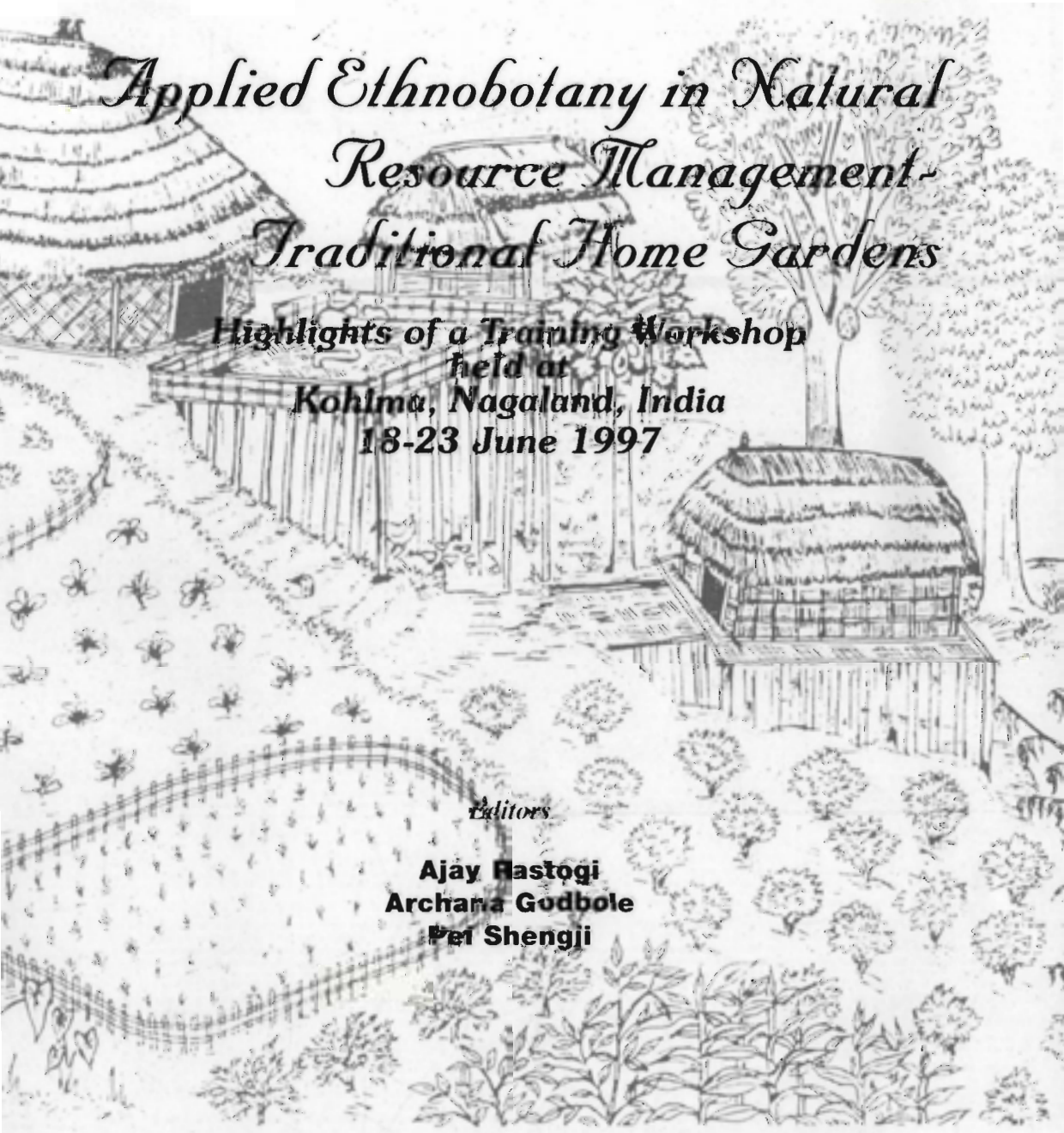

Applied Ethnobotany in Natural Resource Management - Traditional Home Gardens

Highlights of a Training Workshop held at Kohima, Nagaland, India 18-23 June 1997

Editors

Ajay Rastogi
Archana Godbole
Pei Shengji

International Centre for Integrated Mountain Development
Kathmandu, Nepal
1998

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Foreword

The Hindu Kush-Himalayan (HKH) region has unique importance because of its diverse biophysical environment and the extremely rich culture of its inhabitants belonging to hundreds of ethnic groups and indigenous communities. The International Centre for Integrated Mountain Development (ICIMOD) has a strong commitment to sustainable development of this region and has strong links with government as well as non-governmental institutions in the regional member countries of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. The United Nations Scientific and Cultural Organization (UNESCO) and ICIMOD, with financial assistance from the International Development Agency of Denmark (DANIDA), have launched a three-year programme to develop the field of ethnobotany applied to indigenous management and conservation of plant resources through capacity building, supporting research and promoting action-oriented field projects.

The need for training workshops is emphasised under this project to orient field researchers towards applied ethnobotanical work in conservation and community development. Five such national and sub-regional training workshops were organized in the ICIMOD member countries in close cooperation with national organizations. In order to focus discussion during the course of the workshops and to present appropriate field techniques and methods for applied ethnobotanical work, each workshop was assigned a definite theme. In the case of north-eastern India, the theme was traditional home garden systems. Home gardens are known to supplement swidden farming practices prevalent in most traditional mountainous societies around the world. With this in view, the workshop report includes an overview of current research in home garden systems as well as analyses of the approaches followed in these diverse traditional systems.

The Nagaland Environmental Protection and Economic Development (NEPED) Project of the Government of Nagaland hosted the workshop. This project, undertaken with financial assistance from the International Development Agency of Canada (CIDA), is actively engaged in promotion of improved agroforestry techniques building upon the traditional knowledge and skills of native farmers. Organization of the workshop was further facilitated by the Applied Environmental Research Foundation, an organization pioneering action research in applied ethnobotany and assisting NEPED on botanical aspects of the programme. Participants and resource persons came from many diverse institutions representing the north-eastern mountainous states. The Uttar Pradesh Academy for Administration, a partner institution of ICIMOD in the Uttarakhand region of the State, also contributed by sending two staff members from their Mountain Cell to participate in the workshop.

It is hoped that the network of people actively involved in applied ethnobotanical work in the region and those who came together as a part of the workshop will further benefit by the publication of this report. The publication will also make a useful contribution to the recognition of indigenous knowledge of the local communities particularly in management of home garden systems. At a broader

level, it gives the underlying message that true participation of local communities for the benefit of society can only be brought about by incorporating their traditional skills in community development and conservation projects.

Egbert Pelinck,
Director General

Acknowledgements

The workshop agreement was made at a meeting between Mr A.M. Gokhale, Chairman, NEPED Steering Committee, and Mr Egbert Pelinck, Director General, ICIMOD at Nagaland Bahavan in New Delhi on 19 July 1996. Their full support to the successful organization of this workshop is appreciated. The visionary leadership of the NEPED team leader, Mr R. Kevichusa, and the dedication of all other members of the project operations' unit are duly acknowledged. The opportunity of sustained interaction with the four local experts was extremely rewarding for other participants, and they are thanked for their time and patience. Many Naga villagers of Khuzama, Zulake, Khonoma, and all the vendors from the local market of Kohima town parted with pieces of wisdom during discussions during field work and, without their positive interest and participation, it would not have been possible to carry out the exercises successfully. The support of Dr Robert Hoeft and Dr Yildiz Aumeeruddy, coordinators of the People and Plants initiative based in UNESCO, is duly acknowledged. Many colleagues at AERF and ICIMOD assisted in the successful organization of the workshop and their help is appreciated and acknowledged.

Abstract

A training workshop on applied ethnobotany at Kohima in Nagaland was organized jointly by ICIMOD, NEPED and AERF covering various aspects of nature conservation and community development projects and utilising home gardens as a thematic focus. Twenty-two participants and resource persons from all over the north-eastern states of India came together to share their experiences and learn about research approaches in the field of ethnobotany. The report, 'Applied Ethnobotany in Natural Resource Management: Traditional Home Gardens', highlights the aspects of traditional knowledge in household production systems. Home gardens are known to complement swidden agriculture and animal husbandry practices utilising land and other resources extremely efficiently in mountain areas. Involvement of local experts to talk about indigenous knowledge aspects during the course of discussions on various topics proved very helpful for clarifying many concepts and issues that surfaced during the workshop. The report consists of three main sections. An introductory section provides relevant background information and introduces the theme of the workshop in detail, and the second section provides an overview of research and approaches to analysing home garden systems. The third section provides information on various field visits, an account of interactions with NEPED, and orientation to the market survey exercise. Five annexes give details of survey formats, programme of the workshop, participant information, and workshop evaluation.

Contents

Background to the Workshop

Theme of the Workshop

The workshop planning process was initiated by the Hindu Kush-Himalayan Ethnobotany Programme of the International Centre for Integrated Mountain Development (ICIMOD) based in Kathmandu. This regional centre is committed to the sustainable development of the Hindu Kush-Himalayan (HKH) region and has strong links with government as well as non-government institutions in the regional member countries of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. In order to plan the activities of the Ethnobotany Programme experts from participating member countries were invited to a meeting in which representatives from the Nagaland Environmental Protection and Economic Development (NEPED) Project and the Applied Environmental Research Foundation (AERF) also participated. These projects are closely associated with UNESCO, WWF, and the Royal Botanical Gardens' (Kew) initiative on People and Plants. Therefore programme co-ordinators from UNESCO and country representatives from WWF were also present. The programme approach that emerged from the discussions seeks to assimilate the following public policy issues and principles.

- The principle that all development projects addressing issues related to agriculture, livestock and pasture, agroforestry, forestry, land-use planning, watershed management and other natural resource management fields should take into account the traditional wisdom and expertise of local inhabitants.
- The principle that the interface between people and nature must be addressed in conservation projects that propose setting aside productive lands as protected areas for the conservation of biodiversity. The perceptions, uses and traditional methods of management of natural resources by local inhabitants should be taken into account.
- The principle that the intellectual property rights of people with indigenous knowledge, including special ethnobotanical knowledge, should be respected.

The need was recognised for training workshops to develop the field of ethnobotany applied in the management and conservation of plant resources through capacity building, supporting research and promoting action-oriented field projects in the HKH region. This need stems from the recognition that people in rural communities often have detailed and profound knowledge of the properties and ecology of locally occurring plants and rely on them for many of their foods, medicines, fuel, building materials, and other products. However, much of this knowledge is being lost with the transformation of local ecosystems and local cultures. Over-harvesting of non-cultivated plants is increasingly common: it is often caused by loss of habitat, increase in local use and the growing demands of trade. Long-term conservation of plant resources and of the knowledge associated with them are needed for the benefit of local people and for their potential use by communities in other places. Ethnobotanists can work together with local people to study and record the uses of plant resources, identify cases of over-harvesting of non-cultivated plants, find sustainable harvesting methods and investigate alternatives such as cultivation. Similarly it was thought necessary to develop methodologies to understand the issues related to resource management and community development.

The need for region-specific workshops for the orientation and exchange of information among researchers and development workers led to the development of various specific themes. Such a workshop was considered important for north-eastern India, mainly because resource depletion and population growth are fast in this region, and there is an urgent need to work for equitable resource management with people's participation. So far, the ethnobotanical work in the region has been restricted to ethnobotanical and medico-botanical inventories. The ethnic communities in this region are heterogeneous and their problems are area/ecosystem specific. These tribal communities are different from other tribal communities in the rest of the HKH region in many ways. Through this workshop the understanding of the people's concept of ethnoecology will be developed when coupled with studies of resource-use patterns.

Commitment from the Naga representatives and AERF helped through NEPED being the host organization for the workshop. The Director General and Head of the Mountain Natural Resourses' Division of ICIMOD made a visit to Nagaland and other states of north-eastern India in March 1997. They felt that exposure to the activities and orientation to the approach of the NEPED Project would be in itself a substantial learning experience for all the participants attending the workshop. Nagaland is very rich in plant and animal resources, and there is tremendous diversity in the uses of plants and animals. So far only ethnobotanical inventories have been done, and efforts to document the use of indigenous knowledge in natural resource management have been limited. Nagaland has rich cultural diversity. Fourteen principal tribal communities use a range of approaches and methods for natural resource management of a variety of agroecosystems.

The aim of this regional workshop was to discuss the issues of natural resource management in general and Home Garden systems in particular and to develop appropriate methods to understand and analyse traditional practices for incorporation into community development and conservation programmes. The workshop process was designed in such a way that it provided an environment for sharing knowledge and resources for the development of a network of multidisciplinary ethnobotanical expertise in the region.

Theme of the workshop

The theme of this training workshop was the maintenance of useful biodiversity through the Home Garden tradition by indigenous communities of north-eastern India. This theme was representative and helped to initiate discussions on other related topics such as *jhum* cultivation (shifting cultivation), agroforestry, interlinkages of traditional agroecosystems, community forests, etc. Ultimately it provided a methodological framework for finding solutions for conservation and community development based on ethnobotanical knowledge and indigenous understanding of resource management.

This theme also helped to generate discussion on the cultural context of natural resource management, cultural beliefs which underlie conservation of biological diversity, the symbolic significance of plant uses, etc. Each of the north-eastern states of India is unique and different as far as resource management

systems and cultural diversity are concerned. Discussions on the workshop theme helped to identify issues related to conservation, community development and resource management. The theme also helped participants to select appropriate methodologies to resolve the issues using ethnobotanical skills. Workshop discussions based on the Home Garden systems of traditional communities emphasised the need for enhancing the understanding of indigenous knowledge among scientists and aiding the search for alternatives for conservation and community development using indigenous knowledge.

Traditional Home Garden Systems

Home Gardens: Traditional Systems for Maintenance of Biodiversity

Archana Godbole
Applied Environmental Research Foundation

Introduction

Home Gardens (also known as compound farms, homestead and mixed gardens) are usually the small plots of land surrounding the house. They are found in traditional communities all over the world and are one of the more intensively cultivated parts of an overall farm. Home Gardens are important agroecosystems and are a source of subsistence and cash resources. They are characterised by a mixture of annual or perennial species grown in association. They commonly exhibit a layered vertical structure of trees, shrubs and ground cover plants which recreate some of the features of nutrient recycling, soil protection and effective use of space below and above the soil surface. They also act as a repository and testing site for uncommon species and varieties of plants (Padoch and Jong 1991) and can be used to spread farm work, output and income more evenly throughout the year (Ninez 1984). Home Gardens are a source of edible, medicinal and other useful plants. The Home Gardens of Southeast Asia provide the most vivid illustration of the importance of plants in providing needs for the family. Within perhaps 50 m of each dwelling can be found bananas, coconuts, sugar apples, mangoes, many leafy vegetables, palms, and even fuelwood and timber trees. In Indonesia no less than 37 fruit tree species have been found growing in just one Home Garden.

Research needs

The importance of Home Gardens has been detailed for regions such as Southeast Asia (Soemarwoto and Soemarwoto 1982; Wiersum 1982) and Central America (Anderson 1950). However, such studies have hardly been initiated in the culturally and biologically diverse region of north-eastern India. Most of the tribes from north-eastern India, especially from Arunachal Pradesh, Manipur and Nagaland, have a well-developed tradition of maintaining Home Gardens, and thereby preserving the useful biodiversity of the region. Our recent studies of Konyak Home Gardens in northern Nagaland revealed that more than 120 plant species are found in large, spacious Home Gardens. Even plants such as tea, coffee, *Aquillaria agallocha* and cardamom are being grown. Along with a large number of vegetables and fruits, timber and fuelwood species are also planted. A market survey of Kohima and Mon town markets showed that out of a total of 68 plant products recorded, 40 are harvested from Home Gardens. This clearly indicates the role of Home Gardens in the economy of these communities.

Selling of Home Garden products in Kohima Market - Pei Shengji

The study of Home Gardens is important for enhancing the understanding of indigenous knowledge in natural resource management, as well as for understanding its role in biodiversity conservation and community development. There is a need to formulate a research programme on Home Gardens in the high diversity area of north-eastern India. The research and studies on Home Gardens of indigenous communities could be based around the following topics.

1. **Functions of Home Gardens**

- Cultivation of useful plants: annuals/perennials (mainly herbaceous) as well as trees and shrubs
- Provision of products for household use and cash income (marketability)
- Testing sites for introduced crops such as introduced banana varieties, coffee, etc to check their suitability for large-scale cultivation (experimentation)
- Resting area for livestock such as chickens, pigs, ducks, etc (supplementary activities)
- Place for growing and cultivating culturally significant commodities—specific varieties of beans, gourds—in different tribal areas
- Easy availability of certain commodities that may not be cultivated on a large scale in *jhum* or terrace fields or for specific needs
- Provision of specific dietary considerations for different tribes

2. **Diversity within/among Home Gardens**

- Size and shape
- Location: around the house or slightly away from the village in specific areas or around the temporary hut in shilting cultivation [SC]fields
- Diversity of habits of plants: herbs, climbers, tubers, rhizomes, shrubs, trees, and even crops such as maize and sugarcane
- Diversity of species cultivated
- Diversity within species, i.e., varieties
- Management practices
- Organization and spatial pattern
- Provision of a variety of necessities throughout the year

Role of Home Gardens in maintaining biodiversity. Home Gardens play a significant role in maintaining biodiversity. The selection of plants grown is dependent on specific community needs, e.g., certain very hot chilli varieties with high capsicin content are only cultivated in *Lotha* and *Konyak* Naga Home Gardens. Some leafy vegetables are grown in both Home Gardens and *jhum* fields, but others are only grown in Home Gardens.

Role of Home Gardens in domestication of wild species. It was observed in *Konyak* Home Gardens that forest trees such as *Aquillaria agallocha*, some varieties of bamboo, and fruit trees are successfully domesticated and cultivated. Multipurpose forest trees are cultivated in the Home Gardens of Kara (Nair and Krishnankutty 1984).

Role of Home Gardens in the economy: Home Gardens are used widely to supplement outputs from other agroecosystems, such as *jhum* and terraced

fields, by providing a variety of other subsistence and commercial crops. Certain products are specially cultivated in Konyak Home Gardens as they are in great demand for the local market of Mon town. Recently, local communities have started managing their Home Gardens in response to the needs of buyers. It is necessary to assess the changing pattern of Home Gardens and its effect on the household economy.

Role of Home Gardens in local diet. The staple food of shifting cultivators of the tropics is mainly rice. Meat is the main source of protein. However, large amounts of leafy vegetables, nuts, tubers, rhizomes and fruits are frequently used in the diets of local communities. In Konyak Home Gardens, 154 plant products used in the local diet have been recorded and have immense importance for the health of the Konyaks. It is necessary to assess the role of Home Garden products in the local diet. The plants grown become a resting and breeding ground for many edible insects. The impact of this small-scale supplementary agroecosystem on diversity and availability of insects should be documented.

Cultural significance of Home Gardens. Rico-Gray et al. (1990) have pointed out that Mayan Home Gardens, mainly those of the villages closer to Merida and other cities, tend to have more ornamental plants and commercial varieties of fruit trees at the expense of more traditional elements of Home Gardens. This changing pattern of Home Gardens and the effect of modern development are interesting aspects of present cultivation practices. Such an assessment will be helpful for understanding the cultural significance of Home Gardens.

Role of women in maintaining Home Gardens. Women are aware of the use of plants and the means of maintaining them. In many traditional societies it is only the women who have accumulated traditional knowledge about the food and other household products that plants can supply. Women are engaged in cooking and know the requirements for it. They have developed the skills to cultivate and maintain important plant species supplying these needs. *Konyak* women, for example, could name 29 plant products from Home Gardens while men could name 12 such products only. Women are better judges at selecting species to be cultivated in Home Gardens in response to the needs and demands of local markets. In most local markets surveyed in north-eastern India, the vendors are mainly women.

Conclusion

Although historically they have been little appreciated, tropical Home Gardens are traditional resource management technologies that have recently been hailed as highly productive and largely sustainable agroecosystems. The Home Garden is but one of a very large array of agroecosystems that traditional communities maintain. Many of the species that are grown in Home Gardens are also found in agricultural fields/*jhum* fields or on the fallow land that most households manage and many can be collected from nearby forests. The Home Gardens of tropical indigenous communities deserve to be examined in far greater detail. The study of Home Gardens could be used as a tool to develop methodologies for the application of traditional knowledge in conservation and community development.

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Overview of Research in Home Garden Systems

M. Millat-e-Mustafa
Institute of Forestry and Environmental Sciences

Introduction

Home Gardens can be defined as the land surrounding a house on which a mixture of annual and perennial plants are grown, together with or without animals, and largely managed by the household members for their own use or commercial purposes. Brownrigg (1985) defines the term as '*a supplementary food production system by and for members of a group of people with rights to the land, who eat meals together regularly*'. Fernandes and Nair (1986) state that the term Home Garden can mean anything from growing vegetables behind houses to complex multistoried systems. They defined the term as '*land-use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and, invariably, livestock, within the compounds of individual houses, the whole crop-tree-animal unit being intensively managed by family labour*'.

Ethnobotany Project Coordinator Visits Naga Swiddeners - Pei Shengji

Home Gardens are an ancient and widespread agroforestry system. While the focus on the system as a development strategy is relatively recent, its existence as a traditional land-use practice spans centuries, even millennia in some cases (Lai 1989). According to Hutterer (1984), the system may have developed in prehistoric times when hunters and gatherers deliberately or accidentally dispersed seeds of highly-valued fruit trees in the vicinity of their camp sites. Brownrigg (1985), in his literature review (cited in Soemarwoto 1987), mentioned that Home Gardens in the Near East were documented in paintings, papyrus illustration and texts dating to the third millennium BC. The systems have survived throughout the centuries as the result of long-term adaptation of cultivated plants and cultural techniques to local ecological conditions; and they have in many cases reached a noticeable degree of harmonisation with the natural environment (Michon 1983). Farmers who practice the systems are guided, perhaps in the absence of a unified set of expert recommendations, by their own perceptions and convictions about species' selection, admixture and management, so that each farm unit is a specialised entity in itself (Fernandes and Nair 1986).

Home Gardens are fundamental to peasants' lives because they are not only units of production but are also part of the habitation unit of the peasant family (Buylla Roces et al. 1989). Although there are many variations in Home Garden design and pattern, the basic features remain the same (Christanty 1985). A Home Garden usually contains a house, a bare space and a cultivated space.

Usually the cultivated space (the garden) surrounds the house, in front of the house as a frontyard or behind the house as a backyard. The bare space is used for various social and ceremonial activities. Intensive uses of cultivated space, the multiple functions of farmyard plantings, and predominance of root, tuber and tree crops are some of the characteristic traits of traditional Home Gardens in many parts of the world (Ninez 1987). The gardens often feature low-capital input and simple technology and are intensively managed by family labour. Yields are generally low but stable and sustainable (Fernandes and Nair 1986; Ninez 1987; Soemarwoto 1987). Personal preferences and attitudes, socioeconomic status and culture often reflect the appearance, structure and function of the Home Gardens (Christanty 1985).

Various authors have used numerous terms to denote these practices. These include, for example, mixed-garden horticulture (Terra 1954), mixed garden or house garden (Stoler 1978), Home Garden (Millat-e-Mustafa 1996), Javanese Home Garden (Soemarwoto et al. 1985), compound farm (Lagemann 1977; Okafor and Fernandes 1987), kitchen garden (Brierley 1985), household garden (Vasey 1985), tropical mixed garden (Price 1982), quintal (Posey 1985), *calmil* (Palerm 1967), *pekarangan* (Soemarwoto et al. 1985), *kandyan* garden (Jacob and Alles 1987), and homestead agroforestry (Leuschner and Khaleque 1987).

Home Garden characterisation

Despite their potentials, Home Gardens are often ignored as an important part of traditional farming systems by scientists and development agents, largely because of their small size and apparent insignificance (Bunderson et al. 1990). They are often viewed as an example of primitive, underdeveloped agriculture compared to modern high-yielding technological agrosystems (Michon et al. 1983). Many studies have reported the existence of Home Gardens in various regions of the world (Table 1), but very few studies have adequately analysed the structure, species' composition, diversity and management aspects of Home Gardens (Tables 2 and 3).

Home Garden structure

The vertical stratification of vegetation within Home Gardens has been long recognised as a characteristic feature although the variation of height within any one stratum has led to some arguments as to the distinctness of the various strata recognised by various authors. Barrau (1961), Michon (1983), Altieri and Farrell (1984), Fernandes et al. (1984), Okafor and Fernandes (1987), Oduol and Aluma (1990), Millat-e-Mustafa (1996) give schematic presentations of vertical structures from various geographical regions and observe that the canopies of most Home Gardens consist of between two and six strata. Millat-e-Mustafa (1996) provides a general summary of strata.

<1 m	Vegetables, spices, tubers, roots, pineapple
1-3 m	Food plants, e.g., lemon, banana, papaya, guava
3-5 m	Saplings of fruit/timber trees all growing taller
5-7 m	Fruit/timber trees, some growing taller
7-9 m	A few fruit/timber trees
>9 m	Timber trees, bamboo

Table 1: Literature on the Qualitative Description of Home Gardens from R&D across the World

Country	Specific home gardens	References
a) Asia and the Pacific region		
Bangladesh	Bangladesh home gardens	Chowdhury 1993
	Bangladesh home gardens	Hocking and Islam 1994
	Bangladesh home gardens	Leuschner and Khaleque 1987
India	Kerala home gardens	Nair and Sreedharan 1986
	Kerala home gardens	Salam and Sreekumar 1991
Indonesia	Javanese home gardens	Abdoellah and Marten 1986
	Javanese home gardens	Ahmad et al. 1980
	Javanese home gardens	Christanty et al. 1986
	Javanese home gardens	Raintree 1978
	Pekarangan	Soemarwoto and Soemarwoto 1984
	Javanese home gardens	Soemarwoto et al. 1985
Sri Lanka	Sri Lankan home gardens	Wickramasinghe 1992
Regional Home gardens	South East Asia	Anderson 1979
	Asia	Ninez 1987
	Indian Subcontinent	Singh 1987
	Tropical	Soemarwoto 1987
	Asia and the Pacific	Tejwani and Lai 1992
	Tropical	Torquebiau 1992
	Tropical	Wojtkowski 1993
b) American region		
Regional	Tropical American home gardens	Budowski 1985
Home gardens	American home gardens	Ninez 1987
c) African region		
Swaziland	Swazi home gardens	Allen 1990
Tanzania	Tanzanian home gardens	Rugalema et al. 1994
Zimbabwe	Zimbabwe home gardens	Campbell et al. 1991
Regional Home gardens	Sub-Sahara	Cook and Grut 1989
	Africa	Mergen 1987
	Africa	Ninez 1987
	Tropical Africa	Okigbo 1987

He stresses that these strata are dynamic and there is constant recruitment from one stratum to another. Soemarwoto (1987) first analysed strata in Javanese Home Gardens as above, then gave the percentages of numbers of species and numbers of plants contained in each layer, showing that these were highest in the lowest layer and lowest in the upper layer, thus adding an element to the picture of vegetation distribution over the garden as a whole.

Table 2: Literature from around the World on the Structure of Home Gardens

Country	Horizontal structure	Vertical structure	References
a) Asia and the Pacific region			
India	RA	4 strata	Jose and Shanmugaratnam 1993
	HA	*	Kumar et al. 1994
		4 strata	Nair 1979
	RA		Nair and Krishnankutty 1984
Indonesia	HA		Christanty 1985
		4 strata	Christanty et al. 1986
		4 strata	Jensen 1993
	RA		Mergen 1987
		3-5 strata, species richness and density higher in lower stratum	Michon 1983
	HA	3-5 strata	Soemarwoto 1987
Nepal	HA		Tuladhar 1990
Pacific		4 strata	Barrau 1961
Philippines		4 strata	Sommers 1978
Sri Lanka	HA		Jacob and Alles 1987
		3 strata	McConnell and Dharmapala 1973
	HA		Nanayakkara 1990
		4 strata, vertical dominance of species on the basis of RIV	Perera and Rajapakse 1991
b) American region			
Grenada		4 strata	Brierley 1985
Mexico		4 strata	Gliessman et al. 1981
c) African region			
Nigeria	HA	4 strata	Okafor and Fernandes 1987
		4 strata	Okigbo 1987
Tanzania		4 strata	Alriksson and Ohlsson 1990
	HA	4 strata	Fernandes et al. 1984
Uganda	HA	4 strata	Oduol and Aluma 1990

* Blank cell indicates no information is available.
RA = Regular arrangement, HA = Haphazard and irregular arrangement

Table 3: Literature from around the World on Home Garden Floristics

Country	Total species	Species' composition	Species' similarity	Species' diversity	References
a) Asia and the Pacific region					
	52	*			Abedin and Quddus 1990
	21	+			Akhtar et al. 1989
	28	+			Alam et al. 1990
		+			Dasgupta et al. 1990
Bangladesh	20	+			Islam and Ahmed 1987
		+			Islam et al. 1990
	28	+			Kar et al. 1990
		+			Khaleque 1987
		+			Khan et al. 1990
	34	+			Miah et al. 1990
	92	+	60-76%		Millat-e-Mustafa 1996
	52	+			Momin et al. 1990
China	300				Shengji 1985
Fiji	61				Thaman 1990
India	127		28.57 -81.08 %	H' = 1.13-3.02, E = 0.37-0.54	Kumar et al. 1994
	30				Nair and Sreedharan 1986
	36				Babu et al. 1992
	196			H' = 2.79	Abdoellah and Isnawan 1980
				H' = 3.71	Christanty 1985
	60				Jensen 1993
Indonesia	607			H' = 2.73-2.99	Karyono et al. 1978
	191				Mergen 1987
	500	+			Michon 1983
	600				Soemarwoto 1987
	180				Sollart 1986
Nepal	129				Thapa 1994
Philippines	74	+			Sommers 1978
	41				UNICEF 1982
PNG	114				Thaman 1990
Sri Lanka	65				Perera and Rajapaksa 1991
	170				Southern 1994
Thailand	100				Kamtuo et al. 1985
Tonga	65				Thaman 1990
b) American region					
Grenada	31	+		H' = 0.24	Brierley 1985
Martinique	67				Kimber 1966
	338				Buylla Roces et al. 1989
Mexico		+			Gliessman et al. 1981
	135		49-59%	H' = 1.6	Rico-Gray et al. 1990
Peru	29				Padoch and Jong 1987
	168				Padoch and Jong 1991
c) African region					
Nigeria	60				Bittenbender 1985
		+			Okafor and Fernandes 1987
Tanzania	111				Oktingati et al. 1984

* Blank cell indicates no information is available.
+ indicates more food and fruit producing species.

Many authors (Table 2) from tropical regions describe Home Gardens on first sight as haphazard, random, even anarchic and, rather poetically, 'order in disorder'. Within Kandy Home Gardens of Sri Lanka, Jacob and Alles (1987) and Nanayakkara (1990) failed to find any spatial pattern of species' distribution. A similar observation is also made by Tuladhar (1990) for the Home Gardens of Nepal and Kumar et al. (1994) for the Kerala Home Gardens of India.

The opposite view is also expressed by a number of authors for the horizontal arrangement of plants in tropical Home Gardens. Fernandes and Nair (1986) claim that the Pacific Home Gardens present a more clearly defined spatial arrangement of plants following the orientation and relief characteristics of the watershed and each species perfectly occupies the available space in the Home Gardens. According to Nair and Krishnankutty (1984), a certain general pattern in arrangement of plants seems to exist in the Home Gardens of Kerala. However, Christanty et al. (1986), Ahmad et al. (1980), Sommers (1978) and Wickramasinghe (1992) mention that the spatial arrangement of plants in a Home Garden is always determined by various factors such as light, water and fertility requirements, security and crop protection, health, aesthetics and efficiency of space utilisation.

Home Garden floristic diversity

Diversity is defined as 'many different species and their intensity of interactions occurring in a small space at one time' (Harmer 1991) and indeed this definition neatly encapsulates the concept of diversity in Home Gardens, since there is a great variety of interactions taking place vertically, horizontally and temporally within one garden often of less than one hectare. There are different degrees of diversity, here involving a spectrum ranging from 29 species to 191 species in one garden (see below), but basically diversity begins to exist when there is more than one crop included in a small area. Diversity can be measured in as much as individual species can be counted but this must be in relation to the scale of the garden. Home Gardens are almost universally reported as being on average less than one hectare (e.g., FAO 1986; Altieri and Farrell 1984) as in Chilean gardens; Nair and Sreedharan (1986) observed gardens in Kandy 0.4 - 2.0 ha in size; and some gardens noted in Bangladesh can be as small as 0.02 ha (Millat-e-Mustafa, 1996).

Diversity is well documented in the literature with exhaustive lists of species found. Almost every author who covers a Home Garden from a particular country gives a list of the species found in the garden. Some are short and general whereas others provide long lists of every species identified. There is even an entire article devoted to the plant species in Chagga Home Gardens (Oktingati et al. 1984). The range of species reported goes from 29 'useful' species in one garden in Peruvian Amazon (Padoch and Jong 1987) to more than 600 species found in both seasons in gardens ranging from the highlands to the lowlands of Java (Soemarwoto 1987). There are a variety of methods for cataloguing plant species. Some authors take individual gardens, e.g., Chambers et al. (1989) counted 70 species in one garden in Bangladesh. Mergen (1987) goes further—having reported 191 species in one garden in Java (the upper limit for number of species in one garden found in the literature), he then categorises the species, e.g., 37 species of fruit trees, 21 herb species, etc. Other authors look at a village as a whole, e.g. in Mexico, 338 species were found in gardens in one

village (Buylla Roces et al. 1989) and, in Java, over 500 species were encountered in a village by Michon (1983). Oktingati et al. (1984) surveyed 30 farms where they noted 111 different species. Millat-e-Mustafa (1996) recorded 92 perennial species in the set of 80 Home Gardens surveyed in four physiographic regions (20 from each region) of Bangladesh.

Home Gardens are a highly efficient form of land use, incorporating a variety of crops with different growth habits. Although there is little quantitative information regarding species' composition in the Home Gardens (Table 3), the studies of Barrau (1961) in the Pacific, McConnell and Dharmapala (1973) in Sri Lanka, Sommers (1978) in the Philippines, Michon et al. (1983) in Java, and Boonkird et al. (1984) in Thailand have acknowledged the predominance of fruit and food-producing species in the Home Gardens of the respective countries. Food production is thus the primary function and role of most Home Gardens.

Factors affecting diversity

A variety of factors affecting diversity are reported. Mergen (1987) cites personal choice of the farmer but more often external forces come into play. Soemarwoto (1987) has a concise catalogue of factors—better financial position leading to fewer food crops and more ornamentals, scarcity of labour prompting farmers to grow more labour-saving perennials and the proximity of markets, influencing farmers to include cash crops in their gardens. In the Home Gardens of Kerala, cocoa and coconuts have become dominant (Nair and Sreedharan 1986) while Chagga farmers juggle with coffee and food crops depending on market demand and the need for food (Fernandes and Nair 1986). Soemarwoto also mentions population pressure, which decreases the size of landholdings, subsequently, although cropping intensity increases, the price is usually the sacrifice of species' diversity. Other authors agree: e.g., in Java, gradually more annual crops are included until, under pressure of providing immediate food for the family, only staple crops such as cassava dominate (Wiersum, 1982). A similar situation has turned previously species-rich Nigerian Home Gardens into virtual monocultures (Mergen 1987).

The management skills of farmers world-wide, acquired empirically over generations, in dealing with the diversity of their gardens are constantly emphasised, e.g., Michon et al. (1983) claim that Javanese farmers have such a thorough knowledge of ecology that they can often choose the correct 'niche' for each plant depending on the gradient of light and humidity, and this seems to correspond to its ecological niche in the natural forest. Experimentation to increase diversity is also widely recorded. In the Andes, Ninez (1987) reports on gardens being used as informal experimentation stations for new varieties and exotic species. Chambers et al. (1989) and Fujisaka and Wollenberg (1991) found that, particularly in newly-established gardens in Kenya and the Philippines, farmers chose gardens for testing and observing new cultivars and species' combinations and for domesticating wild plants.

Importance of diversity

Authors agree on the wide range of uses for products from gardens. The multipurpose tree crops can provide shade (e.g., for coffee and for sitting under),

living fences, fodder and mulch, bee forage, fuelwood, fruit, timber and poles. Other components provide food both for home consumption and for sale if a surplus remains, protection against pests, cash crops, medicines, spices, mushrooms, fibres for ropes and mats, and even simply for ornamentation. In some gardens, e.g., in Kandy, seemingly useless species are retained, but information on these is minimal. One of the most striking features of Home Gardens, observed on all three continents (e.g., Michon (1983) in Java; Okafor and Fernandes (1987) in Nigeria; Buylla Roces et al. (1989) in Mexico; and Millat-e-Mustafa (1996) in Bangladesh) is that, due to such great diversity of species and their varied biological cycles, having the effect of staggering production of food crops, small daily harvests can be made year round for immediate home consumption.

The diversity of plants reduces soil erosion. Young (1989) devised two categories of vegetation in relation to soil erosion by rain—trees as barriers and as cover—remarking that trees alone, as barriers, only slightly reduce erosion, but in Home Gardens it is the ground surface litter cover which is crucial. Soemarwoto (1987) takes a different angle and divides erosion into two categories—splash and surface erosion—and goes into precise details of leaf driptips and droplet size in relation to splash erosion, whilst agreeing with Young about the vital necessity of ground cover. Other authors, however, do not go into such detail.

Most sources recognise that the species' diversity of Home Gardens represents a valuable genetic resource. Two aspects of this are examined: Ninez (1987) sees this as a way of preserving species uneconomical in field production and notes that, in Peru, landraces of vanishing cultivars are found solely in Andean gardens, whereas both Fernandes and Nair (1986) and Michon et al. (1983) view Home Gardens as a valuable gene pool for breeding and improvement programmes since selection processes, both natural and human, have occurred over the years. However, Soemarwoto (1987) regrets the genetic erosion resulting from commercialisation in areas of Java—75 varieties of mango were reported in one area in the 1920s but nowadays in many places, to supply urban markets, there is only one variety.

Diversity is seen by many authors (Fernandes et al. 1984; Mergen 1987; FAO 1989; Millat-e-Mustafa 1996) as a safeguard against pest and disease. '*The advantage of a species-rich polyculture is undoubtedly that the risk of losses is spread among many species*' (Soemarwoto 1987). Altieri et al. (1987) give evidence from trials performed in Mexico that polyculture can foster improved biological control of pests and that a diversity of species can harbour both pests and their natural enemies. They state that further research is warranted in this area, but few sources mention the presence of beneficial insect predators. The sources are stronger on reporting local strategies to combat pests and diseases. The Kayapo Indians of Brazil manipulate fire which eradicates certain insects but encourages ants which in turn repel other pests (Mergen 1987). In Kerala, coconut root wilt has swept through gardens, thus farmers have resorted to greater diversity of intercrops to sustain production levels (Nair and Sreedharan 1986). There is an example of farmers using one species to protect another in Chile where an otherwise useless species is retained to keep chickens healthy.

Animal diversity

In addition to the variety of nutrition derived from food crops, diets are further augmented by animal products. Brownrigg's literature review (1985) indicated that animals were found in virtually all types of Home Garden. Other examples of Home Gardens with animals are the Chagga gardens in Tanzania (Fernandes et al., 1984), the Home Gardens in Ghana (Asare et al. 1985), Grenada (Brierley 1985), Indonesia (Soemarwoto et al. 1985), India (Nair and Sreedharan 1986) and Bangladesh (Leuschner and Khaleque 1987). Most of the literature mentions animals—poultry, pigs, rabbits, cows, sheep, goats, buffalo, fish and bees, even butterflies and crocodiles in Papua New Guinea (Bourke 1984), and Michon et al. (1986) report the importance of wild fauna in pollination and seed dispersal in Sumatran gardens. However, far less attention is paid to animal than to plant species. Reasons for the lack of animals are also noted: in Java there are no pigs on religious grounds (Soemarwoto 1987) whereas in Nigeria the keeping of some livestock is almost ruled out by the presence of tsetse flies (Okafor and Fernandes 1987).

Home Garden production

Production is the prime reason for the existence of Home Gardens, but the continuing capacity to produce depends on the sustainability of the gardens. Although, as noted above, Home Gardens are ecologically stable and continuously provide a variety of produce, yet authors usually comment on the low productivity. Capital inputs are low (Soemarwoto 1987) with the exception of the family labour inputs, which Cook and Grut (1989) find to be particularly high where soil moisture and fertility have to be maintained by continuous additions of water and organic matter.

Figures to quantify production in Home Gardens are scanty. Soemarwoto (1987), Ninez (1987), Stoler (1978) and Nair and Sreedharan (1986) provide figures for income derived from gardens, and Fernandes et al. (1984) quote amounts of produce (beans, coffee and bananas) harvested from Chagga gardens, but admit that fruit, vegetable and herb production remains unquantified. Ninez (1987) explains that this is because the production is usually for immediate family consumption therefore goes unassessed in official statistics. Farmers are usually aware that crops are not producing at maximum capacity but total production is greater and more diverse, with risks minimised and greater long-term sustainability ensured (Altieri and Farrell 1984).

Nutrient cycling and recycling in Home Gardens

Mergen (1987) suggests that Home Gardens can produce everything necessary without straining the carrying capacity of the land. It is precisely the combination of elements which forms the nutrient cycle that is so crucial to the sustainability of the system. Michon et al. (1983) provide an excellent summary of the processes involved which are sufficient to maintain soil fertility, dividing them into two—matter and water cycling, and recycling of waste products. Wiersum (1982) observed that gardens are usually dominated by perennial crops therefore a high ratio of the nutrients are stored in the vegetation rather than the soil leading to nutrient cycling via the litter, and a relatively small hazard from leaching and erosion. Litter and fallen trees are frequently cited as con-

tributing to nutrient cycling (e.g., Buylla Roces et al., 1989; Ninez, 1987) and in many gardens legumes are planted for their nitrogen-fixing properties (e.g., Balasubramanian and Egli (1986) in Rwanda; and Nair and Sreedharan (1986) in Kerala). Nair and Sreedharan (1986) report that gardens of Kerala cause substantial improvements in the physical and biological characteristics of the soil. This may be true in the case of nitrogen fixation but they offer no evidence of quantification to back up their claims. Young (1989) is more cautious and argues on the basis of research that at the moment there is only limited evidence to suggest that agroforestry systems can maintain soil organic matter.

Most sources report the cycling process of waste garden products and fodder being fed to animals whose manure is then used to fertilize the crops. Green maturing and mulching is also widely practised. The role of animals as recycling agents is depicted in the literature as being as important as their role as producers. In Chagga gardens, livestock are stall fed with fodder from the garden and with kitchen waste, and the manure spread over the gardens (Fernandes et al. 1984) whereas in Mexico pigs and chickens wander freely (Buylla Roces et al. 1989). Mulch is universally used. In many sources bananas are noted for their high organic matter and the excellent mulching effect of their refuse (e.g.. Watson [1982] in Nigeria) and in Chile guano, ash and straw is used (Altieri and Farrell 1984). In Bangladesh, Leuschner and Khaleque (1987) observe that because of the scarcity of fuelwood, all house, garden and animal residues are used for cooking, but surprisingly omit to comment on the effect of this on the system. Soemarwoto (1987) laments the advent of chemical fertilizers into Javanese systems—composting is now deemed cumbersome—resulting in the recycling systems beginning a decline which in the long run will affect soil structure and fertility.

Much has been written about nutrient cycling and recycling but almost nothing is said about the role of roots, apart from nitrogen fixation. Fernandes and Nair (1986) admit little is known about the function of roots but presume they do not overlap greatly and that dynamic equilibrium occurs below as well as above ground. Michon (1983) briefly mentions the advantages of diversified root systems. Wiersum's theory (1982) that mineral uptake occurs through deeply rooted perennials from deeper soil layers is dismissed as unproven by Young (1989). This lack of attention is surprising in the light of Young's observations that tree roots play a central role in maintaining soil organic matter and physical properties and are the below ground equivalent of litter.

Interactions among Home Garden components

Interactions among components are frequently mentioned as a typical feature of Home Gardens but rarely analysed in detail. Complexity is stressed and perhaps this is the underlying reason why analysis is scarce. Nair and Sreedharan (1986) describe Kerala Home Gardens species by species, noting interactions between individuals: this is useful but diverts attention from the holistic nature of the garden as one interaction system. Fernandes and Nair (1986) admit there is no available data on interactions between components in Chagga gardens. The most impressive accounts of interactions come from Michon et al. (1983) who preface their exposition '*if an analysis of the gardens is to be successful, it must use a global approach*'. Gardens are likened to natural forest ecosystems

with their interrelated dynamic processes. An architectural analysis is used to focus on relations between different elements, and plants are classified as having potential, actual and decaying production. Light availability and human factors often dictate diversity, and a chablis, produced by the removal of a large tree, begins a cycle of regeneration and succession in which a range of plant species takes part. The process differs from natural forests chiefly in that the dynamics are speeded up by the farmers. Thus, although the producing landscape is unsettled over time, its structure and function remain stable.

Indigenous management techniques

The management of the traditional Home Garden systems has evolved as a response to many factors, cultural, economic, and environmental as well as personal preferences (Southern 1994). Since farmers live in intimate contact with their Home Garden production systems, it is reasonable to assume that they have detailed knowledge of the components that they manage in their Home Gardens, and the interactions between them and the local environment. Farmers' indigenous knowledge is often characterised as highly specific and context-bound, with knowledge emerging simply from localised, practical experience (Scoones and Thompson 1994). Local communities in many areas benefit from generations of experience of the management of complex land-use systems that take advantage of the benefits of stability and sustainability associated with complexity. They continuously conduct their own trials, particularly adopt and adapt technologies to their specific circumstances and spread innovations through their networks (Cornwall et al. 1994). Their experimentation is quicker and more able to accommodate changing circumstances and diversity than those of research scientists.

Many authors acknowledge the management skills of farmers in dealing with the complex Home Gardens that they have acquired empirically over generations. For example, Michon et al. (1983) claim that Javanese farmers have such a thorough knowledge of ecology that they can often choose the correct niche for each plant depending on the gradient of light and humidity, and this seems to correspond to its ecological niche in the natural forest. In fact, the diversified structure of the Home Garden provides knowledge of a broad range of plant species and systems to the farmers. Farmers utilise this knowledge to manage plant species with different means of propagation, life form and origins with a variety of uses. However, literature provides little basis for the management of Home Gardens across the world. Management activities for Home Gardens available from the literature include planting materials used to regenerate the Home Garden plants; cultural operations such as weeding and pruning; watering and fertilizing; labour forces required for Home Garden management; and the constraints of the present management systems.

Planting materials used for regeneration

Seeds, seedlings and vegetative propagules are all used by farmers to regenerate their Home Garden plants in Bangladesh (Millat-e-Mustafa 1996). Indeed fruit trees may spring up wherever people eat fruits and leave the seeds behind. Farmers also scatter the seeds or nuts in suitable places. Sometimes bats, squirrels or birds also act as vectors. Seedlings of valuable species are also used to

propagate plants whenever available. Fernandes et al. (1984) in Chagga Home Gardens and Millat-e-Mustafa (1996) in Bangladeshi Home Gardens report that farmers also encourage naturally arriving seedlings of valuable species to grow.

Farmers collect their planting materials from different sources. Millat-e-Mustafa (1996) reports that the farmers of Bangladesh obtain different planting materials from their own Home Gardens, relatives and neighbours, markets and occasionally from government nurseries. Wickramasinghe (1992) reports that in Sri Lanka most planting materials are obtained freely from neighbours, and that farmers also occasionally buy seedlings of valuable species from the market.

Cultural operations

Removal and/or partly uprooting of undesirable species from the Home Gardens through weeding is a common cultural practice reported by Sollart (1986) and Bompard et al. (1980) from Javanese Home Gardens, and Millat-e-Mustafa (1996) from Bangladesh Home Garden. The practice of farmers in west Java of partly uprooting weeds under trees and leaving them to decompose illustrates how weeding is an integral part of skilful management of traditional systems: the soil is covered, nutrients recycled and unnecessary work avoided (Bompard et al. 1980). Weeding may follow a schedule or be done from time to time as required. Sollart (1986) mentions that the farmers of Javanese Home Gardens weed when time is available but they do it at least once every two months.

Pruning is another important cultural operation practised by the farmers for various reasons. Millat-e-Mustafa (1996) mention that, in Bangladesh, farmers prune trees to increase fruit and timber production, to facilitate harvesting of fruits, to avoid conflicts with the neighbours due to excessive lateral growth of plants, and to provide light to the more valuable understorey plants.

Several authors (Bompard et al. [1980] from Java; Fernandes et al. [1984] from Chagga Home Gardens; Nair and Sreedharan [1986] and Dadhwal et al. [1989] from India; Hossain et al. [1988], Alam et al. [1990], Miah et al. [1990] and Millat-e-Mustafa [1996] from Bangladesh; and Thaman [1990] from the Pacific) report that farmers generally use farmyard manure and organic manure/compost for the soil fertility management of their Home Gardens and application of chemical fertilizer is very rare and limited to valuable species only during early stages of development and/or during fruiting. Irrigation is carried out on a very limited scale for high-valued trees during the dry season and/or early stage of establishment of seedlings in different agroecological zones of Bangladesh (Hossain et al. 1988; Alam et al. 1990; Miah et al. 1990).

Labour Requirements for Home Garden Management

Several authors mentioned the low-labour demand for Home Gardens from different countries, e.g., half hour to two hours daily in 500m^2 Home Gardens of the Philippines (Sommers 1978). A similar range is reported in Indonesia (Haryadi (1975) cited in Christanty (1985)); 50 minutes per day in 200m^2 Home Gardens in Lima (Ninez 1985); 35-45 days of family labour per year during the year for Home Gardens' establishment and 17-22 days during subsequent years in Mexico (Buylla Roces et al. 1989).

Several authors (e.g., Stoler 1978; Ahmad et al. 1980; Hossain et al. 1988; Millat-e-Mustafa 1996) mention that there is a clear sharing of tasks between women and men for the management of Home Gardens. According to Stoler (1978), Home Garden cultivation occupies only eight per cent of the total working time of men and an insignificant amount of time for women, but Ahmad et al. (1980) found that in west Java women spent 9.4 per cent of their productive activities in the Home Garden while men spent only 2.3 per cent of their productive activities. In Bangladesh farmers spent only from 4.8–12.2 per cent of their total labour in Home Garden management; up to as much as 64 per cent of the total labour requirements for the Home Garden are met by hired labour, the larger the farm, the greater the use of such hired labour (Millat-e-Mustafa 1996).

Constraints of the present management system

Many sources (e.g., Liyanage et al. 1984; Hossain et al. 1988; Alam et al. 1990; Miah et al. 1990; Millat-e-Mustafa 1996) mentioned a number of constraints faced by the farmers in managing their Home Gardens. Some of the common constraints are lack of funds, land, planting materials, technical know-how, and natural calamities such as drought and floods. Almost all Home Gardens face at least three of the constraints mentioned above.

Sustainability of Home Gardens

Young (1989) provides a simple definition of sustainability: '**production + conservation = sustainability**' elaborating later '*sustainable land use is that which maintains an acceptable level of production and at the same time conserves the basic resources on which production depends, so enabling production to be maintained*'. This definition perfectly brings out the cyclic nature of sustainability that is so vital to the continuous functioning of Home Gardens.

Sustainability is a relatively new subject and has only recently become a focus of attention (Young 1989), thus, although many authors believe it is a feature of Home Gardens and diversity is a key contributing factor, there is even less quantification in the documentation of sustainability than there is for diversity (perhaps diversity is easier to quantify). The basis for the arguments of many authors that Home Gardens are sustainable often rests on the fact that the gardens have been functioning efficiently for years, even centuries (e.g., Jacob and Alles [1987] in Sri Lanka; and Okafor and Fernandes [1987] in Nigeria). Fernandes et al. (1984) note that in the Chagga gardens stability has existed for centuries and, although the recent cash crop element fails every three or four years, the system as a whole has never failed.

Several authors (e.g., Michon et al. 1983; Soemarwoto 1987) compare the structure of Home Gardens to that of natural forests and here, particularly, a link between diversity and sustainability is believed to exist, since natural tropical forests, which often have a great variety of species, seem to be extremely sustainable ecosystems.

What authors often fail to emphasise when celebrating the sustainability of Home Gardens, is that many are situated on fertile soils which are relatively easy to maintain and need little improvement, e.g., the volcanic soils of Java noted by

Wiersum (1982) and the deep alluvial soils high in organic matter in Chile (Altieri and Farrell 1984). Mention is usually only made of soils when they are poor. Wiersum continues, saying that, in Java, gardens hardly ever exist on tertiary soils. This observation is backed up by African examples; e.g., in Rwanda, competing species cause farmers' management problems in areas of poor soils, and in some places a continuous decline in soil fertility has been detected (Balasubramanian and Egli, 1986).

With these examples in mind, caution should be exercised in overgeneralising about the extrapolation of the Home Garden system to poor soils, e.g., Jacob and Alles (1987) believe there are good possibilities for making marginal lands in Sri Lanka more productive by means of the Home Garden system only on the basis of their observations of existing Home Gardens.

New gardens

Several articles deal with newly-established gardens. Boonkird et al. (1984) describe attempts to rehabilitate degraded lands in Thailand by granting shifting cultivators land for permanent gardens. However, only the briefest mention is made of difficulties encountered in establishment on poor soils or of previously mobile peoples creating a complex garden system—as Michon et al. (1983) suggest '*such systems demand a very refined knowledge in their establishment as well as in their management*'.

However, in a similar situation in the Philippines, Fujisaka and Wollenberg (1991) stress that farmers on new lands experienced considerable difficulties and passed through several experimental stages before settling for a Home Garden-type agroforestry solution. This article provides a comprehensive view of the trials involved in rehabilitating land.

Nair and Sreedharan (1986) report on the immediate success of a three-tier multicropped garden established on undeveloped arid land, and, on this basis, the authors recommend that this be used as a model for future development. On the evidence of the Philippines' example and a catalogue of failures recorded in Kerkhof's account (1990) of African projects, Nair and Sreedharan's results seem suspiciously straightforward since their statement is not backed up with sufficient evidence of other trials or research.

Changes and threats

Home Gardens have remained sustainable through the ability of farmers to adapt to new circumstances, and the fact that species alter without affecting the overall structure and productivity. But nowadays, with the increasing pressure to include cash crops in gardens, there is doubt whether the system is sufficiently flexible to accommodate these changes. One of the most useful accounts of change is Soemarwoto's article (1987) in which his stated objective is not only to describe the system but also to examine its potential for future development. He mentions current improvements but then lists a range of threats that result. These threats are nearly all connected with loss of species' diversity. He warns against concentrating only on the tangible economic and nutritional aspects at the expense of intangible ecological and social values. As a result, versatility is

limited, genetic erosion sets in, losses to pests and diseases increase and soil erosion becomes a problem, exacerbated by a decline in mulching in response to the availability of chemical fertilizers.

Many sources (e.g., FAO 1986; Foley and Barnard 1984; Singh 1987) agree with this diagnosis and have similar examples of sustainability sacrificed to productivity. As an extreme example, in Nigeria, Okafor and Fernandes (1987) report that recent wealth acquired from the oil boom has led to some farmers clearing their gardens with bulldozers and substituting high-input monocropping. The result has been soil degradation, leading to lower yields than before. However, some systems have been adapted: e.g., in Kerala the large-scale introduction of cocoa to gardens in the 1970s was often replaced by fodder grasses, bananas and tuber crops when cocoa prices later dropped (Chacko 1991).

Wiersum (1982) emphasises the rapid changes occurring nowadays to which the previously flexible systems are failing to adjust. The main threat is from the pressures of population and modern agriculture. Increases in population have led to diminishing crop diversity as farmers' struggle to grow enough staple food crops, though they know diversity confers more advantages. At the same time agricultural development workers, often backed by the government or NGOs, are imposing their single component approach on many farmers and pressurising them to change over to monocropping. In Africa migration poses a major threat, e.g., in Uganda (Oduol and Aluma 1990) and the Chagga gardens (Fernandes et al. 1984). Young people are migrating so there will be no one left to inherit the traditional skills necessary to keep the complex Home Gardens operating.

Too often the crucial relationship between structure and function is ignored. However, both Soemarwoto (1987) and Michon et al. (1983) mention it: Soemarwoto explains that manipulation of structure can lead to unforeseen loss of valuable functions, and Michon et al. (1983) caution against the careless establishment of new dynamics in crop succession since this can lead to a failure of the whole system. Soemarwoto concludes that nowadays sustainability is being jeopardised, in turn putting future productivity at risk.

Conclusion

In the last decade, because of the resurgence of interest in small-scale farming, many authors have 'jumped on to the Home Gardens' bandwagon'. A wide range of literature has resulted. There are many articles that have taken one region, provided a description—often long and detailed, and useful as far as it goes, with lists, tables and diagrams of species—and then briefly concluded that gardens are good but need improvement. Some less useful articles have already been mentioned. Coverage of African gardens is disappointing (e.g., Oduol and Aluma [1990] on Ugandan gardens; and Fernandes et al. [1984] on the Chagga Home Gardens) as is Jacob's and Alles' (1987) article describing Kandyan gardens. Altieri and Farrell (1984) state at the beginning of their article that their scope is limited to description and therefore wisely do not attempt a discussion of more complex issues. Quantitative data are rare, though some sources, e.g., Soemarwoto (1987) do provide statistics. Discussion of interaction is also scanty.

In fact, overall, actual documented experimentation with quantitative data is scanty and most articles seem to reach their conclusion by observation followed by inference based on current theories (Forrester 1992). There may be several reasons for this: perhaps with little previous work done there are no examples to follow, perhaps it is because of the complexity of the systems or because there is inadequate appreciation among scientists of their importance and potential, or perhaps because agricultural researchers tend to be specialists, focusing on precise elements, thus missing the essence of Home Gardens.

Home Gardens are widespread throughout the tropical and subtropical world but are in general very thinly covered, particularly those in Indochina, the Pacific, and South and Central America. Indonesia dominates in the literature and has also produced some of the most impressive articles, all mentioned above. Apart from Soemarwoto's excellent account (1987), there are three other general articles, by Ninez (1987), Fernandes and Nair (1986) and Mergen (1987), which all provide a useful overview of gardens round the world. Ninez gives a broad view of tropical and temperate gardens, Fernandes and Nair (1986) examine diversity thoroughly with lists, tables and diagrams, and Mergen (1987), having summarised systems from different regions, stresses the importance of complex interactions and recommends a multidisciplinary approach to further research, emphasising indigenous knowledge.

However, whereas Ninez only describes her article as a 'framework', Fernandes and Nair claim to examine sustainability but can do no more than repeat the fact that Home Gardens have been producing sustained yields for centuries and draw the conclusion '*thus they are ecologically sound and biologically sustainable*'. This is typical of the majority of accounts that generally do not add anything new on sustainability; e.g., the summary of sustainability of Fernandes et al. (1984) is '*the system still appears to be working well with the majority of farmers*'. Many authors automatically conclude that diversity leads to an increase in sustainability, but this is almost never substantiated with scientific research, and, in the light of research such as that of Goodman (1975) casting doubt on the hypothesis that a greater number of interacting species provides a more stable balance in nature, it certainly should be. Soemarwoto (1987) admits that the ecological functions of Home Gardens have generally been taken for granted and, even after examining the evidence, recognises that he can say no more than '*it seems reasonable to conclude that Home Gardens are a sustainable production system*'.

Most authors see a promising future for Home Gardens — with reservations. On the evidence from natural forests and Home Gardens through history, it does seem likely that diversity contributes to sustainability. However, while research is required to establish this more precisely, more urgent research is needed into finding ways to increase production while maintaining diversity and long-term sustainability, perhaps in part by rehabilitating the traditional knowledge underlying the success of gardens up to now (Michon et al. 1983). Ninez (1987) holds that Home Gardens represent one of the last frontiers for increasing food production, and urges '*let the persistence of families all over the globe in growing their own food speak for itself*'.

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An Approach Towards Analysis of Home Gardens

M. Millat-e-Mustafa
Institute of Forestry and Environmental Sciences

Home Gardens are an ancient and widespread agroforestry system. They can be defined as the land surrounding a house on which a mixture of annual and perennial plants are grown together with or without animals and largely managed by the household members for their own use or commercial purposes. The components of Home Garden systems are so intimately mixed in horizontal and vertical strata, as well as in time, that complete interaction exists between the soil, plants, other components and environmental factors on farmers' plots.

Home Gardens can be studied from the point of view of their organization, i.e., how they are composed (their floristic composition and diversity), the kinds of structure hidden in the apparently disorderly mixture of trees and crops, and the indigenous management techniques that make the systems sustainable over generations. The objective of this chapter is to review the range of methods available for Home Garden analysis.

Home Garden floristics

Species' inventory

The simplest and most rapid way of describing vegetation is to list the species present within a Home Garden and to attach to each species a subjective assessment of its abundance. Home Gardens are almost universally reported as being on average less than one hectare (e.g., FAO 1986; Altieri and Farrell 1984; Millat-e-Mustafa 1996), thus to get a broad view of the wide range of species and categories of plants in Home Gardens, it is always advisable for complete enumeration of individuals of species rather than sampling. In such a situation a north-south baseline could be established to divide a Home Garden into two roughly equal parts. Sample centre points are demarcated on this line at 10-m intervals until the boundary is reached. From the centre points, additional lines perpendicular to the baseline are demarcated towards the east and west as far as the Home Garden limit. By creating further points at 10-m intervals on these east-west lines, a 10 m x 10 m sample grid is generated. In each grid, the individuals of all species with their location coordinates, total height, crown diameter and crown height are recorded.

Species' frequency

The contribution made by each species in a Home Garden can be expressed as a percentage of the total number of species, which is called frequency. Since frequency often reflects the patterns of distribution of individuals as well as their density, it also expresses information about both pattern and abundance.

Species' composition

Plants can be classified taxonomically into families, genera, species, varieties, etc. This, however, is not the only way to classify plants. Species and individuals can be grouped into life form or growth form classes on the basis of their similarities in structure and function. A plant life form is usually understood to be a growth form, which displays an obvious relationship to important environmental factors. For example, a deciduous tree is a plant life form that responds to an unfavourable season by shedding its leaves. On the basis of functions, plants can also be grouped broadly into food- and fruit-producing species, timber and fuelwood species, spices, medicinal, ornamental and miscellaneous. Those species that could not be grouped under the first five categories are the ones classified as miscellaneous.

Distribution of number of trees by diameter classes

Distribution by diameter classes is a common method of grouping trees and many inventory data are available for trees already classified into diameter classes. Diameter at breast height (DBH) is the easiest tree measurement, in spite of the difficulty caused by the presence of buttresses. Measurement units, class intervals, and lower limits for diameter differ significantly from one species to another.

Density

Density is defined as the number of individuals of a particular species per unit area. Thus density can be found by using the formula

$$\text{Density} = \frac{\text{Average number of individuals}}{\text{Area sampled}}$$

Species' ordination

Species ordination refers to the arrangement of species in relation to environmental gradients, or axes that may correspond to environmental gradients. One of the main purposes of such an arrangement is the recognition of joint variation in community composition and environmental factors. Ordination produces a more realistic representation of community variation and provides a better way of identifying the environmental factors that control the distribution of a species. DECORANA - the most widely used ordination technique in ecology is a computer programme, written by Mark Hill in the late 1970s, which uses a refined version of correspondence analysis. The refinement is de-trending (DECORANA - DEtrended Correspondence Analysis) which is intended to reduce some of the distortion of the ecological data that can occur during normal correspondence analysis. DECORANA has several advantages over other ordination techniques (Hill and Gauch 1980) as follow.

- Its performance is the best of the ordination techniques tested, and both species and sample ordinations are produced simultaneously.
- The axes are scaled in standard deviation units with a definite meaning,

- The computing time rises only linearly with the amount of data to be analysed; very large data sets present no special difficulty.

Species' dominance

In given uniform climatic, topographic and edaphic conditions, it is considered that the dominant species is the most important factor in determining the character of the community and the relative abundance of the remaining species in the community. It cannot be said that the most frequent species is the dominant; for where there is a great difference in the life form of species, the largest species is often dominant, and it rarely happens that the largest species is also numerically the commonest. So the individuals of a species having greater Relative Importance Values (RIV) are dominant to individuals of any other species. To determine species' dominance, RIV are calculated according to the formula of Myres and Shelton (1980) as follows.

RIV = Relative frequency + Relative density + Relative cover

where,

$$\text{relative frequency} = \frac{\text{Percentage frequency of species A}}{\text{Sum of all species' percentage frequencies}} \times 100$$

$$\text{relative density} = \frac{\text{Density of species A}}{\text{Density of all species}} \times 100$$

$$\text{relative cover} = \frac{\text{Crown area of species A}}{\text{Crown area of all species}} \times 100$$

RIV is a unitless score that combines the three measures, giving each equal weight, and can be used as a ranking of the dominance of each species in the community. The maximum relative importance value of a species is 300.

Similarity of species

To find the species similarity between two communities, Sfrenson's coefficient of similarity, expressed as a percentage (Muller and Ellenberg 1974), can be calculated using the following formula.

$$\text{Similarity coefficient} = \frac{2c}{a + b} \times 100$$

where,

a = number of species present in community A
b = number of species present in community B
c = number of species common to both communities

Sfrenson's coefficient of similarity expresses the actually-measured coinciding species' occurrence against the theoretically possible one. When the communities under study contain the same species, the value of the index is 100 (the

maximum value) and when the communities contain entirely different sets of species, the value of the index is 0.

Species' diversity

Species' diversity is used to describe the relationship between the number of species and the number of individuals and diversity, as a consistent, measurable characteristic of communities. It can only exist if these communities have a definable structure which is a property of the communities as a whole and not of the separate species within it.

Species' diversity is determined using Shannon's index (Fowler and Cohen 1992) as follows.

$$H' = - \sum P_i \ln P_i$$

where,

H' = Shannon's index
P_i = proportion of a particular species in a sample

Shannon's index has probably been the most widely used index in community ecology. It has two properties that have made it a popular measure of species' diversity: (a) $H' = 0$ if, and only if, there is one species in the sample; and (b) H' is maximum only when all species are represented by the same number of individuals, i.e., a perfectly even distribution of abundance.

Shannon's evenness index

Evenness represents a measure of homogeneity or relative diversity, and it gives the real distribution compared to maximum dispersion taking into account the number of species present in a community. This is expressed as the ratio between the observed diversity, H', and the maximum theoretical diversity, H_{max} (calculated by assuming that the species present in a given sample are all represented by equal numbers).

From Shannon's index, evenness is estimated as follows (Zar 1984).

$$E = \frac{H'}{H_{max}}$$

where,

E = evenness index
H' = Shannon's index of diversity
H_{max} = ln S, where, S = number of species.

The value of E can vary from 0 (when there is only one species in the sample) to 1 (when the species present in a given sample are all represented by an equal number of individuals).

Species' richness index

The species' richness of a Home Garden corresponds to the total number of species present in it and is thus an indicator of the relative wealth of species in that Home Garden. Species' richness is estimated as Mergalef's index as follows.

$$R = \frac{S-1}{\ln n}$$

where,

R = Mergalef's richness index
S = total number of species
n = total number of individuals

Structure of Home Garden vegetation

The structure of Home Garden vegetation can be defined by two components: (a) the horizontal arrangement of species, i.e., the spatial distribution of individuals; and (b) the vertical arrangement of species, i.e., the stratification of the vegetation.

Horizontal structure

Typical Home Gardens usually present the appearance of a crowded haphazard assemblage of trees, shrubs, herbs, climbers and creeping plants. Most farmers try to optimise their Home Gardens by planting as many crops as they can in the limited space available and in the physical constraints of their home environment (Sommers 1978; Millat-e-Mustafa 1996).

The horizontal structure of vegetation is assessed in terms of species' locations within the Home Gardens. Species' locations within the Home Gardens are assessed in relation to distance from the living quarters. Four quadrants can be distinguished. The quadrant containing the living quarters is taken as the first quadrant. The next nearest quadrant to the middle of the living quarters is taken as the second quadrant and that beyond the third quadrant. The fourth quadrant is that most distant from the living quarters. The species present, grouped according to function, are assessed by quadrant. Each function group is also assessed as the percentage of the number of different species present in each quadrant. Species' location within the Home Gardens could also be considered with respect to major locations: only the border, only the interior part, and both border and interior parts.

Vertical structure

A prominent structural characteristic of the Home Garden is the great diversity of species with many life forms varying from those creeping on the ground, such as sweet potatoes, to tall trees of 10 m or more, e.g., the coconut palm. These create the forest-like multi-storey canopy structure of many Home Gardens. On a more local scale, a structural approach can be used to simplify the

organization of complex vegetation types. The vertical structure of the Home Gardens can be summarised by referring individuals to different vertical strata on the basis of specific height classes.

Architecture

The architecture of Home Gardens is reflected in an assemblage of relationships between the dimensions of various parts of the plants. The architecture of Home Gardens can be described by means of a profile diagram. The profile diagram enables the construction of a scale diagram of the vegetation using accurate measurements of the position, height, height to the first branch, and depth and crown diameter of all the trees on narrow sample strips. Since spacing is a three-dimensional property, it is important to choose a transect-width for the profile diagram that conveys the correct plant spacing of the garden. The width should usually not exceed a few metres.

Crown cover

Cover is defined as the proportion of ground occupied by perpendicular projection on to it of the aerial parts of individuals of the species under consideration, and it is usually expressed as a percentage. Because of the overlayering of different species, the total cover of an area may exceed 100 per cent and, in the case of Home Gardens, it may reach several hundred per cent. Crown cover is calculated according to the formula of an ellipse as follows.

$$C = 0.25 \times D_1 \times D_2 \times p$$

where,

D_1 = largest crown diameter
D_2 = diameter perpendicular to D_1.

Crown volume or crown bulk is calculated according to the formula of an ellipsoid as follows.

$$V = 0.167 \times D_1 \times D_2 \times (H - LCL) \times p$$

where,

D_1 = largest crown diameter
D_2 = diameter perpendicular to D_1
H = total height
LCL = height up to lower crown limit
thus, $H - HCL$ = crown depth

To find the dominant position of certain species in different strata, the crown-depth could be divided into one-metre stratum units. The number of trees of the same species appearing in each stratum is counted. Taking each stratum separately, the stratum with the highest number of trees is accorded 100 per cent value, and its tree number is used as a basis for the percentage calculation of tree numbers in other strata. The figure will show the distribution of individual trees at different heights.

Indigenous management techniques

Exploration of indigenous management techniques of Home Gardens is always a complex exercise and the use of a multi-method approach using a combination of techniques is often advantageous (Kilahama 1994; Southern 1994). Participatory rural appraisal (PRA) is one of the most effective multi-method approaches as it encourages local people to express knowledge in their own terms by minimising the influences of the researchers (Chambers 1990). The various participatory methods that could be used to investigate indigenous management techniques are outlined below.

Tree-use matrix

Tree-use matrix is a powerful technique that can be used to understand farmers' decision-making processes in recognising the uses of different species of plants through interactions among farmers and family members (Freudenberger, 1994). The scoring technique, which is an output of the tree-use matrix exercise, is a useful tool to rank species according to their multiple uses. The ranking highlights the differences in priorities and differences in decision-making criteria used as expressed by good and bad properties of each species.

Procedure of tree-use matrix exercise

In a tree-use matrix exercise, a vegetation survey is made to list species present in the Home Garden. The farmer of that Home Garden is then asked to collect the leaves/twigs of each species present in his/her Home Garden to allow cross-checking of species with the list made from the vegetation survey. If any species is missing, the farmer is asked to provide it. To begin the exercise, leaves/twigs of all species present in the Home Garden are placed in lines away from the observer to represent rows of a table marked on the ground. Columns representing uses are then marked out. In the cells, the farmer places a number of beans proportional to the importance of each species for each use (e.g., four for very good, three for good, two for fair, one for not good). After the matrix is completed, the beans against each species are counted. A preference list of species is then made putting the species with highest score first. Cross-checking preferences of species is then made by asking the farmer to order the species according to his/her preference. How the farmer arranged the species is checked with the score of the species. Inconsistencies are resolved by consulting further with the farmer.

Semi-structured interviews

This is a guided interview that is started by checking the different management issues for which the farmer's opinion is wanted. On each key topic the farmer is free to express his/her own views. The interview is guided to cover the key topics on the checklist while leaving room to pursue any relevant subjects brought up by the farmer. A semi-structured questionnaire indicating key topics for exploring indigenous management techniques of Home Gardens used by Millat-e-Mustafa (1996) is mentioned below.

Question 1: 'What planting materials do you use for your Home Garden plants?' This is to elicit farmers' knowledge about regeneration procedures with differ-

ent Home Garden plants. The relative advantages and disadvantages of various types of planting material for different species are ascertained through further questions.

Question 2: 'What are the sources of different planting materials?' This is to establish the relative contribution of different sources of planting materials in the Home Gardens.

Question 3: 'Do you follow any criteria to select mother trees to collect planting materials?' This retrieves farmers' knowledge about the introduction of improved varieties of species in the Home Gardens. If the farmers say 'Yes', then details of the criteria for mother-tree selection and the types of species for which mother trees are selected could be sought with more questions.

Question 4: 'What sizes of seedling are available to plant and which one do you prefer and why?' This is to explore farmers' silvicultural knowledge about different sizes of seedling.

Question 5: 'Do you adopt any spacing at the time of planting?' This question is to gather information about any horizontal arrangements of species in the Home Gardens. If the response is 'Yes', further questions could be asked to ascertain the planting spacing and the reasons for its use.

Question 6: 'Do you carry out weeding, lopping, pruning, thinning, coppicing, pollarding in your Home Garden?' Weeding and thinning determine the horizontal structure of the Home Gardens, while pruning determines how the farmers regulate sunlight in the Home Garden. In the case of 'Yes' answers, further questions could be posed to find out why, and to what the operations are applied.

Question 7: 'Do you water and manure your Home Garden plants?' This question is used to produce an idea of the effort given to managing the Home Garden. If the reply is 'Yes', the frequency and quantity of watering and manuring, and the name of the species to which these were applied, could be determined with further questions.

Calendars

Calendars are tools that help to explore changes taking place over the period of a year. They can be useful in counteracting time biases because they are used to find out what happens in different seasons. Knowledge of local calendars and classification systems often provides important information about gender roles in different farming activities (Molnar 1989).

Daily activity and seasonal calendars are in common use to explore gender roles in Home Gardens. A daily activity calendar is used to find out day-to-day gender roles in Home Garden activities. The calendar is drawn on the ground, putting different sections of the day (morning, late morning, afternoon, late afternoon, evening and night) against different genders (male adult, female adult, male child and female child). Seasonal calendars are used to find out the seasonality of household labour for the Home Garden. Hiring-in labour for Home

Garden management activities in different seasons can also be recorded. In all cases, beans are used to indicate the number of days engaged in different activities.

Sketch mapping

A sketch map is a simple diagram which informants can use to present the physical aspect of their Home Garden. It is a simple, schematic device which presents information in a readily understandable visual form (Conway 1989). Sketch maps can be used to show, roughly to scale, the spatial relationships of living houses, cattle and poultry sheds, ponds, yards, vegetable gardens, planting area, specific locations of species on the ground, etc. Another use of sketch maps is for gaining insight into people's perceptions of their environment. Sketch maps create new avenues for discussion about different management aspects of the Home Gardens.

Garden planning by semi-structured map

This is a technique to help make predictions about decision-making which involves creating hypothetical scenarios in which local experts can be asked 'What if?' questions (Benfer and Furbee 1990). Changing one or more of the characteristics of the scenario and repeating the knowledge-elicitation exercise can help researchers identify the dynamics of decision-making rules. This technique can be started by drawing out the boundaries, area and soil type of a fictitious garden so that a farmer could demonstrate how she/he would approach the design and planning of a new Home Garden by diagramming and answering 'What if?' questions. The exercise aims to discover what factors are taken into account when considering garden establishment and development.

Conclusion

This chapter has outlined the methods most frequently used for describing and analysing vegetation of Home Gardens. In some circumstances the choice of method is immediately obvious, but more frequently the researcher is faced with selecting from as many as half-a-dozen, all of which appear to have equivalent advantages and disadvantages. In this situation the final decision will have to be made on the basis of the objectives of the study.

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Field Exercises and Site Actions

NEPED: An Example of the Application of Ethnobotany to Conservation and Community Development

Vengota Nakro and Qutovi Wotsa
Project Operations Unit, NEPED

The participants at the workshop were familiarised with details of the work of NEPED as a model project through field visits, interactions with staff and participating farmers. The Nagaland Environmental Protection and Economic Development (NEPED) through people's action is a five-year project undertaken by the State Government of Nagaland with the help of the International Development Agency of Canada (CIDA) and the India-Canada Environmental Facility (ICEF). NEPED is a unique project in the way that it has pooled officials from different government departments to create a multidisciplinary team that is referred to as the Project Operations' Unit. The main objectives of the project are as follow.

- To identify and demonstrate, to the local communities and government extension agencies, a number of packages of practices that will lead to more sustainable resource management in agriculture and on community and private forest lands.

- To build capacities in the local communities and the project organization to address people's needs and to evolve systems that will enable the Nagas to manage their resources in a sustainable manner.

- To identify and promote private and other initiatives to create marketing outlets for surplus products.

The overall goal of the project is to bring about development based on people's understanding of resources. The first step in this process is to intervene in the management of agriculture and forest lands. Nagaland is one of the seven states of north-eastern India. North-eastern India is recognised as a 'hot spot' of biodiversity, which overlaps with cultural biodiversity. Sixteen tribes inhabit the state. The main source of subsistence is *jhum* (shifting cultivation) for the majority of the population (900 out of 1200 villages). Terrace cultivation is practised wherever suitable land is available. Shifting cultivation is combined with primitive agroforestry techniques, maintenance of Home Gardens, and community forests.

NEPED Team Leader in discussion with the Director General of ICIMOD during Field Visit - Pei Shengji

Increasing pressure on land in recent years has led to a shortening of the shifting cultivation cycle. Loss of forest cover due to commercial logging is also a critical concern. Intensification of *jhum* has

led to degradation of forest resources, accelerated erosion and disruption of hydrology. This has had a negative effect on the agricultural yield and threatens the sustainable livelihood of Nagas. Lack of a marketing structure is also responsible for the low level of economic activities.

These problems are addressed by NEPED in a unique way. The answers are not sought from work carried out in situations differing from those in Nagaland. NEPED aims to find solutions which are locale specific. To achieve this, the traditional practices of shifting cultivation were studied from all over Nagaland. *Angami* Nagas have a practice of keeping alder (*Alnus nepalensis*) stumps in a *jhum* field when clearing is done. These stumps are coppiced then grow after the field is left fallow. *Alnus* wood is thus available after completion of one cycle, i.e., 8-10 years. As part of NEPED, this method is being improved to suit varied ecological conditions.

The project has a large component of applied research and training. Local researchers have conducted ethnobotanical surveys for documenting biodiversity and traditional knowledge about it. Various timber trees were identified from these surveys and 50 were short listed for further trials. In the targetted 1,000 villages, test plots have been established to carry out growth trials of these selected species. In each village there are two test plots. Along with timber trees, plantation of agar trees (*Aquillaria agallocha*) has also been carried out. After completion of the trials, the selected species will be used for plantation in the shifting cultivation fallow on a large scale. In this way NEPED is trying to provide an alternative which is replicable in similar geographical situations. Further analysis of ethnobiological data may provide information on non-timber forest products (NTFPs) that can also be incorporated into the proposed agroforestry model. Improving the skills of local people is emphasised in the project. NEPED officers carry out training programmes for farmers to demonstrate propagation and cultivation techniques.

Village community organization is very strong in Nagaland. Therefore a systematic effort was made to obtain local people's participation. Involvement of the local governing body in determining the extent of natural resource use and identification of associated problems has proved to be a great success. The village development board (VDB) carries out the administration of the project at local level. This institution is a modification of the traditional village administrative body of *gaonburas* (village elders). Traditionally, village elders represented each clan in the village and looked after the functioning of the community. VDB is similar to this and is thus a representative body of the village.

NEPED as an operating unit

An integrated approach was taken to bring all the concerned government departments together to make the programme successful. The project officers of NEPED are drawn from various government departments such as Agriculture, Soil Sciences, Rural Development, Tourism, Forestry, etc. These officers work together in a group named the Project Operations' Unit. These officers were selected on the basis of their interest, sincerity and zeal for the work of community development. This has helped to strengthen inter-institutional cooperation.

Along with the local people, the district project team is also involved in implementation and training to obtain people's participation. As in many other traditional societies, women play a significant role in resource management in Naga society. NEPED has a special component to increase women's understanding of *jhum* improvement techniques. Training and interaction sessions are regularly organized, especially for women. Such efforts help women to take part in decision-making, and this empowers them.

In the last phase of the project stress will be given to identifying potential markets for the wood and non-wood products available from agroforestry systems. A permanent marketing structure will provide economic benefits for the Nagaland people and guarantee improved livelihoods. So far, in the first two and half years of NEPED, more than 600 villages have been covered by its activities. NEPED is a learning process for POU members as well as for the people of Nagaland.

Interactions with the local experts and their key role in the project

Four local experts—Mr S. Atong, Mr Tenzamo, Mr Rakhosiünü and Mr Iachiinii—represent four tribes—Sema, Lotha, Chakhesang and *Angami* respectively. The use of local experts is a concept developed by NEPED during the inception phase. In most research and implementation projects, local people's participation is restricted to informants or participants in the implementation process. However, NEPED takes the guidance of local experts, who are knowledgeable village elders, from the beginning. The local experts' advice is based on their intimate knowledge of traditional resource use and management practices as well as village community organization. These local experts are well respected within the community. They work to facilitate understanding of project activities amongst the village community and maintain feedback mechanisms to strengthen the flow of information. NEPED recognises these local experts as key persons playing a leading role in the project and are given operational responsibilities in project implementation. They are paid members of the project team and have equal status with NEPED POU members.

Workshop participants immensely benefitted from the presence of the four local experts who expressed their views on traditional *jhum* improvement/modification practices, causes of decline in such practices, need for their revival, etc. Such interaction led to more concrete understanding of indigenous knowledge of traditional communities and practices developed and followed, particularly by the four major tribes that these experts represented. For example, Chakhesang people understand that tree tomato plants growing in shade possess thin leaves, and although they give low yields the fruit is high quality. Therefore, Chakhesangs prefer to plant these trees in the shade of taller trees. Similarly they understand the relationship between longer fallow cycles and increased fertility and a lower percentage of weeds during *jhum*-ing.

These local experts also helped and participated in the workshop field work during the market survey exercise and visits to Home Gardens. At the beginning they were not clear about the objectives and methods for such exercises but later began to appreciate and take positive interest in such applied research work. They were a little disappointed too as they were expecting that workshop

participants could provide immediate solutions to their problems: for example, how to take an integrated approach for improving *jhum* and fallow management; the development of a marketing framework for local products; etc. Participants on the other hand were not really prepared to voice their opinions with only such limited exposure. However, there were interesting discussions on various scientific aspects of issues such as soil fertility maintenance and erosion control in various forms of shifting agriculture. It was observed that, in the initial days of discussions in the classroom, the local experts listened carefully without much interaction; however, they become more active when the workshop participants were on the field trip.

Role of women in NEPED

The coordinator for the gender programme of NEPED also talked about the gradual increase in women's involvement in the project, which was almost negligible in the beginning and early stages. Although Naga women play an important role inside the house and outside—in the management of natural resources in their agricultural fields and community forests—they are not very empowered by society. In order to address the problems that arise because women are not able to participate in key decisions that affect everybody, NEPED has started training programmes over the last two years to develop the confidence of women. The project has also initiated a programme of giving some test plots exclusively to women. These measures are proving effective and now more women are coming forward to take responsibility for setting up test plots on their own. Traditionally, in some Naga communities, such as the *Chakhesang*, women are involved in the management of particular village-protected forests. One such test plot managed by women was visited by participants as part of workshop field work. This exposure gave an idea of how indigenous knowledge could be used in today's context and how modifications made in indigenous practices could be more economically beneficial. Most important is the positive response of local people to a large-scale implementation project such as NEPED. Such a response has been observed because the method selected for improvement of *jhum* is based on the indigenous knowledge and proven practices of the traditional communities of Nagaland. Women are now taking an interest in NEPED activities such as nurseries and plantation of useful local species on the *jhum* fallow.

Demonstration of the computer programme developed for plant identification

Participants were also given a live demonstration and hands-on experience in using the computer programme developed for plant identification by NEPED POU members Mr Kikon and Vengota Nakro. The work was started before the inception of NEPED during a brief ethnobotanical survey of 50 villages from Nagaland that revealed the frustration of not being able to identify plants scientifically without the help of systematic botanists. Therefore, a simple programme based on Lotus 1-2-3 version 4 software was developed. This programme works on the principle of elimination by way of identifying key characteristics.

The survey of the fifty villages covered most of the major tribes such as the *Angami, Chakhesang, Lotha, Sema, Aao*, etc. The inventory consisted of useful

plants and various varieties of rice, millet, fruits and other cultivated species. This enumeration was carried out entirely by village elders. The main problem in further analysis of these data was to identify the wild species recorded by local name. It was impossible to collect a sample of every species for identification by taxonomists. Unfortunately, few POU members are trained in field botany. Mr A.M. Gokhale, the chairman of the steering committee of NEPED, started to develop the programme in order to enable all members of the project team to identify plants using a few characteristics such as shape and size of leaves, presence or absence of odour, etc. Initially, all the information available about the plants of north-eastern India from regional florae, such as the *Flora of Assam*, *Forest Flora of Meghalaya* and others, was entered into the computer. Simple visual characteristics, such as leaf shape, its margin, its upper and lower surface, its colour, bark texture, etc, were given preference over complicated morphological characteristics such as gynoecium type, placentation type, anthers, etc. With the help of these basic search files the programme evolved in such a way that, if one enters two or three visual characteristics of a plant, the search criteria programme will provide a list of 10-50 species fulfilling them. By adding more characteristics, it is possible to eliminate species and thus shorten the list of choices until at least the genus can be identified, if not the exact species. Help can be sought from systematic botanists or existing florae for further classification at the level of species or sub-species.

This software is useful for the following reasons.

- The database and software is user-friendly.
- This is a perfect combination for introduction to botany as well as to computers.
- Frequent use of the database is useful in making people more observant and conscious of the plant diversity around them.
- Little training or practice is required to use the database for reasonably accurate identification of plants.
- Use of the database helps minimise the time required for identifying plants by referring to books of florae. It also saves the space required for maintaining these books.
- It is useful for immediately finding examples of unique combinations in nature, with the help of the database, e.g., compound-whorled leaves of *Kiegelia pinnata*.
- Most importantly, the use of this database automatically builds awareness about available plant resources in Nagaland.

Local Market Surveys: A Tool for Assessment of Natural Resource Use Patterns

Archana Godbole and Aparna Watve
Applied Environmental Research Foundation

Introduction

Participants undertook a market survey exercise. Diversity in use of plant and animal resources is best reflected in the local markets. Wild food plants, medicinal plants, edible insects and animals, and many other products of biological origin have a very specific regional value in the day-to-day life of local communities. Local market surveys, their qualitative analysis and quantification of certain aspects, such as the number of vendors, the products sold by them, commodities, prices, etc, are helpful in understanding the natural resource use patterns and availability of natural resources within a particular region. Proper quantitative analysis might prove helpful in defining the sustainability of natural resources used.

Naga Women Vegetable Vendors - Pei Shengji

The main objectives of local market surveys were

- to assess the local uses of resources,
- to determine natural resource use patterns for specific commodities,
- to understand the dependence of Naga tribals on the surrounding resource areas, and
- to evaluate the sustainability of the natural resources and the factors responsible for it.

The local market surveys carried out during the course of the workshop were conducted in Kohima town. Kohima township is the capital of Nagaland and has a fair representation of all the Naga tribes. Various tribal groups use many different plants and animals in their regular diet, as well as for other day-to-day needs. Most of these commodities are available in Kohima market, which caters to the needs of almost all tribes. Kohima is located in the south-western corner of Nagaland, therefore, a supplementary survey had been conducted earlier by the authors in Mon township, located in northern Nagaland. Mon is mainly occupied by *Konyak* Nagas and a few other tribes such as the *Aao* and *Chang*. The data presented in this section are a result of two years of field work and were used to familiarise the participants with the methodology and analysis used. The comparative analysis of both surveys indicated the different natural resource use patterns based on the availability of commodities in the surrounding resource areas.

Methodology

The simple methodology used for these local market surveys mainly involved the participatory observations of the vendors and buyers along with use of semi-structured and structured interviews. Similarly, informal discussions with interpreters helped with the analysis of the data collected during the market survey. After the market surveys in Kohima and Mon, surveys of Home Gardens were also carried out to check the origin of various commodities in the market.

Observations

Commodities' diversity. A variety of plants, animals and other products of biological origin were being sold (Tables 1, 2, and 3). These products were either harvested from *jhum* fields, Home Gardens, or collected from the wild. There was a clear division of items available from the Naga hills and from the Assam plains. Most commodities were being sold raw, i.e., fruits, vegetables, meat, fish, and insects. Only a few products were sold processed, e.g., fermented bamboo shoots, powdered *Rhus* seeds and dried *Zanthoxyllum* seeds.

Vendors. Permanent vendors occupy the main shelter erected for the market. Temporary vendors are allowed to occupy any space after paying a nominal tax to Kohima town council. The number of temporary vendors far exceeded the permanent vendors in Kohima market. The permanent vendors are of the *Angami* tribe, which is dominant in Kohima district. The temporary stall owners were of different tribes such as the *Lotha, Chakhesang* and *Sema*(s) from districts adjoining Kohima. In Mon township, the vendors were mainly *Konyak*(s) from the surrounding areas. There is no permanent shelter available; the market runs along a road with vendors on both sides. Although most of the vendors are temporary, they occupy the same place almost every day.

Buyers. In Kohima market, buyers are of different tribes such as the *Angami, Aao*, and *Chakhesang*; however, in Mon township, the buyers are mainly *Konyak*(s) along with some *Aao* and *Angami*(s) settled in Mon town. In Kohima market, there are many commodities collected from the wild (ferns, birds, deer meat) and harvested from Home Gardens (beans, gourds and other vegetables). Such commodities are in demand as there is little space and time available in Kohima for collection from the wild or cultivation in Home Gardens. In Mon market, demand for products from Home Gardens was less as every village house still has a properly maintained Home Garden. Here the demand was mainly for products such as *tambul* (processed *Areca* nuts), fish and other products from the Assam plains, along with items such as wild animals and birds.

Role of women in the local markets. It was observed in both the Kohima and Mon markets that 90-95 per cent of the vendors and buyers were women. Women vendors reported that men are engaged in hunting and collection of commodities from the wild. Women look after the management, cultivation, harvesting and processing of products. Sometimes men help in bringing the products from their village to the local market. They also reported that, as a result of trading, they do achieve a certain control over the household economy, but it is usually restricted to using the money gained from marketing for buying other necessary commodities such as clothes, salt, bamboo baskets, etc.

Rhythms of the market. It is very interesting to note the rhythms of the market, i.e., the changes that occur at regular intervals. During the first two hours there is a particular range of products for sale such as perishable vegetables, high-demand items such as hornet bees and their larvae, oak-leaf borer grubs, etc. Marketing activities are at a peak during these two hours. After this initial sale another range of commodities, such as dried fish, spices, rats and snails, meat, fermented bamboo shoots, etc, become available. The main reasons for such changing patterns are the limited space available for the display of items, the creation of false shortages and the availability of storage space. The distance that has to be covered for bringing the product to market and the time required for travelling are also important. Temporary vendor stalls and the vendors of Mon may not exhibit such rhythms as they offer all their items for sale at once. Such changes are essentially a feature of bigger local markets. These are daily markets (Monday to Friday).

Economic transactions. Tribals carry their goods collected or harvested early in the morning to the market place. The permanent stall holders buy commodities from villagers on a wholesale basis. Villagers who do not have enough produce for sale in bulk to retailers occupy temporary places and sell on a retail basis. Permanent vendors also supply some products from their Home Garden or *jhum* fields. Prices varied depending on the amount, quantity and demand for particular commodities such as dog's meat, birds, wild vegetables and ferns, etc. All transactions involved money, bartering was observed only rarely.

Geographical setting. As stated earlier Kohima is located in south-western Nagaland. Kohima township is surrounded by Phek, Zunebato and Wokha districts. In Kohima and Phek districts there is less *jhum* cultivation and the forest areas are better preserved. Wokha and Zunebato districts have extensive areas of *jhum* with no traditionally preserved forests or terrace cultivation. Communications in these two districts are poor, therefore, the quantity of commodities originating from *jhum* fields, Home Gardens and *jhum* fallow is limited. Forest-originated products coming from Phek district are limited due to the distance and time required for travel. The bulk of forest products is supplied from Kohima district itself (from Zulake forest area). Interestingly products such as fish, dried fish, oil and salt also have a high demand; they come from the Assam plains. Poor communication does not affect the supply of these commodities as Kohima township is well connected to Assam via Dimapur.

In Mon market, commodities are supplied from the surrounding villages such as Mon village, Longching, Tanhai, etc. Most of the villagers walk from their villages to Mon to sell their produce at the market. Most of the forest-originated goods come from northern Mon district where there are preserved forests. Products from the Assam plains, such as *tambul*, fish, etc, have a high demand although the Assam plains are rather far away from Mon town.

Need for quantification

To make a systematic appraisal of market transactions and to evaluate sustainability of the natural resource use patterns of the Nagas, quantification is important. Quantification has been attempted to compare the prices and quantities available for sale in order to determine whether this can serve as an indicator of availability of these items. Similarly, quantification is also necessary in

terms of number of vendors, their total supply and sale, and the overall value of the resources. Such quantification is important for assessing the cultural importance and local use of resources. Quantification would also help to give a rating to ecological and cultural values, to identify the need for organized marketing of certain commodities, and to design strategies for their protection and conservation in the wild. It is also necessary to quantify the size of market transactions and its relationship with the average income of Nagas in Kohima in order to understand the economics of natural resource use.

Constraints

A quantitative comparison of items is not possible as the units for sale and uses of each item were different. A comparison between the relative effort needed for harvesting and collection from the wild and its relation with prices was not possible because a method could not be worked out for calculating the labour involved in bringing produce to market. The cost of processing, if any (e.g., fermented bamboo shoots), is not calculated and added to the prices of the commodities but considered as a part of day-to-day activities. Both Kohima and Mon markets are unorganized and there is no uniformity in the price indicators, which makes quantification more difficult. To estimate the cost of cultivation and other inputs for the production of various commodities from Home Gardens is also difficult, although this is an important factor in deciding prices. All present methods for collecting data for quantification are time consuming. It is necessary to develop simple, suitable and quick methods for data collection as most local market surveys are a part of larger ethnobiological research projects.

Conclusion

Daily markets in townships such as Kohima and Mon focus on local demand. Such local market surveys could be used to identify local resource needs. Such studies would also help to assess the role of existing agroecosystems in natural resource use and management. Quantitative studies carried out during such market surveys will help to evaluate the sustainability of resource use. Such studies can also identify commercial opportunities in resource utilisation and may also be used to develop enterprise potential for economic and environmental sustainability. Figure 3 explains the factors responsible for high prices and the unorganized state of local markets in Nagaland. Local markets and the transactions within them throw light on cultural aspects of natural resource use patterns.

Suggestions

A number of commodities such as wild vegetables, fruits, insects and animals have a high demand, and there is much scope for domestication of such items. Domestication will help to reduce the pressure on existing forests. It will also ensure a continuous supply. Some vegetables and fruits have a high demand but cannot be marketed because of the non-availability of proper post-harvest technology and storage facilities. Specific research is needed to develop proper strategies for improving post-harvest technology and storage facilities. The market is unorganized. Domestication, improved post-harvest techniques, and organized markets will help to achieve proper and sustainable resource use.

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Table 1: Products of Animal Origin

No.	Animal	Unit	Price	Availability
1.	honeybees with comb	piece	Rs 25	W
2.	hornet nest	piece (30 cm x 45 cm)	Rs 150	W
3.	borer larvae - 1	tub	Rs 50	W
4.	borer larvae - 2	number	Rs 100	W
5.	borer larvae - 3	tub	Rs 50	W
6.	borer larvae - 4	tub	Rs 50	W
7.	frogs' back legs	number	Rs 250	S&B
8.	frogs' front legs	number	Rs 200	S&B
9.	frogs' smoked	number	Rs 50/6	S&B
10.	frogs' live	number	Rs 20/6	S&B
11.	snails var. 1	mug	Rs 20	W
12.	snails var. 2	mug	Rs 20	W
13.	snails var. 3	mug	Rs 20	W
14.	snails var. 4	mug	Rs 20	W
15.	snails var. 5	mug	Rs 20	W
16.	bird - sengye	number	Rs 50	W
17.	bird - ewu	number	Rs 50	W
18.	bird - green pigeon	number	Rs 50	W
19.	bird - kev	number	Rs 50	W
20.	bird - goofy	number	Rs 50	W
21.	bird -blue rock pigeon	number	Rs 50	W
22.	duck	number	Rs 50	W
23.	squirrel	number	Rs 35	W
24.	bay bamboo rat	number	Rs 30	W
25.	deer	kg	Rs 50	W
26.	dog	kg	Rs 100	H
27.	smoked fish (17 types)	kg	Rs 100	P
28.	fresh fish	number	Rs 20	P
29.	fish fry	packet	Rs 10	S&B

Table 2: Products of Plant Origin

No.	Plant	Part used	Unit	Price	Availability
1.	(Liliaceae)	leaves	bundles	Rs 10	HG
2.	*Allium cepa*	cloves & leaves	bundles	Rs 20	HG
3.	*Allium sativum*	bulbs	bundles	Rs 10	HG
4.	*Amorphophallus* sp.	corm	kg	Rs 10	S&B
5.	*Ananas comosus*	fruits	piece	Rs 2	S&B
6.	*Areca catechu* (tambul)	fruits	bundles	Rs 5	P
7.	bamboo shoots 1	shoots	number	Rs 10	W
8.	bamboo shoots 2	shoots	number	Rs 10	W
9.	beans	sprouts	bundles	Rs 10	HG
10.	black beans	pods	bundles	Rs 10	HG
11.	*Brassica* sp.	leaves	bundles	Rs 10	HG

Table 2 Cont.....

No.	Plant	Part used	Unit	Price	Availability
12.	*Capsicum annuam* dried	powder	packets	Rs 25	HG
13.	*Capsicum annuam* var. 1	fruits	bundles	Rs 10	HG
14.	*Capsicum annuam* var. 2	fruits	bundles	Rs 10	HG
15.	*Capsicum annuam* var. 3	fruits	bundles	Rs 10	HG
16.	*Capsicum annuam* var. 4	fruits	bundles	Rs 10	HG
17.	*Capsicum annuam* var. 5	fruits	bundles	Rs 20	S&B
18.	*Colocasia* sp.	leaves	bundles	Rs 10	S&B
19.	*Colocasia* sp. 1	stem	number	Rs 10	S&B
20.	*Colocasia* sp. 2	stem	number	Rs 10	HG
21.	*Coriandrum sativum*	leaves	bundles	Rs 10	HG
22.	*Cucurbita maxima*	fruits	number	Rs 2-5	HG
23.	*Cucurbita* sp.	leaves	bundles	Rs 5	HG
24.	*Cucurbita* sp.	fruit	size	Rs 10	HG
25.	*Cyphomandra betacia* (tree tomato)	fruits	bundles	Rs 10	HG
26.	dried mushrooms	fruit bodies	packets	Rs 10	W
27.	fermented bamboo shoots	shoots	packets	Rs 20	W
28.	fermented *Glycine max*	pods	packets	Rs 20	S&B
29.	fern	fronds	bundles	Rs 5	W
30.	*Ficus carica*	fruits	number	Rs 10	HG
31.	*Garcinia* sp.	fruit	bundles	Rs 15	W
32.	*Hibiscus mutabilis*	leaves	bundles	Rs 10	HG
33.	*Litsea citrata*	seeds	bundles	Rs 5	W
34.	*Lycopersicum esculantum* var. 1	fruits	bundles	Rs 10	HG
35.	*Lycopersicum esculantum* var. 2	fruits	bundles	Rs 10	HG
36.	*Mentha viridis*	leaves	bundles	Rs 10	HG
37.	millet 1	seeds	packets	Rs 10	S&B
38.	millet 2	seeds	packets	Rs 10	S&B
39.	millet dehusked	seeds	packets	Rs 20	S&B
40.	*Momordica charantia*	fruits	kg	Rs 10	HG
41.	*Musa sapiantum* var. 1	leaves	bundles	Rs 5	S&B
42.	*Musa sapiantum* var. 1	fruits	number	Rs 10-12	S&B
43.	*Musa sapiantum* var. 2	stems	number	Rs 5/3	S&B
44.	*Musa sapiantum* var. 2	fruits	number	Rs 10	S&B
45.	*Ocimum* dried	leaves	bundles	Rs 5	W
46.	*Ocimum* sp.	leaves	bundles	Rs 5	W
47.	*Oryza sativa*	grain	kg	Rs 12	S&B
48.	*Parkia roxburghii*	pods	bundle	Rs 8	W
49.	*Passiflora edulis*	fruit	number	Rs 10	HG
50.	*Passiflora edulis*	leaves	bundles	Rs 5	HG
51.	*Piper betel*	leaves	bundles	Rs 5	HG
52.	*Psophocarpus tetragonolobus*	pods	bundles	Rs 10	HG

Table 2 Cont.....

No.	Plant	Part used	Unit	Price	Availability
53.	*Punica granatum*	fruits	number	Rs 4	HG
54.	*Pyrus malus*	fruits	kg	Rs 30	HG
55.	*Pyrus* sp.	fruit	number	Rs 10	HG
56.	red beans	pods	bundles	Rs 10	HG
57.	*Segium edule*	leaves	bundles	Rs 10	HG
58.	*Segium edule*	fruits	number	Rs 10/6	HG
59.	*Solanum melongena* var. 1	fruits	bundles	Rs 5/15	S&B
60.	*Solanum melongena* var. 2	fruits	bundles	Rs 5/15	HG
61.	*Solanum melongena* var. 3	fruits	bundles	Rs 5/15	HG
62.	*Solanum tuberosum*	tubers	kg	Rs 8	HG
63.	*Tamarindus indica*	pods	packets	Rs 10	P
64.	*Zanthoxyllum* sp.	seed	bundles	Rs 10	W
65.	*Zea mays* var. 1	cobs	number	Rs 10/6-8	S&B
66.	*Zea mays* var. 2	cobs	number	Rs 10/6-8	S&B
67.	*Zingiber officinale* var. 1	rhizome & leaves	bundles	Rs 10	HG
68.	*Zingiber officinale* var. 2	rhizome and leaves	bundles	Rs 10	HG

Table 3: Miscellaneous produce

No.	Product	Unit	Price	Availability
1.	brooms	number	Rs 10	H
2.	candle stand	number	Rs 20	H
3	containers made of gourd	number and size	Rs 5-15	HG
4	honey bottle	number	Rs 250	W
5	honey with comb pieces	packet	Rs 20	W
6	ornamental plants	number	Rs 10	P
7	*Rhus* seed coat powder	glass	Rs 5	W
8	shawls	number	Rs 250	H
9	sponge	number	Rs 5/3	HG

Availability	Wild	S&B	P	F	HG
No. of products	34	22	5	3	40

Abbreviations: H = house; HG = homegarden; P = plains; W = wild; S&B = slash and burn cultivation.

Angami Home Gardens

Archana Godbole
Applied Environmental research foundation

The role of Home Gardens in maintaining useful biodiversity was the theme of the workshop, and a field exercise was designed to study Home Gardens in the *Angami* Naga village of Khuzama. *Angami* Nagas are well aquainted with the environment around them and have learned to use and manage their limited land and water resources through experience and experimentation over the generations. *Angami* territory is restricted to the southern Kohima district. In *Angami* territory, a large amount of land is available for wet or terraced rice cultivation. It is a permanent agricultural system. However, because of intensive cultivation practices and low-quality soils, the *Angami* sometimes prepare new terraced fields and abandon the old ones. If these abandoned fields are close to the village, they are often used as Home Gardens. The tradition of Home Gardens is well developed and many are so extensive that there are areas for cultivation of maize and millet. Also large portions of *Angami* Home Gardens are occupied by commercial plantations of fruit trees such as oranges and crops such as potatoes.

Khuzama is a small village 25 km from Kohima on the Kohima–Imphal road. The participants formed two groups. One group led by Ajay Rastogi, S.K. Barik and Dhrupad Choudhary carried out ecological data collection from Home Gardens within the village. The other group led by Vincent Darlong and Archana Godbole collected data on socioeconomic and cultural aspects of Home Gardens.

By collecting socioeconomic data and information on needs, it is possible to identify two or three different types of Home Garden maintained by the *Angami* Nagas. They are (a) a small kitchen gardens around the house with small plots for chilli and vegetables with one or two fruit trees; (b) *tejeye*—larger traditional Home Gardens—away from the house situated on terraced fields on the upper level and cultivated like Home Gardens but with planned commercial objectives; and (c) *mejye* community Home Gardens on community-owned terrace fields cultivated like Home Gardens.

Management practices are different for these three types of Home Garden system. In *tejeye* the main emphasis is on commercially important crops such as potato and fruit trees, and intensive water management is observed. *Tejeye* is in fact the extension of terrace fields but is different in terms of plant composition. These Home Gardens have more perennials than are found in kitchen gardens. Decision-making and selection of species are driven by market forces. Greater biodiversity is maintained in the kitchen gardens.

Many indigenous practices have been observed in these *tejeye*, for example, the traditional practices of manuring with *pidi* (*Solanum* leaves) to get rid of pests and insects. Alder trees increase soil fertility and improve the growth of fruit trees. Therefore a few alder trees are maintained in these gardens. Trees such

as *Melia* and *Cedrella* are also planted to increase soil fertility and control insect pests, while *Prunus* sp is used as a wind break on terrace bunds. Grafting, using wild plants to render plants resistant to pests and diseases, is common in Khuzama village.

Socioeconomic patterns observed indicate that such supplementary systems are extremely important for local people. Changes within the traditional *tejeye* management practices are mainly as a result of demand from the market, manpower availability, and the changing economic needs of the people.

The availability of terraced land and the well-developed traditional irrigation system of the *Angami* Nagas mean that the structure and management of *Angami* Home Gardens are strikingly different from other north-eastern communities. See for example the Home Garden system of the *Metei* community of Imphal, Manipur (Box 1), and that of the *Konyak* Naga community of Nagaland (Box 2).

The different types of *Angami* Home Garden observed in Khuzama clearly indicate that the concept of social attachment to Home Gardens and the linkage with culture are changing very quickly. The choice of species to be cultivated in Home Gardens is no longer dependent on the social and cultural needs of livelihood and house-building. Now it is directly dependent on the economic importance of the species and is driven by market forces. Historical linkages associated with Home Garden cultivation are also changing. Varieties of vegetables and fruits used since time immemorial are vanishing and being replaced by economically important newer species and varieties.

Another important feature of the *Angami* Home Garden is the aesthetic sense. In more than 90 per cent of the Home Gardens of Khuzama many ornamental plants and orchids can be seen. The choice of species to be grown in Home Gardens is very specific, e.g., in the Home Garden of Mr Punokiel many medicinal plants are seen. He is a traditional healer, especially interested in the cultivation of specific medicinal herbs. In many other Home Gardens, banana plantations (local varieties) are dominant. These bananas are sold on the roadside, as Khuzama is on the Kohima–Imphal highway, often by children. *Angami* Home Gardens are a good example of optimisation of limited space for economic purposes.

The field work in Khuzama village gave an opportunity to workshop participants to understand the need for documentation and research in ethnobotany. It exposed them to a completely different pattern of indigenous management practices with three different types of Home Garden. It also provided an insight into how and why indigenous knowledge systems are working and/or changing in today's context. A village development board meeting organized in Khuzama with participants gave an idea of village community organization in the Naga village.

Role of women in local markets and maintenance of Home Gardens

During the first two field work sessions it was observed that women play key roles in the overall organization and management of Home Gardens as well as local markets. In most of the local markets surveyed from north-eastern India

Box 1: *Metei* Home Gardens of Manipur

The Home Garden in Manipur is a traditional conservation area. A number of micro-habitats in Home Gardens are favoured by animal components depending upon the religious and economic background of the community — besides their interest. It may be variable in size and shape. The Home Gardens vary from hill to valley, reflecting the variations of soil topography, climatic conditions, and cultural practices of the people. It appears that the regimes of moisture and nutrients must be varying in different areas, the penetration of light into the gaps creating a heterogeneous landscape and promoting patchiness.

In the valley, Home Gardens are quite diverse and complex. In hilly areas in the village that are permanent, large Home Gardens contain species for food, fibre, fuel, timbre, medicine, and species of sociocultural importance. The hill Home Gardens have the following features.

a. Cultivation of wild species such as oaks, cedars, toonas, and red wood.
b. Economically important plants like Ericas and Bamboos
c. Varieties of chilli, tomato, and cabbage along with other local vegetables
d. Varied floristic patterns, representing trees from valleys and hills

Structure and orgnaization of *Metei* Home Gardens

These Home Gardens, locally known as ***Iingkhol,*** are a mosaic and include the following components

a. Perennial, multipurpose trees of horticultural importance, timber or medicines
b. Various micro-habitats such as water resources with aquaculture of fish, mat grass, *Euryale ferox,* a traditional delicacy, fishery, poultry, cowshed, rabbit house etc.
c. Cash crop section for annuals
d. Frontal hut, ***Shangoy,*** for socioreligious functions
e. Sacred Basil plant in the centre of the courtyard (*shumang*)
f. Separate areas for raising ornamentals, bananas, spices, vegetables
g. Fencing with bamboo species.

Home Gardens are fenced by different bamboo species usually in the front and back, whereas the perennial species may demarcate the sides of it. The space for the traditional hut where the socioreligious functions are held is the characteristic feature of the traditional system in which the walls are made from thickly set reeds plastered with mud, wooden poles are used, and the roof is covered with thatch grass. This is the place where cattle may often be put for want of space. Fragrant flowers like *Thevesia, Nyctanthus, Jasminum,* and Lilies, etc and multipurpose banana plantations surround the deity temple located in the front of the house. The backside of the residential unit is grassland with many grasses used for thatching, binding and fodder purposes. Perennial wild or cultivated multipurpose trees characteristic of the region demarcate the ultimate boundary.

Asha Gupta, Kanchipur University, Manipur

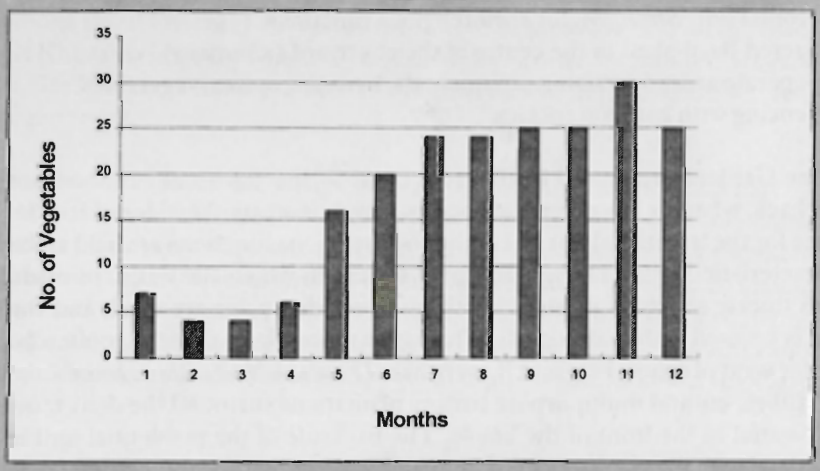
Box 2: Home Gardens of the *Konyak* Nagas of Nagaland, India

Konyak Nagas, considered the most primitive tribals of Nagaland, are in fact expert agriculturists who, even today, live in harmony with nature. *Konyak*(s) have successfully maintained a sustainable supply of natural resources for many years through various land management systems. These traditional systems of land management have been developed through indigenous knowledge blended with innovative skills. One of these traditional systems of land management is the Home Garden maintained around their houses.

The data collected from three villages—Liangnyu, Mon and Tanhai from Mon District of Nagaland—highlight the following details of Home Gardens.

In all 32 Home Gardens were surveyed from three villages, of which 10 Home Gardens were from Liangnyu, 11 Home Gardens from Mon, and 11 from Tanhai (covering around 10-20 % of the total households). Tanhai had the maximum number of species (122) and the largest average size of Home Garden. 87 species have so far been recorded from Mon and 45 species from Liangnyu.

Konyak Home Gardens exhibit a wide diversity in size, shape, location and composition. The management, organization and spatial patterns show the maximum use of available land using different combinations of trees, shrubs and herbaceous plant species in a year. Generally, selection of plants depends on daily necessities. Many of these species have multiple uses. The owners show a tendency towards cultivating mainly edible fruit and vegetables. Other categories include plants yielding timber, fuelwood, fumigators, masticators, spices, beverages, construction materials, basketry materials, medicines, poisons and ornaments. The numbers of vegetables available in the *Konyak* Home Gardens each month are illustrated in the box below.



Number of Vegetables Available in Each Month from Home Gardens

Archana Godbole, Swapna Prabhu and Aparna Watve
Applied Environmental Research Foundation, Pune.

vendors are mainly women. The number of women vendors was far greater than men vendors. Women vendors are associated with all types of products whereas male vendors specialise in the sale of certain products such as the meat of wild animals, etc. Hunting is done by men. Men help to carry the goods from village to local markets, paying rent for the permanent or temporary stalls, etc. However, women are the key persons deciding the price of items and overall transactions. They help the household economy with extra earnings made in the market.

Women are aware of the utility of plant diversity and means for maintaining it. In many traditional societies it is only women who have accumulated traditional knowledge about food and other household products that plants can supply. Women are engaged in cooking and understand the requirements for it. They have developed the skills to cultivate and maintain important plant species to supply these requirements. *Konyak* women, for example, could named 29 products of plant origin from Home Gardens while men could name only 12. Women are better judges at selecting species to be cultivated in Home Gardens in response to the needs and demands of local markets.

Traditional *jhum* (shifting cultivation) of the *Angami* Nagas

Together with the visit to the *Angami* Home Gardens, a visit to observe the traditional fallow management practices of *Angami* Nagas in the village of Khonoma was also undertaken. For several generations *Angami* Nagas have been managing their *jhum* fallow using alder (*Alnus nepalensis*) trees. These alder trees grow profusely within the cycle years, i.e., 8-10 years, and provide valuable timber and fuelwood. The stumps are kept in the field, which in turn increases soil fertility. These stumps, located on the contours, also help to check soil erosion. Primary land shaping using alder trunks is common. *Angami* farmers recognise that crops growing near *Alnus nepalensis* perform better, and this observation has provided the impetus for *jhum* cultivators to begin experimentation with cropping patterns that exploit the agronomic properties of alder on a more systematic basis.

Anecdotal evidence shows that, through centuries of trial and error, Nagaland farmers gradually evolved their contemporary system of maintaining *Alnus* stumps scattered throughout their *jhum* fields. The age of the system is evident in farmers' estimates that individual trees are up to 150 years old, their careful management passed from generation to generation almost as family heirlooms. During the fallow period, rapid coppice growth from these interstitial stumps forms a closed canopy and shades out light-demanding weeds. Significant N-fixation and copious litter fall rejuvenates soil chemicals and physical properties. Fallow is reopened by careful pollarding of the coppice against the main trunk. Harvested coppices are used for poles and fuelwood and the remaining slash is burned in tightly controlled fires. *Jhum* crops, generally upland rice, maize, sorghum and millets and an array of secondary cultigens, are then dibbled di-

Alder-based fallow management - Ajay Rastogi

rectly. This innovative manipulation of *Alnus* has permitted Nagaland farmers to intensify swiddening into a two-year cropping and two-year fallow cycle (total cycle length of four years)—a relatively intense 1:1 ratio of cropping to fallow periods. Other than manure deposited by livestock and the decomposition of crop residues, no external inputs are applied to the system, yet crop yields are reported to be as high now as at any time within memory.

This field visit also gave, participants a chance to observe the Zhulake forest—the best-maintained prime forest in Kohima district. The population is comparatively sparse around Zhulake forest. Villages around Zhulake manage and maintain the forest for timber and wildlife resources. The forest also serves as grazing grounds for semi-domesticated *mithun*(s) (bulls), which are an important meat source in Naga life and have tremendous cultural significance. Interactions with local people provided much information about the fallow management and community forest management of the *Angami* Nagas.

Discussions on the Methodological Framework

As one of the objectives of the workshop was to develop a methodological framework/ guideline for short- and long-term ethnobotanical studies, two sessions were devoted to the task of understanding various field methods and to developing a survey format to be used, particularly in the workshop field work.

Participatory methodologies help to increase the awareness and confidence of communities, but they also pose certain problems. Choosing the correct participatory methodology is dependent on the area, community and status of resources within that area. Participatory methodologies such as RRA (rapid rural appraisal) and PRA (participatory rural appraisal) have their own limitations. RRA is a quick method for brief analysis of the field situation; little or no time is available for rechecking and confirmation of the data collected. RRA is useful to many people from villagers and field workers to academicians and scientists. However, successful use of RRA and PRA requires many skills such as communication, facilitation and conflict negotiation. On occasion, rapid assessment can create confusion, especially if there is a time constraint. PRA is comparatively more time consuming both for researchers and communities. It can be difficult for communities to allow time for interviews, and continuous questioning may develop interview fatigue. These methods are training oriented also.

During the morning session (19 June 1997) S.K. Barik, Arvind Saklani and Dhrupad Choudhary discussed the use of ecological quantification methods in ethnobotanical studies. Dr Barik explained in detail methods such as estimation of seedling/sapling density, productivity competition assessment, allelopathic interactions, association analysis, etc. Some participants not trained in field ecology found it a little difficult, but later when simple formats for collecting data for such detailed analysis were developed, everyone understood the need for and use of such ecological methods in ethnobotanical studies. Survey formats for field data collection are given in Annex 1. Use of ecological quantification methods are helpful for checking the science behind traditional practices and the exact role of practices such as cropping pattern and fallow management in sustainable resource use. Participants accepted the fact that ecological data collection is time consuming and proper value estimations need continuous data collection and observations over a long period of time. For short-term research programmes, a few parameters such as productivity, spatial patterns, etc can be used effectively to enhance the understanding of indigenous knowledge systems.

In the afternoon session, Archana Godbole, Vincent Darlong, and K. Haridasan discussed the methodological framework necessary for socioeconomic studies in relation to ethnobotanical studies. The discussion focused on Home Gardens.

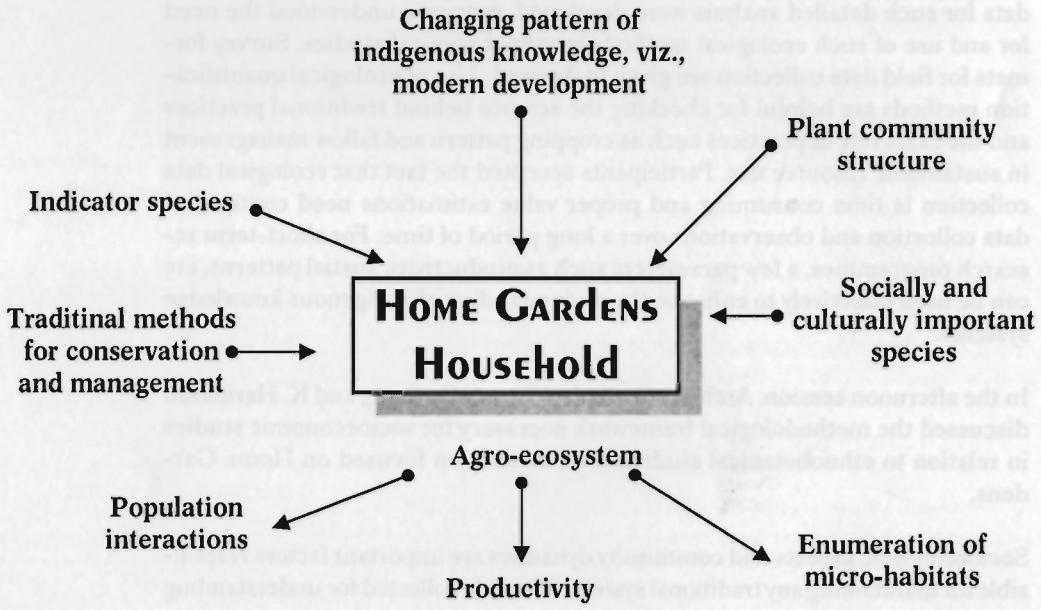
Socioeconomic aspects and community dynamics are important factors responsible for maintaining any traditional system. The data collected for understanding

these factors are normally qualitative data and need rechecking and confirmation from time to time. However, the more qualitative the data that are collected and interpreted, the easier it is to select particular criteria for quantification and to frame specific research questions. For the workshop field work, it was decided to concentrate on social, cultural, economic and management aspects of indigenous practices of maintaining Home Gardens (Figure 1). The ecological aspects were also discussed (Figure 2). The use of RRA and PRA techniques for such data collection is well understood, but to obtain specific and accurate information with a focus, survey guidelines/formats were prepared (Annex 2). Annex 3 provides the formats for various components of the market survey exercise.

Figure 1: Socioeconomic Aspects of Home Gardens

SOCIAL	ECONOMIC	CULTURAL	MANAGEMENT
Social Functions	Productivity	Attitudinal change	Specific practices
Role of Women	Utilisation	Cultural ethos	Calendar of activities
Social relationship	Provisions for adverse conditions	Social trends	Decision-making
		Social functions	Working pattern

Figure 2: Ecological Aspects of Home Gardens



Systematic data collection

There is a wide variety of methodologies available for data collection and analysis used by various related disciplines, depending on the choice of research topic. Therefore, as a starting point, it is essential to define a domain for the subject of interest that not only limits the scope of data collection but also helps to build the data systematically. Systematic data collection using an explicit methodology helps to ensure the arrival at logical conclusions. Since most ethnobotanical research rests on interviewing, the domain may be defined as an organized set of words, concepts or sentences, all on the same level of contrast and that jointly referring to a single conceptual sphere. For greater precision, the domain should be defined by the informants. There are many ways to compile the list of items to define the domain of study items and the most useful general technique is the free listing task.

Free listing

This technique helps us to understand if the domain is considered culturally important and easily recognisable by the people being interviewed. By framing the right question, free listing can provide a fairly complete set of native categories. When people are asked to recall things, they tend to list the most significant ones. In addition, prominent categories are cited by almost everybody, thus giving some idea of the things that are culturally more important. This information produces a ranking index. This index can be used to decide the size of the data set to be included in the domain. It also helps to decide on the number of respondents for the free listing task. However, for a medium-sized domain (less than 100 or so total categories), the inquiry should be made with approximately 20-30 people. Once it is observed that most of the responses given by new informants are being repeated from old lists, the sample is considered fairly complete. A composite list may be obtained by accumulating information from all the lists.

Identification task

The free listing can be followed by an identification task. A simple way to do this is by collecting specimens of items mentioned in the free lists and taking the specimens to the respondents for identification. It is important to have a proper sample to facilitate identification. The responses from each of the respondents should be recorded separately and later verified for the number of correct answers. This technique provides some idea of who are the more knowledgeable people in the community and also helps to resolve confusion on account of synonyms for the same item. It is useful then to carry out further study with the subject matter specialists after the initial identification task to remove anomalies associated with multiple local names.

Preference ranking

Preference ranking can either be accomplished from the positions in the free lists or obtained by asking the key group of informants again to arrange the items in the order of preference. Each person arranges the items according to personal preference, perceived importance in the community or any other cri-

terion. Each rank is given an integer value (1, 2, 3 and so on) with the most important or preferred item assigned the highest number. These numbers are summed for all respondents, giving an overall ranking for the item by the sample group of respondents. Efforts should be made to cross-check this order of preference with data obtained from interviews or other sources to see if there is consistency in the responses. A more complex version of preference ranking, useful for ranking based on multiple dimensions, is known as direct matrix ranking. Direct matrix ranking takes into consideration several attributes at a time to provide composite scores of the overall multiple use value of items.

Pairwise ranking

In a paired comparison task, items are presented two at a time and respondents are asked which is 'more' or which is 'less'. For 'n' items, a pair comparison design creates n(n-1)/2 pairs. For example, if we wanted someone to order ten items using this method, we would then create 45 pairs and order them at random both within and between pairs. For each pair, respondents are asked which is 'more'. A total order is obtained by summing the number of times each item was chosen. To tabulate the responses, simply sum together all the codes or ranks assigned to each item and present them as shown in Table 1.

Table 1: Scores and Ranks Assigned to each Item Using Pairwise Ranking Method

A	B	C	D	E	F	G	H	I		Score	Rank
									A		
									B		
									C		
									D		
									E		
									F		
									G		
									H		
									I		

In order to gain insight into people's reasoning, respondents can be asked to describe why one option is better or worse than the other. In addition, information can be gathered on whether the preferred item has any negative qualities or whether the item not chosen has any positive aspects. Some researchers ask for these comments after each choice, whereas others prefer the respondents to complete the entire task before giving their general observations on the overall pattern that emerges.

Pile sorting

Pile sorting is initiated after the study items have been selected for more detailed data collection. In pile sorting, informants are asked to sort either the items or cards bearing the name/figure of an item into piles so that all items in a pile are more similar to each other than they are to items in separate piles. In the unconstrained version of the pile sorting task, respondents can make as many or as few piles as they wish. In the constrained version, respondents are asked to create a specified number of piles. Respondents are generally asked to group items according to their similarity, without reference to specific criteria. The respondents rather than the researcher decides what criteria are more salient and determine similarity. Pile sorting is easy to administer and allows for the collection of data among a large number of items.

Pile sort tabulation

An item-by-item similarity matrix is created from each individual's sort by tabulating the co-occurrence of items in piles so that items that are together are counted as similar. For example, if data were collected on the similarity of seven items and a respondent put items A, B and C together in a pile, D and E in another pile, and left F and G by themselves (Table 2) then a 7 x 7 table would be created to tabulate similarity among the items. Since A, B and C are categorised together, A and B are similar, B and C are similar, and A and C are similar. Since D and E are also put together in a pile, D and E are similar. Thus each pair would get 'a point of similarity'. This is indicated in the table with a one. For this individual, all other pairs are 'dissimilar' and are recorded as zeros. Similarity matrices are tabulated for each individual and then combined across people. The similarity matrix can then be analysed with a descriptive method such as hierarchical clustering or multidimensional scaling.

Table 2: An Individual's Items Sorted into Piles

A			
B	D		
C	E	F	G
Pile 1	Pile 2	Pile 3	Pile 4

Since A, B, C were together in a pile

cell (A, B) = 1
cell (A, C) = 1
cell (B, C) = 1

Similarity matrix

	A	B	C	D	E	F
B	1					
C	1	1				
D	0	0	0			
E	0	0	0	1		
F	0	0	0	0	0	
G	0	0	0	0	0	0

Standardisation of methods

The standardisation of the methodological framework used for ethnobotanical research is dependent on many factors such as geographical location, systems being analysed, tribe/community, socioeconomic aspects, approachability, etc. It is therefore difficult to standardise methodology. However, it is possible to develop a conceptual framework and selection of particular methods available and tested at different field sites. A multimethod approach using RRA, PRA techniques and tools along with ecological quantification methods is suitable to carry out multi-objective ethnobotanical research within a short span of time, i.e., six months to one year. Quantification of cultural indicators is an added advantage to researchers if the criteria used are selected properly. In any case a multidisciplinary team is an important prerequisite for any applied ethnobotanical research. Effective data collection, using any particular methodology, is dependent on the manpower and funds available. In any action research the first two steps relate to the identification of issues and problems based on observations during the preliminary field visit; and the selection of issues/problems that could be resolved on the basis of research and data analysis.

Informal interactive sessions during the course of the workshop provided additional learning opportunities. In addition to various presentations, POU member, Mr Sancho, gave an illustrated presentation on *jhum* practices in Nagaland and NEPED work by Dr Arvind Saklani provided a short presentation with the help of slides on medicobotanical aspects of Flora of Western Himalayas, and Dr P.K. Singh shared interesting details of the traditional ways to store perishable fruits in Manipur hills.

Specific issues and problems that emerged through workshop discussions and field work.

Workshop field work and discussions focussed on the problems of the north-eastern region as a whole and Nagaland in particular. The main issues highlighted areas follows.

- Tribal communities have tremendous ethnobiological knowledge which they have been using for effective natural resource management since time immemorial. However, the lack of awareness about the value of indigenous knowledge is a critical problem and it is therefore difficult in present circumstances to design community development programmes for effective resource use and conservation.
- Projects such as NEPED are trying to help local communities. However, commodities produced as a result of such efforts are likely to face problems in terms of marketing and thus may adversely affect sustainable production in future. The main problem is that of developing a marketing network and policies for product pricing that protects the interest of the primary producer.
- In the case of Nagaland, the village development board, which is based on a traditional village organizational pattern, functions effectively. However, funds and continuous, effective guidance are sometimes lacking. The model is good and it is important to develop such village-level organization in other states of north-eastern India.

- Poor communication is another important issue in all these states and is directly related to marketing and networking facilities.

Achievements of the workshop

- A process of interaction amongst institutions and interested professionals has been initiated and has highlighted the need for applied ethnobotanical research beyond inventories for a culturally and biologically diverse region such as north-eastern India.
- The workshop provided an opportunity for experts and young researchers from various fields to view the application of ethnobotany in the form of NEPED. Workshop field work provided direct contact with local communities and allowed them to interact with NEPED.
- Workshop exercises helped to develop a methodological framework for short- and long-term applied ethnobotanical research, particularly in the context of Home Gardens. The survey formats prepared in an interactive way could be used further with modifications based on particular research needs in the region and outside.
- The workshop provided an opportunity to develop inter-institutional linkages and better networking of organizations doing similar research in north-eastern India.
- In order to strengthen the scientific understanding and make a comparative assessment of indigenous soil conservation and fertility improvement techniques used by various Naga communities, a field study has been undertaken by a multidisciplinary team comprising of an anthropologist, botanist and a forester. The study is being coordinated by a POU member of NEPED and is supported by the Hindu Kush-Himalayan Ethnobotany Programme of ICIMOD.

Annexes

Annex I
Ecological Evaluation of Indigenous Knowledge Systems

1. System to be evaluated: Homestead garden/(*jhum* field under cultivation/*jhum* fallow/ terrace cultivation/forest/any other)

2. General information about the system

a. Location details:

b. Ownership details:

c. Utilities:

d. Area:

e. Season of data collection:

f. Date:

3. Analysis of plant community structure

Tree

Species	No. of plants	Density / m^2	Total basal area (sq. mm^2)

Shrub

Species	No. of plants	Density / m^2	Total basal area (sq. mm^2)

Herb (based on average of 5-10 1 m x 1 m quadrants)

Species	No. of plants	Density / m^2	Total basal area (sq. mm^2)	Frequency

Creeper

Species	No. of plants	Density / m^2	Total basal area (sq. mm^2)

4. Socially important key species in terms of uses (listing in priority order)

Trees

Shrubs

Herbs

Creepers

5. Documentation of the habitats/micro-habitats encountered

Natural	Presence/absence	Species found
Marshy lands		
Rocky area Decomposed/semi-decomposed tree stumps		
Understorey		
Light gap		
Pits		
Mounds		
Man-made		

6. Regeneration potential

Species	Seedling population		Sapling population	
	No.	Density/m^2	No.	Density/m^2

7. Estimation of productivity

Tree species	Average height/tree (m)	Average diameter/ tree (m)	Volume/ tree (m^{-3})	Bole biomass/ tree (kg)	Leaf/fruit biomass/ tree (kg)	Total biomass/ tree (kg)
Shrub species (kg)				Total biomass/plant		
Herb species				Biomass/m^2 (kg)		

8. Product extraction

Product (kg/no.)	Species	Frequency of extraction Extraction period in (days /per year)	Ave. quantity/day

9. Population interactions

a. Species' associations

Socially key species Associate species in order of their density

b. List of species having allelopathic effect

c. Competition

i) Inter-specific Density/m^2
ii) Intra-specific Density/m^2

d. List of pollinators/predators/dispersers

e. Pests and traditional pest management systems

10. Traditional soil classes (list with salient features)

11. Indicator species identified under traditional systems

Species' indication

12. Details of soil and water conservation principles/methods traditionally used

13. Animal diversity

Species no.

14. Impact of the system on other adjoining land-use systems (qualitative description)

15. Any other specific aspect of the IKS having ecological implications (observations to be recorded)

16. Name of the informant/owner of the system being evaluated, village/tribe and age

Annex II
Information Needs Assessment

Information needs

Name of the village
General village information.

Agriculture

Change over time (years) in land use
Local names of the land units, crop systems
Management of farming systems
Knowledge about the local conditions of soil, plants, etc
Impact of agricultural extension services—mainly on choice of crops
Land ownership

Forestry

Changes within the forest cover
Resource areas, distribution, use patterns
Indicators of biodiversity, abundance of species
Potential for non-timber forest products (NTFPs)
Traditional user rights, community management, if any
Forest management units
Indicators of disturbance
Forest functions
Regeneration capacity
Local terminology for forest types, richness of forest, etc
Vegetation types, degree of biodiversity in each type
Level of awareness of local people

Home Garden

Multipurpose species planted
Parts used/habits
Functions of home garden
Variation in the planting material
Preservation of planting material
Storage of products
Waste recycling
Nursery
Production of manure, etc
Water storage/harvest/management
Species not cultivated but still protected
Management practices/role of gender
Magico/religious rituals, etc

Annex IIIa
Market Survey Economic Aspects

1. Origin

'A'

Item	Locality	Distance by transport (walking 0-10 km/11-20 km/21 km or more)

'B'

Item	Origin (H.,H.G.,W., *jhum*)	Time for collecting/harvesting/bringing to market

2. Quantity

Item	No./unit/bunch/weight (kg)	
a. Animal-based		
b. Plant-based		

3. Economic aspect

Item	Price buying at	Overheads	Price selling at	Price within last 30 days	
				Min.	Max.

4. Demand

a.	Animal-based	i)	ii)	iii)
b.	Plant-based	i)	ii)	iii)

5. Buyer

Item	Buyers: local/outsider

6. Profit/loss

i)	Turnover/day		Rs
ii)	Total dues	(less)	Rs
iii)	Taxes (if any)	(less)	Rs
iv)	Wastage (if any)	(less)	Rs
		Net profit/loss Rs	

Annex IIIb
Resource Availability/Patterns

resource available
- source (wild/home gardens)
- tribewise variation
- special items
- availability in wild

Vendor's name:
Tribe:
Village:

Item name local or botanical or English	Market availability (quantitative)				Source of collection				Place of collection/harvesting							Availability in wild at source			Tribe specificity	Periodicity
	V1	V2		V_n	C	Coll	Sec	Ter	J		T		HG	W	O	C	F	R		
									c	w	c	w								

C = cultivated
Coll = collected

Sec = secondary
Ter = tertiary

HG = Home Garden
T = Terrace
J = *Jhum*
W = Wild
O = Other

c = cultivated
w = wild

Annex IIIc
Biodiversity

Local name	Botanical name	Habit	Habitat	W/HG/C	Part	Purpose	Processing (if any)
Notes: W = wild; HG = homegarden; C = cultivated.							

Annex IV
Schedule of the Workshop

Wednesday 18 June 1997	08.00 to 09.00	Registration and distribution of resource material
	09.00 to 10.00	Opening and inauguration of the workshop by NEPED team leader Mr R. Kevichusha Introduction to People and Plants programme of workshop of UNESCO and overview of HKH ethnobotany programme by Ajay Rastogi
	10.00 to 10.30	Details of workshop programme and theme of the workshop: role of home gardens in maintaining useful biodiversity by Archana Godbole
	10.30 to 12.00	Introduction: participants' presentation 15-20 min each. (including discussions: 2-3 questions for each participant)
	13.00 to 14.00	Lunch
	14.00 to 14.30	Introduction to market survey exercise by Arvind Sakalani and Archana Godbole — Participants split into three groups to discuss the market survey and preparation of formats for data collection: 1. Inventorisation and biodiversity aspect; 2. Economic aspect; 3. Resource availability and use pattern of the commodities available for the sale in the local market at Kohima
	14.30 to 16.30	Group discussions and preparation of formats
	16.30 to 17.00	Presentation of each of three groups in form of slides and charts — Quantitative methodology and its use in applied ethnobotany work by Ajay Rastogi
Thursday 19 June 1997	08.00 to 08.30	Introduction to field work sessions by Ajay Rastogi
	08.30 to 10.00	Development of methodological framework for ecological studies as part of ethnobotanical studies by S.K. Barik, Asha Gupta, Dhrupad Choudhary
	12.00 to 13.00	Lunch
	13.00 to 15.30	Development of methodological framework for socioeconomic studies by V.T. Darlong, Archana Godbole and S.K. Barik
	15.30 to 17.00	Group-wise presentation of market survey

07.00 to 16.00	Field work and data collection from *Angami* home gardens in Khuzama village, 25 km from Kohima (Split into two groups and each group collected data on ecological aspects and socioeconomic aspects)	**Friday 20 June 1997**
08.30 to 16.00	Field visit to Khonoma village to study traditional fallow management practices of *Angami* Nagas	**Saturday 21 June 1997**
16.30 to 17.30	Introduction to computerised database programme developed by NEPED for plant identification	
09.00 to 11.00	Floristics of north-eastern India by Dr K. Haridasan.	**Sunday 22 June 1997**
11.00 to 13.00	Group-wise discussions and analysis work for home garden survey and Khonoma field visit	
13.00 to 14.00	Lunch	
14.00 to 15.30	NEPED presentation by Qutovi Wotsa and Vengota Nakro. Role of women in NEPED by Chosule Kiki	
15.30 to 17.30	*Jhum* cultivation in north-eastern India and tribals perspective of indigenous knowledge — Local village experts: S. Atong, Tenzamo Rukhaso — Discussion on general overview and particular fallow management strategies followed	
17.30 to 18.00	Problem of marketing of local products in north-eastern India by Mr. Arri, NEPED	
07.30 to 10.00	Visit to two NEPED test plots in two groups — One group to see Peducha test plot maintained by women	**Monday 23 June 1997**
12.00 to 13.00	Discussion on field work with presentations	
13.00 to 14.00	Lunch	
14.00 to 14.30	Traditional method of *Kabeye* tribe's fruit preservation by P.K. Singh	
14.30 to 15.30	Evaluation of workshop by Ajay Rastogi	
15.30 to 16.30	Concluding function, distribution of certificates by V.T. Darlong and Chosule Kiki — Vote of thanks by Ajay Rastogi	

Annex V
List of Participants

Participants at the Training Workshop - Ajay Rastogi

Mr S. Atong — Local expert from *Sema* community.

Mr Tenzamo — Local expert from *Lotha* community.

Mr Rakhosiünü — Local expert from *Chakhesang* community.

Mr Iachiinii — Local expert from *Angami* community.

Dr J.K. Pathak
Faculty Member, Disaster Management Cell, Uttar Pradesh Academy of Administration (UPAA), Nainital - 263 001, U.P.

Dr J.K. Pathak, is a research officer working in the Disaster Management Cell (DMC), U.P. Academy of Administration, Nainital. He has done a Ph. D. in the Hydrobiology of six major river systems of the Kumaun Himalayas. His activities at DMC include training programmes for state administrative officers on disaster management, field workshops for villagers, collection and compilation of data on disasters, and preparation and distribution of literature in simple languages to communities on disasters such as earthquakes and landslides.

Dr Asha Gupta
Asst. Professor, Dept. of Life Science, Manipur University, Kanchipur, Imphal - 795 003, Manipur

Asha Gupta is an Assistant Professor at Manipur University. Specialising in Ecology, she has completed post-doctoral research in Plant Ecology in the USSR. Her fields of interest are ecosystem modelling and analysis, conservation biology, and use of ecological methods in ethnobotanical studies. She is organizing a symposium on matrix models in ecology at the International Congress of Ecology in Florence, Italy, in July 1998.

Dr V.T. Darlong
Jt. Director, Govt. of India, Ministry of Environment and Forests, North-eastern Regional Office, Upland Road, Shillong

Vincent Darlong is a Joint Director in the North-eastern Regional Office of the Ministry of Environment and Forests. With Zoology as his background, he has done a Ph. D. on the effects of shifting cultivation. His special interests include biodiversity conservation and socioeconomic development using indigenous knowledge systems.

Dr Dhrupad Choudhary
Reader, Dept. of Life Sciences, Central University, Silchar

Dhrupad Choudhary, formerly scientist-in-charge of the North-eastern unit of GBPIHED, has recently joined Assam University at Silchar as Asst. Professor. He obtained a Ph. D. in Ecology from Oxford and he has worked in the field of ecology and conservation biology. Now in the University, he will be concentrating on animal-plant interactions and natural resource management along with conservation biology.

Mr Pranab Bhujarbaruah
Researcher, Indo-US Primate Project, North-eastern Centre, C - 4 Ashiyana Complex, Maligaon - 781 011, Assam

Pranab Bhujarbaruah is a research fellow of the Indo-US Primate Project. The only botanist in the North-eastern regional centre, he is carrying out research on food habits of primates, special importance of figs in primate food, and the role of primates in forest regeneration. The topics of research include ethnobotany, habitat ecology and medicinal plants.

Dr P. Phartiyal
Faculty member, Uttar Pradesh Academy of Administration (UPAA), Nainital - 263 001, U.P. India

Pushkin Phartiyal is the Project Manager for the Management Unit of Mountain Development at the Centre for Development Studies of UPAA. Responsibilities include organizing training workshops for administrative, forest and development department officials, networking with NGOs in the Uttarakhand region and planning collaborative action research projects. Interest areas are mass communication, sustainable mountain tourism and involvement of hill women in development.

Dr Deojit Baruah
AVARD North East, Club Road, Jorhat, Assam

Dr P.K. Singh
Dept. of Life Science, Manipur University, Manipur

Deojit Baruah is a lecturer of Botany at Majuli College, Assam. Holding a Ph. D. in plant ecology, his field of research covers water pollution and river islands. Currently he is working on medicinal plants used by the tribal inhabitants of Majuli Island. Also actively involved in action programmes, such as tree plantations to protect the soil erosion on the river banks of the Brahamputra in Majuli — which is the world's largest river island.

Dr P.B. Gurung
Curator, Herbarium, Dept. of Botany, NEHU, Shillong - 793 022

P.K. Singh is an assistant professor of Botany at Manipur University, Imphal. As a physiologist he has worked on food valves of wild relatives of cultivated plants such as rice. Currently working on two projects: bamboo and rattans of Manipur and toxicological studies of poisonous plants of Manipur. His main topics of interest include ethnobotany especially wild food plants and biochemistry.

Ms. Farzana Begum
Researcher, Indo-US Primate Project, North-eastern Centre, C - 4 Ashiyana Complex, Maligaon - 781 011, Assam

P.B. Gurung is a taxonomist and curator of the herbarium in the Dept. of Botany, North-eastern Hill University (NEHU), Shillong. He studied the flora of Mokakchung district, Nagaland, for his Ph. D. He has also studied the orchids of Nagaland. His fields of interest are ethnobotany, rare and tribal medicinal plants.

Dr Arvind Saklani
Dept. of Botany, NBRI, Rana Pratap Marg, Lucknow 226 001

Farzana Begum has a postgraduate degree in anthropology and is now working as a research fellow on the Indo-US Primate Project. Her studies related to the primate project include the role of human interventions on the primate habitats and the role of cultural beliefs, useful or otherwise, for primate protection. Due to close interactions with communities in primate habitats, she also developed an interest in ethnobiology and man-animal interactions.

Dr K. Haridasan
Senior Scientist, SFRI,

Arvind Saklani is a taxonomist working in the taxonomy and biodiversity division of the National Botanical Research Institute,

Vanvihar, P.O. Box. 159, Tanagar 791 111, Arunachal Pradesh

Lucknow. He did research for a Ph. D. in the north-eastern states of India. His work on cross-cultural ethnobotany of various tribes in the Himalayan region still continues.

Dr S.K. Barik
Dept. of Ecology, North-eastern Hill University, Shillong, Meghalaya, India

K. Haridasan is a forest botanist with the State Forest Research Institute, Arunachal Pradesh, Tanagar. He has studied on the flora of the north-eastern region for the last two decades and published two volumes of the *Forest Flora of Meghalaya*. He has contributed immensely to the understanding of rare and endemic flora. He is an authority on the flora of Arunachal Pradesh and has many new records to his credit.

Dr Anungla Aier
Lecturer, Dept. of Anthropology, Kohima Science College, Jotsoma, Nagaland

Saroj Barik works with the Centre for Ecodevelopment of the North-eastern Hill University, Shillong. His research work has focussed on regeneration aspects of forest ecology. He is an expert on rehabilitation of degraded forest areas.

Mr Vengota Nakro
NEPED POU member, NEPED, P.O. Box 339, Kohima 791001, Nagaland

Anungla Aier has been teaching anthropology at Kohima Science College, Jotsoma, Nagaland for the last 10 years. She completed her Ph. D. in the ethnohistory of development of the Naga tribes and is especially interested in socioeconomic aspects responsible for acculturation.

Mr Qutovi Wotsa
NEPED POU member, NEPED, P.O. Box 339, Kohima 791001, Nagaland

Originally from the Dept. of Agriculture, State Government of Nagaland. Working at the project's operating unit as a member of NEPED. Mainly interested in traditional agroecosystems of various Naga tribes.

Mr. Kenneth M. Pala
Centre for Environment Education North East Regional Cell (CEE North-East). Chenikuthi, K.K. Bhatta Road, guwahati – 781 003
India

Kenneth Morrison Pala is a Programme Officer with CEE. He is a post graduate in anthropology from NEHU, Shillong, and has been working with CEE for the past four years. He has experience in helping to organize CEE's 8-month long training in environmental education (TEE) programme. he coordinated the BAIDIK (Biodiversity Awareness through Identification and Documentation of Indigeneous Knowledge) programme of CEE in the north-east. He also looks after the National Environmental Education programme in schools (NEEPS).

Dr Archana Godbole
Applied Environmental Research Foundation, Ganga Tara Apts., 917/7 Ganeshwadi, Pune 411004, India

Archana Godbole has a Ph. D. in Ethnobotany from Pune University and has been working as a project coordinator in the Applied Environmental Research Foundation for the last four years. She is involved actively in AERF research work in north-eastern India, especially in Nagaland and Arunachal Pradesh. She is working on developing a model for protection of sacred groves with people's participation in the Western Ghats.

Mr Ajay Rastogi
HKH Ethnobotany Project, MNR Div. ICIMOD, P.O. Box 3226, Kathmandu, Nepal

Ajay Rastogi coordinates the Regional HKH Ethnobotany Project, supported by UNESCO and based at ICIMOD, Kathmandu. Through his work he assists and provides guidance to ethnobotanical projects in Bhutan, Bangladesh, China, India, Nepal and Pakistan. He is involved actively in organizing national and subregional training workshops on applied ethnobotany.

Invited Contributions

1. **Overview of Research in Home Garden System**
   M. Millat-e-Mustafa
   Institute of Forestry and Environmental Sciences
   University of Chittagong
   Chittagong, Bangladesh

2. **An Approach towards Analysis of Home Garden**
   M. Millat-e-Mustafa
   Institute of Forestry and Environmental Sciences
   University of Chittagong
   Chittagong, Bangladesh

Annex 6
Evaluation of the Training Workshop

Dasarath Moktan
Training Officer, DITS, ICIMOD

Documentation, Information and Training Services (DITS)

DITS provides conceptual and logistical support in organizing the training programmes of the thematic divisions. One of the important tasks of DITS is to devise and implement effective systems for evaluating the usefulness and impact of ICIMOD training programmes. Evaluation of programmes is a continuous process adopted at the Centre. The feedback collected through the evaluation is considered a strong mechanism to make the programme effective and useful in order to achieve the stated objectives. At the end of the training session, in consultation with the programme coordinator, a questionnaire is administered, and the completed questionnaire is then analysed by the Training Officer. The findings are passed on to the concerned professional staff as well as others. The National Training Workshop organized in Kohima, Nagaland, was also evaluated and a summary of the feedback is provided below.

Evaluation

The evaluation aimed to have participants' feedback on the management of the workshop, its contents, and fulfilment of its objectives. Sixteen participants out of twenty-two provided us with valuable suggestions on the overall training programme.

Findings

1. Participants' feedback

- According to the feedback of the participants, the programme was successful. It was participatory and very interactive in terms of sharing experiences.
- Ninety-four per cent (94%) of the participants were given enough information regarding this training.
- Eighty-two per cent (82%) of the participants agreed that they were informed well ahead of time.
- Forty-seven per cent (47%) of the participants agreed that the training was 'very useful' and forty-seven per cent (47%) said the training was 'useful'.

2. Other common feedback

- Encourage more representation from local education institutes, e.g. Nagaland University, Science College, local people, etc.
- Brief lecture about field visit may be organized at the site or during field visits as this will provide instant practical understanding of related issues/aspects of the field study.
- Experts from the Tropical Botanical Garden and Research Institute (Trivandrum), Guwahati University and some local medicine practitioners should be invited to this kind of workshop.
- Avoid too many aspects, include only relevant subjects and use simple methods of delivering the knowledge.

- Participants repeatedly said that there was a need for improving the arrangements at the conference hall. If arrangements for the hall and equipment are made prior to the commencement of the programme, it will help the smooth running of the programme. They also suggested that necessary reading material should be made available to the participants in future.

3. Do you feel that enough notification was given to you regarding this training? Please tick (✔) the appropriate answer.

Response

Yes = 94 % No = Nil No response = 6 %

4. Did you receive the formal invitation and/or nomination sufficiently ahead of time?

Response

Yes = 81 % No = 6 % No response = 13 %

5. Would you be interested in participating in similar types of training courses in the future?

Response

Yes = 88 % No = 6 % No response = 6 %

6. Ethnobotany applied to conservation and development here was:

Response

Additional knowledge = 40 %
Additional knowledge and refresher knowledge = 18 %
Additional knowledge and relevant to my work = 6 %
Partly additional knowledge = Nil
Additional knowledge, refresher knowledge and relevant to my work = 12 %
Refresher knowledge = 6 %
Refresher knowledge and partly additional knowledge = 6 %
Not relevant to my work = Nil
Too theoretical = Nil
Relevant to my work = 12 %

7. How will you use what you have learned in this training course?

Response

In teaching/training = Nil
In teaching/training and in applied work = 12 %
In teaching/training, in applied work and research work = 24 %
In teaching/training and research work = 6 %
In research work = 24 %
No response = 34 %

8. In general, how useful have you found this trainers' training course in relation to your work?

Response

Very useful = 47 %
Useful = 47 %
Of little use = Nil
Not useful = Nil
No response = 6 %

9. Which subject or topic do you think will be most beneficial and relevant to you in your job? Please tick (4) the appropriate column.

Aspect of the workshop	Most relevant/ useful (%)	Relevant but less useful (%)	Not relevant/ of little use (%)	No response (%)
Home garden as the theme for the workshop	65	24	6	5
Development of methodological framework for ecological data collection	75	19	-	6
Development of a methodological framework for socio-economic data collection	81	12	-	7
Market survey exercise	81	12	-	6
Fallow management practice of *Angami* Nagas	88	6	-	6

10. How do you feel about the distribution of time among the different aspects of the training programme? Please tick (✓) the appropriate column.

Aspect	Too much (%)	Just right (%)	Too little (%)	No response (%)
Lectures	12	76	12	-
Discussions	18	64	18	-
Field trip	12	88	-	-
Field project work	6	63	31	-
Practical exercises	6	69	19	6

11. To what extent were your expectations met?

Responses

20% = Nil
40% to 60% = 6%
60% = 31%
80% = 45%
100% = 6%
No response = 12%

12. How did you find the following arrangements during the training course? Please tick (✔) the appropriate column.

Items	Excellent (%)	Good (%)	Needs improvement (%)	No response (%)
Conference hall	19	31	50	-
Display	12	38	50	-
Reading materials	25	37	38	-
Overhead projector	6	50	25	19
Food	31	44	-	25
Tea/coffee break	19	56	6	19
Accommodation	38	31	12	19
Transportation	56	25	-	19

13. Considering the contents of the training course, what is your impression about the duration of the training course?

Response

Just O.K. = 69%
Too short = 6%
Too long = 19%
No response = 6%

If too short or too long, what, in your opinion, would be the appropriate length?

Response

10-15 days = 12%
3 days = 12%
No response = 76%

14. Now that you are at the end of the training course, how did you find the overall training course?

Response

As expected = 88%
Too heavy = 12%
Too light = Nil
Too many lectures = Nil

ICIMOD

Founded out of widespread recognition of degradation of mountain environments and the increasing poverty of mountain communities, ICIMOD is concerned with the search for more effective development responses to promote the sustained well being of mountain people.

The Centre was established in 1983 and commenced professional activities in 1984. Though international in its concerns, ICIMOD focusses on the specific, complex, and practical problems of the Hindu Kush-Himalayan Region which covers all or part of eight Sovereign States.

ICIMOD serves as a multidisciplinary documentation centre on integrated mountain development; a focal point for the mobilisation, conduct, and coordination of applied and problem-solving research activities; a focal point for training on integrated mountain development, with special emphasis on the assessment of training needs and the development of relevant training materials based directly on field case studies; and a consultative centre providing expert services on mountain development and resource management.

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Workshop Reports are intended to represent the discussions and conclusions reached at the Workshop and do not necessarily reflect the views of ICIMOD or other participating institutions. Copies of the reports, as well as a Catalogue of all of ICIMOD's Publications, are available upon request from:

Documentation, Information, and Training Service (DITS)
International Centre for Integrated Mountain Development (ICIMOD)
G.P.O. Box 3226
Kathmandu, Nepal

Participating Countries of the Hindu Kush-Himalayan Region

 Afghanistan

 Bangladesh

 Bhutan

 China

 India

 Myanmar

 Nepal

 Pakistan

International Centre for Integrated Mountain Development

4/80 Jawalakhel, G.P.O. Box 3226, Kathmandu, Nepal

Telephone : *(977-1) 525313*
e-mail : *distri@icimod.org.np*

Facsimile : *(977-1) 524509, 536747*
Cable : *ICIMOD NEPAL*