4. AGRICULTURAL DIVERSIFICATION

Woman in her intercropped field with maize, beans and cassava (cereal-legume-rootcrop system) in Agoriata village, eastern Uganda.

Overview

Agricultural diversification is the agricultural practice that seeks the dynamic integration of the broad natural resource diversity, from the genetic to the ecosystem level. It therefore represents an agrobiodiversity component that genuinely embraces the ecosystemic dimensions of agriculture, integrating elements such as crops, livestock, farming practices, ecological processes, and land uses. It consists in the diversification of agricultural systems and practices to better balance social and ecological factors, such as nutrition provision, agroecological management, marketing options, gender equality in farming, conservation of the natural resource base, optimisation of land uses, and low-input agricultural modes.

Agricultural diversification represents an optimal strategy to combat food insecurity and AIDS impact among the rural poor. In particular, it broadens household options for food production and nutrition, expands income-generation sources, provides practical and affordable means for agroecological management, and helps alleviating agricultural labour pressures.

Agricultural diversification is strongly connected to agrobiodiversity and relies upon indigenous agroecological knowledge and practices. In particular, many traditional, neglected and under-utilised crops (as discussed earlier in chapter 3) represent critical resources for

effective agricultural diversification processes. The introduction of new crops and varieties can strengthen agricultural diversification, provided due regard is devoted to ecological, cultural and socio-economic impacts. Local genetic resource management systems, including their gender dimensions, are relevant instruments to advance agricultural diversification.

In Sub-Saharan Africa, farmers have traditionally hold diversified agricultural systems, which are however declining, if not vanishing. Agricultural diversification constitutes a new agricultural development strategy that diversifies agricultural systems to better address agroecological, food security, nutrition, livelihood, and gender conditions. It is thus not a simple activity that merely consisted in increasing the number of crops grown by rural households or in "rescuing" some traditional polyculture systems. It is rather an inter-disciplinary and cross-scale process of agricultural development that interconnects traditional agricultural systems, crop diversity, indigenous knowledge, agroecology science, and new research frontiers. Farmer-based and farmer-led approaches are indispensable.

Agricultural diversification comprises a wide range of potential systems and practices (box 22). Its goal is not the indiscriminate distribution of seeds or encouraging farmers to plant many crops. Agricultural diversification requires creating spaces where indigenous knowledge, innovative agroecological research and farmer-based experimentation concur and reinforce each other. It equally requires the deployment of adequate policy and programme support schemes; for instance, legitimating and promoting the indigenous genetic resource and knowledge base, increasing training to fully divulge the value and benefits of agricultural diversification, supporting research tailored to agricultural diversification, and implementing participatory experimentation. Farmer-to-farmer cooperation schemes are also useful to facilitate an horizontal flow of experiences, knowledge, and agrobiodiversity resources. It is finally important to empower actors that are generally excluded in the process of development, but hold enormous resources and knowledge relevant for sustainable agricultural diversification processes, such as particularly rural women.

Box 22. Agricultural diversification systems and practices:
Selected examples

- Crop diversity farming
- Intercropping systems
- Polycultures
- Shifting cultivation
- Crop rotation
- Inclusion of leguminous crops
- Home gardens
- Introduction of new crops
- Cover cropping
- Agroforestry systems
- Multipurpose crops and species
- Seedbanks
- Fodder production
- Crop-livestock association
- Crop genetic diversity management
- Elaborated fallow systems
- Selective weeding
- Contour planting
- Integrated agriculture-aquaculture
- Cultivation of hillsides
- Crop mosaics
- Cultivation of trees and orchards
- Separation of crops with similar pest and disease susceptibility
- Sustainable grassland management
- Sustainable use of wild ecosystems

Launching agricultural diversification needs preliminary consideration of the existing farming systems, agroecological conditions, and priority needs of farmers. In general terms, agricultural diversification may develop from three different grounds:

a) *Rural communities that maintain comprehensive indigenous polyculture and diversified systems.* In this case, the existing farming dynamics, in terms of the agrobiodiversity and indigenous knowledge they embrace, provides an optimal basis for enhancing agricultural diversification dynamics. Selected innovations and improvements can be integrated. It must be noted that such indigenous polyculture systems are rarely fixed on time, but are continuously evolving according to the constrains and needs of farmers. Accordingly, the challenge for the agricultural sector is to support them to continue evolving in ways that better serve the needs of the rural poor. Selected and well-targeted scientific and technical support is critical.

b) *Rural communities that rely on specific monocultures, generally encompassing a very limited crop resource base (in many cases due to historic agricultural changes attempting to maximise market opportunities).* In these cases, agricultural diversification will entail a transition towards a new farming culture. The interventions required and the intensity of the process will depend upon the status of such market spaces, the state of food security and nutrition, and the agroecological conditions, among other factors.

c) *Rural communities where the cultivation of key commodity crops receives the dominant attention and value, yet substantial agrobiodiversity and diversified farming practices remain, basically under the lead of actors with lower socio-economic recognition (such as women and the smallest landholding households).* Integrative and cross-border efforts will be required with the aim of both legitimating and incorporating the existing agro-biodiversity and indigenous knowledge into the agricultural diversification processes.

Aside from the agroecological benefits, agricultural diversification is especially relevant for poor and small-scale farmers that confront food insecurity, malnutrition, socio-economic marginalisation, or labour shortages.

Members of Nabulamu farmer field school examining an ecological barrier created to conserve soil and water (eastern Uganda).

Values, benefits and potential roles

Substantial research proves the many values and benefits of agricultural diversification, particularly in relation to enhancing sustainable agriculture and strengthening food security in poor rural communities (Altieri, 1995; Cooper *et al.*, 1992; Garí, 2000; Thrupp, 1998). Participatory field research in Uganda and Tanzania further explored agricultural diversification with a focus on food security and AIDS impact (field research, 2001). The values, benefits and services identified through participatory discussions comprise as follows:

1. **Nutrition**. Agricultural diversification is an affordable and immediate way to enhance household nutrition, particularly in the contexts of poverty and socio-economic exclusion. Diversifying food production can directly benefit household nutrition and health quality, hence reducing vulnerability to external food availability and food access. In fact, established experience among rural development practitioners indicates that increasing incomes does not often turn into better nutrition, but food produced in the community is more likely to improve nutrition. Agricultural diversification thus represents a food-based agricultural development strategy with high nutritional impact.

2. **Agroecological management**. Agricultural diversification enables small-scale farmers to manage agroecological conditions, such as drought risks, pest control, and need to cultivate marginal lands. Crops and crop varieties differ in vulnerability to agroecological risks, so that the diversification of farming systems represents an agroecological risk management strategy. Practices like intercropping and field diversification are recognised as efficient and affordable to reduce the incidence and impact of pests. Crop diversification is also relevant in soil conservation strategies; for instance, through the introduction of legume crops which enhance soil fertility, the use of cover crops such as velvet bean (*Mucuna* spp.) to facilitate soil fertility recovery, and the use of crop residues as green manure. Agricultural diversification represents an optimal strategy to address food security among household with limited land resources or forced to use agriculturally marginal lands. Agricultural diversity systems also improve soil and water management, hence optimising the use of resources that are often scarce. Agropastoral systems, fodder production and sustainable grassland management contribute to food production, nutrition and rural livelihoods through broadening and optimising land uses.

3. **Labour**. Agricultural diversification provides a mechanism to alleviate labour stress, as it assists households to optimise labour inputs and to diffuse labour loads through time. For instance, intercropping is a labour-saving strategy, as land preparation and weeding efforts serve simultaneously for different crops and food sources. Crop-livestock systems reduce labour destined to soil fertilisation. In addition, crop diversity diffuses labour, as crops differ in labour needs, labour intensity and timing throughout the agricultural period. Hence, AIDS affected households suffering labour shortages and occasional lack of labour can better conduct agriculture and reduce crop loss risks.

4. **Low-input agriculture**. Agricultural diversification provides affordable, yet more sustainable, means to address important agricultural needs, such as soil fertility and pest management. For instance, the use of legume crops (e.g. bambara nut) and cover crops (e.g. *Mucuna* sp.) enhances soil fertility without jeopardising the household economy

with the purchase of chemical fertilisers. In addition, integrated pest management systems serve crop protection needs without expensive chemical inputs. In that way, agricultural activities do not undermine the household economy.

5. **Land shortage management.** Agricultural diversification provides an optimal strategy to cope with land shortage in terms of food and nutrition security. Land shortage is key constrain for food security and rural development, affecting certain areas, such as particularly in southern Africa, as well as discriminated and vulnerable groups, such as the case of widows, female-headed households and orphans. Agricultural diversification provides an agroecological strategy to optimise the use of scarce land through a combination of subsistence, nutrition and income purposes.

6. **Rural income**. Agricultural diversification is useful to expand income sources, particularly in marginal rural areas. It first serves to maintain a wide range of marketing and income options, thus allowing farmers to cope with market fluctuations and collapses. It provides opportunities to gain access to new or emerging market niches. Overall, agricultural diversification alleviates the insidious dichotomy between food crops and cash crops, leading to a better balance between nutrition and income needs within rural households.

7. **Gender equality**. The institutionalisation and improvement of agricultural diversification can contribute to gender equality in agriculture and food security. That would first help recognising agricultural practices and crops that rural women hold. It would also expand the agricultural space available for women, enhancing their customary tasks. Overall, agricultural diversification would require the joint collaboration of both men and women in agricultural development, integrating their respective knowledge systems and fostering gender equality in the agricultural development process. In essence, agricultural diversification represents an advanced strategy to accommodate the needs, resources, skills and knowledge systems of both men and women farmers.

8. **Healthcare.** Agricultural diversification can contribute to healthcare among poor rural people. In the first place, it broadens the food production base, providing balanced supplies of energy, protein and micronutrient resources that combat malnutrition in a direct and inexpensive way. In addition, agricultural diversification can incorporate the cultivation of medicinal plants.

9. **Farmer autonomy**. Agricultural diversification enhances farmer control over food production and consumption. The promotion of agricultural diversification reverses narrow crop and farming approaches that increase food and livelihood vulnerability among the rural poor, whilst enhancing local autonomy on food production and nutrition. Thus agricultural diversification provides poor households with a broader production base to attend their critical food, nutrition, and livelihood needs alike.

Overall, agricultural diversification provides a resilient and reliable strategy for food security and balanced nutrition, with specific advantages and benefits in the context of HIV/AIDS. Agrobiodiversity and indigenous knowledge are critically relevant for agricultural diversification efforts; in fact they have traditionally supported diversified agricultural systems.

Crop diversity

One of the central strategies for agricultural diversification is crop diversity, at both species and genetic levels. Traditional, neglected and under-utilised crops, as discussed earlier (chapter 3), represent a privileged set of resources for maintaining and developing crop diversity. The introduction of new crops and crop varieties, with all due regard to ecological and cultural impacts, can also contribute to crop diversity and, hence, to agricultural diversification strategies. Above all, the conservation and cultivation of crop diversity entails an agricultural dynamic where crops and crop varieties evolve, but overall system diversity remains.

Crop diversity is the primary basis for agriculture-based nutrition strategies in poor rural areas. Cultivating a diversity of crops ensures the range of nutrients that are required for maintaining healthy lives, especially among children, sick people, aged people, pregnant women, and lactating women. Every crop group is known for specific nutritional values: in general, grain crops are a good source of energy, legume crops supply abundant proteins, and fruit and leafy vegetable crops are excellent sources of micronutrients. Overall, maintaining crop diversity ensures adequate supplies for nutritionally balanced and healthy diets.

Crop diversity improves the local coping capacity with agroecological conditions (tables 5-7). For instance, crop diversity is relevant in land use management, allowing rural households to optimally use available land. In this sense, some crops are well adapted to marginal areas and poor fertility soils, hence integrating these areas into food production. Accordingly, access to sufficient crop diversity is crucial for poor households that only have land in marginal areas, so to farm them adequately. Crop diversity is also relevant for addressing rainfall conditions. For instance, there are crops and crop varieties that suit less-favourable agricultural seasons, thus being able to provide food resources in periods under agroecological limitations, when rainfall is reduced, irregular or unreliable. Crop diversity also broadens the options around food storage and preservation, hence contributing to long-term food security.

Crop diversity provides different options around farm labour (tables 6-7). For instance, some crops have low labour requirements, some crops allow a flexible timing in agricultural activities, and some crops contribute to labour-saving practices. Thus, crop diversity provides AIDS-affected households with practical options to cope with labour constrains.

Crop diversity also allows for a balanced coexistence of both food and cash crops, hence allowing households to better meet both household nutrition and income needs. Overall, crop diversity alleviates tensions between food and cash, as allows for the co-existence of both agricultural resources (table 6). Accordingly, the institutionalisation of crop diversity systems gives equal legitimating and opportunities for the crops and farming needs of both men and women, thus generating spaces for gender equality in crop management. Crop diversity thus alleviates tensions between male-female crops, nutrition-income crops, and staple-minor crops.

Table 5. Crop diversity and land use management in Kagera region (Tanzania)

	Kibanja [1]	Kikamba [2]	Rweya [3]
Bambara nut			X
Banana	X		
Beans	X		
Cassava	X	X	X
Cocoyam	X	X	
Coffee	X		
Groundnut		X	
Maize	X	X	
Sweet potato		X	X
Yams	X	X	X

1. Kibanja [fertile land near the house] is the main field, which is located close to the homestead, where farmers typically conduct banana-coffee based intercropping systems.
2. Kikamba [bush] represents subsidiary land for agriculture.
3. Rweya [grassland] accounts for poor fertility lands.

Source: Field research in diverse villages of Bukoba Rural (Kagera), Tanzania, 2001.

Table 6. Crop diversity in eastern Uganda

Local name [1]	English name	Use value	Labour demand [2]	Food security relevance
Amabere	Sorghum	food	+++	*
Amadimua	Maize	food	+++	*
Amaido	Groundnut	food / cash	++	
Amajanjalo	Beans	food	+	
Amatema	Banana	food / cash	+	
Emabuoni	Sweet potato	food	+	*
Engooli	Cowpea	food	+	
Epamba	Cotton	cash	+++	
Mongo	Cassava	food / cash	++	*
Obule	Finger millet	food / cash [3]	+++	*
Olai	Green gram	food	+	

1. Saamia language.
2. Labour demand is ranked as high (+++), fair (++) and low (+), according to participatory surveys with men and women farmers.
3. Obule [finger millet] has also a cultural value, as it is used in ceremonies.

Source: Field research in Bulobi and Nabulamu villages, in association with "Enjala Siyita" Farmer Field School. Busia, Uganda, 2001.

Table 7. Crop diversity in Soroti district (central Uganda):
Agroecological and labour aspects

Crops	Agroecological, labour and other features
Beans	Cultivated in both 1st and 2nd rain seasons. Low labour inputs. Soil fertilisation properties.
Cassava	High but flexible labour. Cultivated year-round. Market value. Men's crop.
Cowpea	Cultivated in either 1st or 2nd rain seasons. Fair labour requirements. Leaves are edible just a few weeks after seeding (good source of micronutrients).
Finger millet	Cultivated only in 1st rain season. High labour requirements, but very versatile crop. Easy storage and for a long time in traditional granaries. Good, tasty and nutritious food. Habitual women's income source (e.g. marketing, brewing).
Green grams	Adapted to both rain seasons, but generally cultivated in the 2nd rain season. Low labour requirements.
Groundnut	Cultivated in 1st rain season, though some farmer varieties are also adapted to 2nd rain season. Variable labour requirements depending on varieties. Well stored in traditional granaries. Soil fertilisation properties.
Sesame	Adapted to both 1st and 2nd rains, and generally cultivated in 2nd rain as there is more labour and land available. Good source of food and oil. Local rural people have knowledge about efficient drying and storing practices.
Sorghum	Can be cultivated in either 1st or 2nd rain seasons. Low labour requirements. Drought resistant. Well stored in traditional granaries.
Sweet potato	High labour, but farming has flexible timing. Cultivation almost any time year round. Harvesting has more strict timing, but this root crop can be easily dried and stored.

Comments: Soroti has two rain seasons: a major rain season in March-June (1st rain season) and a minor rain season in August-October (2nd rain season). Conducting agriculture in the minor rain season is important to cope with food insecurity risks.

Source: Field research in different rural communities of Soroti district, covering the subcounties of Arapai, Asuret and Kiere.

Farmers with sesame drying in Okunguro village (Soroti, Uganda)

Intercropping systems

Intercropping systems are a widespread practice with notable benefits (Altieri, 1995). However, they are often disregarded as inefficient agricultural systems, and food and agricultural policies and programmes give a disproportionate support for monocropping.

The improvement of intercropping systems is essential in agricultural development and food security strategies among smallholder farmers. Participatory discussion with farmers from Agoriata village (Busia) and Obwakol village (Soroti), both in Uganda, revealed that there already exists substantive awareness on the benefits of intercropping systems, including as follows:

- *Profit maximisation:* intercropping provides a variety of food sources from the same plot, and facilitates an even combination between food and cash crops.
- *Labour optimisation:* field preparation and weeding serve various crops at the same time.
- *Soil fertilisation:* some crops add fertility to the soil and save expenses on fertilisers, such as particularly beans and other leguminous crops, which usually incorporate Nitrogen in the soil through their root nodules.
- *Insurance:* as a farmer rightly stated, "not all crops fail to yield".
- *Integrated pest management:* some crops function as traps for some pests and thus protect other crops, therefore reducing the environmental and economic costs of pesticide use.
- *Water management:* some crops retain water in the soil thanks to their root structure.
- *Land use:* intercropping helps optimising land use, especially when land shortage exists.

Farmers are thus aware of the value and potential of intercropping, yet they lack technical support to improve their intercropping systems, so to adapt them to their evolving needs and constrains. In factor, some farmer field schools informally include intercropping fields in their experimental designs, using their indigenous knowledge and their hypothetical considerations to evaluate intercropping systems and options. For instance, farmers from Akwangalet-Okunguro farmer field school (Asuret, Soroti), in central Uganda, are experimenting with cotton-beans intercropping because cotton market is very fluctuant, so they ensure some food and income from bean production.

Intercropping seems particularly a useful practice for constrained households, as it provides direct benefits in food security. Robina Nabwire, widow and chairwoman of Enjala Siyita Farmer Field School, in Nabulamu village (Busia Province, Uganda), states that she has abandoned cotton and she is abandoning coffee because these crops demand high amounts of labour. She focuses on food crops, which she often inter-plants to optimise the use of labour and space. She asserts as follows: "intercropping assists me very much". However, farmer women often report that their main constrain for intercropping is lack of seed at the right time (personal communication, 2001).

Intercropping is also a relevant strategy for low-input agriculture or, in other words, for designing agricultural systems that are economically responsive. Intercropping often constitutes an agroecological practice for soil, water and pest management. It therefore reduces

the need of chemical inputs, which are often unaffordable for poor farmers and certainly reduce the net economic returns of farming. The science of agroecology provides evidence and "best practices" for intercropping systems, yet they need further institutional and technical support.

Farmers in a field intercropped with beans, root crops and bananas, among other crops, in Kagera region (north Tanzania).

Indigenous farming: The *chihali* system of the Gogo people (Tanzania)

The practice of agricultural diversification requires due regard to indigenous agricultural systems, including their associated crop genetic diversity and traditional agroecological knowledge. In fact, indigenous agriculture is result of a coevolutive interaction between agroecological conditions, traditional knowledge, and local needs. It often provides useful basis for agricultural diversification and represents an excellent basis for sustainable agricultural development. Indigenous agriculture is more likely to meet the food and livelihood needs of the poorest rural people if adequate technical assistance, capacity-building and improvements are deployed.

Indigenous agricultural systems are however under threat due to modern agricultural development projects and socio-economic pressures. This erosion results in more livelihood vulnerability and food insecurity, whilst washing away options for local responses to them. Next there follows an overview of the *chihali* system of the Gogo people, in the drylands of central Tanzania, as example of the complexity, uniqueness and significance of indigenous farming practices, particularly as it matters the pursuit of food security and the agricultural sector response to mitigate HIV/AIDS impacts. Accordingly, agricultural interventions are encouraged to develop and improve these indigenous agricultural systems, rather than disrupting or replacing them with alien approaches that cannot suit the local agroecological conditions and that are deaf to the priority needs of the rural poor, particularly those constrained and impacted by HIV/AIDS epidemic.

As described earlier in chapter 3, the Gogo people of Dodoma drylands, in central Tanzania, conduct a complex intercropping system that is based on 2 cereal crops, 2 legume crops and a diversity of *Cucurbitaceae* crops (table 3 above). The cereal crops, named collectively as *uhemba* in Gogo language, are pearl millet and sorghum; the legume crops are cowpea and lablab bean; and, finally, the *Cucurbitaceae* crops include gourds, pumpkins, melons, and cucumbers. During fieldwork, the author, with permission from farmers, called this intercropping as the *chihali* system, after the name of the traditional gourd recipient that farmers use to mix the seeds of all those crops before seeding. All those crops are cultivated together in the field and thus form a comprehensive intercropping system.

The state of the chihali system is variable throughout Dodoma. Some villages and households maintain it as their fundamental agricultural practice. Some communities have abandoned it progressively in response to agricultural programmes and market prospects, hence focusing on specific monocroppings such as particularly maize, improved sorghum varieties, and grapes. However, the *chihali* system entails some values that are relevant for food security, and that are responsive to the needs of the poorest farmers and HIV/AIDS affected households. In particular, it entails agroecological, food security, labour and economic advantages (box 23).

Woman from a Gogo community, in the central drylands of Tanzania, sowing a field with the *chihali* [gourd recipient], which contains a seed mix of pearl millet varieties, sorghum varieties, two legume crops, and a rich diversity of *Cucurbitaceae*.

Box 23. Analysis of the indigenous *chihali* agricultural system (Dodoma, Tanzania)

1. **Agroecological adaptation.** Many farmers stress that their traditional crop system is adapted to the local agroecological conditions, particularly drought and poor soils. Most of the crops are typically drought resistant. In the intercropping system, crops protect one to another. The root network created by the different crops is likely to retain water. Intercropping pearl millet and sorghum is an advanced strategy for the optimal use of scarce water resources and for minimising drought risks, since both crops have different water requirements during the growing season (Holtland, 1994). In addition, the *chihali* system as a whole allows for agriculture in some of the different soil types of the region. The inclusion of two legume crops represents an inexpensive and labour-free mechanism for improving soil fertility. Intercropping also represents an agroecological mechanism for integrated pest management, which is ecologically sensitive, economically viable, and labour-saving. Finally, intercropping represents a risk management strategy: the diversity of crops cultivated is resilient to agroecological and socio-economic risks. For instance, drought or pests cannot harm all crops, and market fluctuations cannot affect all crops with economic value. In the *chihali* system, farmers maintain crop genetic diversity, which renders them further agroecological values. The diversity of millet and sorghum varieties provide farmers with a broad range of options and values. For instance, cultivated varieties of millet differ in maturing time, susceptibility to birds, and productivity potential, among other aspects. In sorghum, some varieties are more drought resistant, some have stems that provide sugar, some are easy to thresh and thus are labou-saving, and some are very resistant to local pests.

2. **Food security (I): Famine periods.** The diversity of *chihali* crops provides poor farmers with a broad strategy for food security, specifically to confront the seasonal food shortage periods that often occur in semi-arid lands like Dodoma. Some of the minor crops start yielding some food shortly after seeding, about 2 months, just in a time that is often critical for food security among the poorest households as food reserves are depleted after the long dry period. The grains of millet, particularly local varieties, have excellent storage properties and the grain stock remains viable for a long time. The fruits of mahikwi [bitter melon] and majenje [pumpkin] are stored for several months, often preserved over the roofs of houses, just under direct sunlight. In addition, rural women possess knowledge and techniques for the preservation of the leaves of some of the legumes and vegetables cultivated, such as nhandala [cowpea] and matanga [cucumber].

3. **Food security (II): Nutrition.** The crop diversity characteristic of the *chihali* system provides a balanced nutritional supply. In particular, millet and sorghum provide good energy sources and some aminoacid and micronutrient elements; the legumes are good in both energy and protein supplies; and the vegetables are typically excellent micronutrient sources.

4. **Optimal use of labour.** The *chihali* system allows for an optimal allocation of labour, specifically in the agroecological conditions of the Dodoma drylands. In particular, the *chihali* system optimises available land for agriculture, thus helping to reduce land preparation efforts and cope with labour shortages. In particular, land preparation is a demanding task because of soil features and drought. In addition, it has typically to be conducted in a short time period just with the arrival of rains. Hence, land available for agriculture is generally limited due to labour constraints or shortage, so the *chihali* intercropping system maximises crop, food and nutrition production for units of labour and available agricultural land. Moreover, the crop genetic diversity that generally characterises the chihali system includes varieties that are more labour sensitive, as they require less threshing efforts. The labour sensitiveness of the *chihali* system results more relevant in the context of HIV/AIDS, where affected households suffer labour shortages and are likely to confront labour stresses in the short rain period, when land preparation, seeding and weeding are required. The labour unit devoted to the chihali system balances the needs for agroecological risk management, diversified food production, adequate nutritional supplies, and livelihood options.

5. **Low-input agriculture.** The *chihali* system represents an advanced basis for low-input agriculture, thus preventing impoverishment and allowing affordable practices among the rural poor. The agroecological values of the chihali system provide an economically viable means for soil, water and pest management, aside from being ecologically soundness and labour sensitive.

Source: Field research in diverse villages of the Gogo people. Dodoma, Tanzania, 2001.

Agricultural programmes do not only disregard indigenous practices, such as the *chihali* system of the Gogo people, but also undermine them, even if inadvertently. For instance, the introduction of modern varieties of sorghum and millet has accelerated sorghum and millet monocultures and dismantled customary intercropping systems. Farmers systematically exclude modern varieties in their *chihali* system because their experience indicates that such varieties cause genetic deterioration of their local varieties. That is due to the breeding methodologies used in modern plant breeding, which are at odds with farmer crop genetic dynamics. Consequently, farmers receiving modern varieties are recommended to set up separate fields. That increases their labour loads and forces the abandonment of the *chihali* system. Implications include major vulnerability to food insecurity, a limited capacity to achieve balanced nutrition, and agroecological mismanagement, among others.

Abandoning the *chihali* system and shifting towards monocultures seems to increase agroecological problems. For instance, farmers in Makangwa village, where the *chihali* system was significantly displaced and disrupted, collectively report a higher incidence of pests (field research, 2001). In addition, the abandonment of legume crops reduces local means for soil fertilisation. These facts concur with established agroecological knowledge that show that intercropping systems, such may be the *chihali* system, represent an effective strategy for integrated pest management and an ecological mechanism for soil fertilisation (Altieri, 1995).

Moreover, improved varieties are often introduced through agricultural packages that trap farmers in credit. For instance, agricultural extension services introduced the sorghum variety *tegemeo* in the early 1990s as part of the Global 2000 Programme, which gave improved seeds, fertiliser and sometimes pesticides to farmers as a loan (Holtland, 1994). That engaged farmers in a vicious circle of external dependence. Improved seeds need to be regularly purchased because they rapidly undergo genetic deterioration due to the breeding techniques used. Farmers accessing such varieties fall into seed dependency. In essence, these models of agricultural development are not responsive to the conditions and prospects of poor farmers, much less to AIDS affected households. Instead, low-input agricultural practices and specific assistance connected to the *chihali* system would result more useful for the communities.

Finally, past agricultural development programmes promoted single crops for large-scale market exchange. In particular, Dodoma was encouraged to shift towards grapes and maize. However, those programmes did not succeed due to agroecological, farming, cultural and market factors, generating confusion in rural people about how to pursue development. As a consequence, the *chihali* system has resulted misvalued and partly abandoned, whilst the associated indigenous knowledge has not been duly supported, transmitted, and improved.

In the context of AIDS, farmers seem to rely on the *chihali* system (box 24). Interviews to AIDS affected households in rural Dodoma shows that their main coping mechanism is to reduce the farm area, but not to simplify or abandon the *chihali* system. AIDS affected households with labour constrains reduce the cultivated area, but maintain the same crops and agricultural practices due to food security and cultural reasons. Such households state that the *chihali* crops are their food basis, and that no household should miss any of them. Culture and food habits also play a role, yet agricultural programmes tend to neglect them. For instance, a woman heading a 10-member household, including 5 children and a very ill AIDS young woman, states that she maintains the whole *chihali* system because she knows its functioning,

adding that her children should not lack any of the gourds and melons in their diets because that would be shameful for them and the whole family.

In summary, the case of the *chihali* agricultural system in the drylands of Dodoma reveals how important is to advance agricultural development on the basis of existing farming systems. In particular, the *chihali* system proves adapted to the local agroecological constraints, is trusted by local people, provides a balanced household nutrition, and is more labour responsive than other alternatives already experimented or suggested in the area. It is also connected to the farming practices, indigenous knowledge, food habits, and culture of the Gogo people.

Box 24. HIV/AIDS and Gogo farmers in the drylands to Tanzania

Dodoma is the poorest region of Tanzania, located in its central drylands. It is inhabited by Gogo agropastoralists, among other agricultural and pastoral tribes. Food insecurity and malnutrition are important problems. The HIV/AIDS epidemic status is probably high and escalating. A member of a village AIDS committee indicates that 25% of people tested were HIV positive. This AIDS committee, which is a pioneering community organisation combating HIV/AIDS in the region, has about 100 orphans registered and allocated in fostering families.

AIDS affected households are more devoted to their indigenous farming practices because they trust them, they know that they can provide them with balanced food and nutritional supplies, and they are tied to their culture. Most agricultural development programmes introduced or planned for the region are less responsive to the conditions and priority needs of the poorest households and, particularly, AIDS affected households. They are less labour sensitive than customary agricultural systems. Interviews suggest that AIDS affected households rather focus on the agricultural systems they are familiar with, and they trust. Accordingly, a shift in agricultural development programmes is required, placing emphasis on improving the existing indigenous agricultural practices if they want to be responsive to the needs, concerns and capacities of AIDS affected households. In essence, times of crisis are less appropriate to "experiment" with alien or odd strategies. Highly troubled households have no margin left for trials, but rather need that their habitual agricultural systems work better.

Source: Field research in rural areas of Dodoma, Tanzania, 2001.

Concluding comments

Agricultural diversification is a broad agricultural strategy highly relevant for smallholder farmers. It comprises different components, systems and practices. Developing agricultural diversification requires concerted dialogue between traditional agricultural systems and modern agroecological research. Agrobiodiversity and indigenous knowledge are indispensable ingredients for agricultural diversification initiatives.

A comprehensive approach to agricultural diversification is required to accommodate the different opportunities and potential. In particular, agricultural diversification represents a viable and affordable strategy among poor smallholder farmers to improve nutrition, advance agroecological management, cope with labour constrains, enhance low-input and economically responsive agricultural systems, and progress towards sustainable livelihoods.