International Institute for Environment and Development

Sustainable Agriculture and Rural Livelihoods Programme

GATEKEEPER SERIES No. 22

Microenvironments Unobserved

ROBERT CHAMBERS

This Gatekeeper Series is produced by the International Institute for Environment and Development to highlight key topics in the field of sustainable agriculture. Each paper reviews a selected issue of contemporary importance and draws preliminary conclusions of relevance to development activities. References are provided to important sources and background material.

The Swedish International Development Authority (SIDA) funds the series, which is aimed especially at the field staff, researchers and decision makers of such agencies.

Robert Chambers is Visiting Faculty at the Administrative Staff College of India, Hyderabad, India.

This paper is a shorter version of a paper of the same title that appeared in R.P. Singh (ed). Proceedings of the International Symposium on Natural Resources Management in a Sustainable Agriculture. February 6-10,1990, New Delhi, Vol 2, Indian Society of Agronomy, New Delhi.

MICROENVIRONMENTS UNOBSERVED

Robert Chambers

As we enter the 1990s, the dominant paradigm of development expressed by normal professionals and implemented through normal bureaucracy is still top-down and centre-outwards. Power is concentrated in hands of the old men in high offices and central places. Knowledge is generated in universities, laboratories, engineering workshops and research stations, and then transferred packaged for adoption. The approach is centralised, standardised, and simple. Non-adoption by farmers is still attributed to their ignorance and to imperfect communication. When farmers do not adopt, it is not the technology that is to blame but a failure of communication, top-down and one-way, from scientist through to farmer.

In recent years this transfer of technology (TOT) paradigm has been increasingly questioned, even in the citadels of normal professionalism. Reductionist research, high input packages, and top-down extension have had their successes: in the uniform and controlled conditions of industrial and green revolution agriculture they have raised output per unit of land. But the sustainability of that increase is open to question, and TOT does not work well with the more complex, diverse and risk-prone rain-fed agriculture of much of the poorer South. Explanations of non-adoption are now increasingly sought not in the ignorance of farmers, not in the methods of communication, not even so much in the lack of access to inputs, but in the technology itself, the concept of package, and the processes whereby the technology is generated.

With this shift of understanding, a new family of complementary approaches to agricultural research and extension have evolved. These are variously described as farmer-back-to-farmer (Rhoades and Booth, 1982), farmer participatory research (Harrington & Martin, 1988), and farmer first (Lightfoot et al., 1987). These seek to reverse centralist tendencies, emphasising farmers' participation in most or all stages of research, and farmers' own analysis, choice and experimentation. The package of practices is replaced by a basket of choices. Searching for what farmers need becomes an important activity for scientists and extensionists. While TOT simplifies and standardises, farmer first enables farmers to do better by complicating and diversifying their farming systems.

Complexity and Diversity Underperceived

In both agricultural and social sciences, however, complexity and diversity are underperceived, and consequently undervalued.

Sites for Research and Trials

Sites chosen for research and trials tend to screen out topographical and soil variability. One of the first measures undertaken when ICRISAT[1] was founded was to bulldoze and smooth out some of the surface irregularities of the land, making it more amenable to normal experimental procedures. Sites for on-farm trials may similarly be selected for being flat or having an even inclined slope. According to textbooks, soil variation is a problem in selecting land for trials: the patch of land chosen as a block must be as uniform as possible. For research purposes then, uniform conditions are actively created or sought out.

Field Visits

Field visits by scientists are vulnerable to the biases of rural development tourism - spatial, project, person, seasonal, professional and diplomatic (Chambers, 1983). They then see field trials, not indigenous experiments; earth bunds covered in good grass near the main road, not the breached bunds which have contributed to erosion further away. Sometimes roads follow flat ridges, as in parts of Kenya, running through fields of arable crops which are then observed and walked through, to the neglect of the steeper slopes and intensively cultivated valley bottoms (Dewees, 1989). Professionals notice and ask about what concerns their specialisation. Since so many are commodity specialists, this focuses attention on field crops. Prudent officials who are hosts and guides follow the same route and the same rigmarole with a succession of visitors, and themselves have their selective perceptions reinforced through repetition of what they see and say.

Short Time Horizons

In the on-farm situation, it is less farmers and much more non-farming professionals who have short time horizons. Agronomists tend to be concerned with field trials over one or at most a few seasons. Agricultural engineers and soil conservation staff usually work at one-off conservation, carrying out physical works and then moving on to another area. They miss the farmers' experience of what happens to their works over the subsequent years.

Sheer Blindness

Observation that is needed and 'natural' to cultivators and pastoralists has often been trained out of professionals. Book and classroom learning de-skill and dampen curiosity, deterring enquiry beyond narrow physical and disciplinary domains. It is also astonishing how easy it is to fail to notice and ask about something of significance. On a recent village Rapid Rural Appraisal (RRA), when trying to observe points of interest, I nearly walked right past a superbly constructed and exploited silt deposition field. And that was while walking a transect and consciously trying to observe. Ken Wilson reports (1989) from Zimbabwe:

1. International Crops Research Institute for the Semi-Arid Tropics

"During one trip with senior agricultural extension officers, in which I was drawing attention to the positive effects that trees were having on early season crop growth, one of them pondered: why is it that I have been telling farmers to remove them all my life, without ever bothering to look at the effects?"

Combined, these biases in perception screen out much of the diversity and complexity of farming systems. To be sure there have been significant shifts among agricultural scientists, recognising the value of the complications of intercropping and of agroforestry. But even with these concerns, scientists and extensionists are still inclined to imprint linear and large-scale patterns, which may or may not make sense. Line sowing is preferred to broadcast sowing; intercropping is in tidy lines; and agroforestry is often taken to mean alley cropping, with trees and crops in straight lines. Trials on farmers' fields are placed on flat or evenly sloping land. However 'good' the reasons are, the result has been that much has been missed, including farmers' own technology, their experiments, interlinkages within their farming systems, changes over the seasons, and farmers' long-term strategies for soil, water and nutrient concentration.

Livelihoods

In the social sciences, reductionism and professional convenience have also generated a simplified view of rural people's livelihoods. Livelihood can here be defined as means to gain adequate stocks and flows of food and cash to meet basic needs, together with reserves and assets to offset risk, ease shocks, and meet contingencies (WCED, 1987).

In practice, the livelihood strategies of poor people, including resource-poor farmers, are often complex and diverse. Different household members undertake different activities in different places at different times of the year. Besides farming themselves, these can include labouring for other farmers, share-rearing of livestock, work on or for non-farm enterprises, migration, craft work, petty trading, and the gathering, consuming and selling of a large range of common property resources. The livelihoods of poor people can be both complex and different even in the same village (Beck, 1989; Heyer, 1989).

These complexities and differences are underperceived for many reasons:

- the stereotype of poor people is as a simple, uniform, unskilled and inert mass;
- the lack of direct exposure of urban-based professionals to the realities of poor people's livelihood strategies;
- survey questionnaires for social surveys which are drawn up in offices and omit categories of which urban-based professionals are unaware, thereby excluding many livelihood activities;
- survey investigators and respondents whose interest lies in short and simple answers which finish the interview faster;

- the tendency of poor people to give prudent replies to questions and to understate their sources of food and income;
- incomplete accounts in surveys of activities which take place at times of the year other that that of the interview;
- neglect of the economic activities of women and children.

In consequence, survey data and professional opinion sustain an oversimple view of how poor people gain their livelihoods.

Microenvironments Unobserved

These general biases in both agricultural and social sciences combine to hide microenvironments (MEs) from sight, to understate or exclude them in statistics, and to undervalue their importance for livelihoods. In addition, there are other factors specific to the nature of MEs which conceal them from view or insulate them from attention. These can be understood by considering examples of MEs and reflecting on some of their characteristics.

Most agriculture creates or alters microenvironments, through ploughing, irrigation, the micro-climatic effects of crop canopies, effects of grazing and browsing, and so on. The MEs with which we are concerned are more separate and distinct. A microenvironment is a distinct small-scale environment which differs from its surroundings, presenting sharp gradients or contrasts in physical conditions internally and/or externally. Microenvironments can be isolated, or contiguous and repetitive, and natural or made by people or domestic animals. Microenvironments include:

- home gardens (also known as homestead, or household, kitchen, backyard or dooryard gardens)
- vegetable and horticultural patches (protected, with wells, etc.)
- river banks and riverine strips
- levees and natural terraces
- valley bottoms (*fadama, wadi, mbuga, vlei* etc.)
- wet and dry watercourses :
    - rainstreams (dividing and braiding, etc.)
    - dry river beds (*nallas, wadis, luggas* etc.)
    - drainage lines
- alluvial pans
- artificial terraces
- silt trap fields (depositional fields, gully fields etc.)
- raised fields and ditches or ponds (especially in wetlands)
- water harvesting in its many forms
- hedges and windbreaks
- clumps, groves or lines of trees or bushes
- pockets of fertile soil (termitaria, former livestock pens etc.)

- sheltered corners or strips, by aspect of slope, configuration etc
- plots protected from livestock
- flood recession zones small flood plains
- springs and patches of high groundwater and seepage
- strips and pockets of impeded drainage
- lake basins
- ponds, including fishponds
- animal wallows (e.g. for buffalos)

(Apart from personal observation, the main sources for this listing are Richards, 1985; Pacey with Cullis, 1986; Altieri, 1987; Harrison, 1987; Wilken, 1987; and IIED, 1989.)

There are many reasons why professionals have neglected MEs such as these. They include:

Smallness and dispersal. MEs are often half-hidden. They are usually small and dispersed, and many are low-lying. The small or intermediate scale of MEs combines with topography and with the way in which water and soil collect in low places to hide many of them in dips, depressions, valleys, gullies and watercourses where they are easily overlooked by a casual visitor. Professional attention focuses on other scales. Gene Wilken has noted (1987) that "most research has been limited at the technical level to horizontal plant spacing and at the aggregate level to optimum farm size and economies of scale." Normal soils maps also miss much. In India their scale is 1:500,000. In both Kenya and Zambia, it is said that soils maps, because of their scale, have omitted the crucial MEs of riverine strips and areas of seasonal standing water and moisture (known as dambos in Zambia and Zimbabwe).

Research station conditions. Most research is conducted on research stations where undulations and irregularities tend to be eliminated and their ME potential ignored. Some ME types created by farmers may not be feasible or found at all on research stations - for example silt deposition fields. And where MEs are created on research stations, as with the watershed work at ICRISAT, it is difficult to avoid creating special conditions quite different from those of farmers.

Sequential creation. Most professionals have shorter time horizons than most farmers. Soil and water conservation staff with targets seek to complete works within the financial year. But many farmers' MEs take years to develop. Some silt deposition fields in gullies are built up sequentially over years, with rock walls raised annually. Home gardens, and areas near homesteads, where farmyard manure and household organic wastes are used, gain in fertility over time. Runoff watercourse training may be developed gradually over many years, as may many forms of water harvesting which require physical works. Making raised fields and ditch ponds in wetlands in Indonesia leads to sequential cropping in which tree crops gradually come to dominate after 10 to 15 years (Watson, 1988).

Gender. Some MEs, especially home gardens, are mainly the concern of women, and women's concerns are normally neglected by male professionals who are still in the overwhelming majority.

'Unimportant' crops. MEs often grow crops (vegetables, multipurpose trees, less common root crops, etc.) other than the staple foodgrains, root crops and non-food cash crops which are the priorities of research and extension, which are marketed in bulk, and which are estimated and enumerated in official statistics. In Indonesia, the products of home gardens are mostly consumed locally and rarely appear in the statistical record (Soemarwoto and Conway, 1989).

Misfit with normal research. Normal research simplifies in order to measure. But the complexity, diversity and 'untidiness' of many MEs, their non-linear shapes and irregular surfaces, do not lend themselves to standard agronomic trials or measurement, or to mechanisation or high capital inputs. Many MEs use organic, not the preferred inorganic, manures. Many are based on subsoil conditions and rooting patterns which would be costly and tedious to examine and observe. And many develop and exploit diverse complications such as linkages between earth shaping with soil and rocks, the channelling, harvesting and retention of water, a variety of crops and vegetables, livestock including fish, multiple canopies including bushes and trees, and mulches and manures.

Many illustrations of the above could be given. Paul Richards comments on the significance of the niche of run-off (seep-zone) agriculture, in parts of West Africa, on fields which trap moisture and silt from higher up a valley profile, and notes its neglect by 'formal sector' researchers (Richards, 1985). In an RRA in Ethiopia, only by walking a systematic transect was it revealed to outsiders that in a semi-arid environment farmers had, over the years, developed an intensive system for trapping and concentrating silt, water and nutrients in gullies, and growing high value crops including coffee, papaya and *chat* (a narcotic) in the MEs protected by the gully walls (ERCS, 1988). In India, RRAs undertaken in 1989 by MYRADA in Gulbarga District in Karnataka, by Youth for Action in Mahbubnagar District in Andhra Pradesh, and by the Aga Khan Rural Support Programme in Bharuch District in Gujarat have variously identified the creation of MEs to harvest water and soil as prevalent local technology significant economically but in no case recognized or supported by the official soil conservation programmes.

Home gardens are frequently overlooked or misinterpreted. In Bangladesh, Anil Gupta found (1989) that scientists believed that households used homestead space and other resources inefficiently, and that they planted most trees, bushes and vegetables randomly or just let them grow where they came up. But a survey by women scientists, and maps made of home gardens, revealed great complexity and what appeared to be some order in what had been assumed to be disorder.

MEs are thus largely unobserved. Spatially they are hidden by their dispersal. Professionally they are hidden by their irregular untidiness and their misfit with the mainstream priorities of the major disciplines. And temporally, they are hidden by their use in only certain seasons.

Yet in aggregate, they are at present of major significance to sustainable livelihoods. Because of their generally better moisture and fertility conditions than their surroundings, they provide the more reliable component of a farming household's food supply. Moreover, in many environments, MEs have been developed as a form of intensification linked with increasing population density. In future, as rural populations in many places increase yet further, MEs will be developed even more, and will become even more significant for the livelihoods of poor farming households.

Properties of Microenvironments

There are a number of important properties and functions of MEs.

Specialisation

Because MEs differ from their more uniform surroundings, their use also usually differs. An example is paddy grown in silt deposition fields in *nallahs* in semi-arid India. But specialisation, though general, is not universal. Some gully fields in Ethiopia are used to grow the same crop - sorghum - as in neighbouring, more extensive fields, though, it can be expected, with higher yields and lower risk.

Concentration

Farmers' own soil and water 'conservation' is often soil, water and nutrient 'concentration'. Soil concentration occurs when soil or silt is dug from common land and carted to build up fields and fertility. Or erosion is exploited for the low cost transport it provides for silt which is then trapped by rocks, brushwood, trash lines, vegetative barriers or earth bunds. Water concentration occurs when it is channelled, captured and retained in water harvesting. Nutrient concentration occurs through silt deposition, farm yard manure in and near homesteads and in livestock pens, leaf litter under bushes and trees, and organic manures carted to the ME site. And these forms of soil, water and nutrient concentration interact synergistically (see e.g. Kolarkar et al., 1983).

Protection

For domestic and wild animals, many MEs present attractive islands of green in dry expanses, and they are therefore vulnerable to grazing and browsing. Protection is essential except where, as with some eucalypts, plants are unpalatable. Fences, hedges and barriers are necessary and common. Difficulties in protection against animals can deter the creation or exploitation of MEs, or determine what is grown in them. As for climate, many MEs are protected to create their own microclimates, often sheltered from excessive sun, wind and/or water.

Diversity and Complexity

Diversity in species of plant and animal, and complexity in biological relationships between them, are common. Multiple canopies, agroforestry combinations, vining plants, variety of species, and plants at various stages of growth are common characteristics. The movement and arrangement of soil and stones often make the land surface less even and more varied. The untidiness of some MEs incorporates a large number of interactions.

Nutrition and Health

Apart from the quantity and relative stability of the flows of food and income to households from MEs, some, especially home gardens, provide two other benefits: medicinal plants, and vegetables, fruits and other foods for diversified diets which also include more vitamins. Recent findings of dramatic drops in child (aged 6 months to 5 years) mortality with vitamin A supplementation (a 60 per cent reduction in a study near Madurai in South India, and a 45 per cent reduction in a study in Indonesia (Saroj Pachauri pers. comm.) point to the key potential of home gardens as a source of literally life-saving vitamins.

Reserves and Fallbacks

MEs frequently provide reserves to meet contingencies, and for lean seasons and bad years. Trees to which people have clear rights increasingly serve as savings banks which can be cashed to meet seasonal or sudden needs (Chambers and Leach, 1989). A very poor family in Kakamega District in Kenya had, in 1988, a line of Eucalyptus at the bottom of their half acre plot, which they cut and sold, they said, in the lean times of February and March "to buy food and soap". In Sudan, *wadi* cultivation is especially significant in bad years (Ian Scoones pers. Comm..). In Zimbabwe, key resource habitat patches are important for cattle in bad years (Scoones, 1988). Leaf fodder from trees on private land was used by some farmers in Gujarat as their last fallback for feeding their livestock during the great drought of 1987-8. By accumulating reserves of value, and by providing output which lasts longer, MEs thus contribute to the sustainability of livelihoods.

Restraining Migration

Following the analysis of Ester Boserup (1965), the technology used in agriculture, in this case for MEs, is related to population pressure and labour availability. MEs will then be more and more developed and exploited as population pressure increases. In some environments there may be a critical phase when more labour is needed to develop, protect, maintain and exploit them, and when paths diverge: either people migrate, seasonally or permanently, and leave an unsustainable and risky farming system; or they stay and invest in more sustainable intensification. One illustration is water harvesting near Yatenga on the Mossi Plateau in Burkina Faso, where investment of labour in laying out rock bunds and digging pockets for crops has led to higher and more stable production, and reportedly less outmigration. MEs' greater productivity, stability and spread of production period can thus locally support more livelihoods.

Innovation, Experiment and Adaptability

MEs play a vital part in innovations, experimentation and adaptation. Some wild plants which are candidates for domestication are tried first in home gardens. Anil Gupta reports that a survey by women scientists in Bangladesh identified a large number of innovations in home gardens (Gupta, 1989). Calestous Juma notes that farmers place such plants first in environments similar to those where they were found, for example in moist ground near a stream (Juma, 1989), and gradually move them out into harsher environments. Paul Richards observes for West Africa that when farmers carry out experiments, they typically begin in the neglected run-off zone (Richards, 1985). Indeed, *the past failure to observe farmers' experiments may partly stem from the failure to notice the MEs in which they are to be found*. MEs thus contribute to the sustainability of livelihoods by providing locations for experiment, enhancing the adaptability of farmers and their ability to respond to changes and to exploit opportunities.

Whose Knowledge and Creativity Count?

MEs are a domain where villagers' knowledge, creativity and Research and Development (R & D) have advantages compared with the knowledge and R & D of scientists.

In terms of knowledge, scientists have an advantage in their knowledge of and access to information and genetic material from elsewhere; but their capacity for precise measurement is less useful faced with the complexity and diversity of ME conditions than with the simplicities and uniformities of industrial and Green Revolution agriculture. Villagers, on the other hand, know more about the complex and diverse detail of their livelihoods and of local ecology, and of how these mesh and are managed. Villagers also have advantages in local observations over time.

In terms of creativity and R & D, many MEs have been made and exploited by farmers over the ages without any formal scientific input. Home gardens, silt deposition fields, and terraces are examples. MEs proved support for the view that *"...the farmers' role in technology development becomes more critical and increasingly cost-effective as the proposed technology becomes more multi-faceted and complex*" (Sumberg and Okali, 1989). With most MEs scientists have serious disadvantages. Research station conditions are likely to be radically different from those of most MEs: wetland patches in dry areas, for example, cannot be replicated on research stations (IIED, 1989). With the possible exception of some basic research, on-station research concerning MEs is likely to mislead and generate recommendations that misfit rather than help.

In contrast, farmers have several comparative advantages. They are constrained neither by an inflexible experimental design nor by the simplifications demanded by reductionist statistical methods. They do not suffer from scientists' relatively short time horizons, but like the settlers in the wetlands of Java, can embark on processes which will take 10 to 15 years to mature. They can manage the complexities of simultaneous land shaping, concentration of soil, water and nutrients, and sequential changes as trees and other plants grow. They can adapt what they do to diverse and irregular topography, and climatic and social conditions. They can plant complicated mixtures of plants, and can place plants individually to exploit tiny pockets of fertility or protection. They can develop MEs sequentially, maintaining and modifying them as they observe and learn.

Not surprisingly, then, there is much evidence of farmers doing better than non-farming officials or scientists in developing MEs. In Singhbhum District in Bihar, it has been found that soil conservation staff are not as good at selecting water harvesting sites as villagers: those selected by the villagers capture more water (Sinha, 1989). In various parts of the world, government soil conservation programmes using contour earth bunds have actually contributed to erosion. As in Ethiopia, Mexico, and India silt deposition fields appear to be entirely a farmer's technology. In India, at least, they are far superior to the standard gully checks of official soil programmes. It is only reasonable to conclude that programmes for the creation, improvement and exploitation of MEs should be largely determined and implemented by farmers.

Action for the 1990s

The comparative advantage of farmers and disadvantage of scientists in the creation and use of MEs means that less has been lost from past neglect of MEs by non-farming professionals than might at first appear. All the same, the potential of MEs appears large, especially in the semi-arid tropics. And as populations in many countries continue to increase, the need to develop and exploit MEs will become greater. Already in water harvesting, soil conservation and agroforestry, considerable programmes have been mounted by governments and also NGOs, but with only mixed results. The question is what non-farming professionals can do to enable the potential of MEs to be realised more rapidly, effectively and efficiently.

First, **clear and secure rights and tenure** are preconditions. Farmers who sense their tenure is insecure are deterred from taking a long view and from investing labour in land shaping or planting trees. This has been the tragic situation in much of Ethiopia where the 1970s land reform perversely made farmers insecure. In parts of India, too, tree planting and protection by farmers is discouraged by restrictions on rights of harvest and transit (Chambers, Saxena & Shah, 1989). In contrast, land consolidation and the provision of secure land titles to farmers in Kenya has had the opposite effect, supporting a soil conservation programme and also resulting in much tree planting and protection, with research showing the densities of planted trees to be higher the denser the population and the smaller the holdings (Bradley et al., 1985; Peter Dewees, pers. comm.).

Second, **observation and awareness** by professionals are imperative. These can be achieved in many ways. The techniques of rapid and participatory rural appraisal (Khon Kaen University, 1987; IIED, 1988-1990) and especially of agroecosystem analysis (Conway, 1986; McCracken et al., 1988) have much to offer. These include walking transects, mapping village resources, mapping MEs, and the participatory use of aerial photographs to identify MEs and soil patches and zones. The simple act of mapping a home garden or diagramming a transect can have a dramatic effect on personal awareness, sometimes provoking a 'flip' - a professionally and intellectually exciting deeper change in what is seen and how it is seen.

Third, the appropriate paradigm is **farmer first rather than Transfer of Technology (TOT)**. For non-farming agricultural professionals, farmer first entails changes and reversals:

- of location - from on-station to on-farm;
- of learning - from learning from literature and from other non-farmers to learning from and with farmers;
- of role - from teacher who transfers technology to consultant who searches for technology and supports farmers' trials and experiments;
- of content - from the single simple package to the basket spread of diverse choices;
- of direction of transfer - from vertical to lateral with farmers' workshops and visits to each others' MEs;
- and of process - from simplifying and standardising to complicating and diversifying.

Farmers' participation throughout is of paramount importance.

To observe and learn about microenvironments, and to help farm families create and exploit them and improve and intensify their use, presents a challenge to the agricultural and social sciences. Microenvironments demand quiet professional revolutions. These will start not with the lecturer but with the farm family, not just in the classroom but in the field too, not on the research station but in the microenvironments themselves. They will entail not simplifying and standardising but enabling farm families to complicate and diversify. The 1990s will show whether non-farming professionals can make that revolution and usefully meet that challenge, or whether it will be largely unassisted that farmers continue to experiment, innovate, develop and manage on their own.

References

Altieri, Miguel A. 1989. *Agroecology: the Scientific Basis of Alternative Agriculture*. Westview Press, Boulder and IT Publications, London.

Amanor, Kojo. 1989. 340 Abstracts on Farmer Participatory Research, Network Paper 5. Agricultural Administration (Research and Extension) Network, ODI, London.

Beck, Tony. 1989. Survival strategies and power among the poorest in a West Bengal village. *IDS Bulletin*, 20 (2):23-32.

Boserup, Ester. 1965. *The Conditions of Agricultural Growth: the Economics of Agrarian Change Under Population Pressure*. George Allen and Unwin, London.

Bradley, P.N., N. Chavangi and A. van Geldar. 1985. Development Research and Planning in Kenya. *Ambio*, 14 (4-5):228-236.

Chambers, Robert. 1983. *Rural Development: Putting the Last First*. Longman, Harlow, UK.

Chambers, Robert. 1986. Normal Professionalism, New Paradigms and Development, IDS Discussion Paper 227. IDS, December.

Chambers, Robert and Melissa Leach. 1989. Trees to Meet Contingencies: savings and security for the rural poor. *World Development*, 17 (3):329-432.

Chambers, Robert, N.C. Saxena, and Tushaar Shah. 1989. *To the Hands of the Poor: Water and Trees*. Oxford and IBH, New Delhi and IT Publications, London.

Chambers, Robert, A. Pacey and L.A. Thrupp (eds.). 1989. *Farmer First: Farmer Innovation and Agricultural Research*. Intermediate Technology Publications, London.

Chambers, Robert. 1989. A New Administration: beyond Henry Fordism and the self-deceiving state. Paper for the IDS Retreat, 11-12 December 1989.

Conway, Gordon R. 1985. Agroecosystem analysis. *Agric. Admin*, 20:31-55.

Dewees, Peter. 1989. Aerial photography and household studies in Kenya. *RRA Notes*, 7:9-12. IIED, London.

ERCS. 1988. *Rapid Rural Appraisal: A Closer Look at Life in Wollo*. Ethiopian Red Cross Society, Addis Ababa and IIED, London.

Gupta, Anil K. 1989. Scientists' views of farmers' practices in India: barriers to effective interaction. In R. Chambers, A. Pacey and L.A. Thrupp (eds). *Farmer First*, pp 24-31.

Harrison, Paul. 1987. *The Greening of Africa: Breaking through in the Battle for Land and Food*. Paladin Grafton Books, London.

Heyer, Judith. 1989. Landless agricultural labourers' asset strategies. *IDS Bulletin*, 20 (2): 33-40.

IIED. 1988 - 1990. *RRA Notes* (1-9). IIED, London.

IIED. 1989. Patchy Resources in African Drylands: a review of the literature and an agenda for future research and development. A proposal of the Drylands Programme, IIED, London.

Juma, Calestous. 1987. Ecological complexity and agricultural innovation: the use of indigenous genetic resources in Bungoma, Kenya. Paper for the Workshop on Farmers and Agricultural Research: Complementary Methods, IDS 26-31 July, cited in R. Chambers, A. Pacey and L.A. Thrupp (eds.). *Farmer First*, pp. 32-34.

KhonKaen University. 1987. Proceedings of the 1985 International Conference on Rapid Rural Appraisal. Rural Systems Research and Farming Systems Research Projects, University of Khon Kaen, Khon Kaen, Thailand.

Kolarkar, A.S., K.N.K. Murthy and N. Singh. 1983. Khadin - A method of harvesting water for agriculture in the Thar Desert, *Journal of Arid Environments*, 6:59-66.

Lightfoot, C., O. De Guia Jr, A. Aliman and F. Ocado. 1987. Letting farmers decide in on-farm research. Paper to Workshop on Farmers and Agricultural Research: Complementary Methods, IDS, University of Sussex, 26-31 July.

McCracken, Jennifer A., J.N. Pretty and G.R. Conway. Gordon. 1988. *An Introduction to Rapid Rural Appraisal*. IIED, London.

Ninez, Vera, K. 1984. *Household Gardens: theoretical considerations on an old survival strategy*. International Potato Center (CIP), Lima, Peru.

Pacey, Arnold and Adrian Cullis. 1986. *Rainwater Harvesting: the Collection of Rainfall and Runoff in Rural Areas*. Intermediate Technology Publications, London.

Rhoades, Robert E. and Robert Booth. 1982. Farmer-back-to-farmer: a model for generating acceptable agricultural technology. *Agric. Admin*. 11:127-137.

Richards, Paul. 1985. *Indigenous Agricultural Revolution: Ecology and Food Production in West Africa*. Hutchinson, London.

Scoones, Ian. 1988. Patch use by cattle in a dryland environment: farmer knowledge and ecological theory. Paper for the workshop of Socioeconomic Determinants of Livestock Production in Zimbabwe's Communal Areas, Mazvingo, Zimbabwe. Centre for Applied Social Science, University of Zimbabwe.

Sinha, Amarjeet. 1989. Harvesting rain water in the tribal district of Singhbhum. *Wastelands News* 5, (2):2-7. Society for Promotion of Wastelands Development, New Delhi.

Soemarwoto, Otto and Gordon Conway. 1989. The Javanese Homegarden. Typescript, Institute of Ecology, Padjadjaran University, Bandung, Indonesia.

Sumberg, J. and C. Okali. 1989. Farmers, on-farm research and new technology. In R. Chambers, A. Pacey and L.A. Thrupp (eds.). *Farmer First*, pp 109-114.

Watson, Greta. 1988. Settlement in the Coastal Wetlands of Indonesia: an argument for the use of local models in agricultural development. *Crosscurrents*, 1:18-32, September. Rutgers University.

WCED. 1987. *Food 2000: Global Policies for Sustainable Agriculture*. A Report of the Advisory Panel of Food Security, Agriculture, Forestry and Environment to the World Commission on Environment and Development. Zed Books, London and New Jersey.

Wilken, Gene C. 1987. Good Farmers: Traditional Agricultural Resource Management in Mexico and Central America. University of California Press, Berkeley, Los Angeles and London.

Wilson, K.B. 1989. Trees in fields in southern Zimbabwe. *Journal of Southern African Studies*, 15 (2): 369-383.

International Institute for Environment and Development

Sustainable Agriculture and Rural Livelihoods Programme

The Sustainable Agriculture and Rural Livelihoods Programme

The Sustainable Agriculture and Rural Livelihoods Programme of IIED promotes and supports the development of socially and environmentally aware agriculture through policy research, training and capacity strengthening, networking and information dissemination, and advisory services.

The Programme emphasises close collaboration and consultation with a wide range of institutions in the South. Collaborative research projects are aimed at identifying the constraints and potentials of the livelihood strategies of the Third World poor who are affected by ecological, economic and social change. These initiatives focus on the development and application of participatory approaches to research and development; resource conserving technologies and practices; collective approaches to resource management; the value of wild foods and resources; rural-urban interactions; and policies and institutions that work for sustainable agriculture.

The Programme supports the exchange of field experiences through a range of formal and informal publications, including *PLA Notes* (*Notes on Participatory Learning and Action - formerly RRA Notes*), the *IIED Participatory Methodology Series*, the *Working Paper Series*, and the *Gatekeeper Series*. It receives funding from the Swedish International Development Cooperation Agency, the British Department for International Development, the Danish Ministry of Foreign Affairs, the Swiss Agency for Development and Cooperation, and other diverse sources.

International Institute for
Environment and Development
3 Endsleigh Street
London
WC1H 0DD

www.iied.org