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Local Seed Systems and external influences: a Case Study from the United Republic of Tanzania

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Local seed systems and external influences: a case study from the United Republic of Tanzania

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It is based on two studies which were produced under the FAO-LinKS Project in the central and southern highland zones of the United Republic of Tanzania, on local knowledge systems and their importance in the management of local plant genetic resources (Mkuchu *et al.,* 2005; Letayo *et al.,* 2005).

Local seed systems and external influences: a case study from the United Republic of Tanzania

This case study is based on a research on local knowledge systems and agro-biodiversity carried out in Central Zone and Southern Highlands by the FAO LinKS Project. It highlights and explains how political decisions and socio-economic changes have influenced local seed systems and the availability of local seeds in Tanzania over the past 50 years.
The information generated from the research is here put into a wider national context to better understand how farmers and their local seed system react to outside influences such as markets and changes in extension approaches. The report presents the main events and policy changes that may have had a repercussion on local seed systems and associated local knowledge and then analyses their different impact on men and women's access to and control of resources.

INTRODUCTION

Background to the study

FAO launched the LinKS project in 1998 as a regional effort in Southern Africa aimed at raising awareness about how rural men and women use and manage biological diversity. The project is called LinKS because it explores the *linkages* among the crucial issues of local knowledge systems, gender roles and relationships, food provision, and the conservation and management of agro-biodiversity. The project seeks to help development practitioners recognize that male and female farmers' knowledge, practices and skills are often highly sustainable and respectful of the natural ecosystems they depend on for their food and livelihoods. The project was launched in four countries in Southern Africa: Mozambique, Swaziland, the United Republic of Tanzania and Zimbabwe. It works with a diverse range of local institutions – both government and non-governmental – to strengthen their ability to recognize and value this knowledge and to use gender-sensitive and participatory approaches in their work.

The project is administered from FAO Headquarters in Rome. As well as its hands-on field activities, LinKS also plays an important role in collecting information from the project countries and feeding this information into the wider context of FAO's work. The project can contribute to FAO's commitment and work on plant genetic resources, the conservation and management of biodiversity and natural resources management with lessons from the field, experiences and databases.

The study of local knowledge systems and agro-biodiversity in Tanzania was prompted by two major concerns: the limited understanding and recognition of local seed management systems and their relationship with household food security in the country; and the seed history and policy changes in Tanzania over the last 50 years. The study was coordinated and funded by the FAO-LinKS Tanzania project phase two, whose goal is to enhance rural people's food security through promoting the sustainable management of agro-biodiversity and strengthening the capacity of agriculture sector institutions to apply approaches that recognize men and women farmers' knowledge and contributions to seed management programmes and policies.

Tanzania has experienced numerous changes in political, social, economic and environmental policy, as well as changes in the natural environment. These have had an impact on seed management and the evolution of crop diversity. Among the notable policy changes of the last decade and a half is liberalization of the seed industry. Under this liberalization, private companies have been authorized to invest in the seed industry to complement the government's efforts. Despite this development, only a fraction of the seeds

grown by farmers are from national sources. Less than 30 percent of the land in Tanzania is planted to new varieties of maize, sorghum and pearl millet, and less than 10 percent of farmers have ready access to seed of new varieties (Rohrbach *et al*., 2002).

The national seed sector in Tanzania caters mainly for those few crops that it considers major cash crops and/or food staples, and has neglected minor crops that are equally important to household food security. This has left farmers to rely on the local seed system as a major source of seed for most of their crops. This study underlines the importance of the local system in filling the gap in meeting the demand for food crop seeds in the country.

Despite the national seed system's important role, there is limited understanding and recognition of the importance of local knowledge in seed management. Understanding of the state of the agro-biodiversity from which seed is drawn, and the implications of this for future seed and food security and the functioning of local seed management systems, is also limited. Stakeholders also understand little of the linkage between maintaining agro-biodiversity and food security. This study aims to address these gaps by providing empirical evidence on the role of gender-differentiated indigenous knowledge in the management of seed/biodiversity, and the relationships between this and household food security.

The conceptual framework

As one of the factors underpinning the current seed management system in the study area, the evolution of the seed management system over the past 50 years was studied. Links were made among the localized natural environment, the macro-level variables such as policies and political and socio-economic changes, and the micro-level responses at the community and household levels. The study also explored the reasons for gender differences in local knowledge of seed management and biodiversity, and differences in intra-household food security. In rural agriculture-based societies, women and men manage different crops, and this has a varying but significant role in household food security.

People in any rural locality have local knowledge that has been accumulated since farming began more than 10 000 years ago. This knowledge has either been preserved intact or been adapted to the changing interactions, experiences and traditions within the area (Wood and Lenné, 1999). This is the knowledge that local people have used to sustain their environment and livelihoods over years, despite changing socio-economic, political and natural situations. Communities generate and transmit this knowledge over time, in an effort to cope with their own ecological and socio-economic environments. This occurs through a systematic process of observing local conditions, experimenting with solutions and adapting previously identified solutions to modified environmental, socio-economic and technological situations (de Boef *et al*., 1993).

The gender dimensions of biodiversity conservation are also vibrant. Subsistence-oriented female and male farmers have played crucial roles in conserving crop genetic resources in the form of landraces. Landraces are genetic materials conserved *in situ* (on-farm) by growing them continuously. In modern plant breeding programmes, landraces serve as precursors in the development of modern or improved varieties. They also contribute to ensuring household food security, especially for resource-poor households. In response to the loss of habitats, which results from such factors as the encroachment of human activities, plant breeders have introduced *ex situ* conservation. This conserves genetic materials outside their natural habitat, for instance, in modern gene banks (Almekinders and Louwaars, 1999).

In order to harness the indigenous knowledge of local users, some countries have introduced participatory agro-biodiversity management programmes that take indigenous knowledge into account in conservation activities. Such programmes arose when it was realized that the preferences of breeders may differ significantly from those of farmers, resulting in bred varieties not being adopted. Breeders usually consider only the agronomic and physical characteristics, leaving aside both socio-economic factors, including farmers' preferences, and organoleptic aspects (sensory attributes). When farmers have not been involved in variety development from the beginning, the collection of agro-biodiversity from local farming communities proceeds with no understanding of the local knowledge that has

generated and maintained it over generations (Stroud, 1996). Subsequently, not only is indigenous knowledge eroded, but also the resultant improved seeds are unlikely to be adopted. Examples of participatory agro-biodiversity management in Tanzania include the community seed production that is carried out in some regions. Among such initiatives are the On-Farm Seed Production Programme, which is implemented by the Seed Unit of the Ministry of Agriculture and Food Security, the Primary School Seed Multiplication Programme, which is planned and supported by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the Sustainable Seed Multiplication Programme, which is implemented by the Diocese of Central Tanganyika (DCT) (Rohrbach *et al*., 2002).

As gender-based local knowledge plays a central role in defining the activities and strategies used in the management of seeds for improved food security, its link to biodiversity management needs to be closely examined. This case study uses a gender lens to analyse the changes in local seed diversity and management practices that result from changes in the policy, political, social, economic and natural environments.

APPROACH AND METHODOLOGY

Objectives, study area and sample

The broad objective of this study is to enhance the ability of researchers and development workers from key partner organizations to understand local knowledge on the maintenance and use of seed varieties, in order to improve and strengthen household seed and food security. In order to capture all crops, Stroud's (1996) categorization of crops has been adopted. Stroud categorizes Tanzanian crops into three major groups: main staples, minor neglected (marginalized), and collected. Neglected crops are those that the national seed system does not consider, and collected crops are those that occur naturally and for which there are no established seed management and conservation practices even in the local seed system.

There is a great diversity of agricultural zones in Tanzania. For this study, two distinct zones were selected and sampled for comparative purposes. The central zone was selected for its proneness to drought and low exposure to national seed interventions, and the southern highlands because it has been heavily exposed to seed interventions, which have increased the availability of improved varieties. Two villages were identified in the central zone: Misughaa village in Singida Rural District and Dabalo village in Dodoma Rural District. In the southern highlands, Malinzanga village in the Iringa Rural District of Iringa Region and Shinji village in the Ileje District of Mbeya Region were selected. A total of 144 farmers (36 from each village) participated in the study.

Data collection methods and tools

Given the qualitative nature of the study, the main tools used for data collection were open-ended interviews with checklists/guides. The study was conducted in a participatory manner in which focus group discussions (FGDs) were used to gather most of the information from communities. Key informant and individual-based interviews were also conducted. The interview process followed an interactive approach, allowing room for feedback during the interviews. The interviews were accompanied by field visits and observations to assess farmers' activities and validate the accuracy of the information obtained through interviews.

GENDER, SEED AND BIODIVERSITY MANAGEMENT AND FOOD SECURITY

The consequences of major nationwide and natural events on seed and food security

This section describes the major nationwide and localized events of the last 50 years that have had a bearing on changes in biodiversity – that is, on its loss or increase – and, as a consequence, have led to changes in household seed and food security. Where data were available, the study attempted to establish the link between major events and changes in seed availability and food security in the study areas. This section provides a summary of major

changes in the four villages studied. Table 1, at the end of the section, provides more detailed chronological changes in crops and varieties in one of the villages. The information in the table is based on in-depth interviews with older members of the rural community about their perceptions and memories.

Policy and political drives

Pre-independence era (pre-1961): During the pre-independence era, a number of transformational social policy changes were promoted to improve household seed and food security. However, a bias towards the development of cash crops was one of the distinctive characteristics of colonial policy, with the development of food crops and their seeds usually lagging behind. Food security was implicitly assumed in that households were assumed to be food-secure, despite the very limited development of food crops. Policies adopted during this period include the following:

Construction of storage structures: These were built in the chiefs' premises for easy management and security of stored grains. Every season, each family/household was required to contribute from 40 to 60 kg of foodgrain after harvest. The reserved grains were used to provide seeds and food to families whose crops failed in the following season resulting in hunger. This practice was established prior to colonization, but continued throughout the colonial era.

Coercive extension services: The extension service staff of the colonial regime enforced strict by-laws and corporal punishment to increase adoption of the extension messages and packages required for the production of specific crops. Although this approach had a great impact on increasing agricultural production, it was not sustainable. Such socially coercive extension services involved brutality, resulting in farmers' hatred of extension workers. During this era, cash crops were introduced and flourished in some of the areas surveyed. For instance, cotton was introduced in Misughaa village. This was accompanied by production packages that were enforced by colonial extension workers and included row planting, pest and disease control and post-harvest management. As cotton was cultivated on communal farms, it contributed positively to household food security because the proceeds of sales could be used to buy food from the market.

Strong cooperative movements: In Tanzania, the cooperative movement dates back to 1925, when the Kilimanjaro Native Planters' Association (KNPA) was registered. In 1933, the provision of a legal basis for cooperatives paved the way for the Kilimanjaro Native Cooperative Union (KNCU), which later became a legal purchaser of African-grown coffee in the area. Then came the Ngoni-Matengo Cooperative, registered in Songea in 1936 to market fire-cured tobacco. The Victoria Federation of Cooperative Unions (VFCU) was created and registered in 1952 to market the cotton crop (Carlsson, 1992). Major functions of cooperatives during the colonial period were:

- marketing of farm produce;
- distribution of agricultural inputs;
- participation in the struggle for independence.

In the central zone, the executive power of cooperatives was in the hands of chiefs, sub-chiefs, *Wanangwa* (ward executive officers) and militiamen, as noted in Dodoma. The cooperatives provided agricultural inputs and a reliable market, which helped farmers to increase their production of both food and cash crops, hence improving food security.

Post-independence and pre-reform era (1961 to 1980): The transformational policies of the colonial era were followed by post-independence and pre-reform era policy drives, the major

ones being socialism and self-reliance and villagization policies. Theses encouraged food sufficiency more than the cash crop-biased colonial/pre-independence policies had done.

Cooperative movements: After independence, the new government acknowledged the important role of cooperatives in marketing agricultural produce. The Cooperative Union of Tanganyika (CUT) was formed to create an institutional link between cooperatives and the then ruling party – the Tanganyika African National Union (TANU). To stimulate the growth of cooperatives further, the government relaxed the Cooperative Societies Ordinance of 1932 to allow more cooperatives to be registered. Subsequently, many cooperative societies were formed by the new political leadership. As the number of societies grew, the number of regional cooperative unions reduced through amalgamation, from 38 in 1960 to 33 in 1967 (Carlsson, 1992).

Socialism and self-reliance (the Arusha Declaration): The Arusha Declaration of 1967 led to the establishment of communal farming arrangements in which people worked together under the supervision of an extension worker. Such collective farming was aimed at reducing food insecurity in households in rural communities through increased collective production. Research institutions in the country were empowered by the provision of more skilled labour and financial resources. Improved maize varieties were developed and their seeds were produced and widely distributed to farmers. This affected local maize varieties, and indigenous varieties started to disappear, although communities experienced increased biodiversity from the improved varieties. In Dodoma, for instance, new grain seed varieties for sorghum (Serena, Lulu and Sandala) and maize (Katumbili and Mwezi Mmoja) were introduced (see Table 1).

Two major strategies to promote seed multiplication and the distribution of improved varieties were pursued. In 1973, the government created the parastatal Tanzania Seed Company Limited (TANSEED) with monopoly rights to produce, process and distribute or market the seed of most major cereal crops. In the same year, the Tanzania Official Seed Certification Agency (TOSCA) – renamed the Tanzania Official Seed Certification Institute (TOSCI) in 2005 – was formed and mandated with the supervision and quality monitoring of seed production and the training of district extension officers and the Seed Unit of the Ministry of Agriculture. TANSEED only meets up to 10 percent of national seed requirements, and faces particular difficulty in trying to distribute seed commercially beyond a few urban areas (Rohrbach *et al*., 2002). This has been attributed to inefficiency within TANSEED, resulting in a relatively large untapped market for improved seeds, inadequate seed quality control and ineffective application of official regulations (United Republic of Tanzania, 1997).

In addition, seeds from the national system are sold at high prices and are thus not affordable for most farmers. Certain seed varieties do not reach farmers at the right time, especially in less accessible villages. Farmers also argue that seeds from the national seed supply system demand high inputs that many small farmers cannot afford. Figure 1 below shows a linkage map of the national seed system prepared by the stakeholders of the LinKS seed research carried out in Central Zone and Southern Highlands. The map reflects their interpretation of seed flow in Tanzania.

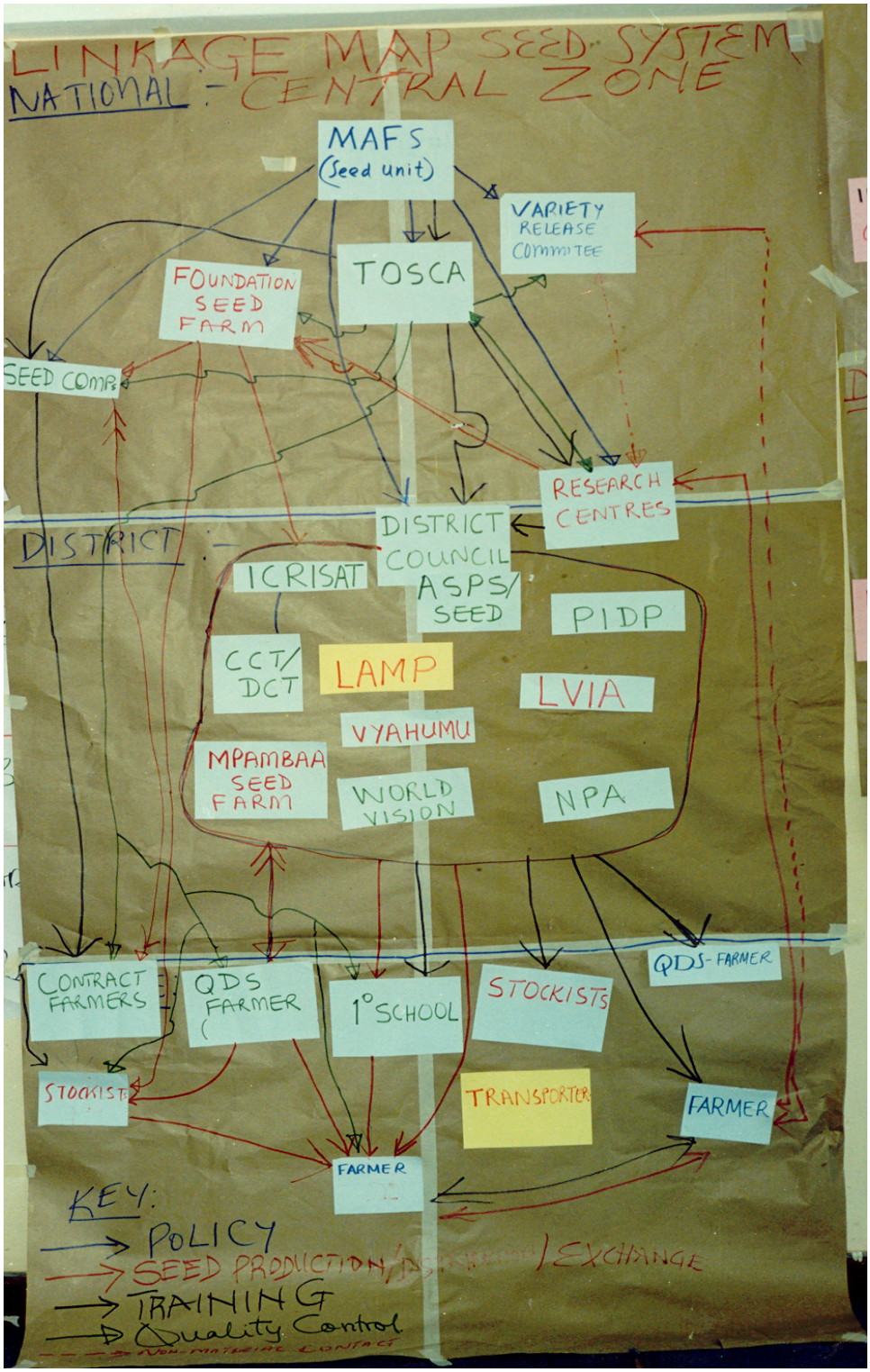

Figure 1 Stakeholder Linkage Map, Central Zone, Tanzania

The villagization policy: As a follow up to the Arusha Declaration, the villagization policy was instituted officially in 1973 and concluded in 1975. It involved evacuating families, through coercion in some cases, from their old settlements to new ones, where they were put together in villages. By the end of 1975, almost everyone had moved to the so-called Development Villages. Villagization was basically a continuation of the Ujamaa village (communal village) concept. The difference being that under communal villages people moved voluntarily, while under villagization they were moved by force – to live in communal villages being a government order.

This move was accompanied by the introduction of agricultural extension services, more improved varieties of food crops, the use of pesticides and fertilizers, and changes in storage techniques. Respondents view this policy as having had more negative than positive implications on household food security because it led to:

- increased distances for farmers from the new settlements to their farmland, and reduced areas of cultivated land per household;
- reduced seed availability, as some farmers lost seed during the move to new settlements, and more seeds were consumed by households that had lost their harvest stocks in the migration; examples of seeds that were lost and/or consumed are maize, sorghum and Bambara nuts;
- loss of fertile land for many farmers, as their old farms were located faraway and were no longer easily accessible;
- increased livestock thefts and reduced purchasing power for households as they had little to sell for income generation.

As the villagization programme unfolded, increased biodiversity was observed as a result of the flow of new varieties from local agricultural research centres, such as Ukiriguru and Ilonga and releases from Serere Research Centre in Uganda, into the new settlements/villages. Many farmers in the two southern highlands survey villages reported that they stopped growing local maize (*Sebea)* on small plots because of its low-yielding characteristics. Resettled farmers eventually stopped growing reddish local maize varieties altogether because they were no longer wanted reddish-coloured flour. This process took a year or two. In most zones, there is only one maize season per year, and when they tried the new white maize varieties farmers found that they preferred their greater palatability and higher-yielding characteristics. They therefore continued to plant white varieties only the following year/season. Sorghum local varieties Lugugu, Hembahemba, Mgali and Nyakwinyamila were lost because farmers stopped growing them as they are susceptible to birds. Among root crops, farmers stopped growing local groundnuts (prostate type) because they are not drought-tolerant. As farmers lost interest in their traditional crop varieties, the diversity of local crop varieties started to dwindle.

Farmers in Shinji village reported that areas under local maize varieties Njelenjele and Sokosela was reduced in 1975 because of their low-yielding and late-maturing characteristics. Instead, the farmers started to grow more of the introduced improved varieties UCAA, Mofati and H336, which are high-yielding and early-maturing. Drought-resistant crops including sorghum, sunflower and cassava were also introduced. During this period, agricultural policies emphasized the use of improved varieties and fertilizers. Agricultural knowledge was provided through extension services aimed at increasing food self-sufficiency at the household level. Varieties of beans such as Chipukupuku, Masusu and Mwasipenjele were introduced, and farmers were taught seed and food storage techniques to reduce losses. However, the introduction of new crop varieties resulted in outbreaks of pests such as stalk borers, leading to the use of pesticides in villages, which had not been necessary in the past.

Two other important declarations were made over this period: Politics is Agriculture (Siasa ni Kilimo) and Agriculture is a Matter of Life or Death (Kilimo cha Kufa na Kupona). Agricultural reforms (Siasa ni Kilimo) in 1974 were intended to increase food production, with the government emphasizing the use of improved crop varieties and agronomical practices. In Malinzanga village, maize varieties such as Tuxpeno, Bwana lomba and Katumani and black sunflower varieties were introduced, which increased crop diversity and improved food security.

Strengthening/formation of crop boards: Another major policy drive during this period was the strengthening or formation of cash crop boards. According to Odergaard (1985), there were four marketing boards before independence: the Tanganyika Coffee Board (TCB), the Lint and Seed Marketing Board (LSMB), the Tanganyika Pyrethrum Board (TPB), and the

Tanganyika Tea Board (TTB). After independence, crop boards were formed for each major cash crop. The main role of these boards was to coordinate marketing activities at the central level, and to explore and obtain access to opportunities in external markets; these functions could not be performed by cooperative unions owing to their localized and decentralized nature. By the end of 1963, 12 national marketing boards had been set up; these then appointed the cooperative unions as purchasing agents. The marketing system consisted of a three-tier set-up of primary cooperative societies at the local level, cooperative unions at the regional level, and marketing boards at the national level (Carlsson, 1992).

The marketing boards promoted the building of storage facilities in villages (go-downs), provided subsidized inputs such as seeds and fertilizers, and ensured that output markets were readily available for farmers in rural areas. The villages, particularly Misughaa, increased their cotton production (input supply and marketing for cotton was overseen by the Cotton Board), which increased the purchasing power of households and, as a corollary, improved household food security.

Policy and socio-economic drives in the economic reform era: 1980 marked the beginning of the era of economic and social liberalization. With pressure from international financial institutions, such as the International Monetary Fund (IMF) and the World Bank, and other donors, Tanzania embarked on a path of social and economic reforms. These were popularly dubbed "structural adjustment policies" and aimed to revamp the economy. They were accompanied by political liberalization to allow multiparty politics, and governance reforms to enhance the accountability of public institutions. Although it led to macroeconomic stability, the impact on agriculture of the liberalization programme and other macroeconomic policies adopted since has been slow, given the importance of agriculture for the Tanzanian economy. The expected growth of the agriculture sector has not occurred, and improved food security and development of the rural economy have been equally slow. Food insecurity remains a threat, particularly in rural areas, and food aid from abroad is still sometimes needed to fill food shortfalls.

The Economic Reform Programme: In 1985/1986, the government adopted the three-year Economic Recovery Programme (ERP) with support from the IMF, the World Bank and other international donors. This was followed by the second Recovery Programme (ERP II), also called the Economic and Social Action Plan (ESAP), which was implemented from 1989 to 1992. The main elements of these programmes were reduction of the fiscal deficit, a series of large devaluations, import liberalization, a drive to achieve positive real interest rates, and price deregulation for most consumer items.

As well as the major macroeconomic reforms, there were also specific reforms for the agriculture sector, including liberalization of domestic food markets. Between 1986 and 1989, private trade in food crops was deregulated, starting with minor crops and leading up to include maize and rice. Then, in 1993, the liberalization of traditional exports began, with changes in the marketing arrangements for coffee, cotton, tobacco and cashew nuts allowing private traders to buy, process and export these crops (United Republic of Tanzania, World Bank and IFPRI, 2000). The idea behind this move was for the government to disengage from the direct production and marketing of crops in order to focus on essential public services for agricultural development, such as research, extension, sanitary regulations and quality control.

For the seed system, the main impact of the economic reforms was the entry of private traders into the distribution of seed and other agricultural inputs. Private traders began to distribute fertilizer and other inputs in 1992, and imported them from 1994. This was possible because after 1990 the government no longer controlled seed prices. As of 1998, there were 13 private seed companies operating in Tanzania (Mfungahema, 1999). Most of these were concentrating on the import of seeds for a few horticultural crops with a few selling seed for staple cereal crops; however, access to improved seed remained limited in most parts of the country (Rohrbach *et al.,* 2002).

Contrary to the improved performance that the reforms were expected to bring, liberalization had a negative affect on output and producers' earnings from major cash crops, such as coffee and cotton. As a result, in some communities, these crops were abandoned and starting to disappear. Communities are now returning to them, however, as Tanzania continues slowly to regain international markets for these crops, while exploring alternative crops to diversify risks. For example, cotton cultivation in Malinzanga village dropped drastically in 1985 because of the lack of market, but was reintroduced in 1993 as nationwide efforts were made to cushion the agriculture sector against the adverse impacts of liberalization. In Misughaa village, cotton disappeared owing to the loss of stable and reliable markets following the collapse of cooperatives.

The introduction of improved food crop varieties was intensified during the liberalization era. In Shinji village, many crop varieties were introduced throughout the 1980s and 1990s in response to market forces and government interventions aimed at improving food security at the household level. Among the varieties introduced were the maize hybrids MH17, MH18, Katumani and MH14, and the bean varieties Kigoma, Maini, Kablanketi and Mashabala. The rice variety Kilombero was also introduced (see Table 1), as were two sorghum varieties – Tegemeo and Serena – and a banana variety. These varieties improved food and income at the household level because of their high yield potential and marketability. Many households in the area abandoned the local bean breeds Nambisa and Masipenjile because varieties with higher market value and improved organoleptic aspects were introduced. Over this period, the government also promoted the drought-resistant sorghum variety Serena in drought-prone areas (see Table 1).

The government banned bush clearing and burning in the early 1990s as an environmental protection strategy. This made it difficult for many farmers in Shinji village to grow finger millet, which needs virgin land after slash-and-burn practices. It also caused simsim and cowpea to start disappearing, as these were grown in association with finger millet in mixed cropping systems. Soybean was introduced in 2000 by the Ileje Rural Development Trust Fund (IRDTF), but had disappeared by 2002 owing to a lack of local markets and because people in the area did not like it as food. The black variety of castor oil had been produced in Shinji village since its inception in the early 1950s, but it became less important and disappeared in the 1980s when imports of other types of skin-softening oil surged on to the market and into local shops. Some farmers still grow a few castor plants for medicinal purposes.

The closure of the parastatal Dodoma Wine Company (DOWICO) in Dodoma had a negative impact on grape production because DOWICO used to be the major buyer of grapes. As a consequence, Dabalo and other villages in Dodoma have decreased their grape production substantially.

Agricultural and livestock policy (1997): This policy acknowledges the role of indigenous knowledge in seed management, although indirectly through a policy clause that mandates the encouragement and facilitation of national and local seed production, conditioning[1] and marketing. A notable new development after the inception of the policy was the production of quality declared seeds (QDS) at the farm level. Among the positive impacts of this are the increased availability of improved seed at the farm level and the initiation of open markets for crops. Other implications of the policy are an increased emphasis on irrigation faming, which has led to the expansion of horticulture, as noted in Dabalo village, and a change in the agricultural extension approach from the contact farmer to the group approach and farmer field schools (FFS). Remarkable improvements have also been made regarding the adoption of new improved technologies and farmers' experimentation, because the new approaches

[1] Seed conditioning involves the following steps: removing impurities and bad-quality seeds, calibrating seeds, using pesticides to protect seeds, and putting seeds in sacks or leaving them in bulk for storage in well-ventilated metallic warehouses before distribution.

make it possible to reach more farmers than the individual farmer extension approach of the past. The policy is operationalized through the Agricultural Sector Development Strategy (ASDS) (United Republic of Tanzania, 2001).

Under the QDS system, the village community selects farmers to produce seeds of various crops to be sold to other farmers at affordable prices. To make the system successful, the village agricultural field officer and the village government closely supervise the farmers involved in seed production. Experts from the district agricultural office, the Seed Unit of the Ministry of Agriculture and TOSCI provide technical backstopping and approve the seeds before they are sold to other farmers or multiplied.

Other important policies and strategies: Among the policies and strategies that have underlined the importance of investing in agriculture as the backbone of the Tanzanian economy are the Food and Nutrition Policy of 1992, the Agricultural Sector Development Strategy (ASDS) of 2001, the Rural Development Strategy (RDS) of 2001, the Poverty Reduction Strategy Paper (PRSP) of 2001, and the renamed poverty reduction strategy the National Strategy for Growth and Reduction of Poverty (NSGRP or, in Swahili, MKUKUTA) of 2005 (United Republic of Tanzania, 2005). RDS and ASDS emphasize the importance of research that actively involves farmers, livestock keepers and agribusinesses in formulating research priorities and systematically monitoring and evaluating research results. RDS also notes that it is important to attract private investment not only for agricultural extension and/or research, but also for agricultural technological evolution, such as large- and small-scale mechanization. The need for research agendas that focus on the needs of women farmers is also underlined.

Whereas some policy drives and declarations, such as Agriculture is a Matter of Life or Death (Kilimo cha Kufa na Kupona), included packages for agricultural improvement – and thus food security – others have contributed to household food security more implicitly. These include adult education and universal primary education (UPE) drives, which led to reform of teaching curricula to include education on improved agricultural practices and the creation of gardens in schools where children can learn by seeing and practising. Several other sector policies that were formulated during the liberalization period have had an implicit impact on agricultural performance. These include the Water Policy of 2002, the Forestry Policy of 1998, the Wildlife Policy of 1997 and the National Environmental Policy of 1997.

It is worth noting that the Plant Protection Act of 2001 gives farmers plant breeders' rights over their seeds and plant varieties. However, most farmers have no knowledge of either the act or the procedures for acquiring rights over their products and seed production processes.

Although policy guidance on the conservation and management of biodiversity is provided by the Agricultural and Livestock Policy and the National Environmental Policy, indigenous knowledge has not received adequate attention in the overall policy framework. Kaiza-Boshe (FAO, 2003) observes that the National Cultural Policy is the only policy to give indigenous knowledge a central role, but this policy is poorly placed to influence the recognition of indigenous knowledge and the implementation of other policies.

Other changes: Several other changes that have occurred cannot be linked to a specific policy change or natural event. In both Misughaa and Dabalo villages, a change from livestock to crop farming systems has been observed. There have also been gradual changes from mixed cropping to sole cropping. These changes are associated with institutional and market changes at various times. Some crops, such as castor, have been lost, while others, such as yellow maize, paddy rice, tomato, cabbage, egg plant and fruits (guava and pawpaw), have been introduced. Over the years, the crops grown have changed in response to their importance for food security, their marketability and the introduction of new food or cash crops. For instance, the introduction of cotton as a cash crop led to the disappearance of castor.

In Dabalo village, new varieties of Bambara nut and pearl millet were introduced in 1968. More recently, in 1998/1999, several crop varieties were recorded as lost, including sorghum (Mhumputa, Hemba hemba, Sanyaji, Tooga, Serena and Lulu), maize (Sabatele), lablab (white and black) and tobacco (Magogo). At the same time, new crop varieties, including

maize, have been introduced. Maize has become a dominant crop because of its increased importance for food and cash. Kaliba *et al.* (1998) attributed the adoption of maize variety CG 4142 in the intermediate zone and its dissemination in the central zone to the efficient marketing strategies of Cargil Seed Company.

It is worth noting that in some areas, as exemplified by the Misughaa village case study, the introduction of new crops or improved varieties has not caused much loss of local landraces, and instead the two types coexist. In other areas, such as Dabalo village, the introduction of new varieties has led to the loss of traditional ones. The introduction of maize as a cereal food crop, and later a cash crop, has changed eating habits, leading to the loss of local sorghum and pearl millet landraces. However, mixed cropping continues to dominate the system because crops have different drought tolerance, disease resistance, time to maturity and roles in improving food security.

The nodal farmer concept: During the economic reform era, the concept of nodal farmers was introduced as a way of tapping indigenous knowledge. Nodal farmers are highly knowledgeable of different varieties of crop species in their villages. Most nodal farmers are elderly people who conserve several local varieties for different purposes. They play an important role in advising other farmers on planting, seed utilization, storage and other husbandry practices related to the varieties they conserve.

Natural events

Drought incidences*:* In the southern highlands, incidents of drought occurred in the 1950s and 1960s, causing frequent food shortage. As a consequence, in Malinzanga village drought-tolerant crops such as Bambara nut, sunflower and watermelon were introduced. Farmers exchanged labour for the seeds of preferred crop varieties. Collected crops became important, with farmers using wild fruits and certain types of grass for food, and learning how to mix fruits of the baobab tree with honey to eat. When they experienced shortages, some farmers borrowed seeds from neighbours, returning them after the harvest. Bambara nuts disappeared in the 1970s as a result of continuous droughts. Drought in 2000/2003 caused by weather changes led to the introduction of new high-yielding and early-maturing maize varieties, such as DK 8071 and CG4142.

Drought forced farmers at Shinji village to look elsewhere for seeds of different crops and varieties. They travelled to the nearby district of Tukuyu, where they found crops such as Livingstone potato, finger millet, sorghum, castor oil and simsim, which they then introduced into their own village. In addition, migrants from the Nyiha and Nyamwanga tribes who came to settle in Shinji during this period introduced other crops, such as pumpkin, groundnut, coco yam, banana, pigeon pea, cassava and cowpea.

In the central zone, some crops and varieties, such as yellow maize, were originally brought in for hunger relief in 1964, but are now important varieties grown locally. Immigrants also brought new crops and varieties. In Misughaa village, Wazigua immigrants and business people brought new varieties of watermelon, sugarcane, paddy rice, tomato, cabbage and fruits (guava and pawpaw).

Heavy rainfall*:* Good rains allow the successful cultivation of crops with high water requirements, but they may also be associated with the outbreak of pests. Shinji village has benefited from heavy rains; good rains in the 1960s led to the adoption of sugarcane, onion, amaranth and tomato in lowland areas. Rice production was introduced in 1993, and increased considerably during El Nino rains in 1998, thus improving food security. Heavy rains in 1996 intensified the production of sugarcane and vegetables such as tomato and onion.

TABLE 1

Crop and variety changes in Dabalo village

Period	Crop	Varieties		Important characteristics	Cause of change/source
		Lost	Incoming		
1960	Groundnut	-	*Mambunga*	Large grain size	Preferred by business people
	Castor	-	Black variety	Drought-tolerant Black seeds	Introduction of cash crop
			Red variety	Drought-tolerant Red seeds	Introduction of cash crop
			White variety	Drought-tolerant White seeds	Introduction of cash crop
1968-71	Bambara nut	-	*Mangambwa*	Drought-tolerant	Drought-tolerant
		-	*Tindilinda*	Drought-tolerant	Drought-tolerant
	Pearl millet	-	*Buruma*	Drought-tolerant High-yielding	Drought-tolerant
1972	Sorghum	-	*Lulu*	Early-maturing Short variety High-yielding White seeds	Release from Ilonga Research Centre
			Serena	Red seeds Early-maturing High-yielding Bird-resistant Drought-tolerant	Release from Serere Research Centre in Uganda; brought by government as a food security crop in drought-prone areas
1974-75	Cassava	-	Not identified	Drought-tolerant	Introduced as a food security crop after the drought and hunger of 1973
	Maize	-	Yellow corn	Yellow seeds High-yielding	Food aid from United States
1982	Sorghum	*Lugugu* (local landrace)	-	Late-maturing Tall Highly susceptible to bird attack	Continued crop failure owing to drought/short rains
			Sandala	Early-maturing Good brewing quality Suitable for stiff porridge	From neighbouring villages
1991	Grape	Makutopora red	-	Red wine	Lack of market after the collapse of Dodoma Wine Company Ltd
	Maize	-	*Staha*	Improved Early-maturing High-yielding Short variety	Release from Ilonga Research Centre Morogoro
			Ilonga	Improved variety Early-maturing High-yielding Short variety	Release from Ilonga Research Centre Morogoro
			Kito	Early-maturing Low-yielding	Release from Ilonga Research Centre Morogoro
	Sorghum	-	*Tegemeo*	Short variety Improved variety Early-maturing White seeds	Release from Ilonga Research Centre; introduced as a food security crop for low-rainfall areas
1998-2000	Sorghum	*Tooga*	-	Tall variety Late-maturing Local variety	Local people's preference for maize over sorghum

Period	Crop	Varieties		Important characteristics	Cause of change/source
		Lost	Incoming		
		Lulu	-	Short variety Early-maturing Improved variety Highly susceptible to bird attack. Susceptible to mould	Introduction of other improved early-maturing varieties
		-	*Pato*	Improved variety Short variety Early-maturing High-yielding	Release from Ilonga Research Centre
	Lablab	Black variety	-	Drought-tolerant Black seeds	Not marketable
		White variety	-	Drought-tolerant White seeds	Not marketable
	Maize		Cargil 4141 and 4142	Improved hybrid variety High-yielding Relatively drought-tolerant	Liberalization of seed policy in the country
		-	TMV1	Improved composite variety Early-maturing High-yielding Small-seeded variety	Release from Ilonga Research Centre Morogoro
	Bean (*Phaseolus)*	-	Kablanketi (small) "soya"	Local landrace Medium-sized seeds Fast cooking	Highly marketable in a liberalized market
	Pearl millet	-	*Okoa*	Improved variety Early-maturing High-yielding	Release from Ilonga Research Centre

Source: Mwanga *et al.*, 2005.

Crops grown and their uses

Table 2 shows the crops grown in the study areas. The major crops are grown for both food and cash, and in most cases there is no clear distinction between the two categories. In the villages surveyed, major changes in varieties grown and preferences were brought about by the introduction of new varieties through government interventions, immigration, changed weather conditions, farmers' and consumers' preferences, and market conditions.

Major crops

An interesting finding from Table 2 is that there is no notable difference between the types of major staple crops grown in the central zone and in the southern highlands, despite the differences in agro-ecological and geographical conditions. Differences are noted in the minor/neglected and collected crops, however. Government interventions through research and extension services have been the major influence behind the introduction and production of improved varieties of maize, rice, beans and sorghum, based on assessment of their potential yields, maturity periods and susceptibility to weather conditions and pests. In rare cases, consumers' preference has also been a motive behind the introduction of new breeding processes. Box 1 describes the many changes in maize varieties grown in the southern highlands study villages over time. In particular, it shows how improved varieties were brought to rural communities and how external influences have increased over time. It also illustrates the sources of new varieties and the extinction of local varieties.

Box 1: Progression of maize varieties

Farmers in the southern highland survey villages mentioned three major sources of new varieties of maize: neighbouring villages/countries, immigrants, and research centres through government interventions.

In Malinzanga village in the 1950s, only one white-seeded local maize variety (Sebea) was grown. Later, a Greek settler brought a new red-grained variety, but this did not fit well with farmers' preferences for making stiff porridge because of its colour. In addition, immigrants – mainly the Wabena tribe – introduced the Bwanalomba variety, and government interventions through research and extension services introduced such improved varieties as Tuxpeno, Katumbili, Katumani, Cargil, Kilima and TMVI. All the varieties introduced were white-seeded. The availability of diverse maize varieties led to the disappearance of red-grained maize. The local white-grained variety, Sebea, which farmers describe as low-yielding but resistant to storage pests, is also now disappearing because many farmers prefer higher-yielding varieties that produce enough for them to eat and a surplus for sale. The production of Sebea is very small and mainly in the hands of a few farmers, especially the elderly who use it for home consumption.

The same was noted in Shinji village, where Sokosela and Njelenje local varieties face extinction, although they have been grown for consumption since the 1950s. In the mid-1960s, improved varieties were introduced by Shinji villagers, especially men who worked in Malawi and Zambia. These varieties included the Malawian hybrids MH336, MH41, MH17, MH18, Mofati and Chitute. Later, the National Maize Programme introduced Ukiriguru (UCA) and Katumani composite varieties to the village.

The introduced improved varieties are high-yielding and early-maturing, but they are susceptible to storage pests. Maize that was previously used for home consumption only has become a major cash crop. This has been intensified by the availability of markets for maize. However, farmers have not had access to improved seeds every year, and this has necessitated the recycling of maize seed, which has had negative repercussions on agricultural production.

Source: Mkuchu *et al*., 2005.

TABLE 2
Crops grown in the study area[2]

Type of crop	Crops grown	Uses	Village(s) where grown
Major crops	Maize	Staple food, brewing	Malinzanga, Shinji, Dabalo
	Sorghum	Staple food, brewing	Shinji, Misughaa, Malinzanga
	Cowpea	Relish	Shinji, Misughaa, Dabalo
	Groundnut	Added value for leafy vegetables	Dabalo, Shinji
	Beans	Relish	Malinzanga, Shinji
	Rice/paddy	Staple food	Malinzanga, Shinji, Misughaa
	Finger millet, pearl millet	Staple food, brewing	Malinzanga, Shinji, Misughaa
	Cassava	Staple food, especially during dry periods	Shinji, Malinzanga
	Bambara nut	Complement to staple food, e.g., boiled with maize	Shinji, Dabalo
	Sweet potato	Staple food	Shinji
	Sunflower	Mainly for market, added value to relish	Shinji, Misughaa, Malinzanga
	Irish potato/ Livingstone potato	Staple food	Shinji
	Banana	Staple food, fruit	Shinji, Malinzanga,
Minor/neglected crops	Pumpkin	Leaves as relish, fruit as staple, seeds for cooking oil and added value to relish	Malinzanga, Shinji, Dabalo, Misughaa
	Watermelon	Fruit	Misughaa, Shinji
	Amaranths	Vegetable	Misughaa, Shinji
	Salads	Vegetable	Misughaa
	Okra	Vegetable	Misughaa
	Eggplant	Vegetable	Misughaa
	Lablab	Relish	Dabalo

[2] The information in this table reflects the view of respondents in the study area and is not necessarily the national classification.

Type of crop	Crops grown	Uses	Village(s) where grown
	Baobab	Fruit	Malinzanga
	Coco yam	Staple food	Shinji
	Sugarcane	Cash crop, snack, juice	Shinji, Misughaa
	Onion	Vegetable	Shinji
	Tomato	Vegetable	Shinji, Misughaa
	Cabbage	Vegetable	Misughaa
	Guava	Fruit	Misughaa
	Pawpaw	Fruit	Misughaa
	Soybean	Relish	Shinji
	Simsim	Added value to relish	Shinji
	Pigeon pea	Relish	Shinji
	Cucumber	Fruit	Misughaa, Dabalo
	Sponge gourd	Same as pumpkin	Misughaa, Dabalo
Colleted crops	Mlenda	Vegetable, fresh leaves as hair shampoo	Misughaa, Dabalo

Sources: Mkuchu *et al.*, 2005; Mwanga *et al.*, 2005.

Minor/neglected crops

Pumpkin is an important traditional crop that has been grown in the study villages for many years and is reliable during food shortages. All the varieties grown are local. Varieties such as Masasa, Magenge and Matondwe are found in Malinzanga village, while the two major varieties grown in Dabalo village are Matumba and Majenje. Farmers also grow local and improved watermelons.

It is worth noting that pumpkin seeds, which in the past were mainly used in various dishes at home and mainly grown by women, have gained markets in towns. The seeds, known as tetere in Malinzanga village, are highly marketable. As a result of the cash value it has earned, men have also developed an interest in this crop as a source of income. Another important neglected crop in drought-prone areas is sponge gourd (Mamumunya). This is very important to farmers in the central zone, where it sometimes dominates farmers' diets – especially during the dry season – because it is well adapted to the agro-ecological conditions. Box 2 describes the varieties grown in the study villages. No incoming new varieties have entered the villages, which can be explained by the lack of influence from the national system.

Box 2: Sponge gourd, a neglected but vital crop

Sponge gourd (*Cucumis cylindrica* or Mamumunya) is a neglected crop in the central zone, but it was reported as an important crop that can be consumed before other crops are ready. Thus, it is a crucial crop in alleviating the transitory food insecurity that is prevalent before the harvest of major food crops. It is used as a food, for making utensils and in rituals, and its seeds are used to extract virgin cooking oil, although the seed coat is a bit harder than that of pumpkin and watermelon. Respondents in Misughaa and Dabalo villages mentioned several varieties of sponge gourd.

The most important sponge gourd varieties in Misughaa village are Itranga la mwana and Itranga makundo. As well as being used as a food, Itranga la mwana is also used for ritual purposes to induce fertility among women with fertility problems. Women prefer the Mwasambaya variety because they can use it to make household utensils such as containers and grinders for groundnuts. Other varieties mentioned were Isukumbu, Inkewa and Mtetua.

In Dabalo village, women indicated Majuka and Mgome varieties, but preferred Mbwagale and Mchayungu because of their higher productivity and shorter time to maturity. Mamumunya meupe (white) and Mamumunya upele (rough) were also mentioned as important varieties grown.

Source: Mwanga *et al.*, 2005.

Collected crops

The agro-biodiversity of collected and neglected food crops has remained more stable than that of staple food crops. Collected and neglected crops have an important role in food security, especially during famine and before the ripening of staple crops. The major collected crop in the central zone is mlenda (*Corchorus olitorus*), the excess of which is dried for use during the dry season.

However, the national seed system has marginalized neglected and collected crops because non-farmer stakeholders do not consider them to be staple foods. Women are responsible for collected and neglected crops and have to prevent men from uprooting mlenda, sponge gourds and pumpkins during weeding.

Gender dimensions in seed management

In rural agricultural societies, both men and women partake in agriculture, and it is increasingly recognized that most farmers are women. There are two main reasons for this: first, women still bear the main responsibility for household sustenance and well-being; and second, women tend to have lower educational status than men and therefore face more difficulties in finding formal wage employment in urban areas. Women and men are assigned specific roles in agriculture, and therefore make different contributions to agro-biodiversity management. Women have the major role in managing neglected and minor crops, which are particularly significant in times of food scarcity. The liberalization era resulted to increased roles for women in household food security and general maintenance, especially after the collapse of major cash crops that had been the main responsibility of men.

Understanding the different roles and knowledge of men and women in agro-biodiversity management is necessary for the preservation of existing biodiversity and the development and adoption of new varieties. Regardless of whether it is men or women who predominate in agriculture and agro-biodiversity management, it is important to shift the focus of research, policies and action planning to include both men and women so that effective interventions in agriculture can be made.

A key issue in seed management is the differentiation of access to and control over resources between the male and female members of a household. Access to and control of resources and the gender division of labour are highly influenced by existing structures and processes at the macro and meso levels and by cultural ideas at the household (micro) level. It is often tradition rather than law that prevents women from controlling the produce accrued from their own efforts on an equal basis with men. When crops gain market value, men tend to take more interest in them and participate more in their seed management and production.

Gender-differentiated control of resources and decision-making

In the study villages, two major categories of access to and ownership of resources were distinguished:

- access to and control over the productive resource base, such as land, water, inputs, technical and market information and technology, and contacts, interpersonal networks and organizations;
- control over the benefits of production, such as cash income, food and other products for home consumption, sale or exchange.

Important changes in the survey villages over the last 50 years have contributed to changes in the resource use, access and control of benefits of men and women at different socio-economic levels. Respondents mentioned that women and men have similar access to and benefits from resources such as land, forest and forest products, water (natural resources), human-made physical resources (houses, hoes, ploughs), finances, human resources and social capital. However, there is gender inequality in the control of resources, particularly of financial resources. Respondents revealed that at all socio-economic levels men continue to control all the major sources of income in households and have the final say in decision-

making on financial aspects, while women control only the cash from petty activities and the sale of labour.

Tasks in the production chain for neglected and minor crops and the gathering and storage of collected foods are clearly differentiated according to gender. These are solely women's tasks, partly because of women's wider knowledge of how to use such crops, which has enhanced their understanding of how to produce them. Use of the proceeds from minor and neglected crops is also within women's jurisdiction. The main role of these crops is to provide relish for the family.

Seed selection and processing

A gender-differentiated breakdown of labour in agricultural production shows that women participate more than men in all the major activities and carry out nearly all the post-harvest activities. As the main actors in harvesting and post-harvest activities, women manage the local seed system, particularly the seeds for food crops. Women from all socio-economic groups are the key selectors of seeds; a process that starts in the field for some crops such as maize and pumpkin. Plants in the field are selected according to their vigour, early maturity, drought tolerance and size of cobs/fruits. Selected plants are marked and harvested separately; for example, selected maize plants are marked by removing the tassel. Further selection takes place during processing, when characters such as seed size, seed colour, cob size and freedom from insect damage are considered.

The processing of produce and seeds differs depending on the type of crop and its importance to the household. Crops that are important to men because of their market value are processed by the whole family, while less valued crops are left to women. For example, maize, rice, groundnut and beans, which are important food and cash crops in the surveyed villages, are processed by both women and men. Women use specific processing techniques, such as shelling whole cobs for maize and the middle of cobs for seed. Women and girls process other crops such as pumpkin and cowpea, which men do not usually deal with.

The treatment methods practised by farmers in the study villages include chemical insecticides and the use ethnobotanicals, such as Lidudwe, *Tefrosia vogalii* (Utupa), *Tagetes minuta* (Manuhanuha), Lidudwe, tobacco leaves and goat dung ashes, for preserving grain seeds. According to the farmers interviewed, the chemical insecticides (Actellic dust) available in village shops are sometimes not as effective as ethnobotanicals and goat dung ashes in controlling storage pests. While men are responsible for the treatment of seed maize, women are responsible for that of other crops.

Seed information flow

Extension services now have considerably more contact with women farmers than they had in the past, when all dialogue between extension officers and farmers was carried out by men. However, there is still inequality regarding men's and women's access to information on improved seeds. This information asymmetry limits women's access to improved seed varieties, particularly the modern varieties that are promoted by extension officers. While men have accrued considerable knowledge of national seed systems through their frequent contacts with extension officers, women's involvement has usually been restricted to local seeds and their management. There is therefore likely to be a gap in addressing the information needs of women when husbands and wives do not cooperate. Contact farmers and extension officers confirmed that women most frequently ask for advice on improved seeds for food crops – their planting, selection and storage – while men usually ask about cash crops and their husbandry. Women were found to be less conversant on:

- nationwide policies and local bylaws regarding seed systems and seed management;
- formal seed education through extension officers

- grassroots support organizations, such as non-governmental organizations (NGOs) and community-based organizations (CBOs), for seed and agriculture-related interventions.

Linkages and networks

The social institutions that control or mediate social relations, especially regarding the resource base and national seed system, have by-passed women for a long time. Economic and educational systems, along with cultural traditions, have also indirectly marginalized the role of women in the national seed system, confining them to the local system. This is mainly attributed to: women's lack of control over financial resources, which limits their willingness and ability to purchase seeds; their limited contact with extension officers, which makes it difficult for women to obtain information on the national seed management system; and the confinement culture whereby women have very few opportunities to share and exchange knowledge and experiences.

A new force to emerge in seed and plant development in the study areas is the NGOs and CBOs that offer alternative ways of understanding and implementing seed interventions. These institutions are central to the Socio-Economic and Gender Analysis (SEAGA) approach because through them social dynamics are negotiated and more effective seed development practices implemented. NGOs and CBOs are also well placed to provide links between local initiatives and external opportunities.

Contact farmers and nodal farmers

The national system (extension services) identifies contact farmers to produce seeds of improved varieties for their villages. Contact farmers follow production packages and guidelines under the supervision of agricultural extension officers. They also participate in the quality declared seed (QDS) system, which is part of the national seed system in Tanzania and empowers progressive farmers to produce QDS to supply to their communities at reduced cost. Nodal farmers, on the other hand, have indigenous knowledge of the local seed system, and are not necessarily directly involved in the production of QDS.

There is a sharp division of gender between the two types. While contact and QDS farmers are in the male-dominated national seed system, nodal farmers serve the local seed system. Contact farmers tend therefore to be mainly progressive male farmers, while there are significant numbers of women nodal farmers, particularly elderly ones. For effective seed management interventions, both systems should be considered. Particular attention also needs to be paid to the empowerment of nodal farmers. Activities are more likely to contribute to raising incomes when they are carried out in a proactive manner.

Although progressive/innovative farmers live in the village, they are not representative of poor men or women. This is because their livelihoods and farming systems are very different from those of most villagers. Innovative farmers are usually the wealthiest farmers; they have huge fields and use tractors, so do not use the same cultivation techniques as small farmers. Contact farmers were also reported to be very busy in their own fields, and did not allot time to sharing their knowledge with other farmers unless those farmers went directly to them to seek information. This underlines the importance of the local seed system and the need to establish a proactive approach to information sharing between contact farmers and other farmers in the villages.

COMPARATIVE ANALYSIS

This section compares the research findings from this study with findings from other countries in the region that participated in the FAO LinKS project, particularly Mozambique and Zimbabwe. The aim is to demonstrate whether issues discussed for Tanzania are also of importance in these countries.

Case studies from Mozambique and Zimbabwe emphasize the importance of the local seed system and social networks in securing seeds. Although Zimbabwe has an advanced national

seed system, as in Tanzania and Mozambique farmers still depend on their own saved seeds most of the time. However, farmers sometimes produce too little and are thus unable to store seeds, so need to obtain them from external sources. There are strong social networks among families and friends, which impose on local farmers the responsibility to help those in need.

In Mozambique, social networks play an important role in disaster management. For example, after the 2000 floods, affected farmers had to look for seeds from other villages that had not been affected, especially in the highlands (FAO, 2004). The floods had a devastating effect on farmers' seed systems because of their abruptness and the timing of the disaster, just before harvest and lasting for about three months. An interesting finding is the two-way traffic of seed movements. To cope with floods, farmers in lowland villages get seeds from the uplands, while to cope with drought, farmers in highland villages get seeds from the lowlands. Crops from the lowlands adapt to highland conditions over time, and vice versa.

In Zimbabwe, national policies are biased towards research, development and distribution and marketing structures that favour improved high-yielding varieties. While improved varieties can be obtained from national seed sources such as seed houses, farmers' cooperatives, supermarkets and shops, this is not the case for traditional varieties (landraces), even though these are the main source of seed for most small-scale farmers. A study in the Ward III area of Zimbabwe reveals that a majority of farmers rely heavily on the seed they have selected and saved themselves (88 percent). The second most important source is neighbours and relatives (62 percent), while only 3 percent of the seed for commonly grown crops in Ward III comes from shops (FAO, 2000). Wealthier farmers often source hybrid seeds from seed houses, farmers' cooperatives and supermarkets, but have to source traditional varieties (landraces) from the local seed exchange system.

The Zimbabwe case study also shows that it is mostly women (62 percent of respondents) who source seed from neighbours and relatives. Generally, men do not source seed from the local system, depending instead on the national sector. Group discussions with both men and women in Ward III indicated that women are the main managers and preservers of local agro-biodiversity, and possess more local knowledge of crop diversity than men do. They are more knowledgeable in terms of ranking landraces for such factors as labour requirements, taste, yield and storage capability

Thus, as in Tanzania, studies from both Mozambique and Zimbabwe accentuate the importance of the local seed system and women's knowledge in the maintenance of agro-biodiversity.

MAJOR LESSONS LEARNED

Based on the research findings and analysis presented in this paper, the following lessons can be drawn:

- In the surveyed villages, major changes in the varieties grown and in preferences were brought about by the introduction of new varieties through government interventions, immigrants, changes in weather conditions, farmers'/consumers' preferences and market conditions.
- Major changes in policy and the natural environment have resulted in the disappearance of some crop varieties and the introduction of others. Because more varieties have been introduced than lost, there are now more crop varieties in the study areas than there were 50 years ago.
- A wealth of indigenous knowledge of the local seed system was found among nodal farmers. Unfortunately, the government has not exploited the full potential of the local seed system, which is not adequately covered by national agriculture policies.
- Nodal farmers in rural areas serve as repositories of local knowledge and *in situ* geneplasm banks.
- Despite massive interventions to introduce improved seed to rural communities, less than 10 percent of farmers are growing improved seeds. This underlines the importance of indigenous knowledge and the local seed system and the need to establish a proactive

approach to sharing information among farmers concerning the benefits of new seed varieties and cultivation methods.

- Farmers were found to have the necessary capacity and knowledge to breed and conserve *in situ* local varieties that meet their preference criteria.
- Women play a significant role in maintaining agro-biodiversity, particularly that of neglected and minor crops, and were found to have much indigenous knowledge of collected crops. Although important for household food security in drought-prone and other areas during food scarcity periods, such crops are neither well developed nor supported through the existing national seed management system.
- Farmers use mainly botanicals to control pests and diseases. Women were found to be at the forefront in this. Chemical pesticides are not widely used because farmers reported that they are sometimes less effective than botanicals. This raises a question about the effectiveness of regulations governing the supply of farm inputs, and their enforcement.

CONCLUSIONS

Major policy drives and natural factors that occurred in the period under study – the past 50 years – have resulted in the adoption of new crop varieties and species and the disappearance of others. Notable changes have been observed in the evolution of breeding skills, particularly of major crops such as maize and beans. This is evidenced by the release of several varieties by local institutions such as Sokoine University of Agriculture and Ukiriguru, Ilonga and Uyole research centres. The new varieties have attributes that are desired by farmers, and have thus replaced indigenous varieties in the surveyed localities.

Over the years, the government has initiated several policy changes with the aim of improving agricultural production and, as a corollary, the livelihoods of rural households. Notable policy changes that have had impacts on seed management include: the Arusha Declaration, which supported the formation of agricultural training and research centres charged with producing improved seed; the formation of TANSEED for seed distribution and TOSCA for seed certification; and liberalization of the economy, which led to the emergence and participation of private seed distributors and developers. Despite these policy changes, however, local seed systems remain the major and most reliable seed source for most socio-economic groups in the study villages. In Tanzania, less than 30 percent of the land is planted to new varieties of maize, sorghum and pearl millet, and less than 10 percent of farmers have ready access to seed of new varieties.

Notwithstanding policy weaknesses in addressing indigenous knowledge, there are commendable (but limited) efforts at the grassroots level to involve farmers in seed development. For example, among the activities of the QDS system, are variety demonstrations. Through these, farmers are given the opportunity to select the varieties they prefer, which are then multiplied. The government should also recognize the importance of the QDS produced by individual farmers in increasing the adoption and accessibility of improved varieties and crop diversity at the farm level for food and seed security.

Farmers brought to light some setbacks in the national seed supply system, and these need to be improved if the system is to benefit many farmers. Seeds from the national system are sold at high prices and are thus unaffordable for most farmers. Furthermore, certain seed varieties do not reach farmers at the right time, especially in less accessible villages. Farmers also mentioned that seeds from the national seed supply system demand high inputs that many small farmers cannot afford.

The study also revealed that nodal farmers hold a broad genetic base and knowledge of local crop varieties. These farmers, most of whom are women, are therefore a good source of local seeds and knowledge about local varieties, and can educate other farmers in the conservation and multiplication of these. Nodal farmers can also play a large role in the national seed system if they are recognized and included in the production of QDS.

Different types of local knowledge are used in the production, treatment and storage of seeds. Among the local knowledge reported by farmers is the use of ethnobotanicals, such as

Tefrosia vogalii (Utupa), *Tagetes minuta* (Manuhanuha), Lidudwe, tobacco leaves and goat dung ashes, for preserving grain seeds.

Women, particularly elderly women, were found to be rich in indigenous knowledge of seed management and biodiversity. They also play an important role in seed management (selection, processing and treatment) and management of the production chain for neglected and minor crops. The management of collected crops was found to be solely within women's domain.

POLICY, RESEARCH AND EXTENSION OPTIONS

In order to enhance awareness and understanding of the roles of local knowledge, gender and agro-biodiversity in seed and agro-biodiversity management, the following recommendations are put forward.

Policy options/issues

The involvement of men and women farmers, extension officers and other stakeholders in formulating and reviewing agriculture and seed policies is of paramount importance. This will make it easier to include farmers' knowledge of the local seed system in existing seed and agriculture policies.

The government needs to revisit the list of main staple food crops and consider farmers' own cultivars and preferences.

A mechanism to strengthen collaboration between men and women farmers and research institutions in future studies and to promote local knowledge and agro-biodiversity is a fundamental issue that policies should address.

Research issues

Linkages need to be established between the staff of the Tanzanian Plant Genetic Resources for food and agriculture (PGRFA) gene bank and nodal farmers so that they can share their germplasm with each other in order to improve the conservation and use of seeds of disappearing crop varieties. This should accompany an in-depth assessment and use of the knowledge of nodal farmers who are conserving and breeding local and modern varieties *in situ*.

Owing to the importance of local cultivars in the breeding process, there is a need for *ex situ* conservation of agro-biodiversity that is in danger of extinction, for example, the local maize varieties Sebea and Sabatele.

When developing seed variety, it is important to consult the end-users so that their preferred characteristics can be incorporated in the new varieties.

Research to improve agronomical practices for neglected crops, such as pumpkin, sponge gourd, cucumber and watermelon, should be considered. As farmers extract and use the oil from pumpkins and sponge gourds, verification research to document the amounts and potential uses of such oils is essential.

Farmers tend to store pumpkins, sponge gourds and cucumbers for consumption during periods of food scarcity. There is a need for research to improve the shelf-life of these crops.

The importance of nodal farmers should be recognized, and their knowledge of the breeding, conservation and documentation of local seeds integrated with the national seed system.

Although farmers use ethnobotanicals to control pests and disease, very little is known about the active ingredients of the materials that they use and whether there are potential health hazards in their use. There is therefore an urgent need for follow-up research to analyse these issues and define appropriate application rates.

As the farming community prefers some of the traits of local varieties, and as there is a wider range of local varieties of cultivars than of improved ones, the national seed system needs to broaden its seed basket to include some of the promising local varieties, thereby giving farmer wider options for seed selection.

Although the HIV/AIDS component was not directly included in the LinKS study, it is clear that the pandemic may have potentially devastating impacts on the seed management system and agro-biodiversity through the erosion/disruption of intergenerational knowledge transfer and the depletion of communities' potential labour force. At present, observation of these impacts is only preliminary and indicative, as it has not been possible to establish the extent of HIV/AIDS incidence in the study areas owing to information and data limitations. An in-depth study of the impact of HIV/AIDS on local knowledge related to seed and agro-biodiversity management is essential.

The FAO LinKS studies concentrated on indigenous knowledge and the management of food and cash crop seeds only. A study on pasture seeds is important given the role of livestock in dry central Tanzania.

Extension services

It is important to sensitize policy-makers to the value of indigenous knowledge in ensuring food security and sustainable biodiversity management. This is a useful way of encouraging policy-makers to install mechanisms that recognize, protect, promote and support the use of indigenous knowledge in the sustainable use and management of biodiversity for food security.

Awareness creation fora regarding the importance of local knowledge should be established for development workers. This will increase the sharing of local knowledge on seed management and the use of botanicals in seed and food preservation, and its transmittal across generations.

The role of farmer field schools in testing promising local varieties and practices in seed management should be promoted.

It is important to help farmers to recognize their plant breeders' rights and enable them to register and improve on the processes that they have established. In order to achieve this, wide dissemination of the 2001 Plant Protection Act is important.

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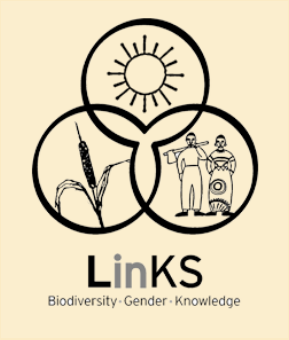

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