Box 6.4 Arranging crops

Plant spacing in maize

Plant spacing in maize varies in Mr Vurayayi's field depending on the soil and water conditions at a particular site. At the dry end of the field, where sandy soils predominate, a wide spacing is used, with rows separated by a medium stride and plants in rows sufficiently far apart so that you can walk between them. However, in other parts of the same field a much more dense plant population is feasible. For instance, where water flows from an anthill to a sink area or where surplus borehole water is channelled into a small garden, plants can be planted at almost double the density without any yield reduction. Plant spacing also changes according to soil type. The sandy soils, with good infiltration, can cope with a higher plant spacing than the clay or anthill soils where large amounts of water are required to get good crops.

Making use of a limited area

Antonio has a small field of only a single plot. As an in-migrant to the area, he is unable to increase the land size. But together with his family he is struggling to get the most out of a very small area. Every portion of the land is planted – even rocky outcrops have been seeded with pearl or finger millet in the hope of yielding something. The main field, however, is almost exclusively maize. The eldest son explains that it is necessary to plant maize, even at the risk of it failing, because maize provides easy food. Maize is the staple crop, it requires relatively little labour in cultivation and processing, and suffers fewer pest attacks (particularly birds) than millet. The maize has been planted in two phases. Household ash, together with some other plant detritus, has been applied to different portions of the plot each year. In those areas where maize has failed, finger millet was transplanted from the rocky sites into the spaces. This transplanting process took place at a number of sites and at a number of times during the 1992–93 season. In other years, replanting of maize would have been attempted, but there was no available seed. Around the house intercropping of water melons and pumpkins is particularly evident. These provide both leaf material for relish and fruits. Wild foods are also harvested from the plot. These include wild fruits from the *Sclerocarya birrea* (*mupfura*) tree, which are transformed into *mukumbi* beer and *shomwe* nuts, and a variety of green vegetables (e.g. *derere*, *rude*) that are collected from the field edges while weeding.

and least common in sunflower and cotton fields. Also intercropping is more prevalent in women's fields, as many of the characteristic intercrops are used by women for preparing relish or providing snacks for themselves or their children.

Three contrasting case studies on intercropping are presented in Box 6.5. They highlight the different incentives and disincentives to carry out complex intercropping and the experiments farmers carry out to see how intercrops affect main crops and vice versa.

Box 6.5 Intercropping

1. Mai Nelly, in common with most farmers in the area, regards intercropping as a good practice. On a small field, returns are maximised and, if the right combinations and the appropriate planting sequences are used, there are limited yield reductions on either crop. In most of Mai Nelly's field, pumpkins (*mananga* of several varieties), water melons and sweet sorghum are growing together with maize, sorghum and finger millet. She received a mixed bag of seed from a friend living nearby which she broadcast liberally over several plots in her field. The same applied to the area around the homestead, where such intercrops are planted even more densely. These intercrops do not have an effect on the main crop. But the intercrops' yield may go down if planted in very dense pearl millet or sorghum. The same applies to cow peas, which are planted between the rows of maize and amongst the finger millet on her farm. Cow peas, if harvested regularly and if planted in relatively widely spaced maize or finger millet, do not suffer.

2. By contrast, Mrs Zivhu does not have any intercrops in her field, except a line of sweet sorghum that got there 'by mistake'. This is because she is a Master Farmer trainee, and the Agritex extension recommendations discourage intercropping. Passing of the Master Farmer certificate means that the standard practice of intercropping must be concealed in the middle of the field away from the extension workers' eyes!

3. Intercropping may be a response to poor germination or seed shortage. Tafirei has in-filled his maize field with sorghum, groundnuts and sunflower in different areas. Since he does not have enough money to purchase more maize seed, and he has some other seed left over, he has decided to opt for a complex cropping pattern in the one plot where maize failed to germinate effectively.

Integrated spatial management for successful farming

It is rare to find farmers who integrate the range of spatial considerations discussed above in the design of their farm. Most farmers are unable, due to constraints of labour or capital, to develop their farms to their full potential. Others are simply not interested, preferring to pursue other livelihood options rather than invest too much in the complex craft of farming in a dryland area.

However, there are some farmers who, together with their families, have truly made the most of spatial variation. One such farmer is Mr Phiri of Msipane area, near Zvishavane. Mr Phiri's farm of 2.5ha consists of a mixture of rock outcrop around the homestead, dryland sandy soils and a small patch of wetland at the bottom of the slope (Figure 6.1). This

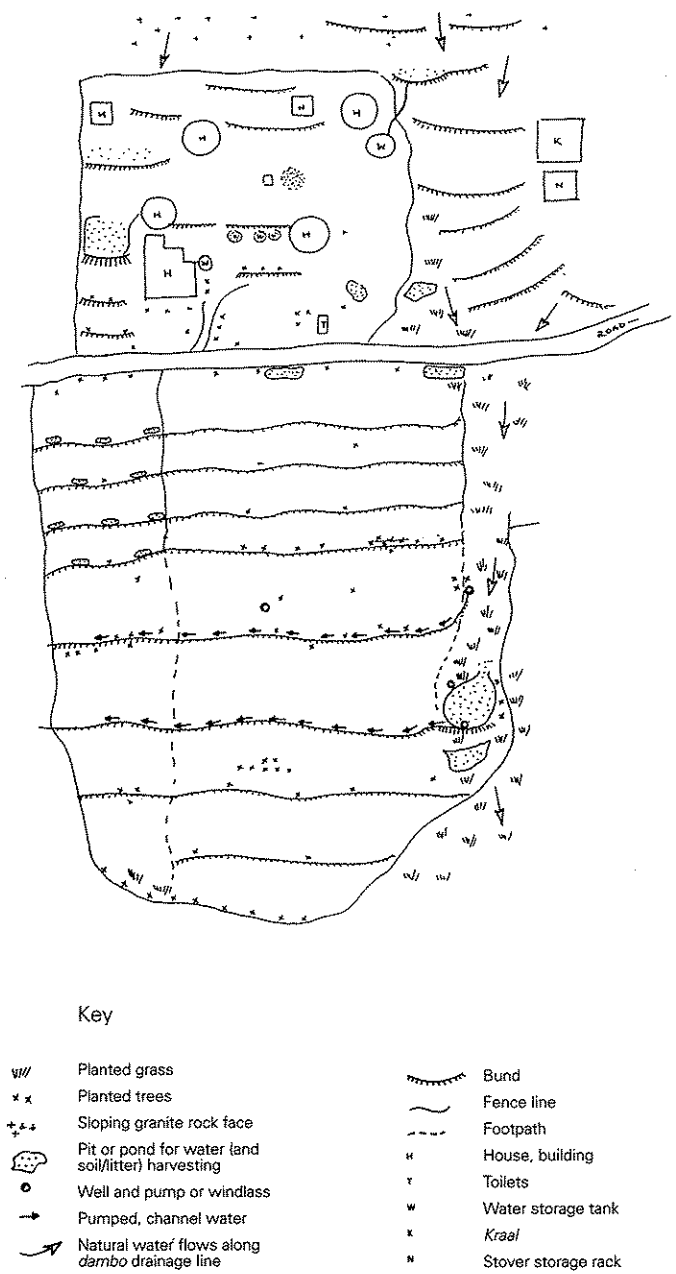

Figure 6.1 Layout of the 2.5 ha farm and homestead area of Mr Phiri, Msipane, Zvishavane, in November 1994

Box 6.6 Making the most of spatial variation

Water flow management, rock catchments and bunds. Water is captured, diverted and stored even before it reaches the field area on Mr Phiri's farm. Above the home a large, granite rock face is used as a catchment surface. Water falling here is directed by a series of bunds towards pits and storage basins dug into the soil at the bottom of the hill and around the home. Through a process of water recharge at all points along the slope, soil moisture is increased in all cultivated areas. As Mr Phiri puts it, 'no water escapes my farm … I must plant the water before the crops.' Water storage is enhanced in the farm with the construction of a pond in the upper part of a small wetland patch (*dambo*). This retains water through most of the dry season, with slow seepage extending the period of wetness in areas adjacent to the pond. Pond water and a series of *dambo* wells open up possibilities of small-scale irrigation through canals to drier areas of the farm.

Slope and field surface management. Natural changes in soil moisture and nutrient availability across the farm's slope are further manipulated by the construction of earth bunds and soil pits. Soil bunds along the contour increase the conservation of water and soil, while field ridges may act to divert surface flow or decrease waterlogging effects in wetter areas. Pits are dug into the contour bund in order to increase infiltration. By changing the function of the contour bund from one primarily designed for preventing soil erosion and so draining water away from the field, Mr Phiri has redesigned them in order that they fulfil a water harvesting function.

Soil management. In the central wetland area, heavier soils, with high nutrient and organic matter content, exist. These soils retain water and provide the best sites for dry-season and drought cropping. High-density maize stands are planted; these may provide a double crop in good seasons. Limited fertility inputs are required in these areas. In areas further away from the central wetland, the drier, sandier soils have a lower nutrient content. These are suited to groundnut, sorghum and millet planting. Additions of manure and termite soil are concentrated here. Mr Phiri makes use of no inorganic fertiliser as he says it destroys the soil. Instead, he uses a range of techniques to improve soil fertility. Continuous ridging helps the build-up of soil organic matter in the ridges. The same effect is achieved by ploughing in crop residues, grass matter and specially grown green manures and alley crops (Chapter 7). Deep ploughing is practised on all plots in order to avoid the development of an impermeable plough pan.

Space management. During the cropping season of 1988–89, 23 different crop species, 26 different tree species, plus bees, fish, reeds and grass fodder were harvested from Mr Phiri's 2.5ha plot. The identification and creation of spatial niches to maintain diversity are important parts of his strategy. Complex intercropping and relay cropping systems are employed which exploit the environmental heterogeneity of the area.

Box 6.6 *(cont.)*

Temporal variation. Micro-management varies seasonally; the complex patterning of crops, trees and grasses is a result of a set of sequential management decisions that emerge through the season. The *dambo* area is used differently between seasons. In drier years, there is less sequential cropping, less rice and less maize planted. In wetter years, multiple cropping of a greater diversity of annual crops is possible, although waterlogging may occur in some parts of the farm.

Source: visits to Mr Phiri's home since 1985 (see also Maseko *et al.*, 1987; Scoones, 1991)

range of available environmental resources is exploited by managing water flows, manipulating field slopes and surfaces, improving soil structure and fertility, and making the most of limited available space (Box 6.6). A mixture of detailed planning and adaptive performance is the key to success.

Mr Phiri's home has become an example for farmers around to follow. Although his neighbours do not try out the whole range of practices, they often come and observe, trying and testing different options on their own land. This process of farmer-to-farmer sharing of ideas and on-farm adaptation has always been the way new practices have spread. However, the formal extension system has, in the past at least, been a constraint to the spread of innovation (Chapter 8). Many of the practices that are so well exemplified in Mr Phiri's farm are not part of the standard set of extension recommendations. Indeed, those following the extension service's Master Farming training used to be actively dissuaded from following some of the practices so central to Mr Phiri's success. For instance, removing trees from fields used to be a requirement of attaining a Master Farmer certificate (Wilson, 1989). Equally, pitting techniques, particularly those that disturb the design of the standard contour ridge, were seriously frowned on. Other practices are in fact illegal, such as the cultivation or the digging of small dams in the *dambo* area. Prior to Independence, Mr Phiri had successfully won a series of court battles with the Department of Natural Resources and had been granted permission to make use of the wetland area. However, others are more cautious about taking on authority, fearing the consequences of apprehension, fines or even arrest.

Fortunately, there is an increasing recognition among the extension services that the initiatives of people like Mr Phiri are useful opportunities for spreading ideas. As part of the work of the Zvishavane Water Projects which Mr Phiri established in 1987, large numbers of extension workers from all over the country now visit his farm, along with farmers from different areas. Following linkages made between Mr Phiri and farmer

groups supported by Intermediate Technology, a number of innovations, including infiltration pits, shallow wells and rock dams, are beginning to spread in nearby Chivi (Hagmann and Murwirwa, 1994)

Conclusion

Making use of a wide range of agricultural management options, differentiated in space at different scales, is a vital component of farmers' strategies. Spreading risk across slopes, between different sites and exploiting a range of microenvironments allow a diverse response to uncertain events and the contrasting dynamics of different parts of the landscape. This is combined with detailed management of field-level soil and water processes and plant–soil–water interactions. The art of dryland farming always makes the most of this spatial complexity. In a dry area, the manipulation of spatial processes to increase the availability of water is central. Through a variety of techniques farmers are able to reshape their landscapes, fields and plots to increase water availability for crops and so reduce the production risks of dryland agriculture. The ability to do so depends on access to and control over land resources, capital and labour.

In order to increase the diversity of options available to farmers, research and extension approaches that encourage local experimentation and farmer-to-farmer sharing are the only way an adaptive approach to agricultural resource management can be encouraged at a broad scale. Because of spatial heterogeneity, simple generalisations about site-specific solutions are impossible. Instead, generalisations about processes are more appropriate, both in terms of key agroecological processes of significance to dryland survival and in terms of the processes by which experimentation, innovation and sharing can be encouraged. These themes are pursued further in the next two chapters.

Note

1. The fifteen most common trees retained in fields in nearby Mazvihwa communal area are (in order of occurrence frequency): *Sclerocarya birrea, Azanza garkeana, Diospyros mespiliformis, Lannea stuhlmanni, Strychnos madagascarensis, Berchemia discolor, Strychnos spinosa, Colophospermum mopane, Gardenia spatufolia, Combretum imberbe, Afzelia quanzensis, Kigelia africana, Lonchocarpus capassa* and *Kirkia acuminata* (Gumbo *et al.*, 1990).