research is needed to look at the efficacy of these plant-based treatments and to study options for cultivating them to ease the pressure on the environment. This is especially important in relation to endangered tree species with medicinal properties, which are currently being overexploited and extracted for purposes supposedly related to the treatment of HIV/AIDS.

3.4 WHAT WE HAVE LEARNED SO FAR

- There are several drivers that impact crop diversity: introduction of new crops and varieties; natural climate events; changes in household structure as a result of HIV/AIDS.
- Introduction of new crops and improved varieties is one of the main drivers that impacts agro-biodiversity, food security and seed management.
- There is a need for the formal sector to recognize the impact of climate change and address the new challenges.
- Long-term diseases, such as HIV/AIDS, are a driver for change due to their negative impact on family resources.

Questions to address to different socio-economic groups to gain a better understanding of the impact of new crops and varieties include the following[6]:	Is the number of plant varieties per crop grown by men and women in the locality stable, increasing or decreasing?	Is the number of varieties of traditional crops used in food production – including staple crops –stable or increasing?
	Is the amount of land devoted to modern cultivars increasing or decreasing? Are there gender differences in the allocation of land? Are there any compensating measures in place, such as allocation of small plots for traditional crops?	Are there efforts to broaden the genetic bases of crops with narrow genetic bases?
	Is the number of male and female farmers engaged in *in situ* management of Plant Genetic Resources for Food and Agriculture (PGRFA) stable, increasing or decreasing?	Can farmers afford access to the plant varieties they need and can they save, reuse and exchange them according to their customary practices?

[6] Questions adapted from Anderson 2006.

Questions that address the impact of extreme weather events and climate change include:	What are the main criteria when selecting new crops and varieties?	How many of your crops and varieties are tolerant to drought?
	How frequently do you experience drought in this area?	Are those mainly local crops and varieties or are they improved crops and varieties?
		How do you cope in years with extreme drought?

The issue of long-term disease is very sensitive to discuss with household members. To obtain meaningful information, the project needs to establish a strong relationship of trust before being able to explore this aspect in any detail. However, a few preliminary questions can be asked, including:	Do HIV/AIDS-affected households have the same access to seeds and food as other households in the community?	Are HIV/AIDS-affected households involved in the formal and/or informal seed system?
	What are the main crops and food sources that HIV/AIDS-affected households rely on for food security?	