The role of indigenous woody species in 'farmer-led' agricultural change in south east Nigeria, West Africa.

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ABSTRACT

This thesis examines the role of indigenous woody species in 'farmer-led' agricultural change in south east Nigeria. The study, carried out in parts of Cross River State and Akwa Ibom State, is set in the context of the recent trend among development professionals to stress the use of indigenous species and local knowledge in future development projects.

Emphasising throughout the use of both indigenous knowledge and indigenous woody species, as well as participatory research techniques, the study comprised three main stages.

The first stage was the selection of three study villages in different agroecological zones, one in a heavily forested area, one in a derived savanna area, and one in an area with little natural 'bush' remaining. Social surveys were carried out in the study villages to collect information concerning agricultural methods and problems, and the local use of woody species. The ethnobotanical results from this survey were documented and analysed, and the results were used in an examination of the impact of population density on the development of local natural resource management systems and indigenous agricultural innovation.

Secondly, four indigenous woody species were selected in conjunction with the local communities, namely: *Albizia zygia*, *Dialium guineense*, *Ricinodendron heudelotii* and *Uvaria chamae*. A botanical study, including germination and growth trials in Calabar and phenological observations in the field, was conducted in relation to these four species.

Finally, using the data collected during the social surveys, field trials and observations, an attempt was made to work with the villagers to develop ways in which some of the most pressing agricultural problems could be addressed using local knowledge and resources. As a result, a framework was developed for use in future rural development projects in the region, in an attempt to contribute to the current move by development professionals towards fuller community participation.

Key words: agroforestry, indigenous woody species, 'farmer-led' innovation, germination trials, phenology, *Albizia zygia*, *Dialium guineense*, *Ricinodendron heudelotii*, *Uvaria chamae*, community participation, south east Nigeria.

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LIST OF ACRONYMS AND ABBREVIATIONS USED

ADP	Agricultural Development Project
AFNETA	Alley Farming Network for Tropical Africa
AFRENA	Agroforestry Research Network for Africa
CATIE	Centro Agronomico Tropical de Investigacion y Enseñanza
CRADP	Cross River Agricultural Development Project
CRNP	Cross River National Park
CRSFP	Cross River State Forestry Project
D&D	Diagnosis and Design
DFRRI	Directorate of Foods, Roads and Rural Infrastructure
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GRP	Green Revolution Programme
HYV	High Yielding Variety
IADP	Integrated Agricultural Development Project
ICRAF	International Council for Research in Agroforestry
IIED	International Institute for Environment and Development
IITA	International Institute for Tropical Agriculture
IMF	International Monetary Fund
IRDP	Integrated Rural Development Project
IRRI	International Rice Research Institute
LGA	Local Government Area
MPTS	Multipurpose Trees and Shrubs
NGO	Non-governmental Organisation
NNMC	Nigerian Newspaper Manufacturing Company
NTFP	Non-timber Forest Product
ODA	Overseas Development Administration
OFN	Operation Feed the Nation
ODNRI	Overseas Development Natural Resources Institute
PAP	Projet Agropastoral de Nyabisindu
PRA	Participatory Rural Appraisal
RBDA	River Basin Development Authority
SAP	Structural Adjustment Programme
SECAP	Soil Erosion Control and Agroforestry Project
SMP	Strategic Management Plan
T&V	Training and Visit
WWF	World Wide Fund for Nature

CHAPTER 1

Agroforestry and sustainable rural development in the South.

1.1 Introduction

The aim of this chapter is to outline the way in which the study was carried out, and to present a summary of relevant rural development concepts, in order that the research is put into context. Initially, in **Section 1.2**, there is a brief description of the study location and methods, and what the study aimed to achieve. Following this (1.3) is a discussion of forestry, agricultural and agroforestry development in the South over the last twenty-five years, providing a background against which to set the study as a whole. In **Section 1.4**, concepts such as agroforestry, traditional extension methods and participatory development practices are introduced. Finally, in **Sections 1.5** and **1.6**, there is a summary of recent trends in rural development thinking and a discussion of how it is hoped this study, and the extension tool that is developed from it, will add to the rapidly expanding debate among development professionals in this field. The chapter ends with a description of the structure of the thesis in **Section 1.7**.

1.2 The aims of the study

In recent years there has been a growing appreciation of the appropriateness of indigenous methods of cultivation, selection of varieties, and knowledge of the local environment for agricultural research and development (Dixon, 1990; Haverkort *et al.*, 1991). During the past decade more professionals have begun to see the value of documenting the existing systems, and of working with and through the local systems to improve upon them (Warren *et al.*, 1995). As a continuation of this theme, the key aim of this study is to document some of the local ethnobotanical knowledge of woody species and, using this data, to examine the farm forestry, or agroforestry, potential of four tree species indigenous to south eastern Nigeria and used within the traditional farming systems of the area. The species studied in detail were selected in consultation with farmers for the development of more sustainable farming systems. Emphasis is placed not only on indigenous tree and shrub species, but also on the use of participatory research methods in order to utilise fully local knowledge and innovative ability. It is argued that the methods for agroforestry in general, and community-based agroforestry research in particular, should begin to constitute a radical departure from traditional agronomy, and even from many of the farming systems research methods that have become established in formal 'scientific' circles (Rocheleau *et al.*, 1989).

Questions, rather than hypotheses, were used to create the research framework because it was felt that this would allow the development of a more iterative approach, appropriate to the nature of this study with its use, as far as possible, of community-led research. An attempt is made to address the following questions:

i) Is there a need for the intensification of agriculture due to recent changes in land-use patterns and an increase in the farming population? Is this need perceived by the local people? Can the need be partly addressed by making use of indigenous tree species?

ii) Can farmers' existing knowledge about selected indigenous tree species make a significant contribution to the modification of farming systems?

iii) Is germination and early establishment of the selected species easy enough to enable their use at village level? Is germination of the selected species by farmers already taking place?

iv) Is it possible to develop a framework that can be used to guide an interactive development process between farmers and extension agents?

The two main villages were selected from different agro-ecological zones within the study area so that comparisons and contrasts could be made between farming methods and uses of indigenous multipurpose trees and shrubs (MPTS) found in both. Data concerning the use of woody species in farming systems in both areas were used in close consultation with farmers to select the four tree or shrub species to be studied in detail. Surveys were also conducted at local markets within the study area in order to gauge the occurrence and market value of some of the products from selected indigenous MPTS species and, for comparison, a survey was carried out in one village in a neighbouring State where the population density is higher than in Cross River State.

The examination of the four selected species, namely *Albizia zygia* (DC.) J.F.Macbr., *Dialium guineense* Willd., *Uvaria chamae* P.Beauv. and *Ricinodendron heudelotii* (Baill.) Heckel[1], involved: discussions with farmers from the study villages; phenological and growth observations of

[1]All taxa recieve their full namenclatural authority on their first appearance in the text, and in Appendix A.

selected trees in the field; germination and growth trials; and, participatory methods of developing appropriate farming systems incorporating the selected species.

The results from the surveys and germination and growth trials were then used in participatory meetings with local people to try and address some of the agricultural problems experienced in the region and outlined during the questionnaire surveys. In this final stage of the study a research framework appropriate for use by farmers and local forestry and agricultural officers within the study area was also developed. It is hoped that this framework, formulated specifically for south eastern Nigeria, can be used by current and future forestry and agricultural development and conservation projects in the region.

1.3 Technology development and transfer

For about the last fifty years, Western professionals and technology have been the basis of many development programmes in the South. This technology and personnel transfer has occurred in both the industrial and the agricultural sectors and largely comprises machinery, chemicals, financial resources and the provision of foreign 'experts', all of which aim to achieve rapid economic growth. Shaw (1987) states that this type of approach represents a quick technical solution to reducing the 'gap' between rich and poor countries.

From the mid-1970s, international aid programmes began to focus their attention on rural development rather than on urban-based industrial development (Richards, 1985) with a focus on the problem of feeding rapidly increasing populations (Conway & Barbier, 1990). These projects were aimed at small farmers, in the form of 'biological packages', which attempted to introduce sedentary, intensive farming systems so that farmers were able to get higher yields with reduced or no fallow periods. This was to be achieved by developing High Yielding Varieties (HYVs) and early ripening strains of many staple crops including rice, maize and cassava. In order for these crops to thrive on the same land area over many seasons, careful management and large quantities of chemical fertilizers and pesticides are required. In other cases the introduction of an exotic crop took place, a successful example of this being soybean which is now cultivated in nine African countries (Shannon & Kalala, 1994). The projects, known as Integrated Agricultural (or Rural) Development Projects (IADPs or IRDPs), generally supply farmers of small plots with seed or seedlings, fertilizer, credit to purchase the input package and extension advice. Many IRDPs also attempt to solve some of the basic infrastructure and welfare constraints in the areas concerned (Richards, 1985).

In 1960, the International Rice Research Institute (IRRI) was set up at Los Banos in the Philippines (Glaeser, 1987). The first release of HYV rice, IR 8, took place in 1966 and yields of up to 6,400 kg ha^{-1} were obtained under ideal conditions at a time when the Philippine average was 1,300 kg ha^{-1}. The success of the newly developed strains appeared limitless and by 1970 Pakistan ceased to be dependent on wheat imports from the United States, while other countries, such as Sri Lanka and the Philippines, achieved record harvests. Yields of HYVs of rice in India over the decade between 1968-78 averaged about twice that of non-HYVs (Dalrymple, 1986). In western Kenya, the Kitale hybrids of maize were adopted by a large proportion of farmers in two out of three districts (Bates & Lofchie, 1980). Per capita food production in the South has risen by 7% since the mid 1960s, with an increase of over 27% in Asia and only in Africa has there been a decline (Conway & Barbier, 1990).

The initial success of the HYV strains soon encountered problems, such as little disease resistance, sensitivity to environmental and water conditions, and poor protein content in the grain (Dalrymple, 1986), and received criticism due to the reliance on chemical inputs and reliable irrigation systems (Egger & Glaeser, 1984). The introduction and use of HYVs also suffered from problems of equity. For example, resowing of rice from the harvested grain resulted in a rapid loss of HYV qualities, and therefore the possibility of participation by subsistence farmers in the 'Green Revolution' was limited (Dixon, 1990). Although progress was made and overall food production was increased in some areas, this did not seem to be able to solve, or even keep pace with, the enormous environmental problems facing the planet (Leakey, 1994). Difficulties were encountered in several areas with the introduction, and adoption, of high yielding staples. In Ghana, for example, a survey conducted in 1988 discovered that although ten different strains of HYVs of cassava had been developed by IITA and introduced to the area, farmers were returning to local varieties after one or two seasons due to the palatability and cooking problems encountered with the new types (IITA conference, Cape Coast, Ghana, 1989). In south western Nigeria adoption rates of improved cassava varieties were extremely variable, and this has been partially explained by Polson and Spencer (1991) as being due to socio-economic and demographic factors not accounted for during extension programmes.

Atte (1989) states that conditions of rural people have often worsened as alien rural development strategies imported from the North have failed to fit into the local environment. World Bank African livestock projects reviewed in 1985 had negative economic returns averaging minus 2%, against an average gain of 11% for the regions not involved in the projects (Harrison, 1987). Conway and Barbier (1990) point to growing evidence of diminishing returns from intensive production with HYVs. Where technologies have been imposed and have failed to improve the situation of the rural people, it has become evident that introduced farming methods are often neither economically nor ecologically sustainable and are therefore only a short-term answer to the problem of sustainable agricultural production. Particularly in agriculture, the combination of massive external inputs of costly fertilizers, herbicides, fungicides and pesticides has not only been unable to maintain adequate production levels, but has created an alarming situation of near-bankruptcy and pollution in both the economic and ecological sectors of developing countries (Slikkerveer, 1995). Fujisaka (1994) states that six reasons why farmers in south east Asia do not adopt innovations intended to improve the sustainability of upland agriculture are that the innovation addresses the wrong problem; farmer practice is equal to or better than the innovation; the innovation does not work; extension fails; the innovation is too costly; and social factors, such as insecure tenure of land. In contrast, the failure of many such projects has, in the past, frequently been blamed on the farmers themselves who have come to be known as 'conservative' and 'unwilling' to adopt new techniques, seeds, fertilizers and pesticides. In an example from Peru, where farmers were given a much higher yielding maize than the local variety, after good uptake of the seed in the first year, farmers went back to planting lower yielding local varieties in following years. When the farmers were asked why this had occurred it was pointed out that, although there were eleven traditional ways of cooking maize in the area, there was not one method suitable for the new variety which was very hard (Atte, pers.com., 1993). In many cases, crops have vital secondary functions which are ignored during HYV development. Timberlake (1988) gives an example from Ethiopia where peasants were offered a sorghum which matured in three months, but they would not plant it. In the highlands, farmers use sorghum stalks as a roofing material, and both the leaves and stalks as fodder for livestock. The fast-growing sorghum did not have the right kind of stalks and leaves.

The high frequency of introduction of inappropriate agricultural packages (Osborn, 1995) can be argued to be largely due to the research and development being controlled almost entirely by outsiders. Haverkort *et al*. (1991) argue that in many cases, agencies which were established to support agricultural technology development have tried to take this activity away from the local people and reduce farmers to simple adopters of technologies developed by others. Local people were rarely asked to define their problems, and little attempt was made to discover how the indigenes themselves were trying to alleviate these problems.

> "...the rural people are objects to be studied, not consulted. They are targets for the outsiders' ideas and initiatives; persons to be manipulated in accordance with their benefactors' views of what is best for them, not what is best to themselves."
>
> (Hatch, 1976:6)

In 1986, Chambers suggested that this problem is caused by the dominance of what he terms 'normal professionalism', where the thinking, values, methods, and behaviour in a profession or discipline are stable or conservative. This is linked with core-periphery structures of power and knowledge, reproduced through teaching and defended by specialisation. The maintenance of this structure is evident in the Training and Visit

System, pioneered in the 1970s by the World Bank (Adams, 1982), and adopted by the agricultural extension departments of many developing countries. In this system, extension agents receive fortnightly training in which they are taught a new technique or idea to extend to the farmers in the following two weeks. Decisions about what skills are taught are generally taken by senior officials, and extension agents merely act as a link in the chain moving ideas from the top to the villages, rather than responding to farmers' problems. The traits common to such development initiatives were described by Hatch (1976:7):

> "The development profession suffers from an entrenched superiority complex with respect to the small scale farmer. We believe that our modern technology is infinitely superior to his. We conduct our research and assistance efforts as if we know everything and our clients nothing."

In contrast Chambers describes 'new professionalism' as reversing the values, research methods, roles and power relations of 'normal' professionalism. It uses the 'last-first' paradigm which includes learning from the poor, decentralisation, empowerment, local initiative and diversity. The contrasts between 'normal' and 'new' professionalism are outlined in Table 1.1.

Although it is an integral part of human-environment interaction, much writing on sustainable development is curiously devoid of politics (Bryant, 1991). Chambers (1991) has attempted in part to address this shortfall by emphasising the dominance of the elite in the 'normal' professional structure of government and development agencies, and the simplified 'broad brush' approaches which generally emerge from them. Just because a state or agency has access to facts and is overtly sensitive to development and ecological issues, it does not automatically follow that its development policies and programmes will act to make best use of the information (Bryant, 1991), especially if such actions threaten the *status quo* of its wider, often self-preservationist, policies. Thus, until it is the rural people themselves who are able to devise and implement their own development projects, within a framework of 'new' professionalism, the level of success of such projects is unlikely to improve.

Table 1.1 Preferred research approaches and methods (After Chambers, 1986).

	Normal, core or first	**New, peripheral or last**
basic logic	reductionist	holistic
learning mode	data collection 'objective' analysis	gaining experience 'subjective' judgement
information accepted and admitted	'hard', quantified, precise, visible	'soft', qualitative, imprecise, invisible
methods used	precise measurement, formal surveys, formal questionnaires	visual assessment, RRAs, semi-structured interviews
experimental conditions	few variables controlled laboratory conditions, holding much constant	many variables uncontrolled, real conditions allowing much to vary
location	on-station, in-laboratory, in-office	in field
priorities determined by	professionals	user-clients
evaluation by	peers, research sponsors	user-clients

Development processes initiated by external agencies often stagnate or even collapse after the departure of the extension agent. It is therefore important that emphasis is placed, not on technology transfer, but on guaranteeing a level of skill in the target group which will be able to identify problems in the future and find appropriate solutions (Ho, 1992). Rhoades (1988) argues that agricultural researchers should not reject previous research and development methods with the advent of new ones, but should use the past experience to gain a deeper understanding and more comprehensive view of agricultural research as a whole, enabling them to develop approaches appropriate to each socio-economic and environmental situation.

1.4 Agroforestry

Attempts to define and give meaning to the concept of agroforestry started between 1977 and 1979, and Combe and Budowski (1979) noted the importance of the inclusion of the tree element in any definition. This was assumed, in many cases, to be timber, or some other forestry use, but later the term 'woody perennial' was introduced by Lundgren and Raintree (1982) to remedy this. Sombarriba (1992) presents an analysis of many of the other definitions of agroforestry that have been attempted (King, 1979; Huxley, 1983; Nair, 1985). A common definition of agroforestry, now widely accepted and used by the International Council for Research in Agroforestry (ICRAF) in Kenya, is:

> "Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components."
>
> (Lundgren & Raintree, 1982:39)

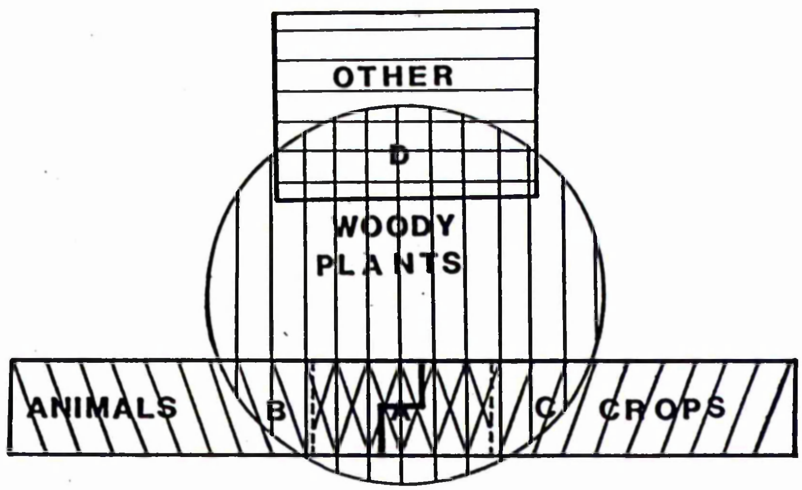
Agroforestry, therefore, uses woody perennials within farming systems to enable them to be more productive and sustainable. Ecological sustainability is achieved by a carefully planned rotation of crops and the use of foliage from the trees or shrubs as mulch and green manure. The mulch helps to retain soil moisture and prevent soil erosion, and the green manure aims to add humus and nutrients to the soil. Nitrogen-fixing trees or crops, which are able to fix atmospheric nitrogen and make it available for use by plants, can also be used within the system. Economic sustainability is achieved due to the reduced need for expensive chemical inputs once the agroforestry system is established. The trees or shrubs in an agroforestry system can also be present for other reasons such as the production of fruit or fuelwood, or to provide shade for grazing animals. Agroforestry is therefore a range of options and the selection of a particular set of options reflects a range of reasons for adopting or developing the systems.

In his discussion of 'normal' and 'new' professionalism, Chambers (1986) uses agroforestry as an example of a discipline which can fit into the new professional outlook. Agroforestry is a major component in the farming systems of hundreds of millions of poor farmers, but which the normal professions find difficult to include in any single discipline. Professional forestry is concerned with trees in forests, agricultural sciences with crops, and animal sciences with animals. In most countries forestry and agriculture are still housed in separate ministries or departments, which naturally creates barriers to communication and co-operation (Budleman, 1991). Agroforestry is often seen as a low status activity, the responsibility of a junior forester isolated in a Ministry of Agriculture, or of a junior agricultural scientist in a Ministry of Forests, or of no one at all (Chambers, 1986). In the Annual Reports of the Cross River State Forestry Division from 1988 - 1992, for example, there is no mention made of *any* agroforestry activities.

1.4.1 Development of agroforestry

The low professional status of agroforestry was indeed the case in 1986, but it can now be argued that the discipline is steadily taking on all the traits of 'normal' professionalism with the development of research centres, common methodologies and techniques, the use of a few exotic tree species and the acceptance of agroforestry as a science in its own right. Work began on formal, institutionalised agroforestry development in the late 1970s, and research centres were set up in many regions of the world. In Nairobi, Kenya, ICRAF was established and much of the early scientific research into agroforestry systems took place there. Agroforestry research programmes were also initiated at Centro Agronomico Tropical de Investigacion y Enseñanza (CATIE) in Costa Rica and at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. Various systems were developed using a number of mainly exotic tree and shrub species. The most common of these was alley farming, where the woody components, known as multi-purpose trees and shrubs (MPTS), are grown in the form of hedges, and crops are planted in the alleys formed between the hedges. The prunings from the hedges are used as mulch/green manure and in some cases also provide small-sized fuelwood and some fodder. The origin and concept of alley cropping are described by Kang and Wilson (1987). Examples of MPTS species used in the development of these systems are *Cajanus cajan* (L.) Millsp., *Gliricidia sepium* (Jacq.) Walp., *Leucaena leucocephala* (Lam.) De Wit, and *Sesbania grandiflora* (L.) Pers. (Rachie, 1983; Ngambeki, 1985 and

Duguma *et al.*, 1988; Palada *et al.*, 1992; Karim *et al.*, 1993; Larbi *et al.*, 1993).



A - Agrosilvopastoral systems

B - Silvopastoral systems

C - Agrisilvicultural systems

D - Other agroforestry systems

Figure 1.1 The combinations of different components which are the basis of the classification of agroforestry systems.

Other types of agroforestry system were also developed which emphasise different aspects of production and use different components and management techniques. The various agroforestry systems can be separated into groups entitled agrosilvopastoral systems, silvopastoral systems, agrisilvicultural systems, and others, such as the combination of aquaculture with MPTS. The distribution of components within these groups of agroforestry systems is shown in Figure 1.1. Each of these groups have the same components in common within the group, but there are many different management systems and crop/MPTS/livestock combinations which form specific examples of each type of system.

Agrosilvopastoral systems are those in which MPTS, crops and livestock are combined. Often in these systems the MPTS and crops are grown together on the same land area and the livestock are kept in pens or stalls and fed with fodder from the hedgerows or boundaries in a 'cut and carry' system (Jabbar *et al.*, 1992). The livestock may also be let into the field after the crops have been harvested to graze on the crop residues and fertilize the soil with their manure as shown in a system developed for Amazonian small farmers (Loker, 1994).

Silvopastoral systems combine MPTS and livestock in the same land management unit. This is often achieved by growing trees which produce a crop such as coconuts (*Cocos nucifera* L.) or oil palm kernels (*Elaeis guineensis* Jacq.), while grazing livestock underneath or between them. In Brazil work has been carried out which indicates that grazing cattle and sheep in eucalypt plantations can help control grass competition and reduce stand establishment costs without affecting eucalypt survival and growth (Couto *et al.*, 1994). Another example of silvopastoralism is the production of fuelwood by growing trees on rangeland or pasture areas.

Agrisilvicultural systems combine MPTS and crops. The most common, and therefore the most highly developed example, is alley cropping as described above and many examples exist (eg. Ruhigwa *et al.*, 1994; Schroth *et al.*, 1995). However, MPTS can be combined with crops in other ways, as when planted as a boundary, which also produces mulch, green manure and/or fruit, or when planted within the field at random for shade or for use as yam stakes during cultivation, and/or to act as soil improvers during the fallow period (eg. Drechsel *et al.*, 1991).

One system of combining crops and trees is carried out by many forestry departments is **taungya**. This term was initially used to describe a system of slash and burn cultivation carried out by the hill peoples of Burma. However in the 1860's a forester called Brandis devised a modified version of **taungya** in order to advance the development of teak (*Tectona grandis* L.*f.*) plantations in the region. The procedure involved raising an arable crop on a cleared area for two years, and, in the third year, crop and teak seeds or seedlings were sown together. The arable crops were cut and removed on ripening, leaving a plantation of teak seedlings (Stebbing, 1923). Much of the initial work for this system of plantation establishment is carried out by farmers who clear the land and tend the tree seedlings in their first year, in return for access to the land on which to grow their own crops.

Kiriinya (1994) argues that **taungya** systems can produce food which will help increase national food production, and Hofstad (1978) has calculated that this system is more profitable than forestry alone. This can be true under properly managed conditions, temporarily solving the problem of access to agricultural land for some farmers, but, in areas where low levels of staffing and/or funding have meant that **taungya** programmes are not properly monitored, they can, in contrast, be a cause of land degradation (Kiriinya, 1994). For example in Cross River State, Nigeria, large areas of Forest Reserve have been given over to **taungya**, using *Gmelina arborea* Roxb., which has largely failed to achieve its objective of reforesting degraded land, and has not alleviated the pressure for farmland in the area (Dunn *et al.*, 1996). Although it can be argued that **taungya** is not a sustainable farming system, as the land is taken out of agricultural production once the tree canopy has closed (King, 1989), forestry departments often cite it in reports as an *agroforestry* activity. Odunlami (1991) describes the agroforestry component of the Ondo State Afforestation project as 'farming for pay' and 'own your own crop' systems. Both of these involve the intercropping of maize and/or cassava with *G. arborea*, in other words **taungya**, in which the planned end product is a timber plantation.

Other agroforestry systems include silvoaquaculture, or the combination of fish, ponds, trees and farms (Wouters, 1994), and there are many examples of this throughout the South (Lightfoot, 1991; Zou & Sanford, 1990; D'Silva & Maughan, 1994). Traditional tree crops such as cocoa and coffee are also combined with other trees; for example oil palm trees have been underplanted with cocoa in Ghana (Amoah *et al.*, 1995) and in Côte d'Ivoire forty-one different tree species are used as shade in cocoa and coffee farms (Herzog, 1994).

With the development of the science of agroforestry, research programmes have become more formalized, following established patterns, using a few, well tested MPTS and with much collection of intricate data. In some cases, for example the examination of the value of particular chemicals found in leaf matter for manure or fodder, or the production of models (eg. Barnes, 1995; Jackson *et al.*, 1995), such information may be applicable to many species. However, in other instances more limited data which can only be used for one or a few species in one area or soil type is produced (eg. Kerkhof, 1987; Mureithi *et al.*, 1995). In 1986 the Alley Farming Network for Tropical Africa (AFNETA) was established, a further specialisation within agroforestry indicative of the shift towards 'normal' professionalism. Although recently there have been moves to emphasise research on indigenous tree and shrub species, such as at the IITA research station in Onne and recent programmes by ICRAF (ICRAF, 1994), agroforestry trials are generally still very formalised and are carried out at research stations, and even if they are carried out on-farm are planned and implemented by scientists, rather than in farmers' fields, by local people (see 7.4.1). Kang (1993) reviews the past achievements of alley farming, and although many of its limitations are outlined, he still concludes by emphasising (what he perceives as) a need for more detailed 'scientific' research into certain aspects of the technology - ie. greater specialisation typical of normal professionalism. Owino (1992) discusses the improvement of multipurpose tree and shrub species by selection and breeding, work which once again can only be carried out on a few 'high priority' species. This is of use in areas where, for example, demand is high for particular fruit tree species and the development of earlier fruiting varieties can be advantageous. However, it also introduces the possibility of the reduction of species diversity in an area, and thus a potential lowering in market value and an higher economic impact of damage from pests and diseases. Some other examples of the type of agroforestry research currently carried out at ICRAF, IITA and other such establishments are:

i) An examination of the root distribution of *Acioa barteri* Engl. (*Dactyladenia barteri*), *Alchornea cordifolia* Schum. & Thonn., *Cassia siamea* Lam. and *Gmelina arborea* (the last two of which are exotics) in alley farming at Onne Research Station (IITA) in southern Nigeria (Ruhigwa *et al.*, 1992);

ii) An investigation of the optimum fodder/mulch allocation of tree foliage under alley farming in southwest Nigeria using *Leucaena leucocephala* and *Gliricidia sepium* (both exotic) (Jabbar *et al.*, 1992);
iii) Nitrogen contribution by *L. leucocephala* in alley cropping (Mulongoy & Sanginga, 1990).

Many of the agroforestry systems have achieved excellent results on research farms, and agroforestry has been viewed by many as the solution to the world farming problem. However, as with other 'normal' professions, much of this agroforestry research has failed to take account of farmers needs and wants, or to use the vast store of indigenous knowledge in the development of localised, appropriate agroforestry systems. Although the ICRAF approach to agroforestry systems research states that its basic objective is to develop technologies and solve farmers' problems in priority land- use systems in specific ecozones (Avila & Scott, 1989), it appears that the farmer is seen very much as a passive partner in the whole process. In the past, little or no consultation with farmers has taken place, or at least not until the research project is nearing completion (Dunn, 1990; Shepherd *et al.*, 1994). Once these highly developed systems began to be introduced to farmers by extension agents, their inappropriateness soon became apparent and problems arose. Many of the agroforestry systems developed at research centres required complicated management techniques, the use of exotic MPTS, and in some cases the use of HYV and fast ripening strains of crops and/or chemical inputs (Palada *et al.*, 1992; Szott & Kass, 1993; Evensen *et al.*, 1995). The rate of adoption of agroforestry techniques was very low in some areas, or farmers adopted them and then soon returned to old farming methods. Ong (1994) and Lal (1991) examine alley farming research and conclude that researchers have probably overestimated the capacity of the technology to increase crop yield. Such problems are not unique to alley cropping experimentation and are probably common to all agroforestry technologies (Coe, 1994).

Two examples from Africa of agroforestry projects with limited success are described by Kerkhof (1990). In Rwanda, the Projet Agropastoral de Nyabisindu (PAP) has been attempting to promote improved agricultural methods over the past twenty years. Leguminous shrubs have been emphasised from the outset for soil improvement, but farmers are still rejecting these in favour of planting *Grevillia robusta* Cunn. for timber production. Although PAP has helped to increase tree growing in the project area, it is felt that project staff have been rather inflexible regarding the species they are emphasising and more impact could have been made if greater note was taken of farmers' wishes. The Soil Erosion Control and Agroforestry Project (SECAP) in Tanzania has had only limited success. Many factors can be said to account for this including: emphasis by project staff on exotic tree species (*Leucaena leucocephala* and *Calliandra calothyrsus* Meissn.) which do not grow well in the region; the development of a labour intensive management system (contour planting and stall feeding of livestock); and little or no account taken of indigenous species which are locally known for soil improvement (eg. *Albizia schimperiana* Oliv.) and which farmers will plant if they can obtain seedlings. Research has been almost entirely separate from the project and little account has been taken of local knowledge before introducing inappropriate agroforestry packages.

In an agroforestry programme in south east Nigeria, researchers found that the 'limited success' of two systems of browse tree cultivation, alley farming and intensive feed gardens, was largely due to the absence of farmer participation early in the research process (Francis & Atta-Krah, 1989). There was little diffusion of the technology beyond the original participants as most farmers were unable to adopt and utilise the technologies being promoted, even though based on 'perceived needs'. Very often socio-economic conditions are not taken into consideration when developing agroforestry systems even though studies have shown that these are important in determining the level of uptake of the new systems. For example, Careness and Kurtz (1993) have identified land ownership and labour availability as the two most significant factors which contribute to agroforestry adoption in Senegal. Many of the possible reasons for the low adoption rates of newly developed agroforestry systems were discussed in detail in 1.3 and in Atta-Krah (1991).

1.4.2 Agroforestry and extension

> "The history of formal-sector interventions in West Africa is that many have proved to be irrelevant or harmful, even when aimed directly at small-holders, because of a failure to assess local interests in advance."
>
> (Richards, 1985:14)

The problem of the inappropriateness of agroforestry research, and therefore the development of the techniques being offered in many agricultural projects, became evident to the author during work in Sri Lanka and Ghana from 1987 to 1990. In both cases, agroforestry has been taken on by forestry and agriculture departments with great enthusiasm, but with little or no prior knowledge or experience on the part of their officials and no discussion with the communities towards which such projects are directed. This has led to a number of mistakes being made, which have in turn given low success rates in the introduction of agroforestry systems.

In many cases exotic MPTS species are used on demonstration farms, and in areas where they do not thrive, farmers may come to the conclusion that agroforestry is not the answer. This is happening in parts of Ghana, where demonstration plots using *Leucaena leucocephala* have been established by the Agroforestry Unit of the Department of Agriculture in areas with unsuitable soils and climatic conditions. As a result all that the plots are demonstrating is the poor performance of this exotic MPTS species in these areas. The type of management system to be demonstrated is also often carelessly selected, and in many districts in Ghana the only type of agroforestry to be shown is alley farming. Farmers are therefore led to believe that this alone is 'agroforestry', as extension agents place no value on any indigenous systems that have developed locally, and farmers have decided that it is not an appropriate solution to their agricultural problems. In Sri Lanka, many of the agroforestry demonstration plots set up by the Forestry Department show the **taungya** system as described in 1.4.1.

In both Ghana and Sri Lanka, the agroforestry programmes have generally been run in the spirit of 'normal' professionalism. Exotic MPTS tested on research stations (often in different countries) by (often foreign) scientists are selected by outsiders as the solution to a local farming problem, and only later when the project is established, are local people's requests and knowledge gradually taken into account. The same is true in eastern and southern Africa where most existing agroforestry programmes suffer from an imbalance of technical and social expertise, and from a lack of accountability to their rural clients (Rocheleau, 1987).

The high frequency of use of exotic woody species in agroforestry development has caused concern to be voiced in some circles. Hughes and Styles (1987) point out the costs of introducing exotic species, the main problem being the severe weediness which has occurred in some areas due to the aggressive combination of the early flowering, successful seed dispersal and seed longevity exhibited by many of these species, all necessitating expensive control programmes. Hawthorne (1995) gives an example of *Azadirachta indica* A.Juss. rampant on Ghana's coastal plain, initially a desirable species, but one which has now become an ecological problem.

Although it can be argued that in the past the emphasis put on exotic MPTS in agroforestry development has been too great, there are cases in which the use of these species is appropriate. Where farmland has become so degraded that it will no longer support indigenous tree species, examples exist where exotic MPTS have been used as an emergency measure to bind the soil together and begin to establish a litter and humus layer, thus revitalising the soil enough to plant crops. Saline irrigation land, for example, can be reclaimed by planting salt-tolerant trees such as eucalyptus, *Prosopis juliflora* (Swartz) DC (Singh, 1995), or *Acacia niolotica* (L.)Willd. (Harrison, 1987). These species reduce waterlogging and open up the soil so that salts can be leached down from the surface, making it possible for the land to support crops and indigenous tree species once more. Holden and Joseph (1991) found during research in Zambia where farmers were unwilling to use an indigenous, nitrogen-fixing species, *Sesbania macrantha* Welw. ex Phill.& Hutch., that working with indigenous species is not always easier than working with exotics, and depends very much on the role the species play in the culture. However these cases should not be used as an excuse to ignore the agroforestry potential of indigenous MPTS species (Dunn, 1990) or the innovative ability of local farmers.

1.5 Indigenous agroforestry

Although agroforestry has only recently been recognised as a 'science', it has been practised in many parts of the tropics for thousands of years. Farmers, who have a good knowledge of local crop and tree species, soil and climatic conditions and labour availability, have been able to develop efficient and sustainable farming systems appropriate to their own agro-ecological situations. This has tended to occur most where there has been a long established scarcity of farm land that has developed over time, allowing the innovations to be made gradually. Some of the most highly developed home garden or compound farm systems, for example, are found in Java (Michon, 1983; de Foresta & Michon, 1994; de Foresta *et al.*, 1994) and in parts of south eastern Nigeria (Okafor & Fernandes, 1987), where pressure for farmland has long been in existence. In other areas, local people grow seedlings or protect 'wildings' of favoured species for transplanting onto their compounds or farms (Kerkhof, 1990). In Bamileke country, western Cameroon, farmers combine a wide range of woody species with food crops in highly productive agricultural systems, using the practice of pole cutting for plantation tree and hedge management (Gautier, 1995). Rusten and Gold (1995) state that to divorce the concept of agroforestry from its indigenous roots is to underplay unfairly its historical significance as the precursor to modern agroforestry, the goodness of fit which often obtains between indigenous agroforestries and their environments, and the potential contribution of indigenous agroforestry in terms of part, or even whole, models of agroforestry systems. Alcorn (1995) suggests that traditional agroforestry systems differ from the simple modern forms in a number of ways:

a) they integrate native species;
b) they make use of 'natural' environmental variation;
c) 'natural' forest regeneration processes are used as management tools;
d) a large number of species are included in each system;
e) agroforestry plots are integrated into a diversified farmland; and,
f) there is variation among farms using the same basic system.

Farmers also have detailed knowledge of related environmental conditions (Binns, 1994). In Yoruba areas of Nigeria, local people have different names for different types of slopes, soil types, valleys, hills and rocks - producing an array of twenty-seven different categories (Atte, 1989). Adoption of HYV varieties of rice in Malaysia during the 1960's and 1970's was very low and subsequent research showed that selections of HYVs by scientists were based on one or two characteristics: yield and photo-period sensitivity. In contrast, farmers select the most appropriate rice types from local varieties using a much wider range of criteria such as resistance to flood, drought and disease; the quality of grain; ease of harvesting and threshing; length of growing season; and yield (Dixon, 1990), and a deeper knowledge of local socio-economic and environmental conditions. Detailed descriptions of some indigenous Nigerian agroforestry systems are found in Chapter 2.

It is pertinent at this point to consider why, if all this indigenous knowledge exists, there is a need at all for outside intervention to help farmers to develop improved farming systems. It may be argued that in areas such as Cross River State in south eastern Nigeria, which have recently become more accessible to immigrants (see 7.2.1), human-induced changes to the ecology of the area are taking place too fast for the gradual process of experimentation and innovation to be effective in time to halt large-scale soil degradation. Boserup's theory of agricultural change (Boserup, 1965) suggests that farmers are only likely to innovate if they are under pressure to do so when population growth undermines the basis of subsistence. Any intervention which does take place should therefore aim only to speed up the process by which farming systems are modified. Farmers are more likely to take the risks inherent in adopting new farming technologies if land is in short supply and there is pressure to increase output per unit area (Rigg, 1989). Often reactions to the increase in pressure for land only occur once serious soil degradation has taken place. Development interventions should thus aim to reduce reaction times to changing environmental and socio-economic conditions so that innovations can be developed before the available farmland requires a period of intensive rehabilitation rather than a more simple modification of existing agricultural systems.

Neither modern agriculture, with its cost implications, high energy demand and occasional environmental disregard, nor indigenous traditional agriculture, with its low yields are exactly what will be needed and desired by farmers of small plots (Phillips & Titilola, 1995). Above all, therefore, agroforestry systems should be developed locally, building upon farming and forestry systems which already exist, but where necessary, making use of data that has been gained through more formal scientific research and development programmes. Shaw (1987:14) summarises the need for the development of appropriate agricultural interventions as follows:

> "The technology must be desired by the farmers, should be superior in most respects to ones which they have long been accustomed, should be compatible with present life style, and in harmony with the local physical environment. These are obviously multiple and competing objectives which have to be assessed in the context of the local farm economy."

Many of the points covered in this section are illustrated well by Harrison (1987) who highlights a number of development projects in Africa which have been successful largely due to local participation in project planning and implementation leading to a high acceptance rate of the technologies and systems.

1.6 Moves towards indigenous participation

In many cases, outside, 'normal professional' attitudes (ie. "what farmers know is of no value to others") have been widely accepted by rural residents (Alcorn, 1995). The author has often heard an apology during interviews as the respondent "...only knows the local name" of a woody species being discussed, and the value of the indigenous botanical knowledge, noted by Irvine as early as 1952, is often not acknowledged. Cabrera and Murillo (1995:70) state that:

> "There can be no true participatory process unless there is recognition within the community itself, that their own folk wisdom is necessary and valid; and unless there are mechanisms that will rediscover, promote and exchange this lore among themselves, first of all."

Participatory research and development projects may begin to redress the balance a little and give local people back pride in their indigenous technical knowledge and farming systems as part of an empowering process.

Work towards developing more appropriate and locally adapted agroforestry systems has already taken place in some areas as scientists have come to realise the value of local knowledge and indigenous MPTS species (Leakey, 1994) and of focusing on data with a local perspective (Madge, 1995). In south eastern Nigeria, Okafor *et al.* have carried out studies on the phenology and traditional uses of many indigenous MPTS species such as *Dacryodes edulis* (G.Don) H.J.Lam., *Irvingia gabonensis* (O'Rorke) Baill., *Treculia africana* Decne., *Pentaclethara macrophylla* Benth. and *Tetrapleura tetraptera* (Schum. & Thonn) Taub. (Okafor 1990, Ejiofor *et al.*, 1987 & 1988; Onyekwelu, 1990). The studies have looked at propagation and budding techniques for these species, examining alternative uses for their fruits and other tree products, and promoting the use of these species in the development of improved farming systems. Workman (1986) carried out trials in Burkina Faso to examine the nodulation potential of some indigenous tree species with and without the inoculation of *Rhizobium*, and Wester & Hogberg (1989) in Guinea-Bissau have examined nodulation in seven indigenous West African tree species.

However, although more research into indigenous MPTS has begun in recent years, there is still a great need for genuine participation on the part of the farmers, from the planning stage of projects through to implementation and evaluation. This has been partially addressed in some cases by ICRAF in Kenya, who have started recently to improve *I. gabonensis* according to farmers' preferences and who are attempting to produce a shorter tree which fruits for a longer period of the year

(ICRAF, 1994). However, in a study carried out by the International Institute for Environment and Development (IIED, 1989) of eighteen 'grassroots participation' projects in the Sahel, only three of the projects had any local participation in the project identification stage and only one involved the 'grassroots' at the monitoring and evaluation phase. In most cases, a compartmentalization of participation took place so that grassroots participation is only solicited at the execution stage of the projects and the project is still planned and controlled by outside experts.

During the period that this study was executed, a number of professionals and researchers have published volumes which examine the problems of utilising local participation, farmer knowledge and indigenous experimentation (eg. Scoones & Thompson, 1994; Neilson, 1994; Biggs, 1995; Warren *et al.*, 1995). However, many of the approaches for addressing the complex situations which arise from genuine indigenous involvement are yet to be practised in the field.

1.7 Structure of the thesis

The arguments and ideas introduced in this chapter are expanded and discussed throughout the thesis. **Chapters** 1 and 2 aim to provide a clear theoretical and geographical background to the study, explaining why the field of research was selected and describing the environment in which the field work took place. **Chapter 3** comprises a discussion of the choice of field research methods, details of the socio-economic and biological surveys carried out, and a description of the three study villages selected. **Chapters 4, 5** and **6** describe and analyse the results from the socio-economic surveys, the biological studies and the participatory meetings respectively. **Chapter 7** attempts to address the questions which are posed in **Section 1.2** of this chapter, and to provide a wider discussion of changing paradigms in agricultural and forestry research and extension, and a description of current extension programmes in Cross River State. **Chapter 8** is in two parts, the first of which is a summary of the theoretical arguments of the thesis, and a discussion of the conclusions that can be drawn. The final part is the presentation of an applied use of the research in the form of a framework for extension agents in the region.

1.8 Conclusions

The main points to be noted from this introductory chapter are as follows:

- The study arose from the author's observations of agroforestry projects in Ghana and Sri Lanka and their apparent lack of success at meeting local farmers' needs.

- The study aims to analyse the potential use of indigenous woody species in agricultural development in south east Nigeria, some aspects of which may be more widely applicable.

- The study also examines the ways in which local people and their indigenous knowledge and skills can be fully integrated into rural development programmes.

- A discussion of the modern scientific development of agroforestry reveals the creation of a number of different methodologies and techniques, most of which make use of a few, well known, exotic tree species.

- Note is made of the growing use of indigenous species and participatory research methods in rural development projects, and their application to this study is discussed briefly.

CHAPTER 2

South east Nigerian land-use systems in the West African context: the study area.

2.1 Introduction

Much of this chapter is descriptive, forming a picture of the study area and the region in which it is located. Initially, in Section 2.2, a discussion of West African agriculture and its change over time is presented, with attention being paid to one of the most important farming systems in the region, namely shifting cultivation or bush fallow. This is followed by a section (2.3) on Nigerian agriculture, including a summary of its recent history, with special attention being paid to the effects of the oil boom of the 1970s, and a description of major farming zones, indigenous agroforestry systems, and common constraints to agricultural production. The second half of the chapter, Section 2.4, is devoted to a description of the study area and includes discussions of soil, climate, vegetation, population, settlement patterns, major land-use systems, and land tenure, all of which provide a background against which to set the results of the research detailed in later chapters.

2.2 West African agriculture

Agriculture is still the most important economic sector in most African countries (Christiaensen *et al.*, 1995). In West Africa agriculture is the main source of livelihood, with about 68% of people engaged in farming (World Bank, 1989). In many countries farming, for many people, is a part-time, but nevertheless important and productive occupation

(Siddle & Swindell, 1990), as the incomes gained from waged employment often have to be supplemented. Agricultural practices and crops vary from one zone to another, but West African farmers have much in common, and it is these similarities which will be discussed to provide a setting in which to examine Nigerian agriculture in a later section.

2.2.1 Nature of traditional farms

Although there has been a great increase in the production of permanent tree crops and crops for markets, a large proportion of West African farmers still mainly farm for subsistence (Ahn, 1970; Ruthenberg, 1980), and only sell any crops which are surplus to household requirements. In the past, when land was plentiful and populations were low, shifting cultivation was the most common agricultural system, involving the building of a new settlement when farmers moved to cultivate new plots of land. In areas of low population density, 25-30 people km^{-2} (Adegbahin & Igboanugo, 1990), this shifting cultivation can be a sustainable agricultural system (Nye & Greenland, 1960; Ahn, 1970; Ruthenberg, 1980; Kleinman *et al.*, 1995), but with sedentarisation of villages and an increasing pressure for agricultural land, the system experiences problems. The term shifting cultivation can also be used to refer to this next, more sedentary stage in agricultural change, and 'shifting' in this case, and more commonly in recent years, refers to the rotation of the use of a fixed number of fields (Peters & Neuenschwander, 1988). In poor communities, such as exist throughout most of sub-Saharan Africa, farmers must make adjustments to the farming systems without access to a wide variety of technological options, especially those that require capital outlay. Thus they rely heavily on traditional technologies and procedures to intensify cultivation on decreased land holdings (Okafor, 1993), as exemplified by many areas of south eastern Nigeria such as Akwa Ibom State which is looked at in the present study. Christiaensen *et al.* (1995) argue that as well as being the main underlying cause of food scarcity, population pressure may also be the driving force for a solution.

In most areas of West Africa today, traditional shifting cultivation has been adapted to compensate for increasing population pressure, and the most common farming system is now the rotation of bush fallow. In this system, cultivated fields form part of a rotation pattern which can involve farm plots, fallow land, and newly developed plots from cleared and burnt forest areas. Fertility management of the farmland also involves a system of intercropping (the mixing together of different crop species) and crop rotation strategies (Richards, 1985), and in some areas compounds contain intensively managed home-gardens which produce crops continually. Igbozurike (1971) states that the practice of intercropping has given sustenance to tropical agriculture in the absence of modern technological inputs that have sustained agriculture in more developed countries. Increases in food production are still being achieved in many areas by a continual expansion of cultivated area to the detriment of 'natural' ecosystems, rather than through any intensification of land already being farmed (Okigbo, 1986). In areas where there is no longer any forest or savanna into which farmland can expand, the bush fallow system has become a rotation of previously farmed plots, and the pressure for land has forced farmers in some areas to return to the same plot after two years, while others may cultivate one plot continuously (Boers, 1990). The immediate result of this, apart from scarcity of firewood and wood for house construction, yam stakes and fencing poles, is the widespread incidence of soil deterioration and degradation in terms of the progressive loss of nutrients and breakdown of soil structure (Okafor, 1993).

Ahn (1970) has produced a useful summary of the advantages and disadvantages of the shifting or bush fallow cultivation systems. The disadvantages are: (1) the great expenditure of labour needed when forest regrowth vegetation is cleared; (2) the generally low yields associated with the system; (3) the considerable proportion of the total land which is in fallow and therefore not productive at any one time; and (4) the fact that the system is stable only as long as fallow periods can be maintained for an adequate period. When fallow periods are reduced, yields decline still further leading to even shorter fallows, so essentially the system only works where the ratio of land to people is high. The advantages of the system can be summarised as: (1) the annual cycle of work is dictated by and adapted to the seasons; (2) the newly planted crop benefits from the ash derived from burning after clearing and nitrate levels have been described as being highest at the beginning of the rains when needed by the new crops; (3) in most forest areas clearing is not complete and shade trees left standing give some protection to the soil and this and little weeding means that once abandoned to fallow the regrowth vegetation quickly takes over; (4) the farmer needs little capital but simple tools and his/her own labour; and (5) provided fallow periods are long enough, soil regeneration is usually sufficient to suggest that the system can be regarded as a permanent one. Further detailed discussions of the bush fallow system and its strengths and weaknesses are found in Ruthenberg, 1980; Okigbo, 1985; Richards, 1985; Fresco, 1986; and Baker, 1989.

2.2.2 Size of farms

Field sizes of most food crop farms are small, over 80% of farms being between < 1 and 5 ha (Okigbo, 1985), ranging from approximately 0.5 - 1.0 ha in the forest belt (Lal, 1991) to 2.0 - 4.0 ha in open savanna land, although farmers often cultivate a number of fields, located at distances of 1 - 11 km from one another in a single year. The small size of the fields is due to a number of factors. First, the amount of work a farmer and his/her family can do with the farm implements available, usually a simple hoe and a 'machet', is influential as the forest or fallow bush must be cleared, and the area is limited by the amount of labour available to the farmer (Ahn, 1970). One factor that became evident during this study is that due to the distance of farm plots from the villages and from each other, especially in forest areas, farmers often have to spend many hours walking to the plots, thus reducing the time available for agricultural work. In areas where pressure for farmland is great such as is found in much of south eastern Nigeria (Okafor, 1993), plot size is small because the land is scarce. In some cases, especially in yam farming areas, the size of farm plot may be determined by the amount of planting material available.

2.2.3 Agricultural regions in West Africa

Agriculture in West Africa can be roughly divided into a number of crop regions, which run approximately from west to east, but many of the characteristics described above are common to all regions. The root-crop zone and the banana and plantain zone, which lie within the forest belt, are farmed predominantly using the bush fallow system, with banana and plantain production being confined to areas where there is still high forest remaining which can be cleared to produce 'new' farmland. North of this area, in the savanna region, is a transition zone where a combination of root crops and cereals are grown, also using the bush fallow system. The rice cultivation zone begins in Côte d'Ivoire and extends westwards along the coast, although pockets of rice cultivation occur throughout the region (Morgan & Pugh, 1969). Across the middle belt of West Africa is the cereal production zone, with Guinea corn being predominant in the southern part, and Bulrush millet being most common in the northern part. In this region too, cattle rearing is an important occupation as the area is relatively free from Tsetse fly. Goats, sheep and poultry, however, are present throughout West Africa.

2.2.4 Agricultural change in West Africa

In West Africa after colonial rule had been imposed, some new crops such as coffee were introduced, but in a number of cases, the arrival and development of exotic cash crops depended almost entirely on indigenous initiatives (Richards, 1985). For example cocoa was brought to Ghana by a migrant returning from Fernando Po (Crowder, 1968), although much of the development of its cultivation techniques can be attributed to the colonial administration (Hill, 1962), and Yoruba freed slaves returning from Brazil to Lagos carried with them the technique for producing *garri* (ground, fermented and dried cassava mixed with water to provide an 'instant' staple) which enables the use of high yielding 'bitter' varieties of cassava.

Although on the whole investment in the agricultural sector by French and British colonial governments was limited, from 1900 onwards, more attention began to be given to agricultural research and extension. Up until 1920, activities by agricultural departments in British West Africa were based on what is termed the 'Caribbean Model', that is concentration on export cash crops with little or no thought for indigenous food supply (Bates & Lofchie, 1980). In 1920 an agriculturalist with Indian experience was appointed to the Nigerian Department of Agriculture, and with Faulkner's influence, greater emphasis began to be placed on peasant farmer food crops and farming systems (Richards,1985).

Faulkner, suspicious of offering farmers untried innovations, placed much emphasis on research station experimentation, with shifting cultivation being the major focus of the research. Attempts were made to improve rotational fallow farming as it had become in much of Nigeria, with emphasis on green manures and planted fallows in the south, and attempts to introduce a system of mixed farming involving ox ploughing in the north. Faulkner's appreciation of the merits and demerits of shifting cultivation took longer to be accepted in other parts of West Africa, but by the 1940s it was realised that shifting cultivation was less a device of 'barbarism' and more a concession to the nature of West Africa's soils (Richards, 1985).

The eclipse of this approach to agriculture, and the return to favour of technology-intensive systems, was part of the trend in British West Africa which occurred in the climate of post-war commodity shortages. Agriculturalists were influenced by the pressure to develop economic cash crops and by trends in Western European agriculture towards increased mechanisation and specialisation. As a result peasant agriculture, and food crops in particular, were largely ignored (Sutherland, 1987). A number of projects initiated at this time have come to be object lessons in how not to undertake agricultural development: large scale, mechanised and ecologically and socio-economically inappropriate, but still commonly being introduced until the 1970s. Binns (1994) reviews several large-scale projects, such as the 1947-52 East African Groundnut Scheme which was unsuccessful, and concludes that some of the blame for failures can be attributed to the fact that outside agencies did not attempt to discuss the feasibility of the schemes with local people before implementation. Major investments in research and development in the 1960s and early 1970s centring on cash cropping, purchased inputs, high management levels and technical packages also experienced generally low levels of adoption (Sutherland, 1987).

From the early 1970s onwards, emphasis worldwide began to be placed once again on the small-scale farmer, in the form of Integrated Rural Development Programmes which used biological packages of fertilizer and high-yielding crop varieties, developed at agricultural research stations. For example, the World Bank alone committed over US$ 1000 m during the 1970s to smallholder projects involving research and extension, which rose to US$ 4700 m in the 1980s (Farrington, 1994). However, as has been discussed in **Chapter 1**, many such programmes have met with limited success, although Siddle and Swindell (1990) suggest that the improvement of basic needs for small farmers has occurred in some cases, but that this has been less conspicuous than the advantages which have accrued to the already better-off farmer.

2.3 Agriculture in Nigeria

Until the Nigerian civil war of 1967-70, agriculture dominated Nigeria's economy, contributing 53% to GDP in 1965 (Baker, 1989). In 1973 agriculture fell from 43.03% of GDP to 28.56%, and continued to decline until 1984 when it began to increase once more (Okuneye, 1992). During the same period (1962-1980) other sectors of the economy recorded positive growth rates (Table 2.1), and the agricultural sector only began to recover in the 1981-85 period by which time other sectors were recording negative growth rates. Studies conducted in rural Nigeria indicate an average annual rate of inflation of 30% for the agricultural sector during 1970-80, far higher than the inflation rate for the nation as a whole which was 18.2% for 1970-78 (Baker, 1989).

Table 2.1 Annual growth rates of GDP and selected sectors of the Nigerian economy, 1960-1985 (After: Olanrewaju, 1990).

Period	GDP	Agri-culture	Mining/ Quarrying	Manufac-turing	Distri-bution
1962-68	-0.15	-1.84	13.25	4.00	1.09
1970-74	15.63	-1.22	48.86	0.63	38.98
1975-80	2.75	-0.45	8.10	17.03	2.90
1981-85	-2.48	11.75	-6.75	-8.41	-3.95

However agriculture is still the mainstay of Nigeria's rural economy engaging more than 75% of the population, and being the dominant element in rural land use (Areola, 1991) and contributing 33.5% of GDP in 1993 (Europa, 1995). Although some writers suggest that the decline in the agricultural sector was a result of the oil boom, Forrest (1993) argues that the oil boom had a positive effect on agriculture, raising food prices due to large increases in demand, and allowing larger agricultural subsidies and more government spending in rural areas.

In 1980, before the Federal Government launched the Green Revolution programme, a team of Nigerian and World Bank consultants surveyed past agricultural production in Nigeria and assessed that a gross demand for all food items increasing at a rate of 3.5% per annum would occur in the period 1981-85, while domestic food production was expected to show a growth rate of only 1% per annum (Okuneye, 1992). It was therefore estimated that by 1985 food imports would have grown to represent 24% of the gross food supply of the country, a trend which was impossible to maintain due to declining foreign exchange earnings from the oil market. This is merely one period in the history of the post-independent Nigerian agricultural sector which has experienced decline for many years (Okuneye, 1992; Idachaba, 1980) and which has prompted the establishment of many different government programmes aimed at improving agricultural production.

In 1977, a reorganisation of the regional marketing board system to form a set of seven national marketing boards took place (Forrest, 1993), primarily to promote the production and marketing of their respective commodities - cocoa, rubber, cotton, groundnuts, grain, root crops and oil palm. This was attempted by setting fixed prices for the agricultural products, but over a large number of years the minimum prices did not keep up with consumer price indices and were far lower than would benefit the farmers. This in effect acted as a disincentive to farmers as the low prices were insufficient to justify further investment in their farms, and the boards were eventually disbanded in 1986 (Okuneye, 1992).

Operation Feed the Nation (OFN) was launched in 1976 and was a national emergency campaign designed to stimulate enough Nigerian agriculture to reduce the need for food imports. Farming inputs such as seeds, fertilizer, pesticides, tools, livestock and livestock feed were provided to farmers at subsidised prices and a few people did benefit. However the small scale farmers who form over 90% of Nigeria's farming population and who produce over 75% of total agricultural output hardly benefited (Okuneye, 1992) due to a number of factors, the major one often being the poor distribution and/or 'late arrival' of inputs.

A modified OFN programme, known as the Green Revolution Programme (GRP), was launched in 1980 shortly after the beginning of civilian rule (Nzimiro, 1985). The GRP aimed to accelerate an increase in agricultural production by removing all known constraints to production, to make the country self-sufficient in basic foodstuffs and to rehabilitate export production, but was relatively unsuccessful seeming only to benefit large-scale farmers (Okuneye, 1992). River Basin Development Authorities (RBDA), established in 1976 to manage Nigeria's water so that agricultural production could be carried out successfully in areas where rainfall is insufficient, also had little to show for the N3 billion spent on the programme due to a number of problems such as poor management of irrigation water and fertilizers, high construction costs and lack of institutional capability (Takase & Nakashima, 1993).

In July 1986 the Babangida Government announced a two year structural adjustment programme (SAP), funded by the World Bank and IMF, which aimed at, among other things, expanding non-oil exports and achieving self-sufficiency in food. It is argued that agriculture has been the most successful element of the SAP (Forrest, 1993) with sharp increases in food crop production and a rise in commodity exports. This has been attributed to three main policies:

a) the devaluation of the naira which has promoted commodity exports and discouraged cheap exports;
b) the abolition of state controlled commodity boards and agricultural produce pricing restrictions; and,
c) the imposition of an import ban on wheat, maize and barley.

However small-holder agriculture is still experiencing difficulties, some of which are discussed in 2.3.3 below, and many farmers are being adversely affected by SAP policies.

The current government attempt at improving agricultural production, part of the implementation of the SAP started in 1986, is based on a system that was established in 1975 and known as Agricultural Development Projects (ADPs) (Takase & Nakashima, 1993). In the 1986 budget a clear priority was given to ADPs over RBDAs, and a new, well funded initiative through the Directorate of Foods, Roads and Rural Infrastructure (DFRRI) was set up (Forrest, 1993). One important factor of the ADPs is their integrated approach to rural development issues so that agriculture is not looked at in isolation, but as part of the whole rural scene. However, although some successes have been achieved, the usual problems of inadequate or irregular funding, frequent changes of local and national government and some poorly conceived programmes have meant that the system is still struggling to establish itself as a positive force in rural development. Forrest (1993) concludes that in general SAP reforms were favourable to the rural economy, but that above all they do not appear to have checked the decline in living standards.

2.3.1 Common agricultural systems

As has been noted above, the majority of Nigerian farmers still use traditional farming methods, and are primarily subsistence farmers (Baker, 1989), although there are examples of well-developed systems of cash crop production. This is carried out on a small scale as the smallholder accounts for over 95% of all agricultural output in Nigeria (Iyegha, 1988) and is responsible for over 90% of the nation's food production (Oleyanu, 1980). There are many different traditional and introduced agricultural systems currently being practised in Nigeria, and a large proportion of these are a permutation of the bush fallow system of cultivation.

Nigeria can be divided into three broad agricultural zones (Figure 2.1): (1) the southern tree and root crop zone, (2) the mixed crop zone and (3) the northern grain zone (Nwafor, 1982; Onyemelukwe, 1982; Baker, 1989; Areola, 1991), which correspond well with those described by Udo (1978) for West Africa as a whole, and outlined in 2.2.3.

1) **The Southern Tree and Root Crop Zone** occupies the tropical high forest belt and is a region of high and well distributed rainfall. The major food crops grown mainly in the bush-fallow system and mixed together in farm plots are root crops (yam, cassava and cocoyam) and other water dependent crops such as vegetables, plantains, beans, and maize. Primary forest, mature secondary forest or immature bush is

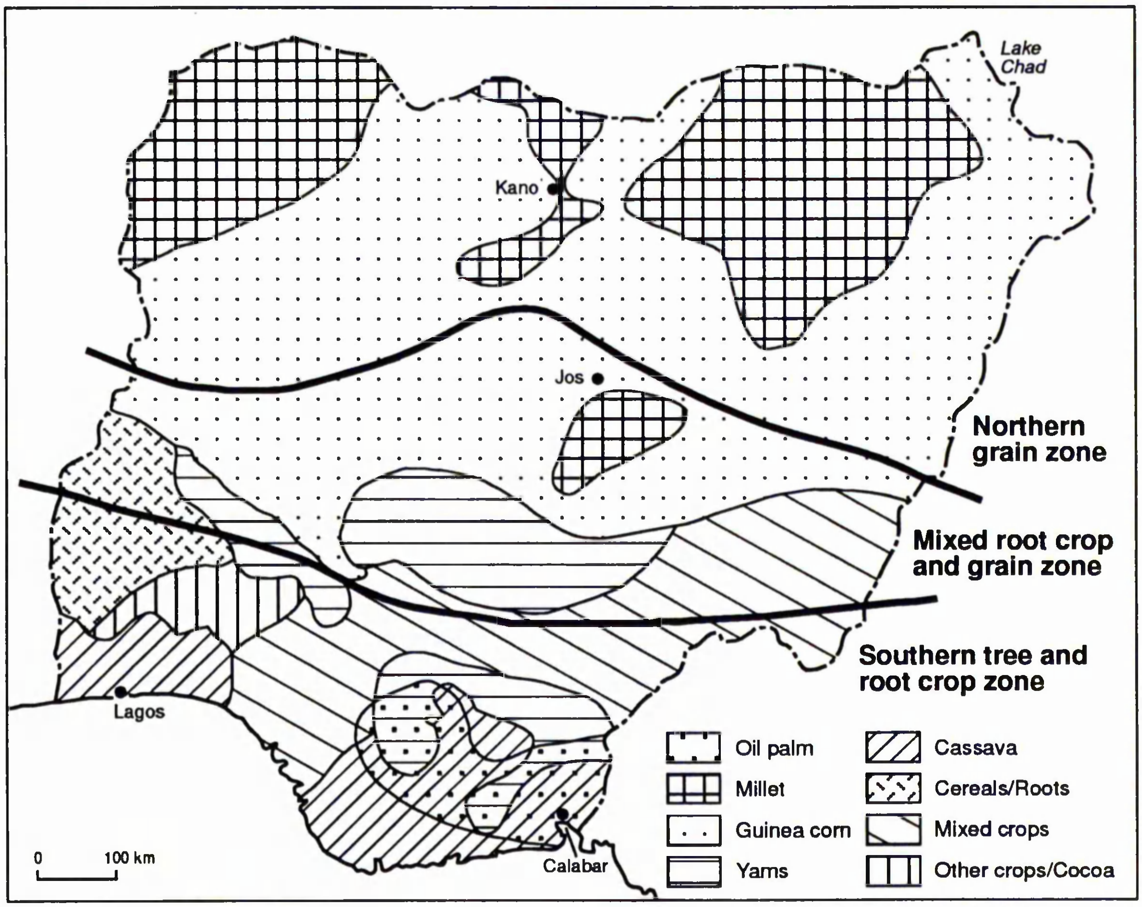


Figure 2.1 The broad agricultural zones of Nigeria and the distribution of the major crops grown within each zone (After: Onyemelukwe, 1982; Nwafor, 1982; Baker, 1989 and Areola, 1991).

cleared at the start of the farming season and the biomass is usually burned. Crops are then planted at the beginning of the rainy season and most are harvested throughout the year as different types mature, except cassava which is left to grow for eighteen months to two years before being harvested. Tree crops provide the major agricultural revenue in the south, cocoa dominates in the west, rubber in the central southern region and oil palm in the south east. The cultivation of swamp rice is also gaining in importance in the south eastern part of the zone. Most of the study area is situated within this zone.

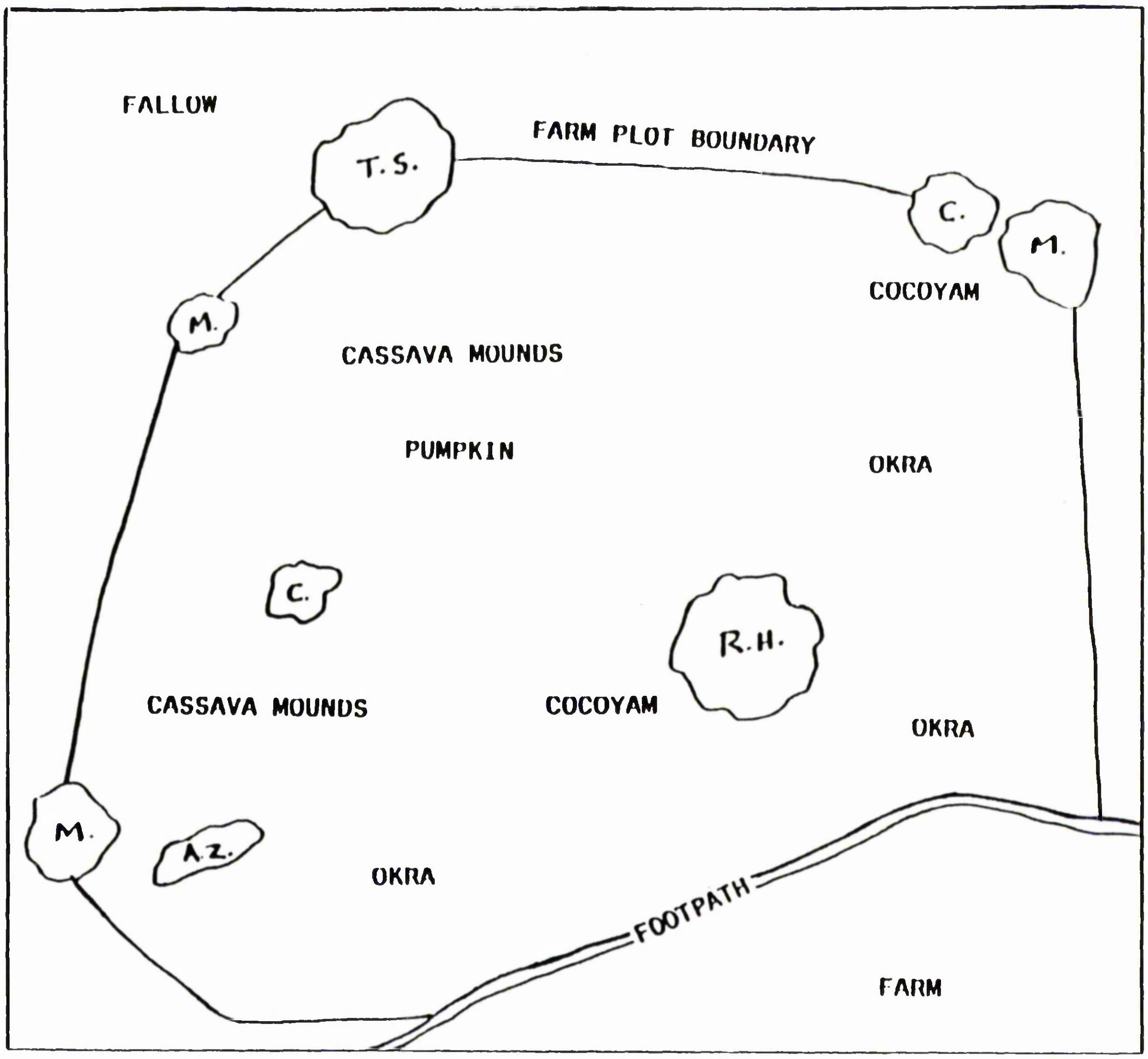
2) **The Mixed Crop Zone** occurs in the Guinea savanna region. In the southern part of the zone, rainfall is adequate for some root crop cultivation and the area is characterised by the production of yams, cassava and rice. Here the system of cultivation is similar to that described for the tree and root crop zone, but often with shorter fallows and less biomass to clear and burn before planting. In the north, cereals such as maize, guinea corn and millet are the dominant crops. The Jos Plateau is an area in which both tropical and sub-tropical crops can be grown at varying altitudes and is well known for the production of many types of sub-tropical vegetables. The northernmost part of the study area is included in this mixed crop zone.

3) **The Northern Grain Zone** begins where rainfall is no longer high enough to support root cropping. Here due to low rainfall, a short wet season and low humidity the principal crops are millet, Guinea corn, rice, beans, cowpeas and groundnuts. It is in this zone that most of the livestock production also takes place, with much of the land being used as open savanna pasture to support cattle, goats and sheep.

2.3.2 Indigenous agroforestry systems

The use of trees in farming is common throughout Nigeria and as such many of the traditional farming systems can be classified as agroforestry. The following section is an attempt to outline many of the indigenous agroforestry practices to be found in Nigeria. It is by no means an exhaustive list as there are many small, localised permutations to be found of various agroforestry systems, but it will give a picture of the current scope of tree use in agriculture.

1) **Bush-fallow cultivation** uses trees as an important part of the whole farming system. In areas of low population density this is a sustainable agroforestry system and fallow periods are long enough for woody vegetation to re-establish itself and to improve soil fertility and structure before the area is cleared for cultivation once again (Adegbehin & Igboanugo, 1990). In these areas, trees dispersed throughout farmland are common (Figure 2.2), some have been left at clearing, while others have been planted by the farmer, and include species used for fruit, building poles, fodder, live fencing, boundary markers, live stakes (Figure 2.3) medicines and even timber. In areas of increasing population density where fallow periods are shorter or no longer exist, trees gradually become less common in the farm plots as they are repeatedly cut and burnt and eventually are eradicated. The soil eventually becomes degraded and the area is unable to support the bush-fallow system of agriculture without other inputs (Takase & Nakashima, 1993). Where farmers have modified the bush-fallow system to reduce damage to naturally occurring trees and to plant and maintain others, the system once again moves towards being a sustainable agroforestry system.



KEY
A.Z. *Albizia zygia* - pruned at clearing
C. *Citrus* spp. - fruit
M. *Mangifera indica* - fruit/boundary marker
R.H. *Ricinodendron heudelotii* - shade
T.S. *Terminalia superba* - timber/boundary marker

Figure 2.2 An idealised example of a 0.5 ha farm plot in the bush fallow system showing the mixture of trees and crops common to many farm plots in the high forest zone (not to scale).

Figure 2.3 *Mangifera indica* (mango) sapling being used as a live stake for yam production on a farm in Abo Mkpang, Cross River State, November 1993 (Photo: the author).

2) **Home garden systems** are found in many areas of Nigeria though are most common in south eastern parts of the country where permanent, intensive multiple cropping, combining food crops, woody species, and often penned or tethered livestock, is practised on areas of land around the home (Adegbehin & Igboanugo, 1990). Here high population densities have made it necessary for farmers to intensify their cultivation systems so that at least some of the land is in full time production (Lal, 1991) and full use is made of all potential inputs such as leaf litter from trees and shrubs, animal manure and household waste. In a study of farming practices in south eastern Nigeria, Lagemann (1977) found that tree cultivation increases with population pressure on the land, with permanently cultivated compounds containing a variety of tree species including oil palm, raphia palms, coconut and fruit trees, intercropped with cassava yams and other arable crops (Arnold, 1990). Okafor and Fernandes (1987) describe in detail the home gardens of south eastern Nigeria and list sixty-nine different tree species that are used as part of the multistoried cropping systems. It is accepted in some circles that such home gardens are efficient and sustainable land use systems, but Torquebiau (1992) argues that there is little quantitative evidence of this to be found in the literature. However, he concludes that home gardens do possess a number of 'sustainability attributes' which help to maintain or even improve the resource base while meeting the farmer's needs.

3) **The taungya system** has been discussed in detail in 1.4.1 and it was argued that, in the forms that are initiated by forestry departments in Nigeria, it cannot be classified as an agroforestry system. However, where farmers have had the chance to initiate their own innovations, some permutations of the **taungya** system are developing which can more

easily be classified as agroforestry systems. A recent study for the Cross River State Forest Department has revealed that in plantations of *Gmelina* and indigenous long-rotation species initially established under the **taungya** system, farmers are increasing the spacing of the trees by carrying out thinning themselves, and then cultivating crops as an understorey. Some examples have been found in the understorey of *Gmelina* plantations where food production has taken place for seven years as farmers have further developed the **taungya** system to take account of the increasing pressure for farm land, and have produced an agroforestry system in which both crops and trees benefit (Etta pers. comm., 1994).

4) **Permanent tree crops** are often grown in conjunction with other tree or arable crops in sustainable agroforestry systems. Oladokun (1990) carried out a survey of cocoa farmers in south western Nigeria which showed that almost all of them intercropped other crops, often six or more types, with cocoa (Figure 2.4). These included food crops such as plantain, cocoyam, cassava, yam, maize, melon, cowpea and pineapple, and tree crops such as oil palm, kola, coffee, coconut and citrus. The comparative differences in popularity of intercropping with cocoa in different areas seems to depend on the amount of land left for other crops, so that intercropping with a large number of species is more likely in highly populated areas.

5) **Trees in pastures** are common in the open savanna woodlands of the Guinea savanna and Sudan savanna regions of northern Nigeria and provide shade and some fodder for the cattle. Without formal agreement, herdsmen also usually let their cattle graze in forest plantations, most of which are government-owned (Adegbehin & Igboanugo, 1990).

Figure 2.4 Cocoa and banana trees growing in the shade of mature forest trees in a farm clearing, Obung village, Cross River State, April 1993 (Photo: R.Dunn).

Much modern agroforestry research has been carried out in Nigeria, especially at the International Institute for Tropical Agriculture (IITA) where a great deal of work on alley farming has taken place (Takase & Nakashima, 1993). Examples of this and other kinds of agroforestry are described by Kang *et al.*, 1986; Adegbehin & Igboanugo, 1990; Mulongoy & Sanginga, 1990; Jabbar *et al.*, 1992; Mittal *et al.*, 1992 and Palada *et al.*, 1992, and have been discussed in 1.4.1.

2.3.3 Constraints on agricultural production

Until Nigeria gained independence in 1961, agriculture was the most important sector of the economy accounting for more than 50% of GDP and over 75% of export earnings. However, due to a number of different factors discussed in 2.3 above, the agricultural sector has experienced decline and in 1991 only provided 39.9% of GDP (Smith, 1994). Although a gradual recovery has begun to take place in the agricultural sector, there are still a number of constraints which must be addressed before Nigeria can begin to approach agricultural self-sufficiency. These constraints are summarised by Okuneye (1992) as follows:

a) A poor and inadequate extension system;
b) The use of crude or traditional farm methods;
c) Heavy financial constraints facing the farmers forcing them to produce products that are of immediate importance to them ie. food for domestic consumption rather than cash crops for sale;
d) Lack of appropriate storage facilities for farm produce;
e) Socio-economic constraints such as risk aversion, land tenure problems, taboos, sanctions, etc.;
f) Market inefficiency and pricing policies such as those imposed in the past by marketing boards; and
g) Erratic weather conditions.

Due to the small-scale and subsistence nature of a majority of Nigeria's agriculture and inappropriate government policies and actions in the

1970s and early 1980s, there is generally a low level of investment on farms as the returns are poor (Olomola & Nwasu, 1993), and as a result simple tools such as hoes and cutlasses are used which make farm work labour intensive. While about 20 person hours are required to produce 4-5 tonnes of maize per hectare in some developed countries, as much as 750-1 000 person hours are needed for one hectare of maize on a traditional farm, the output of which is often less than one tonne (Okuneye, 1992). This combined with the use of poor seed strains and the burning of farms, which although releasing nutrients in the form of ash hinders the necessary soil organisms needed to fix nitrogen, produces a low level of agricultural productivity in Nigeria. During the last fifteen years there has also been a rapidly increasing number of smallholder farmers, due in part to mass unemployment of school leavers in the country (Osemeobo, 1988) and with greater pressure for agricultural land, the soil and many forested areas have quickly become degraded and in some areas gully erosion and in others desertification have become serious problems. Finally, poor rural infrastructure has meant that even though farmers could obtain reasonable prices for their produce, it is often physically or financially impossible for them to gain ready access to markets, so the incentive to increase production above a subsistence level is lost.

2.4 The study area

The study area is located in the south eastern corner of Nigeria comprising Cross River State and part of Akwa Ibom State, and lies approximately between 03°50' to 06°50'N, and 07°50' to 09°50'E. The area is situated in the tropical high forest zone (Figure 2.5) and is part of a belt of dense forest up to 250 km wide which, in the past, ran from

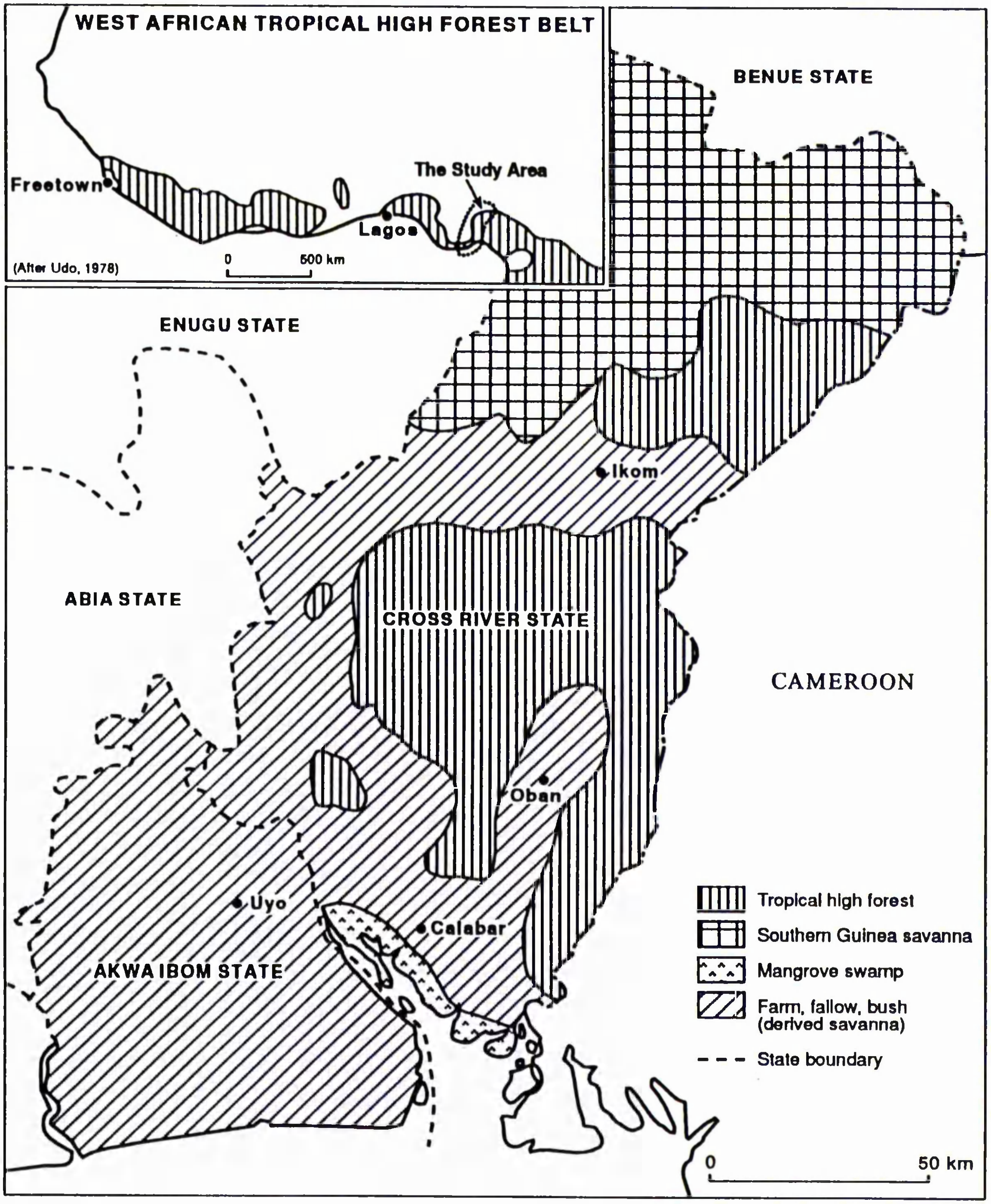


Figure 2.5 The location of the study area, and its position as part of the West African tropical high forest belt.

Senegal across West Africa to southern Nigeria connecting with forests in the Congo Basin, in Gabon and in southern Cameroon. The area is characterised by almost continual high temperatures and humidities, favourable to the existence of species-rich vegetation patterns.

Cross River State is a composite region of the low-lying Cross River plains in the south and two eastern highland areas. Much of the landscape is gently undulating, rising gradually from the coast northwards towards Benue State and eastwards towards the foothills of the Cameroon Mountains. Prominent high areas are the Oban Hills which rise to 915 metres above sea level, and the Obudu Plateau which is at approximately 1 400 metres above sea level. To the west, in Akwa Ibom, the land is flatter, and swampy areas are common.

The north of Cross River State is drained by the Cross River and its tributaries, while the south is drained by the Calabar, Kwa, Ikpan and Ebe rivers. Akwa Ibom is drained by the Ikpan, Kwa Ibo and Inyang Etim Ekpo rivers. The Calabar and the Cross River join to form a network of creeks and an estuary near to Calabar. These large rivers are perennial, but water levels vary greatly with the wet and dry seasons. During the rainy season the Kwa river, for example, rises 2.5 m above its dry season level (Holland *et al.*, 1989), while in the dry season even the larger streams may have such low flows that villagers experience difficulty in obtaining adequate water supplies. Many of the smaller streams disappear completely during the dry season, even in villages close to the forest, making water supply a common problem. Groundwater resources are sparse, and although some aquifers are present, yields are erratic and the water is often saline, so would be unreliable supplies for settlements.

2.4.1 Soils

Although there follows a general description of soil types in the study area, the present study is more concerned with micro-edaphic conditions, varying from farm plot to farm plot, rather than with wider soil classifications. These small-scale soil properties are discussed in **Chapter 5** with respect to the biological data collected.

The study area is made up mainly of acrisols and cambisols with medium to low productivity (Figure 2.6). Along the coast in the delta region, small areas of alluvial soils are present, which are predominantly poorly drained and have highly variable horizons with contrasting textures, morphology and chemical properties (CRADP Report, 1981). The low lying plains of Akwa Ibom consist of poorly drained acrisols with sporadic gleysols. A large majority of the soils in the study area are acid to strongly acid, have low soil nutrient levels, a weak structure and are highly porous. In newly cleared forest areas, soils have high organic carbon levels in the topsoil, but this horizon is usually less than 7 cm thick and levels fall quickly once cultivation takes place (WWF/ODNRI, 1989). Two major basalt flows occur near Ikom and Obubra and form distinct areas of good quality ferrasols which are deep, well structured and with a high nutrient status. Locally, soils around Ikom are well known for their high agricultural productivity.

Large parts of the study area are susceptible to erosion losses with inappropriate land use systems. Average annual soil loss in Nigeria is estimated at 30 tons per hectare, with 50% of total soil loss occuring in the Eastern States (Boers, 1990). In the past, small farm plots, an intact bush fallow system and the maintenance of forest on slopes have

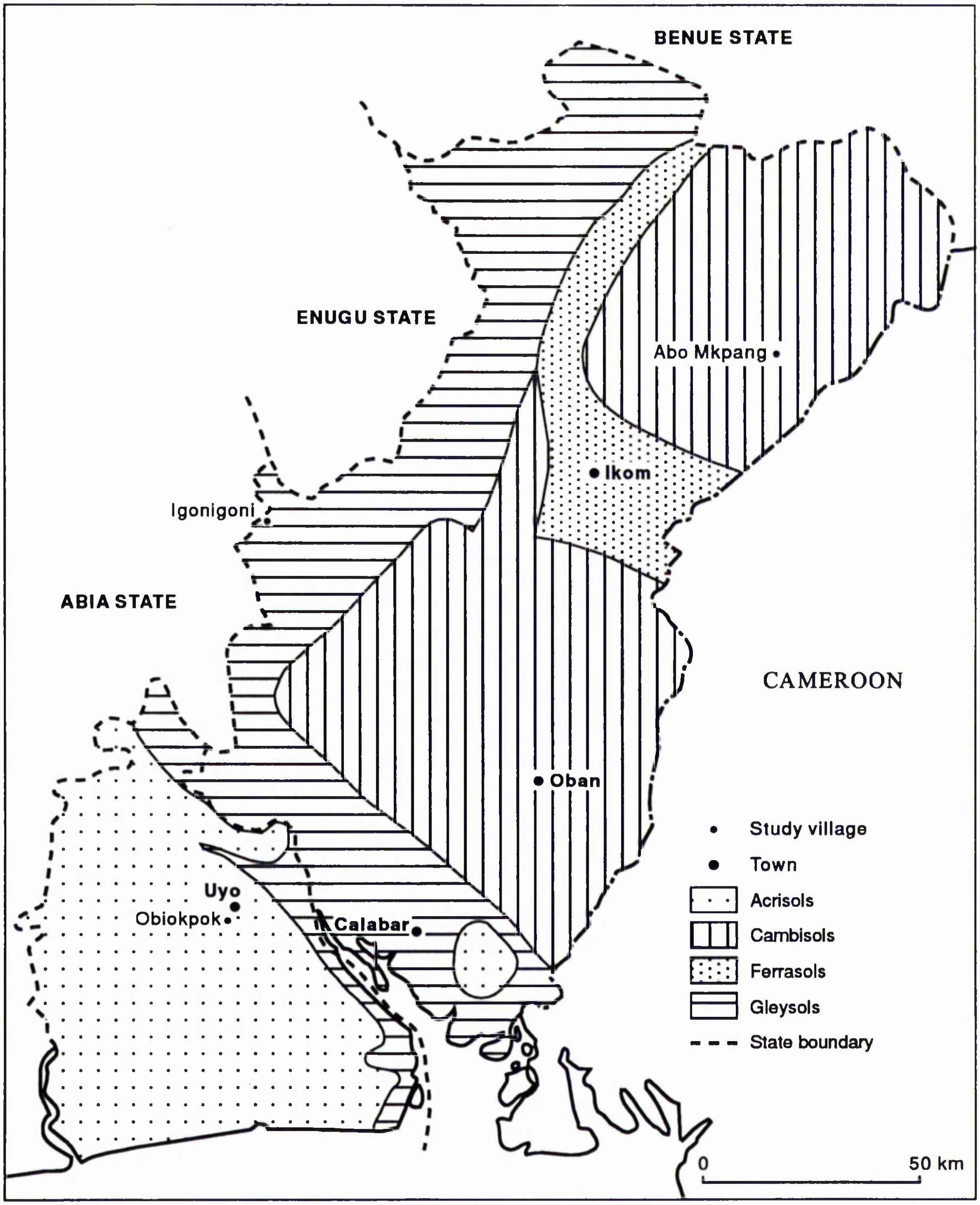


Figure 2.6 The major soil types of the study area (After: Cross River Basin Development Project and Holland *et al.*, 1989).

kept soil losses to a minimum, but with increasing pressure for agricultural land leading to shorter fallow periods and the cultivation of marginal areas, soil erosion is becoming more of a problem (Boers, 1990). When the forest is cleared for farmland, the intensity of rainfall and the depth of the regolith in areas such as Cross River State, can bring about very rapid and large-scale erosion effects. Under saturation conditions, soil slip can bring down entire hillsides, together with the forest they bear (Morgan, 1983).

2.4.2 Climate

A general description of the climate of the study area will appear in the following section, with more detailed discussions of seasonality and rainfall patterns appearing in **Chapter 5**, as part of the analysis of phenological data collected during the biological studies. The data were obtained from the Calabar and Ikom Meteorological offices and from Cross River National Park reports.

Cross River State has an average annual rainfall of approximately 3 500 mm which is seasonally distributed; the rainy season extending on average from April to October, with a peak in June/July; and a marked dry season of four to five months, approximately beginning in November. There is a general decrease in rainfall away from coastal areas northwards and westwards, and an increase in the intensity of the dry season moving from south to north.

There is no data available for local rainfall intensities, but intensities greater than 25 mm hr^{-1} are potentially erosive (Holland *et al.*, 1989) and it can be assumed that much of the rain that falls,

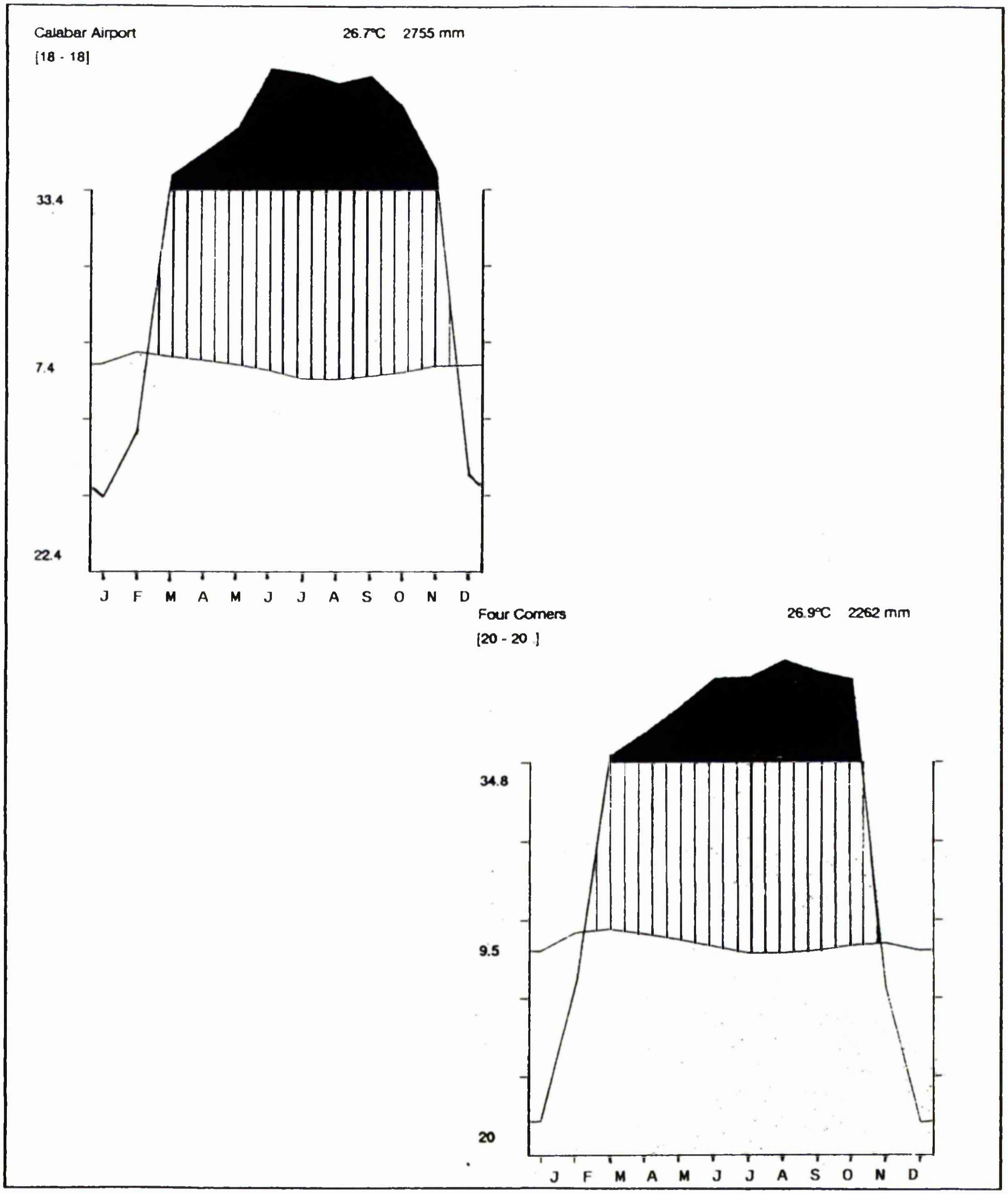


Figure 2.7 Climatic diagrams for Calabar Airport and Four Corners, Ikom produced using data obtained from Calabar and Ikom Government Meteorological offices for 1973-1993 (compiled by K. Schmitt, 1994).

especially during the storms at the beginning and end of the wet season, has a higher intensity than this. (The author has often recorded intensities of more than 40 mm hr^{-1} in her garden in Calabar.) A critical period occurs at the end of the dry season as land is exposed when cleared before planting begins and the erosion risk is high. During the wet season proper, the rainfall is more prolonged, but less intense.

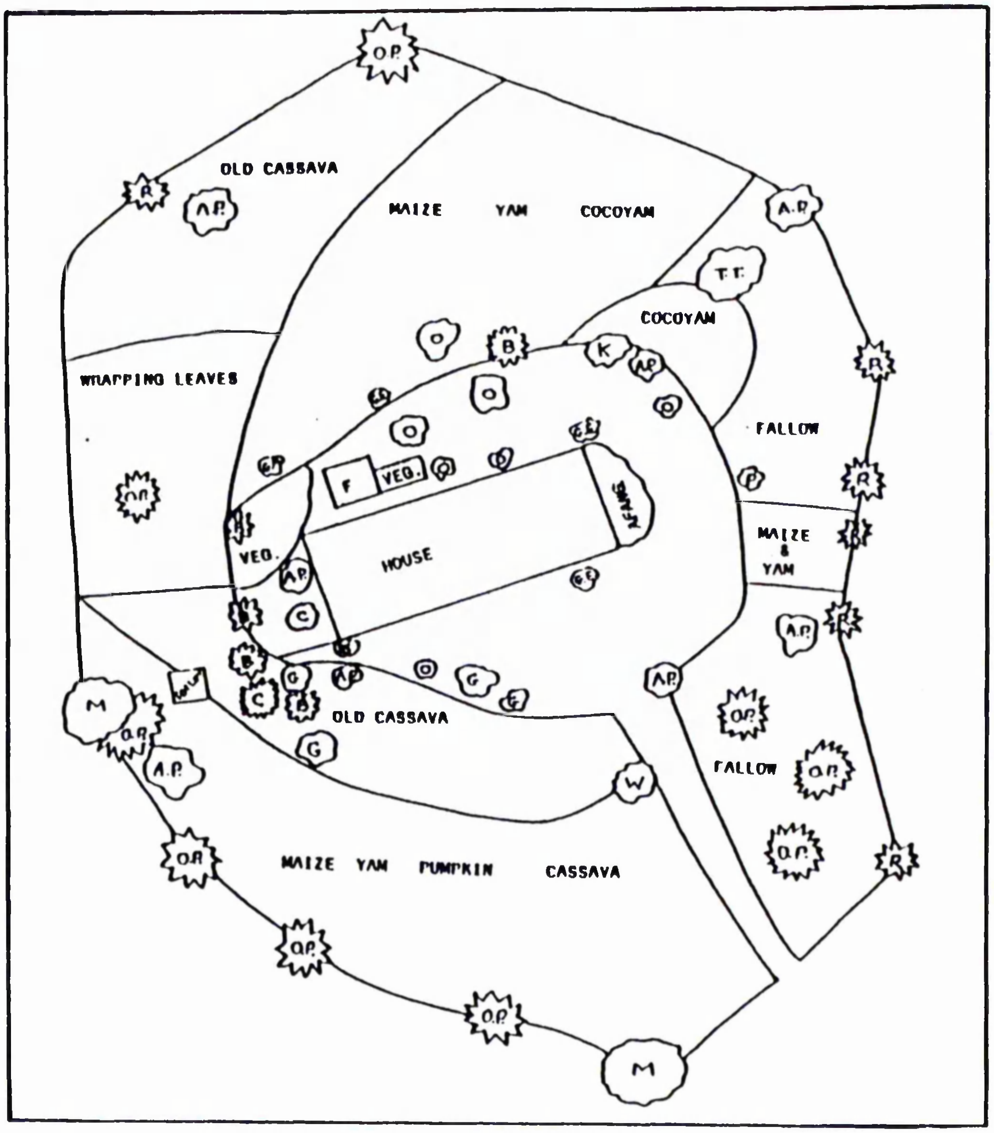
Except in the few areas over 500 m, temperatures are always high in the study area and there is little annual variation, with the lowest temperatures occurring during the rainy season. Relative humidity is also high, but falls from south to north, and values are highest during the rainy season. Figure 2.7 shows a climadiagram produced using data from Calabar and Ikom meteorological offices.

Wind speeds are generally low, except during storms at the beginning and end of the wet season when speeds of up to 70 km hr^{-1} are possible and can cause damage to buildings, farms and forest. The wind is usually southerly, but northerly winds are experienced more during the dry season when the dusty Harmattan wind moves southwards (Holland *et al.*, 1989).

2.4.3 Vegetation

The definitions used for the various forest types described in this section are taken from a combination of Hall & Swaine's (1981) descriptions of Ghanaian forest types and Hall's (1977, 1981) work on forest types in Nigeria, from which further details can be obtained. The study area can be divided into two main vegetation zones and several minor vegetation types[1] (Figure 2.5) which correspond well with the

[1] Some vegetation types are created by human actions (eg. Figure 2.8).



KEY

A.P	African pear (*Dacryodes edulis*)
B	Banana (*Musa sapientum*)
C	Coconut (*Cocos nucifera*)
G	Guava (*Psidium guajava*)
G.E.	Garden egg (*Solanum aethiopicum*)
K	Kola nut (*Kola nitida*)
M	Mango (*Mangifera indica*)
O	Orange (*Citrus* spp.)
O.P.	Oil palm (*Elaeis guineensis*)
P	Pawpaw (*Carica papaya*)
R	Raphia palm (*Raphia hookeri*)
S.S.	Soursop (*Annona muricata*)
T.T.	Timber tree (*Milicia excelsa*)
W	African walnut (*Coula edulis*)
VEG.	Vegetables - tomato, green leaf, water leaf, garden egg.
F	Factory for distilling palm wine to make 'local gin'.

Figure 2.8 One of the most common vegetation types in the west of the study area has been produced by human activity - a homegarden in Obiokpok (not to scale, source: own data, 1993).

agricultural zones of Nigeria, described in 2.3.1. The south is in the high forest belt, and approximately 60% of Nigeria's remaining tropical moist high forest (Whitmore, 1990) is found in Cross River State, the most forested state in the country (Cobham, 1994). The area is made up of a combination of Wet Evergreen, Moist Evergreen, Moist Semi-deciduous and Dry Semi-deciduous forest (Hall & Swaine, 1981) with the latter two types being most common at the boundary between primary and well developed secondary high forest, and 'derived' savanna and southern Guinea savanna areas (Richards, 1952). Hall (1981) states that there is a south-eastern sub-group which is floristically distinct from other high forest types in Nigeria, and this encompasses the study area. The terms primary and secondary forest are used in this description to differentiate between those areas of forest that have recently been disturbed, and those which have not. Collett (1994) suggests that the term secondary forest should be used for forests where the effects of disturbance can still be detected in structure and/or floristics, whereas primary forest will usually be self-maintaining, with the major species regenerating under the normal disturbance regime for the area.

The primary, or currently undisturbed, areas of Wet Evergreen and Moist Evergreen forest are dominated by dense woody vegetation with many tree, shrub and epiphyte species, beneath which grasses are virtually absent. Some early researchers (Chevalier, 1917; Mildbread, 1922) have claimed that no real stratification exists in African high forest, while others (Richards, 1952; Keay, 1953; Longman and Jeník, 1974; Whitmore, 1990) have shown that there is a general uniformity of structure with three strata of trees existing in relatively mature high forest. The top stratum is made up of emergent trees of 30 to 40 metres in height, with most of the valuable timber trees such as *Khaya ivorensis* A. Chev., *Piptadenestrum africanum* (Hook. f.) Brenan, *Pycnanthus angolensis* (Welw.) Warb., and *Terminalia ivorensis* A. Chev., being found in this layer. The second stratum consists of a great variety of woody species of 10 to 30 metres tall with their crowns touching laterally to form the upper canopy. The third stratum, or understorey, is made up of trees of up to 15 m, often bound together with woody climbers. Below this is a shrub and herbaceous layer and it is from this that a large proportion of the great variety of non-timber forest products (NTFPs) are derived, including species of climbers, fungi, herbaceous plants, and animals for bush meat. From personal observations in Cross River State, it is the latter description which seems to fit most closely to the forest structure in the primary and mature secondary high forest.

Where the forest has been cleared for cultivation in the past, mainly in the Moist and Dry Semi-deciduous forest areas, secondary forest has become established, dominated by fast growing pioneer species such as *Musanga cecropioides* R. Br., *Trema orientalis* (L.) Blume and *Albizia zygia* which have short life spans, and *Triplochiton scleroxylon* K. Schum., *Terminalia superba* Engl. & Diels., and *Milicia excelsa* (Welw.) Benth., which persist and will become emergents in any resulting high forest. In Akwa Ibom, in the west of the study area, most of the forest has been converted into farmland so that only small, isolated groves of forest or bush remain.

Throughout the study area, in places where forest is repeatedly cleared and burnt for cultivation, secondary forest succession is eventually replaced by 'derived' savanna which is an open savanna woodland. Since the publication of Griesbach's work (1872) savanna has commonly been defined as vegetation with a continuous grass layer and usually scattered trees. However, it is an ecosystem which is located in a transition zone between rain forest and desert and is extremely variable in both space and time (Schmitt & Adu-Nsiah, 1993). Lamotte and Boulière (1983) stated that there is no such thing as a typical savanna ecosystem, rather there is a gradient of related ecosystems ranging from open woodlands to almost treeless steppes. This final description is most appropriate for the constantly changing vegetation of the derived savanna zone of Cross River State. These areas initially have a number of forest species present, but are quickly invaded by tall savanna grass species such as *Imperata cylindrica* (L.) Rausch.. Most forest species are killed by frequent fires with only a few species such as *Dialium guineense* and *Margaritaria discoidea* (Baill.) Webster surviving. Derived savanna is similar physiognomically, and to some extent floristically, to the southern Guinea savanna, but its origins are betrayed by the presence of wild oil palms (*Elaeis guineensis*) and some other trees characteristic of high forest areas (Richards, 1952). Recent work by Leach & Fairhead (1994) suggests that in some cases 'derived' savanna is in fact land that has been savanna for much longer than has previously been widely accepted, and in Guinea and probably other forest-savanna transition zones of West Africa, what have been called forest relics are in fact areas of forest that are developing and being maintained as part of the landscape due to human actions. The landscape is said to be 'half full' rather than 'half empty' of forest vegetation.

The vegetation in the north of the study area is classified as southern Guinea savanna (Richards, 1952), and consists of a forest-savanna mosaic. Savanna woodland predominates, the most common tree species include *Daniellia oliveri* (Rolfe) Hutch. & Dalz., *Vitex doniana* Sweet, and *Afzelia africana* Sm.. A large number of grasses also exist, but the shrubby weed *Chromolaena odorata* L. has displaced them in many areas.

Mangrove forest, as described by Whitmore (1990), is confined to the south of the study area, especially around the Cross River estuary. The vegetation, characterised by trees with stilt roots and viviparous reproduction, is mainly made up of *Rhizophora* spp., *Hallea* spp. and an exotic palm from Asia, *Nypa fruticans* Wurmb., introduced to Calabar in 1906 (Adegbehin & Nwaigbo, 1990), which has become abundant in the Cross River estuary and the Niger Delta.

2.4.4 Population

Cross River State has a large number of different ethnic groups spread throughout the state. The major ones include the Efiks and Ejagham who occupy the south of the state, and the Ekois comprising the Bahumono, Yakurr, Biase, Mbembe and Abgbo people in the centre. In the north of the state are found the smaller groups of Yalla, Yache, Ukelle, Bette, Boki, Eteng, Ikom, Akujuk, Nkim, Nkum and Bekwarra (Otu, pers comm., 1993). There are several major language groups, and many very localised variations in dialect, even from village to village in some areas, but all have Bantu as a common linguistic root (Morrison, 1989). In Akwa Ibom there are only three major ethnic groups, namely Anang, Oron and Ibibio all with their own languages, but several minor groups are also present who speak local dialects of the major languages. A majority of the population in the study area also speak Pidgin English.

Population densities are generally low in Cross River State, estimates of an average of 50 to 100 inhabitants per km^2 exist with even lower densities in the forested areas (Holland *et al.*, 1989), and are much higher in Akwa Ibom, which is one of the most densely populated states in Nigeria (Olomola & Nwosu, 1993), with up to 600 inhabitants per km^2 (Boers, 1990). As a result of the pressure for farm land arising from the high population density in Akwa Ibom, there is currently a great deal of migration into Cross River in an attempt to find new areas to cultivate. Disputes over land ownership among indigenous communities are common in the study area and in 1992 and 1993 five clashes between communities have occurred, resulting in the loss of many lives and damage to property, and rendering many people homeless. There is also general ill feeling towards non-indigenes of Cross River State when they establish farms or harvest timber and/or NTFPs from the State's forests.

2.4.5 Settlement patterns

Most of the population of Akwa Ibom and Cross River States live in rural settlements consisting of small hamlets and villages. In Akwa Ibom these tend to have a dispersed pattern, with the home compounds being scattered around the whole village territory so that each has a considerable area of farmland adjacent to the house (Figure 2.9.a) (Siddle & Swindell, 1990). In Cross River the villages and hamlets tend to be nucleated, with all houses together in the centre and farmland spread around the outside of the settlement (Figure 2.9.b). Beside many of the major roads, especially in Cross River State, some of the originally nucleated settlements have become more linear as they have grown and spread along the road (Figure 2.9.c). Settlement does not move with changing locations of farm plots in either Akwa Ibom or Cross River states, but in the latter, farmers may sometimes set up camps and reside on a distant farm plot during busy periods.

a)

b)

c)

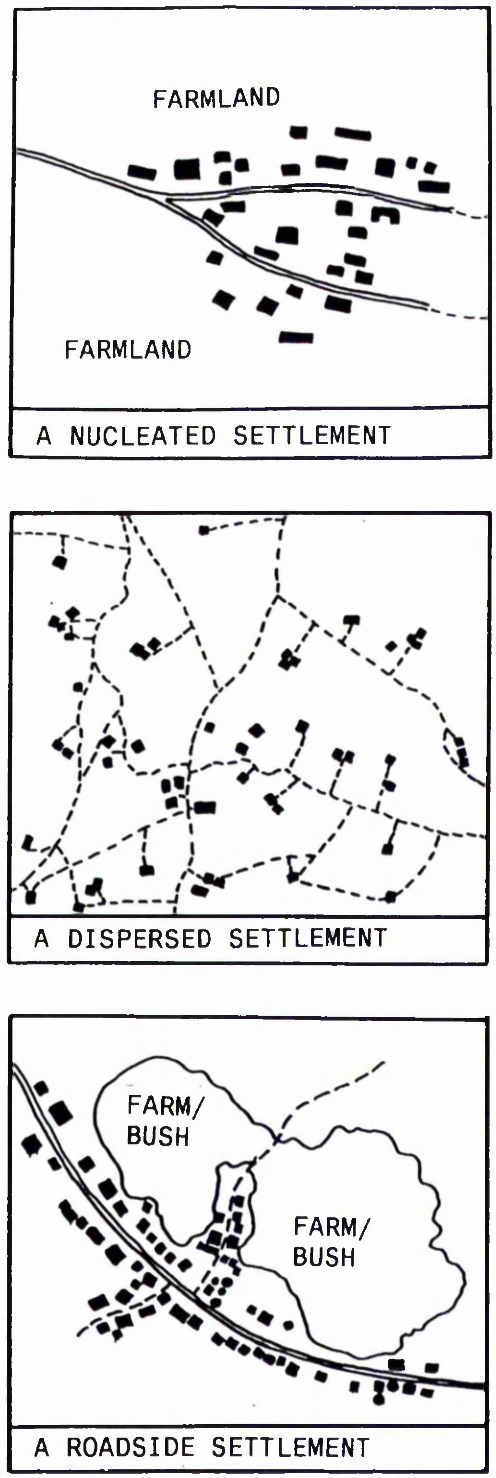


Figure 2.9 The three settlement patterns most commonly found in the study area (After: Udo, 1978).

The major towns of Akwa Ibom and Cross River State, Uyo and Calabar respectively, are the state capitals. Uyo has grown rapidly since 1987 when Akwa Ibom was separated from Cross River to form a new state. Calabar, a town of approximately 75 000 inhabitants, is an old port-town which began as a small fishing village and grew to become an important trading port during the period of the slave trade, and is now the administrative capital of Cross River State. The other large towns in Cross River State, such as Ugep, Ikom, Ogoja and Obudu, are located along the main north-south route.

2.5 Land-use systems in the study area

Most of the people of the study area live in a rural environment and are engaged in some form of agriculture. Therefore, apart from a few towns and quarries, and some minor industry, the rest of the study area comprises forest, secondary bush, fallow, farm or plantation land. The following is a brief description of the many rural land use systems to be found in the study area. All areas and proportions of land use types quoted are approximate and have been obtained from maps produced by the Cross River State Forestry Project and the Cross River Basin Development Authority, and from Forestry Department and National Park reports.

2.5.1 Forested areas

The largest blocks of forested land in the study area make up the Cross River National Park, which was formed by Federal Decree No.36 in 1991 and is approximately 355 000 ha of mainly primary or mature secondary tropical rain forest, most of which was previously Forest Reserve. It is divided into two main blocks, the Oban Division of approximately 274 000 ha in the south which is contiguous with the Korup National Park in Cameroon, and the smaller Okwangwo Division of approximately 81 000 ha in the north. The whole National Park area was initially supported by the World Wide Fund for Nature (WWF), but in September 1993, the management and funding of the Oban Division was taken over by an E.E.C. funded project, while WWF remain as advisers to the Okwangwo Division. There are currently a number of problems, administrative and political, which mean that the future of CRNP is now in question.

Forest reserves were established during the 1920s and 1930s by the Colonial Forest Service when large areas of forest were demarcated and protected by the laws outlined in 2.5.3. Originally there were 610 000 ha of forest reserve, but much of this has become National Park land. Therefore Cross River State now has approximately 270 000 ha of land under forest reserve, although only about 72% of this is primary or mature secondary forest, the rest being swamp forest (4%) or having been cleared for agriculture (18.5%), **taungya** or plantations of *Gmelina arborea* for pulp production (4%), or oil palm (1.5%) (CRSFP(ODA), 1993). Akwa Ibom State has a much smaller area of forest reserve, approximately 32 000 ha, of which 31 000 ha is swamp and mangrove forest at Stubbs Creek on the coast and has recently been made into a Wildlife Sanctuary in which no hunting, cutting or collection of products may take place (Akwa Ibom Forestry Department, pers. comm., 1993).

All areas of forest which exist outside the National Park and Forest Reserves are defined as 'protected' or community forests. These areas can be farmed and/or logged with permission from the Forestry Department but are effectively under the control of the local communities, who have the right to control timber and NTFP extraction and to demand fees and royalties for any products harvested by outsiders. They can manage these forest areas in any way that they see fit, although permits for logging should be obtained, especially for timber to be transported away from the village and sold, so that it has the appropriate hammer marks indicating that it has been legally felled.

Not all forest reserve land is safe from forest clearance, even by the Forest Department itself. Ekinta, an 11 000 ha forest reserve in the south east of the State, provides a good example of accelerated forest loss as a consequence of forest policy that favoured the establishment of fast growing species. The reserve was good quality high forest until the late 1970's but a programme of *Gmelina arborea* plantation establishment by immigrant farmers using the **taungya** system (see 1.4.1) was instigated. However due to a shortage of funds for seedlings and supervision virtually no plantations were established, and in less than a decade 90% of the forest reserve had become cassava farms with hardly a tree standing (Dunn *et al.*, 1996).

2.5.2 Tree crop plantations

Some areas of plantations also exist in the study area. There is approximately 9500 ha of *Gmelina arborea* plantation in Cross River State which is used for paper production at the Nigerian Newspaper Manufacturing Company (NNMC) in Akwa Ibom State. Although the paper factory is in Akwa Ibom, the State only has approximately 400 ha of *Gmelina* plantation, as the population density of this state is nearly seven times that of Cross River State (Dunn *et al.*, 1996) so there is high pressure to use the land for agriculture rather than for forestry.

There is also a small area of *Pinus caribaea* Morelet plantation, near Uyo in Akwa Ibom, for long fibre pulp production.

Rubber (*Hevea brasiliensis* (A.Juss.) Meull.Arg.) is grown on large plantations, owned either by the government or by private companies. The area covered by rubber plantations in Cross River State is approximately 14 600 ha, with less occurring in Akwa Ibom State. There is very little rubber produced by small holders in the study area.

Large-scale oil palm (*Elaeis guineensis*) plantations, both government and privately owned, cover approximately 21 000 ha in Cross River State. There are many small-scale plantations often owned by a few families who join forces to harvest the palm fruits and process the oil and this is especially common in Akwa Ibom where 'palm bush' is a dominant feature. Processing of the palm oil is carried out either in estate factories or in villages. Much of the palm oil from this area is purchased by traders and sold in the north of Nigeria.

Cocoa (*Theobroma cacao*) is produced mainly by small holders in the study area, but there are about 400 ha of privately owned large-scale plantations in Cross River State. It is only a minor cash crop in south eastern Nigeria, the majority of Nigeria's cocoa being produced in the west of the country as described in 2.3.2.

2.5.3 Food crops

The major farming system in the study area is the bush fallow system, as outlined in 2.2.1, where farm plots are originally cleared from forest or secondary bush by cutting and burning, farmed for one or two years and then left to fallow while a new plot is used. In the high forest zone, where primary or mature secondary forest is still present, the land is cleared and burnt, and bananas and plantain are planted that produce for three to ten years. The plot is then left to fallow for three to five years and joins the other plots in the rotation system, in which all the other food crops are grown. The major crops in the region are cassava and yam which are usually planted in mounds and cassava is grown for one or two years before the plot is once again left to fallow. The many other crops grown in different combinations, intercropped with the cassava and yam, are shown in Table 2.2. In areas where there is no longer any forest, the bush fallow system is still practised, but without the first stage of banana and plantain production, and often with shorter fallow periods.

Table 2.2 Key food crops grown both in farm plots and home gardens in the study area (Source: own data 1992-93).

Botanical Name	**Common name**
Amaranthus caudatus	Green leaf
Ananas comosus	Pineapple
Arachis hypogaea	Groundnut
Capsicum annum	Chilli pepper
Cucumeropsis edulis	Melon
Cucumis sativus	Cucumber
Curcurbita pepo	Ndise
Dioscorea spp.	Yam
Gnetum africanum	Afang
Hibiscus esculentum	Okra
Ipomoea batatas	Sweet potato
Lycopersicon esculentum	Tomato
Manihot esculenta	Cassava
Musa paradisiaca	Plantain
Musa sapientum	Banana
Saccharum officinarum	Sugar cane
Talinum triangulare	Water leaf
Telfairia occidentalis	Pumpkin
Vernonia amygdalina	Bitter leaf
Xanthosoma mafaffa	Cocoyam
Zea mays	Maize

Wet rice farming is present in many of the low-lying swampy areas of the study region (see **3.3.2**). Rice seedlings (*Oryza sativa* L.) are raised in nurseries and then transplanted to the fields. The fields are often large and farmed by more than one family, the boundaries of each section being marked by bamboo poles. No irrigation is used, the rice grows during the rainy season when the fields are flooded and is harvested at the beginning of the dry season.

Figure 2.10 'Palm bush' in Obiokpok village, Akwa Ibom State, June 1993 (Photo: the author).

In Akwa Ibom State, where the highest population densities in the study area exist, an agricultural system has evolved to take account of shortened fallow periods. Here, highly developed compound gardens of approximately 0.25 - 0.50 ha, comprising woody perennials, annual crops and livestock exist around each house as described in 2.3.2. The multi-storey structure and addition of crop residues, household waste and animal manures maintain soil fertility and allow more sustainable production of food crops (Okafor and Fernandes, 1987). Around the villages in Akwa Ibom a fallow rotation system is used in the fields which, due to short fallows, have very few trees remaining. Oil palm (*Elaeis guineensis*) is the predominant tree as it is highly valued and therefore preserved, and the fallow areas are generally known as 'palm bush' (Figure 2.10).

2.5.4 Livestock

The most important livestock in the study area, both in terms of income generated and nutrition provided, are chickens, goats and sheep. Chickens are usually free range and used mainly for meat as most of the eggs laid are kept for hatching chicks which are more valuable than the eggs themselves. Goats and sheep are usually either tethered or free range, but penned animals are more common in Akwa Ibom. In some villages goats and sheep are not allowed to be kept as, roaming freely, they often cause a great deal of damage to farms. Pigs are uncommon in the study area.

Trypanosomiasis spread by the tsetse fly is present in the study area, therefore cattle are only present for short periods of time when they are brought from the north to be slaughtered. However, a government owned cattle ranch does exist on the Obudu Plateau, which is free from trypanosomiasis due to its high altitude. The ranch covers an area of about 64 km^2 and breeds cattle for both meat and dairy production, as well as goats and sheep.

2.6 Land tenure

Land tenure in Africa is usually extremely complex, caused by a combination of different categories of land under traditional law, the addition of modern land tenure laws and categories of land, and a distinction being made between tree tenure and the land on which trees are planted. Land tenure plays a significant role in the adoption and continuation of agroforestry technologies and Lawry *et al.* (1994) state that 66% of land in Nigeria is under a tenure system that provides long-term security and is therefore favourable for agroforestry. Much of the information given in this section has been obtained through discussions with forest officers and villagers before and during the fieldwork period (April 1992 to December 1993).

2.6.1 Traditional land tenure

The complexity of traditional land tenure systems is largely due to the existence of various categories of land to which different rules and patterns of use apply. These land tenure systems have great regional variations, and those found in south east Nigeria are less well documented and more complex than those of the south west (Francis, 1987). However an attempt will be made to describe broadly the relevant traditional land tenure systems found in the study area, even though there is considerable variation in ecological conditions, population densities, farming systems, dialect and terminology within the region.

In Cross River State each village has community lands surrounding the village, on which individuals can farm, but to which they have no title. Title to land can be achieved by individuals through inheritance, or by clearing primary high forest for farming. Even if the cleared land is only planted for one season, no other person has the right to occupancy at any time in the future (Holland *et al.*, 1987). In the case of land which is cleared or inherited, the owner has full rights to its produce, and may build or plant permanent crops on it as he/she pleases (Chubb, 1961). In both Akwa Ibom and Cross River states, the available land is divided into village territories and people from one village cannot own land from a different village. If any company wishes to establish a plantation on community land, then they must pay an annual rent to the community. For example ONREL, a large oil palm and rubber estate near Oban village, pay an annual rent to the village for the use of its land, and provide a generator and fuel for street lighting (Francis, 1987).

Non-indigenes of the State have no traditional rights over land. Most immigration into Cross River State occurs by Ibibios and Ibos from Akwa Ibom, Abia and Enugu States which have population densities of up to 600 inhabitants per km^2, and they are obliged to rent land from the indigenous communities. Even if primary forest is cleared by non-indigenes, rent has to be paid while the immigrant remains in the community, but as long as rent is paid immigrants can clear primary forest for farmland as required and this, in combination with forest clearing by indigenes, poses a serious threat to the remaining high forest in Cross River State. Holland *et al.* (1989) estimate that a total of 2 830 ha of primary forest were cleared in 1988/89. In some areas of Cross River State, where primary forest no longer exists, indigenes have to rent land for farming from other members of their own community or from neighbouring communities, and this is known as pledge land. Rents paid are usually token, often in the form of gifts of food and/or drink, but the farmer has unstable tenure, and has to renew the pledge/lease every year. Only annual crops may be planted on pledge land, and it may not be built on, as the erection of buildings or planting of trees may increase the renter's security of tenure which could eventually merge into ownership (Chubb, 1961).

In Akwa Ibom State, land is classified by spatial arrangement and in terms of use. The spatial categorisation of land distinguishes compound land, near farmland and distant farmland. The classification of land according to use distinguishes groves, pasture land and farmland, and farmland can be further classified according to vegetation and soil type (Francis, 1987) for example, farmland rented to grow only cassava is known specifically as '*Ntongwo*' in Obiokpok village. Compound land is always owned by the farmer or members of the family as this is where the house has been built. Near and far farmland is also often owned by the cultivator, but in areas of high population density, renting farmland is common and is carried out in the same way as in Cross River State.

2.6.2 Tree tenure

Most traditional African property systems distinguish between trees and the land on which they are planted. Rights to one may be held and transferred independently of rights to the other, so parallel and distinct systems of land and tree tenure can and do exist (Francis, 1987). It is essential to examine tree tenure in an investigation of agroforestry potentials for the study area as this will help to explain farmers' willingness or reluctance to plant trees on their farmland. Traditional tree tenure laws have little variation within the study region.

Traditional laws relating to tree tenure treat various categories of trees in different ways, the simplest distinction being between naturally regenerated trees (wildings) and trees planted by humans. Naturally regenerated trees are automatically the property of the land owner, but planted trees are the property of the planter even if he/she does not own the land. It is for this reason that permission to plant trees on rented land is usually not given by the landlords. This situation means that there is no incentive to plant trees on borrowed or rented land, and it is unusual for permission to be sought by the tenant to do so. Any trees already present on rented land remain the property of the landlord even when the land is under cultivation by a tenant, and thus the landlord alone has access to any tree products. Trees present on community land, under cultivation by an individual, are the property of the person farming the area during the cultivation period, but revert to being community property while the land is under fallow.

In many communities, trees which are viewed as economic species, such as fruit or timber trees, are often willed or inherited separate to the land on which they are growing. It is therefore not uncommon for a single tree to be owned by three or four families who are descendants of the original owner of the tree, even though the land is used by only one family. In such cases the tree products are sold and the income is divided between the tree's owners. When trees are under community ownership, for example, a fruit tree growing within a village that was present when the area was originally settled, the tree products are usually sold and the income used for village development activities.

2.6.3 Modern land tenure

To further complicate matters, modern land tenure laws have been added to the picture so that areas may now have two or more sets of rules regarding land ownership and use. Examples of areas under 'modern' land tenure laws include large-scale government plantations, forest reserves, protected forest areas and the National Park and its support zone areas.

In September 1978, the Federal Government of Nigeria enacted a Land Use Decree which took effect from October 1979. From this date all land comprising the territory of each state is vested in the Governor of the state who holds it in trust for the benefit of all Nigerians. Therefore the state has the right to grant statutory rights of occupancy and charge rent for the land. It can also revoke any customary rights or acquire land for public use, but it must pay the former occupier compensation equal to any improvements made to the land. In the case of agricultural land, the state must allocate to its former user, alternative land for agriculture (Holland *et al.*, 1989).

In the study area there are two major sets of land tenure laws which are relevant to farming and forestry. The first of these are the laws concerning the forest reserves, most of which were decreed and the boundaries demarcated in the 1920s and 1930s by the colonial administration. The laws governing the forest reserves state that there is to be no small-scale logging or processing of timber in any reserve and hence no clearance for agriculture. Logging may be carried out in forest reserves only in concessions granted to established companies, but minimum girth limits apply and no trees may be felled below the appropriate girth limit without special permission from the Forestry Department. NTFPs may be collected, although for *Garcinia* spp., *Randia* spp., *Carpolobia lutea* G. Don, *Laccosperma* spp., *Calamus* spp. and Maranataceae permits must be obtained from the Forestry Department for the collection of commercial quantities, as defined by the current regulations. Hunting may also be carried out in forest reserves, with the exception of some endangered species which are protected by Federal Decree 11.

The second set of laws relevant to agroforestry are those concerning the new Cross River National Park. This is an area in which no human activity (except for research or tourism) is permitted, so no logging, collection of NTFPs, clearing for farms or hunting may take place. This may produce an artificial reduction in land available for agriculture and bring forward the need for the intensification and increased sustainability of agricultural systems in Cross River State.

Areas outside both Forest Reserve and the National Park and including Protected Forest and Community Forest, fall under the 1978 Land Use Decree (Siddle & Swindell, 1990). With respect to trees this means that no tree may be felled without first obtaining a permit from the Forestry Department, and special permission must be sought if the tree is below the minimum girth limit for that species. However, although permits are usually granted and are often seen merely as a formality, when forest or secondary bush are cleared for farmland this law tends to be ignored by both farmers and the Forestry Department and is only enforced for timber production.

2.7 Conclusions

The following conclusions are drawn for this chapter:

- Most farming in West Africa, and in Nigeria specifically, is conducted by farmers of small plots, using simple tools, mainly for subsistence.

- The Nigerian agriculture sector was in decline from 1967 and only began to recover in the mid-1980s, but agricultural self-sufficiency for the country has still not been reached.

- Bush-fallow rotation is the most common farming system in the study area, but is gradually becoming less productive due to pressure for farmland caused by increasing population through both birth rates and in migration.

- The study area is mainly in the humid tropical high forest zone, with the northernmost parts being located in the drier forest-savanna transition zone.

- Land tenure issues in the study area are complex, arising from a combination of traditional and modern land and tree tenure laws.

CHAPTER 3

Field research methods and the study villages.

3.1 Introduction

As discussed in Chapter 1, to date limited attention has been paid to the agroforestry, or farm forestry, potential of indigenous trees and shrubs, or to the value of indigenous knowledge about local environments, farming systems, and species in much of the tropical world. Rather, most examples of agroforestry research and development projects have so far concentrated on a few woody species about which most is known, usually non-indigenous taxa. In contrast, a wide range of local species and technologies have been largely ignored. The major objective of this study is therefore to examine the suitability of four carefully selected indigenous tree or shrub species for integration into local farming systems, both from the point of view of their ecological potential and of their social and economic acceptability.

This chapter is a description of the methodologies used in the social and biological surveys which took place. It begins, in Section 3.2, with a discussion of participatory research techniques and their relevance and use in the study. Section 3.3 contains descriptions of the study villages, and a discussion of how they were selected. Section 3.4 details the social survey methods used, including the choice of households and informants, and questionnaire development and use. Finally, in Section 3.5, full details of the methods used during the biological studies are presented. It is hoped that the unique combination of social surveys, participatory meetings and biological research will act as an early step in an overall reappraisal of the potential for the use of indigenous trees and shrubs and local knowledge and innovation in the development of appropriate agricultural systems.

3.2 Participatory research

Where possible, the study attempted to use the research approach that has become known as Participatory Rural Appraisal (PRA) which aims at involving farming households from the very beginning of identification of needs to the assessment of completed projects (McCracken *et al.*, 1988). PRA capitalises on and uses local knowledge and skills by involving local people in crucial decision making, so decisions or conclusions reached are practical and acceptable to the people affected by them. Above all it is a mind set by which researchers regard farmers as their equals or partners, with whom important lessons can be learned and relevant decisions made (Atte pers. comm., 1993). PRA does not aim to replace formal research techniques, but rather is a frame of mind that is able to make use of indigenous knowledge and skills to complement more traditional research. Chambers and Guijt (1995:5) describe PRA as "a growing family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act".

Dixon (1990) outlines a case from southern Nigeria where a study of the Variegated Grasshopper (*Zonocerus variegatus*) was undertaken in order to develop a control programme to reduce damage to crops and trees. Many farmers in the region had detailed knowledge concerning the life cycle of the insect and factors influencing mortality rates, and a few had already begun trials of their own control programmes, along the lines of those eventually suggested by the research project. Although some discoveries made by the scientific team were beyond the scope of farmers, in return the farmers were able to provide detailed historical information of insect attacks, as well as the relative significance of damage to minor, but locally significant crops (eg. fluted pumpkin in eastern Nigeria). The combination of these two types of data led to the development of a more locally appropriate control programme than may have arisen from a purely scientific point of view. This illustrates the potential advantages of a research partnership between scientists and farmers.

3.2.1. PRA techniques

PRA is not, therefore, a methodology in itself, but is more a way of combining a number of traditional research techniques in order that the study as a whole is the most appropriate to the chosen objectives, the topic, available time and resources, and the situation on the ground. It has evolved to enable development projects being established in rural areas to be researched and set up quickly, to address those problems that are seen by the communities to be the most important, and above all, to involve local people from the outset.

A PRA team is usually made up of members with different skills, if possible including at least one social scientist (sociologist, anthropologist, economist, community development expert), one natural scientist (forester, agronomist, soil scientist, biologist), and with inputs from many members of the local community. The roles of the PRA team and the villagers are generally quite different from those that they are generally accustomed to playing in development and research work, the villagers moulding the shape of the PRA sessions and having most of the knowledge, and the outsider PRA team acting as partners in learning (Mascarenhas *et al.*, 1991). Atte (1993) lists the following techniques, a combination of all or some of which may be used:

a) Interviews and questionnaire surveys for individuals, household groups and key informants;
b) Use of secondary data sources;
c) Direct observation in the study area;
d) Sampling techniques that can be adapted to particular objectives;
e) Cross checking information from different sources;
f) Methods of obtaining quantitative data - ranking, matrices, seasonality diagrams; and
g) Visual data analysis and presentation.

In order for the research techniques, many of which have been used for many years in more traditional socio-economic and development research, to be used successfully in a PRA framework, the practitioners should use a number of skills or attitudes so that information is collected and disseminated effectively, and projects are developed sensitively. Care should be taken to mould the PRA so that it fits in with local customs, protocol and situations in a delicate way. These skills or attitudes include:

a) Considerable communication skills with many different types and categories of people;
b) An intense curiosity and willingness to learn about new (to the PRA practitioners) situations;
c) Sensitivity to changes, events, diversity, status, local etiquette and political or cultural rules;

d) A non-attachment to status and power;

e) The capacity to begin to analyse data as it is collected so that any change in direction/emphasis that is needed is noted as early as possible; and

g) The concepts and practice of participation involving every relevant group.

(Atte pers. comm., 1993)

Thus the PRA practitioners or 'outsider professionals' have new roles. These include: convener for groups; catalyst and consultant to support, stimulate and advise; facilitator of farmers' own analysis; searcher and supplier of materials, principles and practices for the farmers to try; and travel agent to enable farmers to learn laterally from each other (Chambers, 1993).

3.2.2 PRA in the present study

This study was carried out over a period of eighteen months in the field, and as such it can be argued that as a whole it was not strictly a PRA, because it did not achieve results and begin project implementation quickly. However, throughout the study the emphasis was on indigenous tree species and local knowledge about those species and the communities participated as far as possible in the development of the research framework. The research team comprised a geographer/agroforester and an agricultural economist and, being familiar with the villages, was able to approach the work so that no offence was given to people in the village, and so that the communities were given the chance to participate in the study as much as possible.

The first stage of the study was the collection of information about the use of woody perennials in the study villages. An informal questionnaire was developed in such a way that it was flexible, and the emphasis on particular topics could be changed as the interviews progressed as discussed in 3.4. A checklist of points to be covered was followed by interviewers, but where farmers wanted to discuss a particular point in more detail, or to add some information not initially on the list, this was able to take place. For example discussion of credit facilities for farmers and lack of capital was only a minor topic on the original checklist, but many of the informants (52% of respondents in Abo Mkpang and 48% of respondents in Igonigoni) wished to discuss this in great detail as well as related topics such as the difficulty of buying tools and lack of access to chemical inputs, as they felt they were major agricultural constraints. At this stage most of the interviews were carried out on a one-to-one basis in the respondent's house or on the farm. Information was also gathered on other relevant topics such as laws relating to tree planting or harvesting, and any agricultural problems encountered.

The second stage of the study, the biological observations and trials, was the least participatory of the three in that the selection of sample trees and the monthly biological measurements were carried out by the researcher. However the selection of the four woody species to be studied was carried out in close consultation with the farmers, as discussed in 3.5. Attempts were also made to get selected farmers to participate in village-based germination trials of the four species.

The third stage of the research aimed to combine both the farmers' knowledge about local agricultural systems and their problems, and the biological data collected for the four selected tree species. The problems outlined by farmers during the first stage of the research were re-examined with a view to addressing some of them by making use of the germination, growth and phenological data collected during the biological studies. This stage of the research encountered a number of problems which meant that meetings evolved along different lines in the two villages. Not as much was achieved during this part of the research as was envisaged at the outset, but some useful lessons were learned and have been incorporated into the development of a PRA framework for use by extension agents and other field staff as described in Chapter 8. However it is hoped that the meetings acted as a catalyst for some farmers, who were already aware of many of the agroforestry potentials of the selected trees and who may be able to develop modified farming systems with which to experiment. A full description of the meetings held during this stage of the study is presented in Chapter 6.

3.3 Selection of the study villages

Before embarking on the field work for this study, research was carried out in U.K. and in Nigeria in order to determine the most useful areas from which to select the study villages. The study area as a whole, located in south eastern Nigeria, was selected for the fieldwork because the author would be living in the region with her husband who had been posted there on an ODA-funded forestry project. However, it is also a region in which little work of this kind had previously been carried out, and where many changes in rural land use were taking place, so it was felt that it would be an appropriate area in which to carry out such research.

Due to the nature of this study, it was necessary, especially during the questionnaire survey and participatory meetings stages, to have developed positive relationships with the participants. Therefore in order for the researcher to become very familiar with the study villages, only two were selected for the main research. In order that comparisons could be made, the villages chosen were located in two different vegetation zones, Abo Mkpang in an area with much relatively intact tropical high forest, and Igonigoni in derived savanna in which little or no forest remains, though some woody species are still available and in use (Figure 3.1).

The main criterion used for selection of one study village from each of the vegetation zones was the receptiveness of the people in each village to the work. When describing the study to the villagers, academic reasons for the work were emphasised so that people were not suspicious that the work was being carried out for a government agency and therefore be tempted to withhold information (Dixon & Leach, 1984).

Approximately fifteen villages were visited during preliminary fieldwork (April - June 1992) and the purpose of the study was discussed with the chief and other villagers before the final selection of two was made in Cross River State. Approval to work in the area was also sought and obtained from relevant government agencies such as the Cross River State Forestry Department and the Cross River National Park. This process was eased by previous contact and good relationships with these bodies before fieldwork was initiated.

Obtaining demographic data in Nigeria is extremely difficult. Detailed results of the Government Census carried out in 1992 still have not been

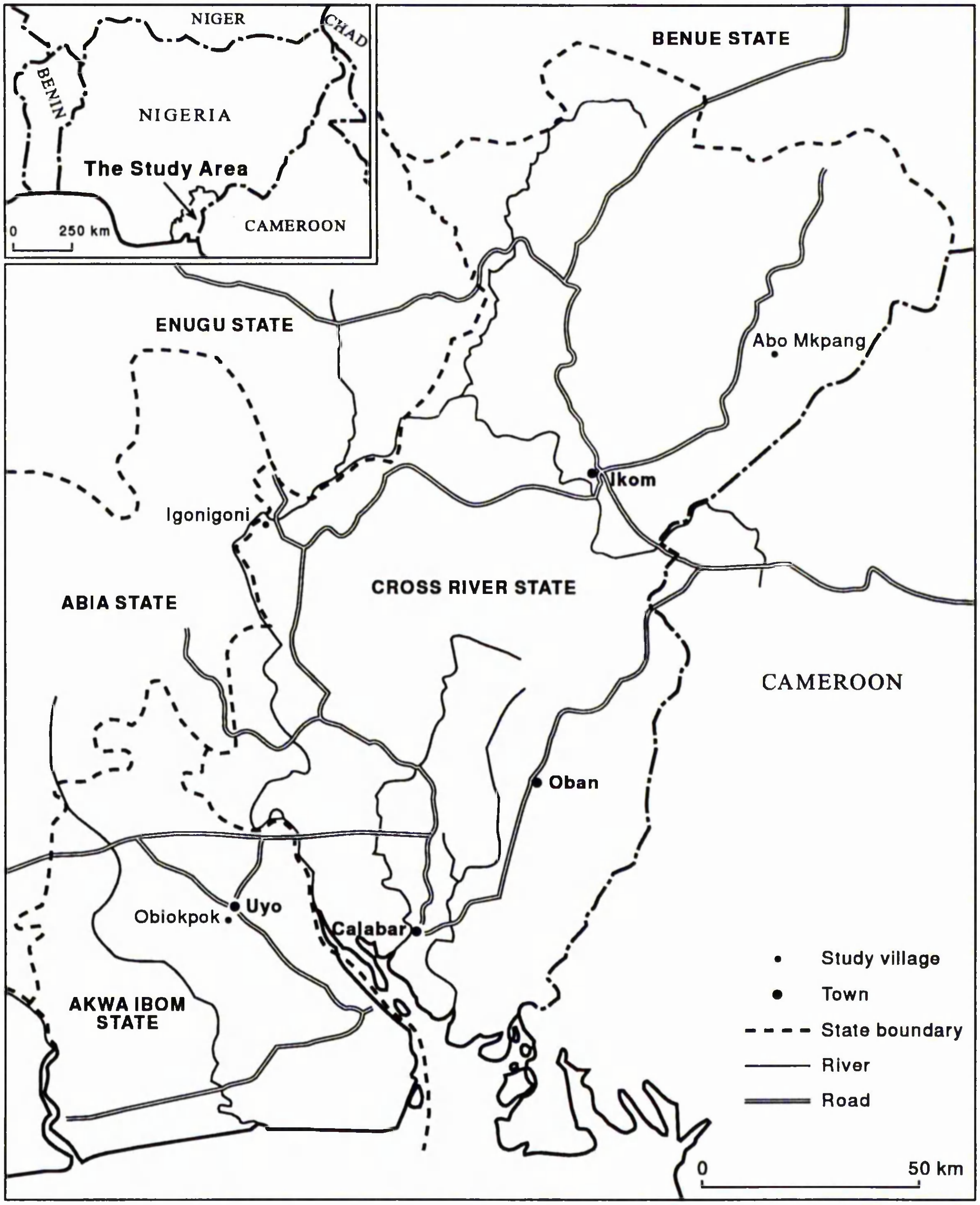


Figure 3.1 The location of the three study villages.

released due to many underlying political problems attached to the data, such as the allocation of State Government Funding according to the population of each state. Therefore, based on information in a CRNP report (Holland *et al.*, 1989) and on the author's previous experience (both immediately prior to the study and while living in other areas of Nigeria for many years from the age of 12) a pragmatic attempt was made to select villages which were representative in size, physical structure, and accessibility, of many rural villages in the state.

Once field work began, the two villages were visited once a month for three or four days each during the period of the questionnaire survey. After the selection of the study trees in each village, regular visits continued in order to make monthly measurements and observations. During the final participatory meetings stage of the field work visits of two to three days were made to each village. Access to Abo Mkpang and Igonigoni was difficult, especially during the rainy season when the tracks leading to them become treacherous. A Landrover was used for all field visits, essential during the wet season when the road to Abo Mkpang was impassable to all but four-wheel drive vehicles. An itinerary of fieldwork visits is shown in **Appendix B**.

In addition to the two main study villages, a third village, Obiokpok, was also selected from a neighbouring state, Akwa Ibom. Forest has not existed in this region for a longer period of time than in the main study area and more intensive farming methods have evolved to counteract the increased pressure for farmland. Obiokpok, typical of many villages in Akwa Ibom, was selected due to contacts already having been established within the village, and therefore the ability to get approval quickly and easily from the Chief and the Village Council for work to be carried out. As a matter of courtesy, the Akwa Ibom State Forestry Department was also informed about the work. The questionnaire survey alone was carried out in this village in order to gather some background and comparative information for the study as a whole.

3.3.1 Study Village 1: Abo Mkpang

Abo Mkpang is located in Boki Local Government Area (LGA) in the northern half of Cross River State, approximately between the two major towns of Ikom to the south west and Obudu to the north east. It is a village of approximately four hundred inhabitants made up of about forty-five households arranged in a nucleated pattern (Figure 3.2). Abo Mkpang is 10 km from any surfaced road, and especially during the rainy season, the bush road leading to it is impassable to all but four-wheel drive vehicles. Most of the dwellings in the village are constructed from poles and mud, with metal roofs (Figure 3.3), although some villagers have cement block houses.

Situated in the high forest zone in an area that is still heavily forested, primarily Wet Evergreen and Moist Evergreen forest as described in 2.4.3, the village is in an area of low population density and is in the Support Zone of the newly formed Cross River National Park, being one of the closest villages to the park itself. Obtaining water supplies in the dry season is a major problem for the community, when the few streams located close to the village disappear, and villagers have to walk into the forest in order to collect clean water. During the wet season most water used for drinking and cooking is rainwater collected from roofs, while bathing and clothes washing is done in nearby streams.

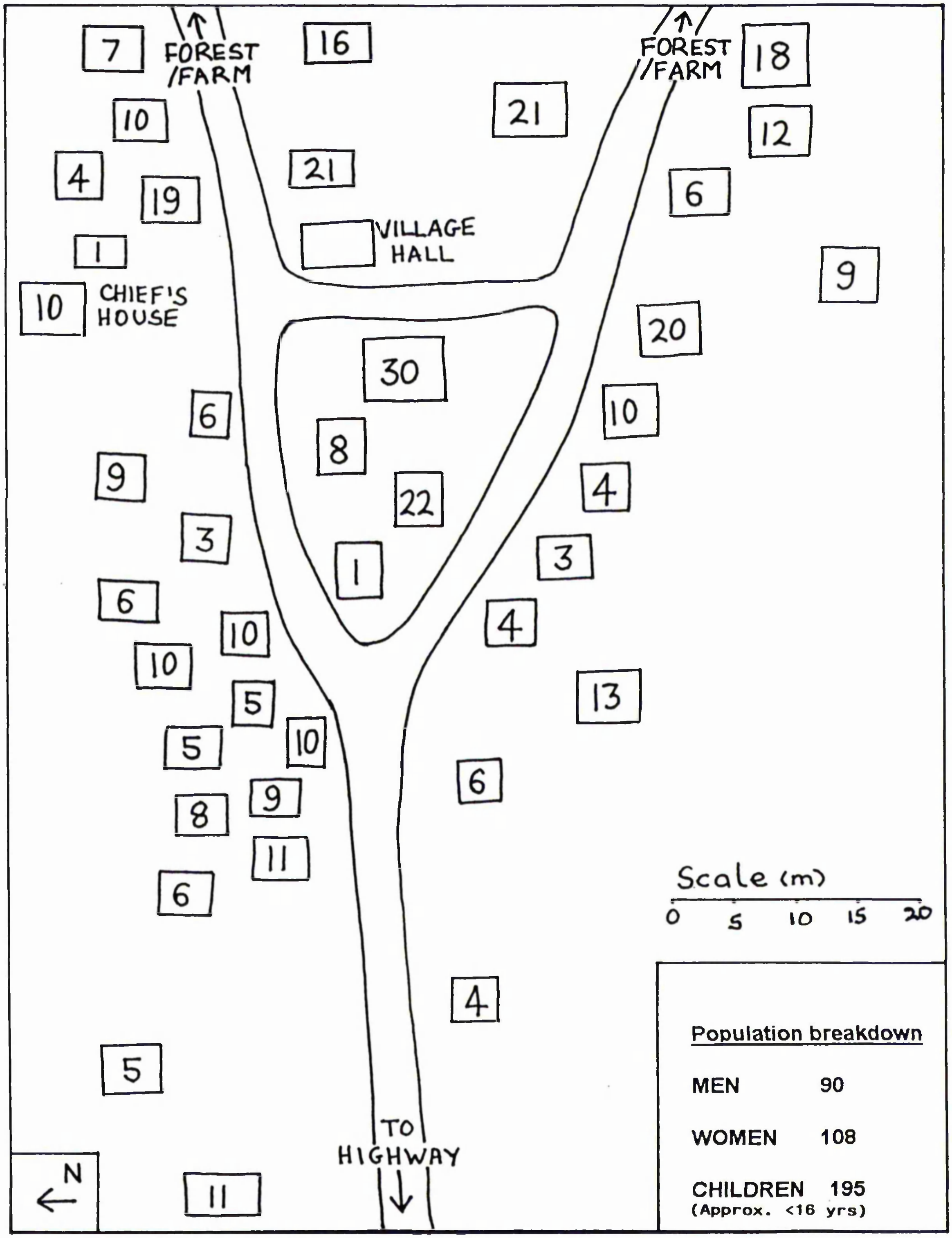


Figure 3.2 Sketch map of Abo Mkpang, Cross River State, showing the number of people resident in each house, produced by a combination of the villagers and the researchers during the survey period, 1992.

Figure 3.3 The centre of Abo Mkpang village, showing the typical mud houses with corrugated metal roofing, October 1994 (Photo: the author).

Agricultural production by inhabitants of Abo Mkpang is largely for subsistence, the food crop farms being cultivated as part of a bush fallow system and the crops being grown in a pattern of intercropping. Cassava is the main staple grown, combined with a mixture of many of the other food crops listed in Table 2.2 (Figure 3.4). Forest land is still easily obtained and 91% of respondents acquire new land by forest clearance, while only 6.5% expand their farm area by inheriting land that has been cultivated in the past. Due to the abundance of undisturbed forest land, many of the families also own banana plantations which are developed only on newly cleared farm plots. Banana stems are brought back to the village from the farm each day and the produce is then sold weekly to buyers who come to the village (Figure

Figure 3.4 An example of a food farm growing cassava and bananas, near Abo Mkpang, Cross River State, September 1993 (Photo: the author).

3.5). The general feeling is that there not a significant pressure for agricultural land. Only 15% of respondents felt that available land is limited, with 85% stating that there is plenty of land. Therefore fallow periods are on average four to seven years in length, with a range of two to fifteen years, and crop yields are said to be satisfactory. Because of this, little is actively done to maintain soil fertility on the farms, but some villagers add household waste to backyard gardens to improve soil fertility there. The only livestock in the village are chickens which are kept by 80% of respondents; goats have been tried in the past, but villagers complained that it was impossible to obtain veterinary extension advice as the village is so remote, so the animals quickly became sick and died. There are plans under the National Park support zone programme to set up a piggery in the village, but at least two years after conception of the idea little has been achieved to this end.

NTFP collection is also an important activity in the village, much of it to supplement the food grown on farms in terms of quantity and variety, but some NTFPs, such as afang (*Gnetum africanum* L.), bush mango (*Irvingia gabonensis*) (see 4.3.2) and bush meat, are mainly sold to outsiders, who then retail them in other areas of Cross River State.

There are few examples of indigenous agroforestry systems in this area, 1
probably because of the abundance of forest close by. Often, when land is initially cleared for agriculture, some of the more valuable trees, such as *Milicia excelsa*, *Terminalia* spp., *Irvingia gabonensis* and *Dacryodes edulis*, are left unharmed, and in some cases are even planted on farm plots. All respondents stated that they have and make use of trees on their farms, usually for obtaining fruit or some other product.

Figure 3.5 Bananas are brought to the village from the farms and are piled in home compounds awaiting collection by traders approximately once a week: Abo Mkpang three days before the traders are due to arrive, September 1993 (Photo: the author).

There is knowledge of the soil-improving qualities of some tree species (**4.3.5**), but none of these are planted, although they may be left standing if present when the forest is initially cleared. Few trees are planted around the houses, most of which are cultivated are exotic fruit trees as is detailed in **4.3**, mainly because of access to the forest and its products.

3.3.2 Study Village 2: Igonigoni

Igonigoni in Abi LGA in the west of Cross River State, the closest major town being Ugep, is a village of approximately seven hundred inhabitants made up of about ninety households arranged in a nucleated pattern (Figure 3.6). A number of the dwellings in the village are part-time residences as their inhabitants work away from home, often in nearby towns such as Ugep, Ikom or Calabar, only returning for holidays or special occasions. Therefore the number of households included in the survey reflects those that are lived in full-time. The village is situated approximately 11 km from a surfaced road, but is less isolated than Abo Mkpang as there is a small ferry area at the end of the track that is used frequently to reach Abia State across the Cross River. Although some dwellings are constructed of mud and thatch, most of the houses in this village are made from cement blocks with zinc roofs. There is no primary forest remaining in this area as it has been cleared for farming (Figure 3.7), and the existing bush, which is severely degraded, is classified as derived savanna as described in **2.4.3**. Available farmland is scarce around the village, 83% of respondents stated that there is a shortage of land in this area, and many people (71%) now rent or borrow plots from neighbouring villages.

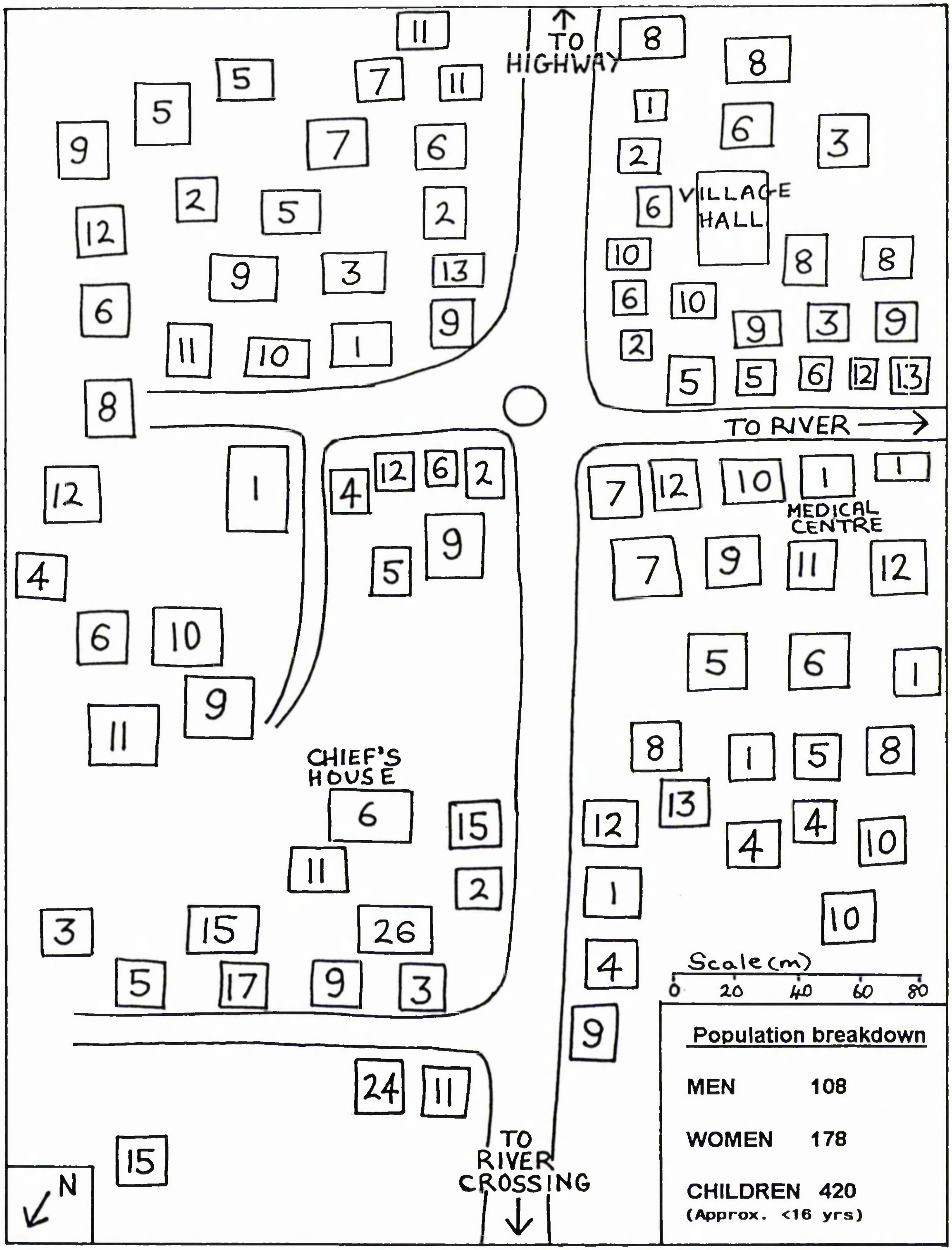


Figure 3.6 Sketch map of Igonigoni, Cross River State, showing the number of people resident in each house, produced by a combination of the villagers and the researchers during the survey period, 1992.

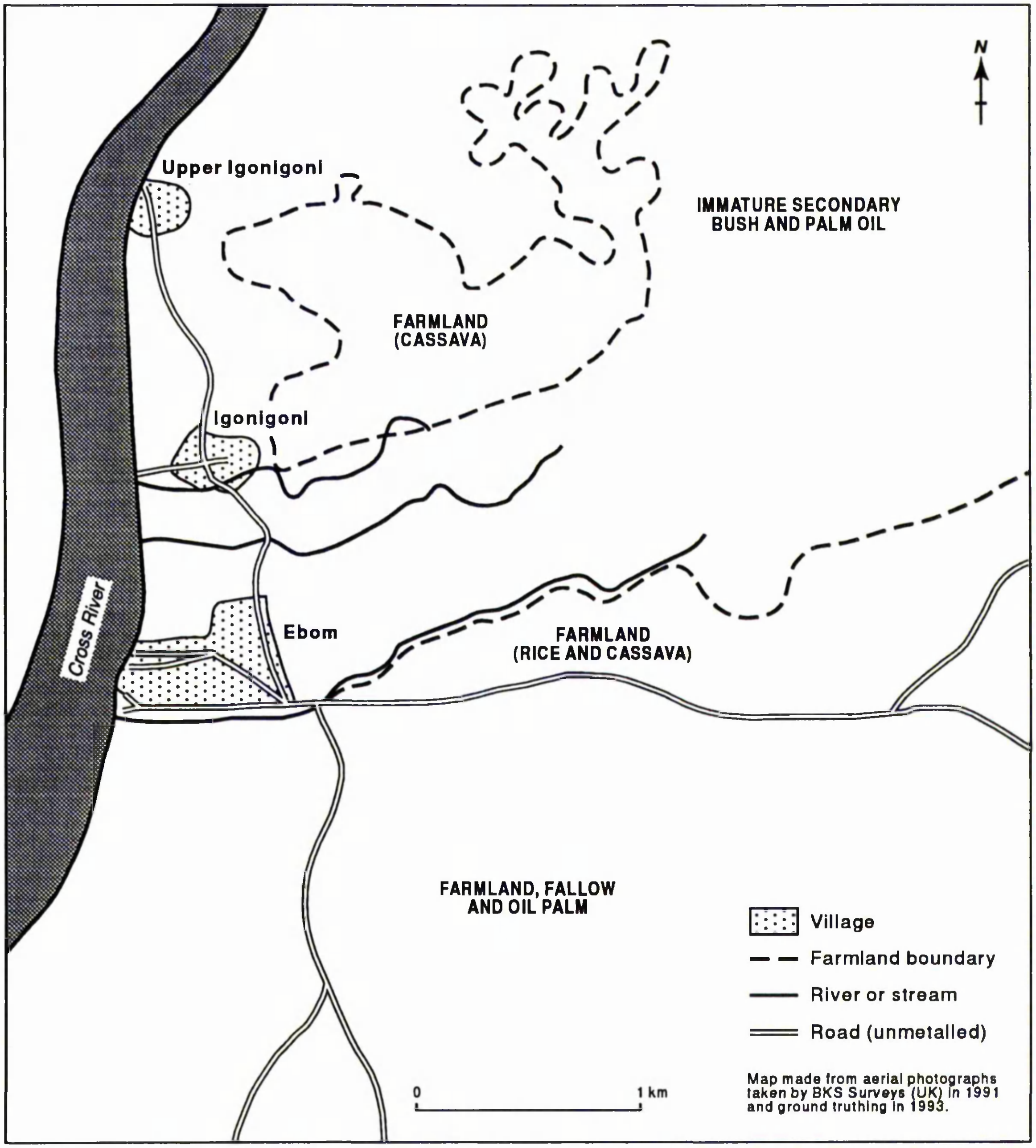


Figure 3.7 A map of Igonigoni village and the surrounding area, 1993.

Figure 3.8 Cassava monocropping on degraded soils, Igonigoni, Cross River State, November 1993 (Photo: the author).

The major farming system employed in the village is rotational bush fallow, with relatively short fallow periods of, on average, one to four years due to the increasing pressure for farmland. As a result of the shortened fallow, during which time very few woody plants have a chance to become re-established, the soil structure is rapidly becoming degraded, and soil fertility is generally low. However, although 40% of people complained of lowering crop yields and 83% mentioned a shortage of land, few efforts are made to add inputs to the soil in an attempt to improve productivity. A few respondents mentioned the use of compost (24%), but this tended to be in the form of household waste being applied to backyard gardens. Much of the farmland can now only support cassava, and it is common to see areas of poor condition, cassava monocropping (Figure 3.8), rather than the mixed intercropping more common in this agro-ecological zone.

There are two more unusual farming systems also employed in Igonigoni, which for many people help them to produce enough food to survive. The first of these is a pattern of 'River farms', an area of land adjacent to the Cross River which is flooded every year and thus is always fertile, owned by 93% of respondents. Here a mixture, primarily of groundnuts and cassava, is grown during the dry season, and harvested at the beginning of the wet season when the area begins to flood again. About 3 km outside the village, some farmers (15% of respondents) also own plots in swamp rice fields. These are unirrigated, the rice being grown during the rainy season when the area is waterlogged, and harvested during the dry season. The fields are generally much larger than one family could cultivate, and are divided into plots, marked by bamboo poles at each corner of the plot. Apart from poultry, which is kept by 63% of respondents, there is no livestock in the village as a local rule forbids the keeping of sheep and goats because they can cause too much damage to farms. However, four of the villagers interviewed own goats which are kept by relatives in a neighbouring village where no such laws exist.

More use is made of areas of land around houses in Igonigoni than in Abo Mkpang, especially for the planting of fruit trees and trees with edible leaves as discussed in **4.3**. This, in part, makes up for the lack of access to bush or forest and the resultant reduction in NTFP availability, by adding variety to the diet, and providing products to be sold to supplement household incomes and is discussed in greater detail in **4.2** and **4.5**.

3.3.3 Study Village 3: Obiokpok

Obiokpok is a village in Nsit Ibom LGA of Akwa Ibom State and lies 9 km south west of the state capital, Uyo. The settlement consists of compounds dispersed throughout the village territory, joined by a network of small tracks (Figure 3.9). The village, located in a region of high population density, is in an area with no forest remaining and only a few isolated patches of immature secondary bush. Most of the land in the village territory is farm or fallow land, which is known as 'palm bush' due to the predominance of oil palms (*Elaeis guineensis*) which are preserved during clearing and burning of the fallow due to their importance for the production of palm fruits (for palm oil) and palm wine. Farms in this area are mainly used for cassava and sweet yam production with a few other crops such as cocoyam, maize, melon, pumpkin and okra sometimes interplanted.

Due to the dispersed settlement pattern typical of this area, each house is surrounded by, on average, 0.25 to 0.5 ha of land which is intensively cultivated in the form of multistorey homegardens. Here many food crops are grown in intimate mixtures, with a large number of trees and shrubs also present. As there is no mature bush in this area, the homegardens have developed to provide many of the products that are no longer available to the villagers. Trees are planted to provide food, medicines, building materials and timber, as well as acting as soil improvers to help maintain productivity of food crops. Some traditional forest NTFPs are also planted, such as afang (*Gnetum africanum*) and wrapping leaves (Marantaceae). Many households (83% of respondents) keep chickens, and 73% of respondents keep sheep and goats, either in stalls or pens, or carefully tethered when grazing so that they cannot cause

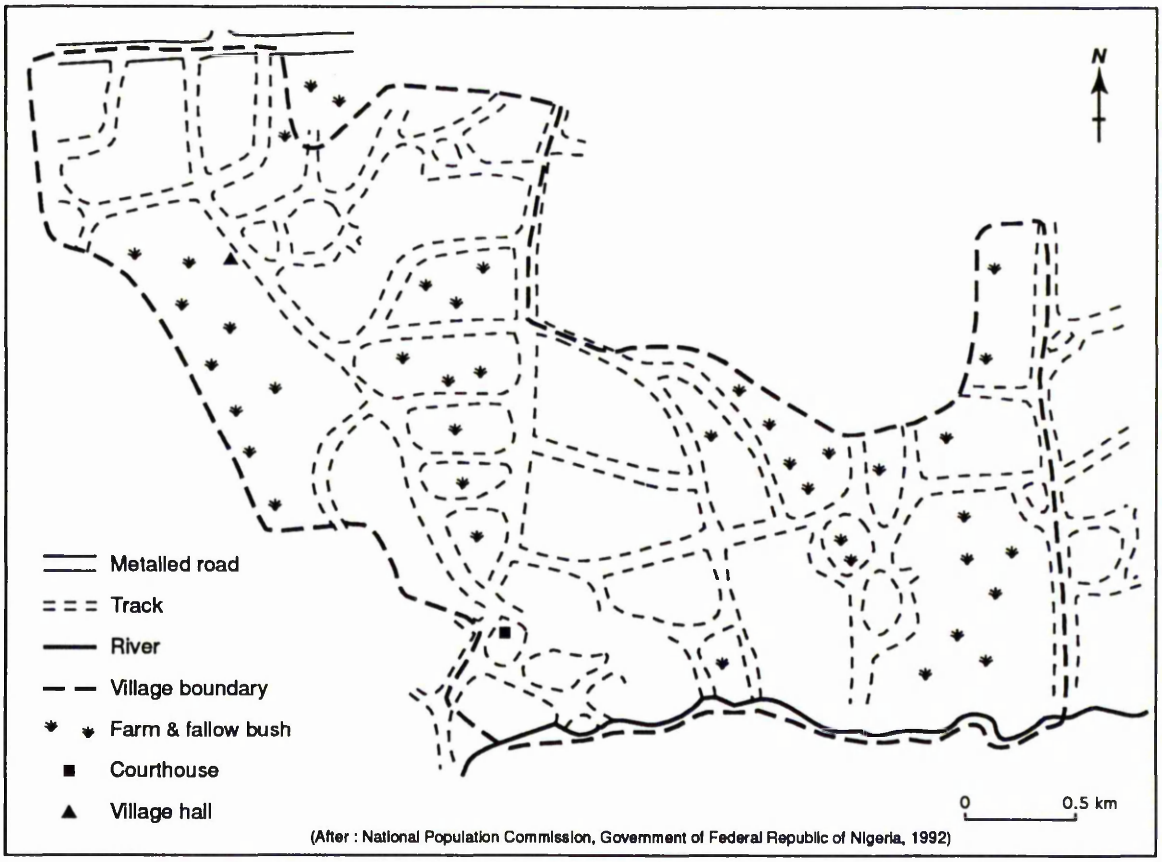


Figure 3.9 A map of Obiokpok village in Akwa Ibom State showing the complex network of tracks joining the dispersed households.

damage to the home gardens. Especially in the home gardens, soil fertility is actively maintained by 71% of respondents. Manure from the livestock and household waste is used by 39%, compost by 12%, chemical fertilizers by 20% and nothing is used by 29%, although litter accumulation and free range chickens were adding to the soil even for these households.

3.4 Social surveys

Although much has been written about general social and economic research in the tropics (Kearl, 1976; Dixon & Leach, 1984) it was not until just over a decade ago that attention was given to the use of socio-economic data in agricultural or forestry-based research (Sutherland, 1987; McCorkle, 1989). As is discussed in detail in Chapter 7, it has gradually been realised that this research should not be carried out in isolation and a number of techniques have been developed to widen forestry or agricultural programmes to include socio-economic considerations (Arnold & Kanowski, 1993).

'Diagnosis and Design' (D&D) was one of the first of such techniques, developed by the International Council for Research in Agroforestry (ICRAF) in Kenya (Raintree, 1987) and aims to involve all the relevant disciplines in any survey work that is carried out. Since its development it has become more common for a multidisciplinary approach, including economics, sociology, forestry, agriculture and anthropology, to be applied to agroforestry and social forestry research (Poostchi, 1986; Cook & Grut, 1989). Such an integrated approach is used primarily as an attempt to address agricultural questions, not in isolation, but by taking account of local knowledge and opinions, and socio-economic and environmental conditions. An example of the use of the D&D system was a survey carried out in southern and central Ghana in 1989 as part of AFRENA (Agroforestry Research Network for Africa), a wider agroforestry research and development programme based in ICRAF, Kenya. Here a research team made up of ICRAF officials, university staff and Agricultural Department officers carried out a ten day tour of the region, speaking to farmers and village heads, and from this developed recommendations and outlines for the establishment of an agroforestry research programme relevant to the area surveyed (Quashie-Sam *et al.*, 1991). Although some attempt was made to include farmers, the planning of the survey (ie. which areas should be visited in the limited time available) and the final discussions and writing of the report, were carried out entirely by ICRAF, university or agriculture department staff. As such practices are still relatively new to farming systems and forestry research, however, there is much that can be learned from the experience gained in traditional socio-economic surveys in the tropics (Nichols, 1991), and more recently from the newer developments such as participatory rural appraisal (Mascarenhas *et al.*, 1991).

The second major development was to begin to involve local people in the research and decision-making processes. This began with a move towards local participation in social science research as it was felt that conventional quantitative and neutral research methods tended to preserve social inequality (Farrington & Martin, 1988). This was accompanied by the development of Farming Systems Research which emerged as a response to the criticism that new agricultural technology was frequently irrelevant to small-scale farmers (Shaner *et al.*, 1982; Sutherland, 1987, Biggs, 1995). A combination of these two approaches has lead to the formation of farmer participatory research which largely arose due to the realisation that resource-poor farmers stand to gain little from 'Green Revolution' agricultural development which is often unable to produce appropriate solutions to the problems of this group of land users. In many cases this does not yet involve farmers in vital decision making stages of research, but merely asks them to carry out research designed by outsiders on their own fields with varying rates of inputs from research and/or extension agencies (Biggs, 1989), as illustrated by the CRADP agroforestry research programme outlined in 7.4.1 (Ateh-Abang, pers.comm., 1994). In order to be most effective it is argued that processes should be evolutionary rather than revolutionary so that the real problems are addressed, and should draw as much as possible on farmers' indigenous technical knowledge (Farrington & Martin, 1988). There are many different approaches to farmer participatory research and the methods used during this study are discussed in detail in relevant sections.

3.4.1 Background data collection

Before embarking on extensive fieldwork, it is important to try and gain as complete a picture of the study area as possible from secondary data sources. This means that once in the field, time is not wasted gathering information that is merely a repetition of that which can be found easily in the literature. Sutherland (1987) feels that literature review is under-used and under-valued in farming-systems research, but Andrew and Hildebrand (1982) caution against use of secondary data without balancing, and partially confirming, them with primary data collected in the field. For this study, collection of data from secondary sources was carried out in the United Kingdom and in Nigeria prior to the start of the field survey work. Unfortunately, available information about the multiple uses of trees in West Africa largely concerns the drier savanna or Sahelian regions rather than the tropical high forest zone (eg. Bergeret & Ribot, 1990; Breman & Kessler, 1995, Schreckenberg, 1996). This is possibly due to the fact that it is the drier regions where most agricultural research and development has taken place in recent years in response to worsening environmental conditions. Therefore, there was not a great deal of background data to be found, especially in the form of previous studies of this kind.

Once in the study area, time was spent becoming familiar with common farming systems as well as other relevant background information such as the presence of Forest Reserves and National Park boundaries. During the introductory period of this study some survey work was carried out for the Cross River National Park Project and this enabled the author to become familiar with a number of villages in the high forest zone. Throughout the study a great deal of useful information not to be found in the literature was gathered through conversations with local field staff and farmers, and as such much anecdotal evidence has been used in descriptions of the study area and its socio-economic conditions (eg. 2.4, 3.3 & 7.2).

The gathering of information from secondary sources also makes the development of questionnaires or field check lists an easier task. With a good background knowledge of the study area it is possible to develop a questionnaire form which should need few major changes (Dixon & Leach, 1984). However, no matter how thorough the work is before the preparation of a questionnaire, parts that are culturally or socio-economically inappropriate to the field situation will still remain (Ifeka, pers.comm., 1994) and the final questionnaire has to be flexible enough so that these problems can be rectified during the actual field surveys. When making use of participatory methods of data collection in the field, survey forms or check lists need to be even more flexible so that it is possible for local people to emphasise those areas which they feel are important.

3.4.2 Development of questionnaire surveys

The questionnaires for this study were developed in Nigeria after a preliminary field work period and in such a way that the interviews that were carried out were as short and as informal as possible. When initially meeting a farmer, explaining the purpose of the study, and asking him to give up some of his time, a long questionnaire, with large quantities of paper in evidence, can be extremely off-putting to the interviewee (Tollens, 1976). In addition, as both the interviewer and the interviewee become tired, inaccurate data maybe collected if the interview continues for an unreasonable length of time, so it is much easier and more effective to carry out short interviews.

Many people in rural areas with non-Western cultures do not respond well to formal, structured interviews as they are not used to answering a series of direct questions (Ziche, 1990). From my own experience of agroforestry diagnosis and design work in Ghana, an informal interview is more useful for gathering the type of information required for this kind of study and for tailoring interviews to suit each respondent, than is a formal question-and-answer-session. If the farmer feels s/he is engaged in a two-way conversation, rather than being interrogated, s/he is often relaxed and willing to speak more fully about particular topics. One criticism levelled at formal quantitative research survey methods is that the research subjects are in reality objects with no influence on the research direction (Streiffeler, 1990). In contrast, an open, informal interview enables the interviewer and the informant to pursue, in depth, any points that seem to be relevant to the study but are not actually detailed on the questionnaire sheet.

Open interviews do, however, produce data which are more difficult to categorize and work with at the analysis stage. The results of descriptive, often non-quantified interviews do not easily lend themselves to statistical analysis (Ziche, 1990). The interviewer should be careful to record information relevant to the study and therefore requires greater skills, understanding, tact and a deeper knowledge of the subject matter than is required in formal interviews (Ziche, 1990). In such situations, interviewers need to be sensitive to the emphasis placed by farmers on particular areas and to focus on these so that any preconceptions that interviewers may have do not reduce or exaggerate the importance, as perceived by the farmers, of certain subjects (Atte, 1980).

When interviewing the farmers in the two main study villages during the first survey period, attempts were made to make the sessions as private as possible so that no bias was introduced into the answers by the presence of other farmers or members of the family. Farmers in a group situation will tend to give similar answers through debate (Röling, 1976), but this discussion aspect was made use of in the third village and during the village meetings described in **Chapter 6**. Privacy was more important when interviewing women, who are generally reluctant to speak at length in the presence of men. It was prudent to make best use of the fact that the author is female in order to make the most of the interview time spent with women. It was also important however, to have a male member on the survey team as many of the men in each village were often only willing to discuss particular topics, such as the use and types of traditional medicines, with a man. In reality, due to the social structure of households and the apparent lack of a need for privacy found in many Nigerian villages, interviews often took place in the presence of an ever-changing audience.

During the survey period, it was found that the most effective way of using the questionnaire forms was simply as a checklist to remind interviewers of important information required and this allowed changes to be made to interviews where necessary. In Igonigoni, for example, the original questionnaire form was inappropriate for gathering information on farming systems, as most families have three types of farm which produce a wide variety of crops at different times of the year, but this was easily remedied so that local farming systems could be fully covered during discussions.

3.4.3 Collection of additional data

Observation in the field was an important data source in this study. This was done both informally during the questionnaire survey period, with observations being noted on the survey sheets, and more formally during the biological survey period as detailed in 3.5. Notes were made on factors such as the surrounding vegetation, slope gradients, soil erosion, crop layout, and so on. In addition it was useful to check visually some of the statements being made by the farmers during the interviews. Sutherland (1987) states that skilful informal interviewing and participant observation, combined with recording, can be very effective data collection techniques.

Informal market surveys were also carried out as part of the field observation. Initially all bush and town markets that were encountered during field work were visited in order to gauge what sort of tree products were for sale. Later in the study, further market visits were made to look at the quantities available and the prices of the products from the four selected trees and shrubs. Information about these tree and shrub products was also obtained from a non-timber forest products (NTFP) survey being carried out by the ODA-funded Cross River State Forestry Project (Alexander & Effa, 1994).

3.4.4 Logistical and social considerations

A research assistant was employed to help with field data collection, both social and biological, and with putting data into the computer. As an agricultural economics graduate of the University of Calabar and an indigene of Cross River State, he had a good background knowledge of agricultural and social practices within the study area prior to beginning the fieldwork. As his mother is Boki, he was also able to assist with questionnaire and interview translation in Abo Mkpang, and his knowledge of a number of other local languages was valuable during market surveys and in the third study village. It was felt that as there are so many languages within the study area, language training for the researcher would not be an appropriate use of time. Therefore apart from a few greetings, she relied on 'pidgin' English (a widely spoken local simplified form of English) and on other people for translation. Pidgen English was especially useful during times of social interaction with the villagers when using a translator is not conducive to relaxed conversation, and the accuracy of what is being said is not so important.

Due to the nature of this study, that is the combination of social and biological research, it was possible to carry out each part of the work at the most appropriate time of the year. Farmers are generally unwilling to spend much time on interviews during busy periods (Kearl, 1976) and so the data collected at these times may be inaccurate as the interviews are conducted too quickly. It thus proved possible to limit the social surveys and participatory research meetings to periods when farm work was at a minimum, while the biological studies could be carried out throughout the year.

The study villages were visited frequently for a period of eighteen months which enabled the researchers to be largely accepted within the communities. All usual protocols were observed at each visit, such as the presentation of a small gift, traditionally a bottle of local spirit, to the Chief, and the acceptance and chewing of kola nut in return. Acceptance, especially by the women, was eased by the presence of the author's daughter who was ten months old at the start of the fieldwork period, as carrying a baby to work is normal practice in the villages. Staying in the villages during fieldwork visits meant that closer relationships could be formed as time was spent visiting people in the evenings. These factors led to ease of execution of the field research and were especially important during the participatory meetings in the final stage of the work, but as discussed in Chapter 6 also produced some problems during this period. Much background information, such as village political intrigue, decisions made by Ekpe or juju courts (the traditional legal system) and difficulties in marketing produce, which would not normally have been obtained through questionnaire sessions, was gathered informally during valuable times socialising with groups of villagers at the end of the day. Being a white female and therefore seen as being different from village women, the researcher was often invited to talk and drink palm wine with groups of men and thus had a chance to hear the views of both gender groups on many matters. Above all, these times led to the creation of a better understanding of the intricate political workings of the villages which hopefully enabled the author to form appropriate and useful expectations about the end use of the research data.

3.4.5 Selection of households

Due to the nature of this study a combination of sampling techniques were used which enabled many of the choices or selections to be based on socio-economic and ecological criteria, rather than purely on their statistical relevance.

The design of a sampling frame can be an extremely important part of survey research where mistakes mean that the data generated do not accurately describe the target population (Andrew & Hildebrand, 1982). One way out of this problem, and that of villagers not understanding why they have/have not been selected for interview, is to interview everyone living in the sampled area (Ziche, 1990). As the two main study villages selected had small populations, it was possible to conduct the questionnaire survey with one member of every household in each village. This avoided the need for a sampling frame and ensured that all socio-economic types in the villages were interviewed. Selection of the member to be interviewed was normally the most senior household member present, and interviews took place at different times of day so no bias was introduced by particular individuals being away from the household at particular times. Heads of household were not specified as the informant group, but rather were included randomly if they happened to be present at the time the interview was conducted. The main reason for this was that in the study area, most heads of household are male and it was felt that this would introduce bias into survey results. Instead a wide variety of informants was included in the survey, with forty male and six female in Abo Mkpang and thirty-five male and thirty-four female in Igonigoni. It is difficult to explain fully the low number of female respondents in Abo Mkpang. One possible reason is that households in this village often contain many extended family members, and therefore a senior male was very likely to be at home when the survey was taking place, and to take the lead in answering questions. Therefore, although females were often present during discussions, they have not been recorded as the main respondent.

In the third study village, which had a larger population and covered a much wider area, a sampling system used was to carry out complete coverage of segments of the village. The village was divided into eleven segments using a 1992 government census map (Figure 3.10) and the segments were numbered, and five selected at random (Dixon & Leach, 1984). Surveying then took place of all households within each of the chosen segments, and the selection of people to be interviewed was the same as in the two main study villages. In most cases two or more people were encouraged to take part in these interviews in anticipation of some useful discussions developing.

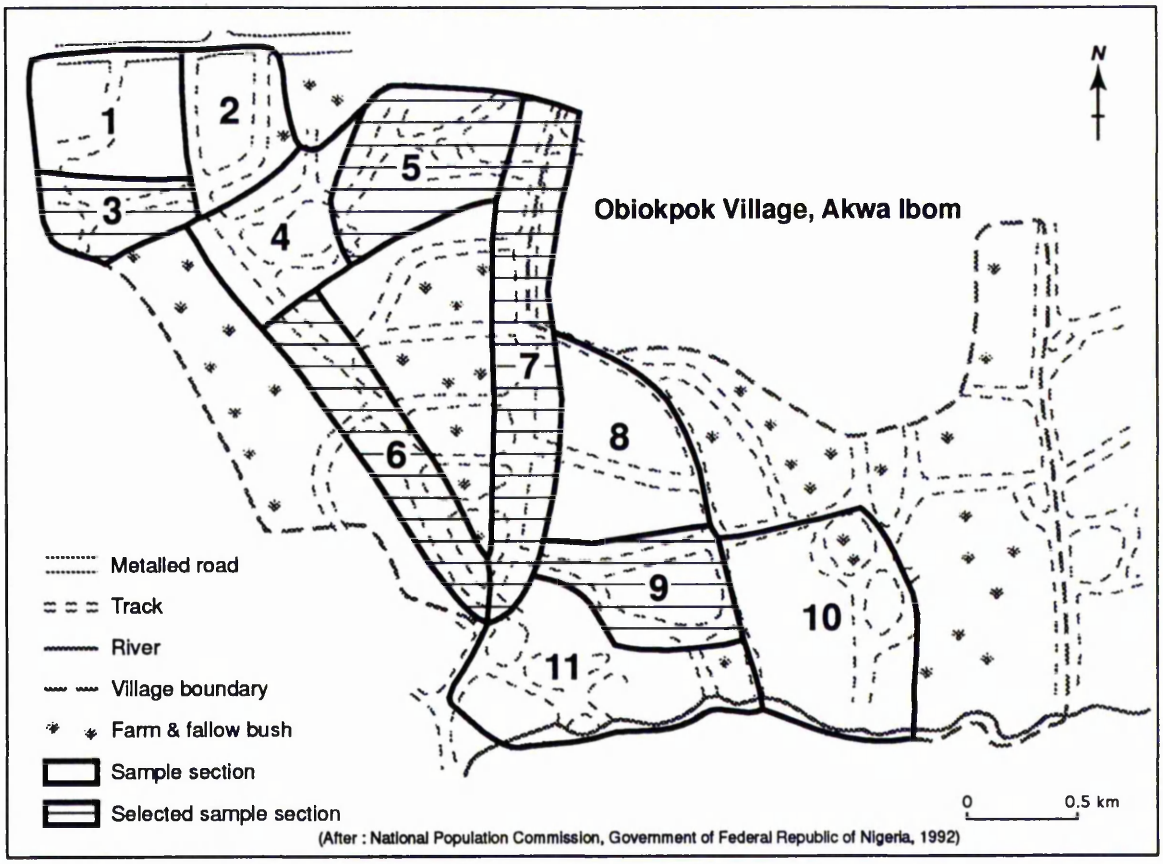


Figure 3.10 The segments making up the sampling frame which was used to select households to take part in the village survey in Obiokpok, Akwa Ibom State, 1993.

3.4.6 Village interviews

After initial preparatory survey work had taken place, which included visits to the selected study villages, discussions with local farmers and experts, and general field observations of farm and forest land, a questionnaire survey form was compiled. Primarily, the aim of this form was to gather data on the following:

a) Information to aid with the selection of tree or shrub species to be studied in the biological survey;

b) Information on general use of tree/shrub services or products from the forest, bush, farmland or around the houses, and which of the species are actually planted;

c) Information on farming patterns, crops grown, fallow length and major problems encountered by farmers;

d) Background information regarding land tenure, land acquisition and local laws of tree use; and

e) Information on the sale and market value of tree products.

Although the questionnaire form (Appendix C) was laid out in a question and answer pattern, it was used by the interviewers to serve merely as a guide or check list. It was felt that any interesting point that arose during the interview should be pursued by the interviewer if it would possibly lead to some useful information not specified on the survey form. Dixon and Leach (1984:11) state that:

> "Marginal notes to, and conversation resulting from, a structured interview may illuminate the analysis of formal data."

For reasons outlined in 3.4.2, the questionnaire form was kept as short and simple as possible. In some cases it was necessary to employ a local translator where pidgin English was not an adequate medium for some of the more complex questions and answers. In such cases, in Abo Mkpang and Obiokpok, the research assistant could translate for interview sessions, while in Igonigoni a local translator was employed. The translator spent time with the fieldworkers before the survey work began so that it was possible to explain the questions and format of the interviews.

During the questionnaire survey most of the trees and shrubs were mentioned using their local names, unless the species was recently introduced to the area in which case an English or common Nigerian name was often used. For example the neem tree (*Azadirachta indica*) is commonly known as '*dogoyoro*' throughout the study area, and a recently introduced tree, *Gmelina arborea*, is referred to by all as 'Gmelina', even though a wide variety of different languages are spoken. In some cases, samples of several of the trees mentioned during an interview were provided at the end so it was possible for some scientific identification of local trees and shrubs to take place in the field. Identification of other species was carried out with the help of botanists from the University of Calabar and local forestry officers.

During the questionnaire survey period, an informal census of each of the two main study villages was carried out. An outline of tracks and major paths was produced, and respondents were asked to draw their own house where they thought it should be. Maps showing all the households and the number of people living in each were compiled in this way (Figure 3.2 and Figure 3.6) and the information is used in 3.3 during descriptions of the study villages. The term children was used to refer to people under the age of sixteen, but due to differences in local definition and frequent uncertainty about age, this figure is only present to give an idea of the population stuctures of the two communities rather than as an accurate number.

3.5 Biological Studies

The biological studies aimed to provide preliminary data on some indigenous tree species that have been little studied, as well as to give some idea about the species' suitability for agroforestry and farm forestry development. The experiments all aimed to use techniques appropriate to the situation, that is avoiding any high-technology approaches, so that in future the methodologies can easily be imitated by farmers and local researchers who are interested in finding out more about the potentials of a wider range of indigenous species. Only methodologies are described in the following section, the results of the trials and botanical surveys being discussed in full in Chapter 5.

The species were selected on the basis that they are already known, and in some cases used, in local land-use systems. The practical choice of the species was carried out by means of social surveys which aimed to gather as much information as possible on traditional uses of the trees and tree products, through careful observations on farm and fallow land, and in discussions with farmers in the study area. Local experts were also shown the lists of species so that they could help to determine which had not yet been studied in detail. A short list of the indigenous species mentioned during each questionnaire survey was presented to the appropriate village. This usually took place with small groups so that discussions could be monitored by the researchers, and the villagers were able to decide which species it would be most useful to examine. Based on these discussions, two species were selected finally from each main study village.

3.5.1 Germination trials

In West Africa there are several pretreatment methods which may be both effective in breaking seed coat dormancy and widely available in rural villages (Todd-Bockarie & Duryea, 1993). Ruminants, with their strong gut acid, have been employed as a pretreatment for hard seed with varying levels of success in several countries (Sheikh, 1980; Kamveti, 1982; Von Maydell, 1983). By varying immersion time and temperature, hot water treatments have effectively been used to break dormancy in several related legumes (Werker, 1980). Mechanical pretreatments such as nicking, sanding, aging, threshing and burning have also improved percentage germination in many hard-seeded species (Msanga & Maghembe, 1986; Kariuki & Powell, 1988; Duguma *et al.*, 1988; West & Marousky, 1989). Seeds of three of the selected species, *Ricinodendron heudelotii*, *Dialium guineense* and *Uvaria chamae*, were collected locally from trees in villages and on farmland, and seed pretreatment and germination trials were conducted in Calabar by the researcher to determine the following factors:

i) Whether any seed pre-treatment is necessary and if so which is the most appropriate treatment to use;

ii) Germination and survival rates for seeds with and without pre-treatment; and

iii) Growth rates of the seedlings.

A standard sheet was used for the collection of data from these experiments, an example of which can be seen in **Appendix D**. The detailed methodologies of the trials are described below.

i) Seed pre-treatment trials on fresh seeds

Some seeds have a hard outer coat which has to be broken in some way before the seeds can germinate. The seeds of the selected species were stored dry, at room temperature, in between the time of collection and the time of planting. Before planting the seeds were treated in two different ways depending upon the nature of the seed. Seeds with a very hard outer coat were cracked, and those with a more fragile coat were soaked. In nature the soaking of the seed and therefore the bursting of the seed coat and start of germination, usually takes place at the beginning of the rainy season and seedlings have a chance to become established before the dry season begins.

a) Seeds were placed in a container, covered with cold water and soaked for twenty-four hours before planting;
b) The seed coat was cracked by tapping it lightly with a small hammer, taking care not to injure the cotyledons; and
c) No pre-treatment was carried out (control).

Treatments using chemicals, such as soaking the seeds in concentrated sulphuric acid (Babeley *et al.*, 1986, Msanga & Maghembe, 1986), were not used as the chemicals would not normally be available to extension workers or farmers.

Polythene pots were filled with a mixture of sand, topsoil and organic matter in a ratio of 1:3:1. These were arranged in a shaded area so that sun and heavy rain did not damage the young seedlings. The polypots were laid out in blocks, as shown in Figure 3.11 below, with treatments containing fifty polythene pots each. The seeds were planted and were watered twice a day throughout the experiment.

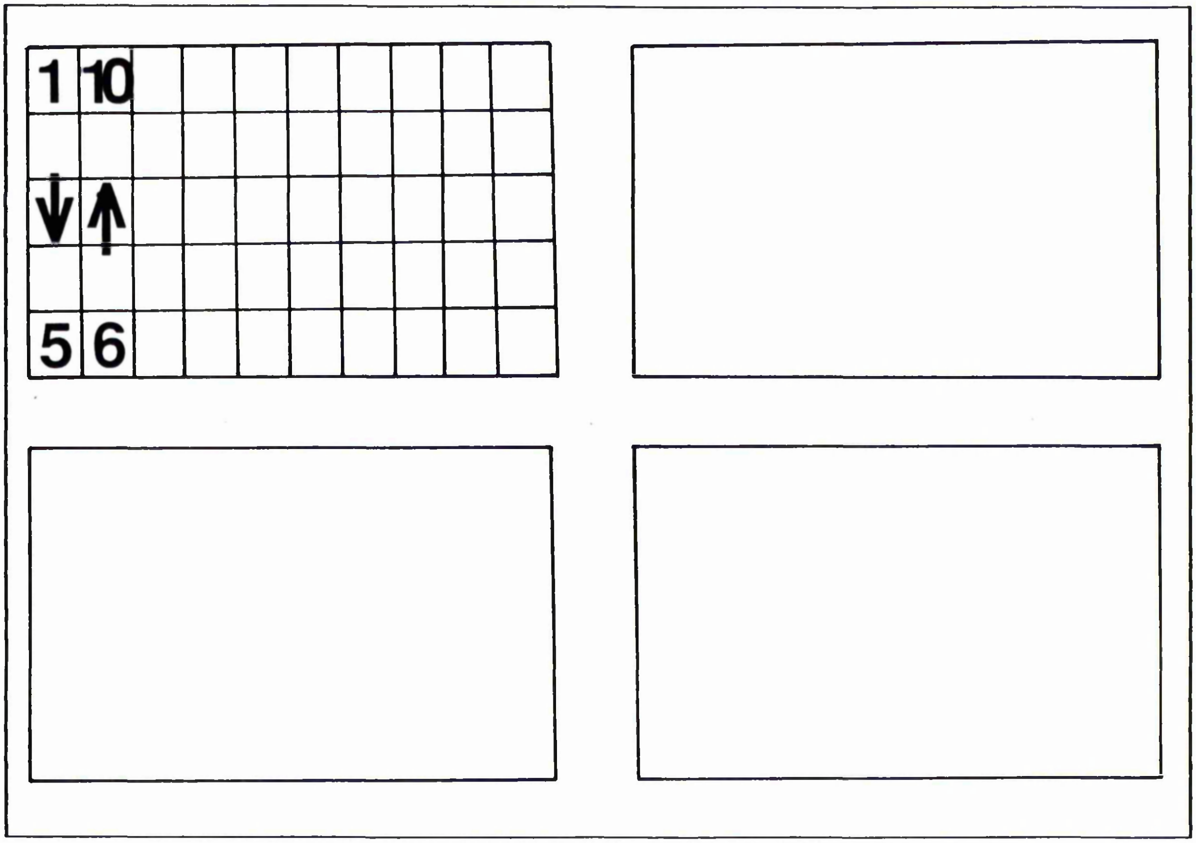


Figure 3.11 Layout of germination trials for *Ricinodendron heudelotii*, *Dialium guineense* and *Uvaria chamae* in Calabar, Cross River State.

The polythene pots were observed daily and the dates of germination of the seeds were recorded. Germination was taken to be the time at which the cotyledons emerged from the soil and opened. Those seedlings which germinated but did not survive and the possible reasons for this were also noted.

Seeds of *Albizia zygia* were not available locally, possibly due to the way in which the species is managed in the farm and fallow system. It would appear that *A. zygia* only produces seed once it reaches full maturity, but as the species is also a short-lived, pioneer the period of seed production is relatively short, as discussed in detail in **Chapter 5**. Fruiting is so rare that most local inhabitants stated that *A. zygia* does not produce seed, but instead 'comes up' on farmland by vegetative propagation. Anticipating this problem, the author took the opportunity to collect seed of *A. zygia* and carry out germination trials in the forest zone of Ghana while working there in 1989/90. Although results of these trials are not directly comparable with those carried out in Cross River State, they do give an estimation of the ease of germination and establishment for village level agroforestry activities.

ii) Germination by selected farmers

An attempt was made to involve farmers in the germination trials so that the ease of germination using traditional methods could be estimated. Five farmers in each village were asked to plant twenty seeds of each of the three species *Ricinodendron heudelotii*, *Dialium guineense* and *Uvaria chamae*, using any method they felt was appropriate. One of the farmers in each village was asked to note the germination methods used, and when and how many of the seeds germinated. On returning to the farmers for results of these trails it was found that none had carried out successful seed germination. A number of reasons were given for this, the main one being that since it is possible to find seedlings in the bush, these are transplanted when a particular tree species is required. Planting of seeds generally only takes place for fruit or timber trees, both of which produce a valuable product, and in the case of fruit trees are often introduced species and therefore not commonly found as seedlings in the bush.

iii) Rate of initial growth

Germinated seedlings of all species and treatments were measured, in centimetres, from where the stem emerged from the soil to the top of the meristem, and had their heights recorded weekly. This allowed for an assessment to be made of the comparative early growth rates of the different species, as well as to observe any effect that the different seed pre-treatments appeared to have on the rates of early growth within a single species. The point at which first branching occurred was also noted. At an average of twelve weeks after germination, ten seedlings of each species were planted out and observations of survival and growth rates were made for a further ten to twenty weeks.

3.5.2. Field Observations

Five routes spreading out in different directions from each of the two main study villages were selected and used as transect paths through farmland, fallow and bush or forest. The routes used were paths that villagers walk on each day to reach agricultural plots located in areas of farmland surrounding the village. The paths were surveyed and twenty-three trees or shrubs for each of the four selected species were located, mapped simply (Figures 3.12 and 3.13) and marked for monthly observations to be carried out. During the selection of individual trees

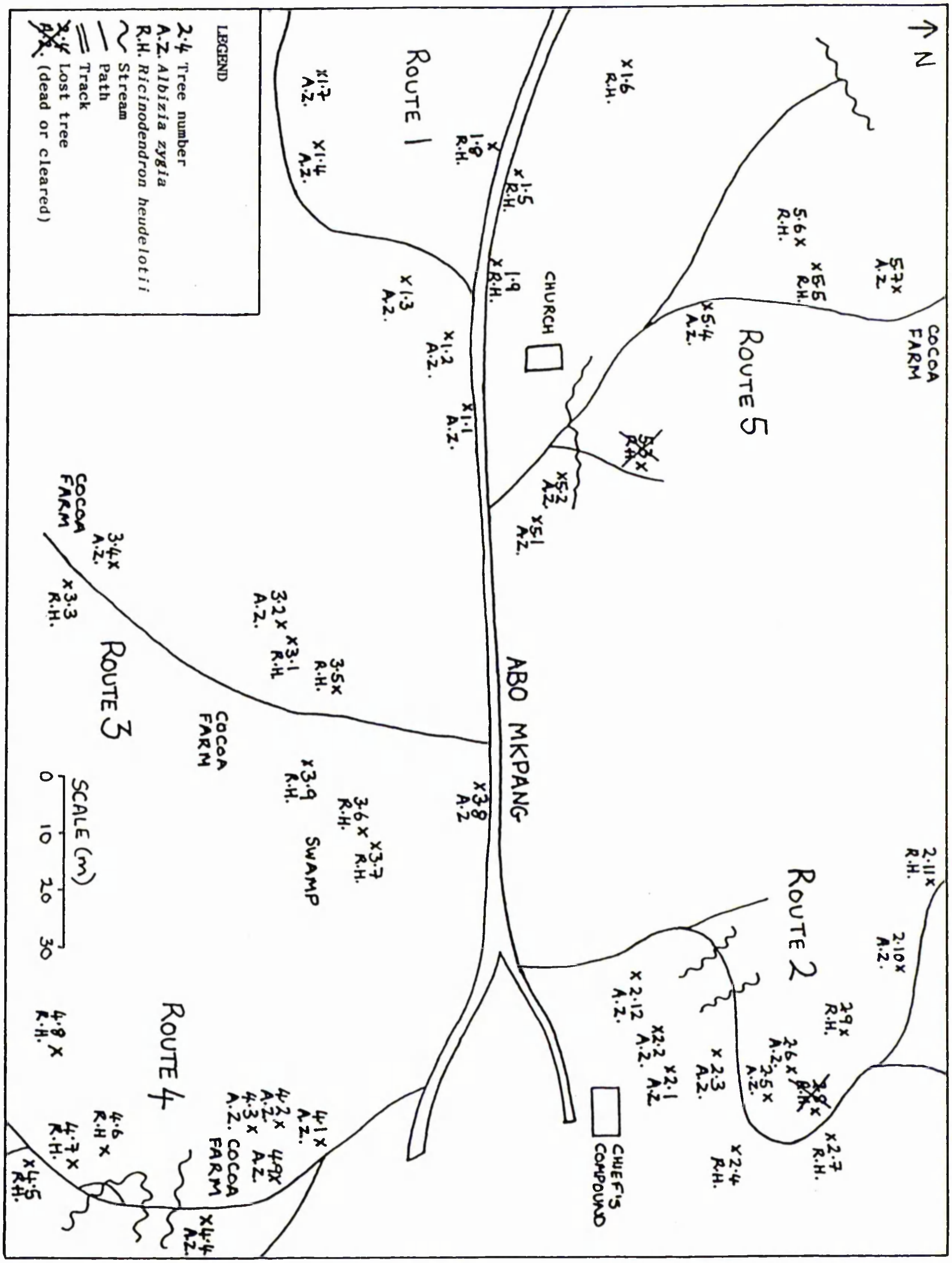


Figure 3.12 A sketch map showing the locations of the study trees in Abo Mkpang, easily reproduced for other species and villages by extension workers and farmers.

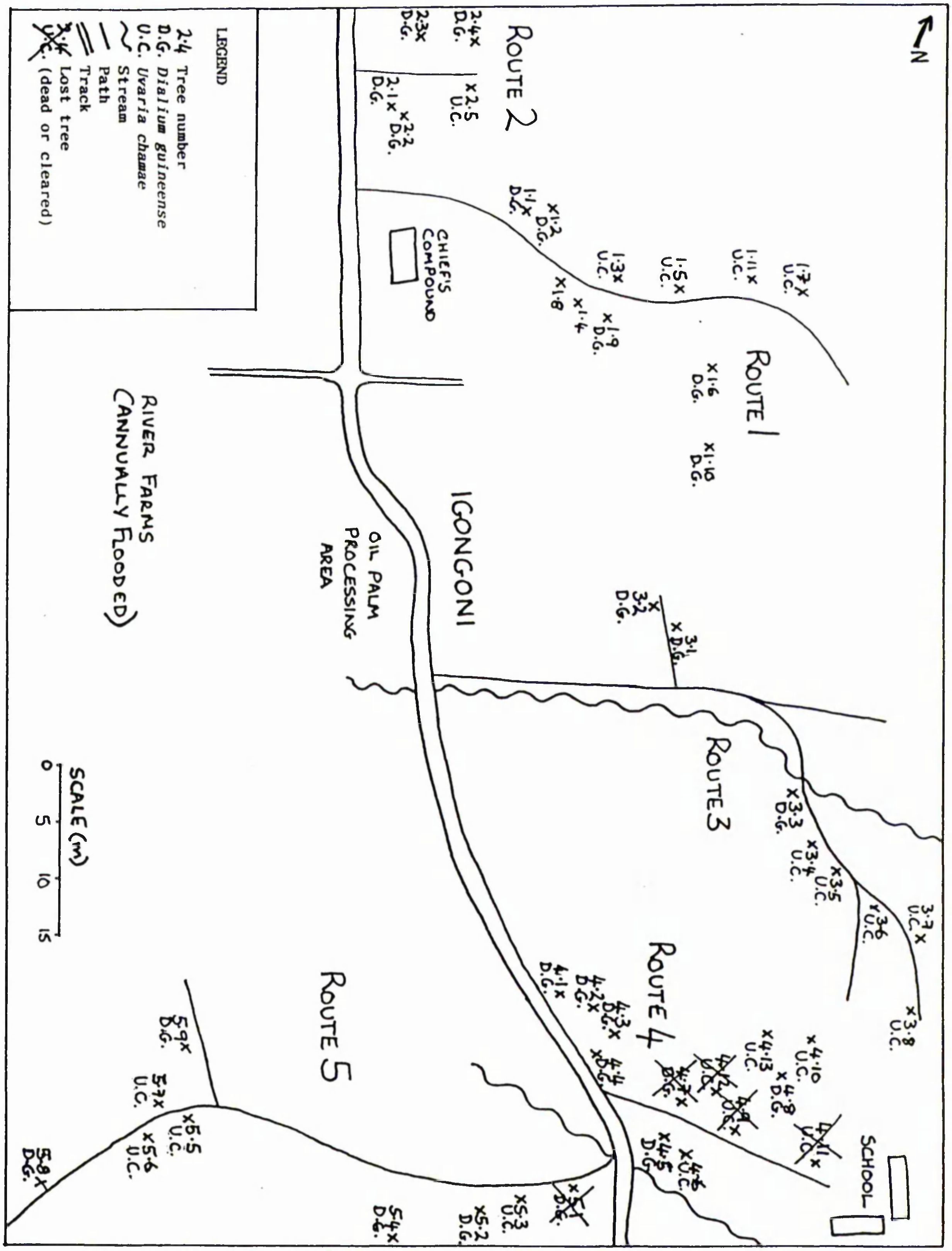


Figure 3.13 A sketch map showing the locations of the study trees in Igonigoni, easily reproduced for other species and villages by extension workers and farmers.

for monthly observations, permission was sought from farmers to mark and measure trees on their land and a full explanation given of the measurements that would be taken. This was important especially as belief in Ju-ju (local witchcraft) is strongly held by most people in the area, and discovering unexplained coloured paint marks on trees in an individual's farmland may have been seen as a curse, and the tree treated accordingly.

It was decided that data should be collected for at least twenty trees of each species, therefore twenty-three trees were selected so that any losses occurring during the survey period could be accommodated. The study specimens were selected simply as they were encountered along each route so that there was no bias introduced by the researcher selecting equal numbers of young and mature trees. The trees or shrubs were marked using a numbering system involving the route number followed by the number of the tree on that route (eg. 2.3), which was either painted onto the stem or written onto a plastic tag and then attached to the tree. Farmers were asked to ignore any markings on the trees and to treat them as they would normally. In this way it was possible to estimate how much each tree/shrub was used as part of the farming system. The following observations were made and noted for each tree or shrub at the time of selection. The field form used to record the observations is shown as Appendix E.

- Location of the tree ie. route number.
- Topography of the site ie. angle and aspect of slope.
- Age of the tree/shrub ie. seedling, young, mature.

The trees and shrubs were visited monthly and phenological and other observations were recorded using the following key (Figure 3.14):

- Type of surrounding vegetation

1 Cultivated land

2 Cleared land (unplanted)

3 Last year's farm

4 Recent fallow

5 Secondary bush/forest.

Figure 3.14 Monthly observations were made of all study trees in both villages: measuring *Albizia zygia* in farmland near Abo Mkpang village, September 1993 (Photo: D.Agom).

- Diameter or height of the tree or shrub in cms.

- Crown status ie. presence of shade/competition from surrounding trees/shrubs (Figure 3.15)

  1 Emergent tree
  2 Competing
  3 Partial overhead light
  4 Side light only
  5 Completely shaded.

- Presence of climbers on the tree or shrub

  0 No climbers
  1 Climbers present
  2 Many climbers present.

- Condition of the tree

  1 Good
  2 Insect damage to leaves
  3 Rotten stem
  4 Damage from burning
  5 Shoots cut/damaged.

- Habit of the tree

  1 Old coppice
  2 Single stem
  3 Flat crown
  4 Low branching/many stems
  5 High branching
  6 Current coppice

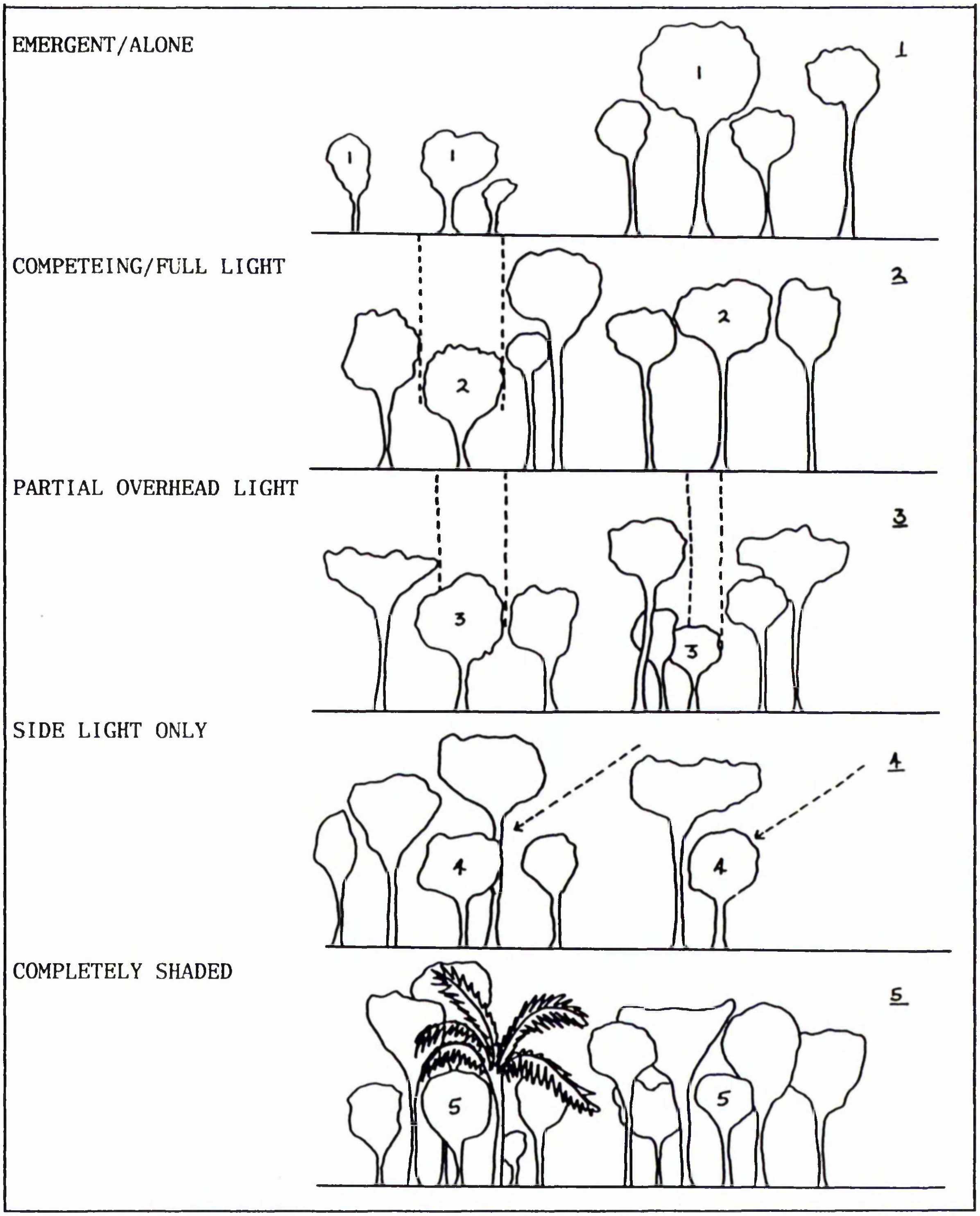


Figure 3.15 Crown status classification used during field observations of sample trees of the four study species (after Synott, 1979).

7 Layered crown

8 Bushy crown

9 Sparse crown.

- Phenology

1 New leaf/shoot flush

2 New leaves

3 Old leaves

4 Flowers

5 Fruits

6 Leaves yellowing

7 Leaves dropped.

In this way it was possible to develop pictures of the four species, as discussed in Chapter 5, especially with respect to how they may behave as part of a farming system. The patterns observed are representative of those likely to be encountered in farming situations in similar environmental conditions elsewhere in Cross River State. It therefore proved possible to produce detailed phenological diagrams for each of the species. Such information is useful for the satisfactory integration of trees into farming systems through the introduction of agroforestry or farm forestry.

3.6 Conclusions

The following points should be noted as a conclusion to this chapter:

- Recent trends in the development of farming-systems research have meant that many traditional sociological survey methods are now being employed as an important part of data collection for agriculturalists, foresters and agroforesters.

- The field work for this study took place in two villages in Cross River State, Abo Mkpang in the forest zone and Igonigoni in the derived savanna zone, and a smaller comparative study was carried out in Obiokpok in neighbouring Akwa Ibom State.

- Where possible participatory research techniques were employed, but there were some limitations as to how far they could be 'farmer-led' due to the context in which the work was carried out.

- The field work described in this chapter is in two main sections: first the questionnaire survey work, followed by germination trials and field measurements and observations for the four selected species.

CHAPTER 4

Trees as providers: changing patterns of tree use with decreasing forest cover.

4.1 Introduction

This is the first of three chapters which present the data collected during the field research period of this study. After a discussion of the role of trees as providers of food and other products, and the evolution of community forest or tree management systems (**Section 4.2**), the data on tree use in the study villages, resulting mainly from the questionnaire survey, is presented in **Section 4.3**. The trees and their uses are divided into eight categories; fruit trees, trees with edible seeds, medicinal trees, timber trees, trees in farming, amenity trees, trees with edible leaves and trees with other uses. The chapter concludes with a brief description of tree use in the third study village, Obiokpok in **Section 4.4**, and a discussion of how tree or forest management differs in the study area according to population density and therefore pressure on local resources (**Section 4.5**).

4.2 Trees as providers

Trees and tree products make a significant contribution to the financial security of many rural households in sub-Saharan Africa and elsewhere in the South (Falconer & Arnold, 1988; Arnold & Kanowski, 1993; Packham, 1993). In a recent survey carried out by the Cross River State Forestry Project (1994), it was found that Cross Riverians make use of at least four hundred and thirty-four different species, 71.5% of which are plants, 74% (of the 71.5%) of which are trees and shrubs. Most of the products extracted by rural people are non-timber forest products (NTFPs), a definition of which is presented by Towson (1995) as being:

> "all the biological material (other than industrial roundwood and derived sawn timber, wood chips, wood-based panels and pulps) that may be extracted from natural ecosystems, managed plantations, etc., and be utilized within the household, be marketed, or have social, cultural or religious significance."
>
> (Anon 1991/2)

The most commonly quoted aspect of NTFPs (Malleson-Amadi, 1993), many of which are tree products, is their contribution to food security, which has been defined by the World Bank (1989) as "access by all people at all times to enough food for an active, healthy life". It has been noted by Okafor (1975) and Okigbo (1977) that edible fruits, seeds and leaves often provide food during the 'hungry' period at the beginning of the agricultural season, when stocks of many staple foods such as yam from the previous year, are exhausted, and new crops have not yet been harvested. A similar situation has been noted in Ghana (Falconer, 1991). In India, Malaysia and Thailand approximately one hundred and fifty species of wild plants have been identified as sources of emergency foods (FAO, 1984). For example *Shorea robusta* Gaertn.f. Roxb., the bark of *Acacia leucophica* (Roxb.) Willd. and *Bombax ceiba* L. are ground into a fine flour to make chapatis, normally made of wheat or rice flour (Falconer, 1990a). However, Miracle (1961) argues that a 'hungry season' does not in fact exist, rather that people state that they are hungry because preferred foods are unavailable and less palatable substitutes, such as cassava instead of yam, are used for these periods.

A study of the Mbuti of Zaire (Ichikawa, 1993) who live in a large expanse of high forest, has shown that they use more than two hundred animal and one hundred plant species as food. Doughty (1979) argues that the progression from hunter-gatherer to shifting and then sedentary agriculture, has greatly reduced the variety of foods eaten by people. In southern Africa for example, Fox and Young (1982) found that veld foods were less commonly consumed than in the past, and that knowledge and diversity of bush resources has declined. A survey of rainforest dwellers in Cameroon, the Mvae and the Yassa people who consume many different forest foods, revealed that their diet is good, and that health problems occur only due to local endemic diseases and parasites, rather than from bad nutrition (de Garine, 1993). NTFPs are therefore important for maintaining some diversity in family diet and although often not consumed in great quantities, wild foods form an essential part of otherwise bland and nutritionally poor diets (Arnold, 1991). Tree products can therefore provide supplements to the staple diet which is often monotonous and lacking in many vitamins and minerals, especially during the 'hungry periods'. In the Machakos district of Kenya, fruit trees such as *Ximeia caffra* Sond. and *Sclerocerya birrea* (A.Rich.) Hochst. are so popular that, increasingly, they are found planted on farms (Wachiiira, 1987). Okafor (1980) states that in the forest zone of Nigeria, various woody plants are good sources of cheap plant proteins and other essential nutrients. In northern Nigeria gathered food is more important as relishes to add interest to staples, and as medicines, than as sustenance (Longhurst, 1986). Products not consumed domestically may also be sold to supplement household income, which enables other foods to be purchased if quantity or variety are insufficient for the family's needs.

The need for supplements to the diet or income can also occur at irregular intervals due to unforeseen circumstances such as unusually adverse climatic conditions and therefore poor or delayed harvests; or large blocks of capital being required for such occasions as weddings and funerals, or to pay for school fees (Chambers & Leach, 1987). In these cases trees are used as a form of savings bank whose products, which include not only foods, but also yam stakes, building materials, firewood, medicines, wood for household utensils, and so on, can be converted into income when the need arises.

NTFPs can also provide regular income, for example in a study by Falconer (1990b) of Kumasi central market in Ghana it was found that about seven hundred people were involved in NTFP trading on a full-time basis. In Nigeria, approximately two-thirds of the residents of cities, and almost all villagers, use chewing sticks in preference to toothbrushes (Mbakwe, 1983) and the production of these sticks provides a steady income for many villagers in forest areas. Such small forest-based enterprise activities (ie. collection and processing of NTFPs) constitute one of the largest sources of non-farm income in the rural areas of developing countries and in many areas they also account for a large part of the total forest harvest (Towsen, 1995).

It is often assumed that all NTFPs which are uncultivated or collected from the 'bush', come from forest areas. In both Ghana and Sierra Leone, however, where local forest use was studied in detail (Falconer, 1991; Richards, 1991), results of the surveys showed that very few 'forest products' were actually collected from forests, the main source of NTFPs in both places being bush fallow areas. In many areas of the wet tropics, much of the supply of forest products comes from areas of bush fallow in less densely populated areas, and from trees on farms where the pressure on the land is high (Arnold & Kanaowski, 1993). Njoku (1983) notes that the density of forest food trees in Imo State, Nigeria, is much lower in natural forest areas than on compound farms. In Cross River State, while many of the most important NTFPs (bush mango, canes, chewing sticks) are gathered in forests, they are also all found on fallow land, and many of them are cultivated or tended on farms (Okafor, 1989). Okafor (1980) also notes that some edible forest trees have widespread distribution throughout the forest zone of Nigeria, such as *Irvingia gabonensis*, *Treculia africana* and *Xylopia aethiopica* (Dunal) A.Rich., and that although their natural density is very low (often less than 2.5 trees ha^{-1}), it has increased considerably with protection and cultivation.

Trees are also valued for a number of service functions they provide outside of the forest environment. In villages, trees of particular species are often planted or protected for shade, as lightening conductors and for socio-cultural roles such as sacred groves; and on farms for shade, moisture retention in the soil, erosion control, live stakes, windbreaks, and for the maintenance of soil fertility. Therefore, in order to try and gain as full a picture as possible, the questionnaire survey conducted for this study gathered information on the use of tree products and services from villages, farm or fallow land, and forest areas.

Shepherd (1993a) has suggested that active management of forest resources, and ultimately the planting and creation of new 'forest areas', increases as natural forest or bush becomes degraded, and access to the products and services coming from such areas is reduced. An attempt is made in Figure 4.1 to represent this situation schematically, and the diagram can be used to predict how likely people are to become involved in active management, depending on the current state of their

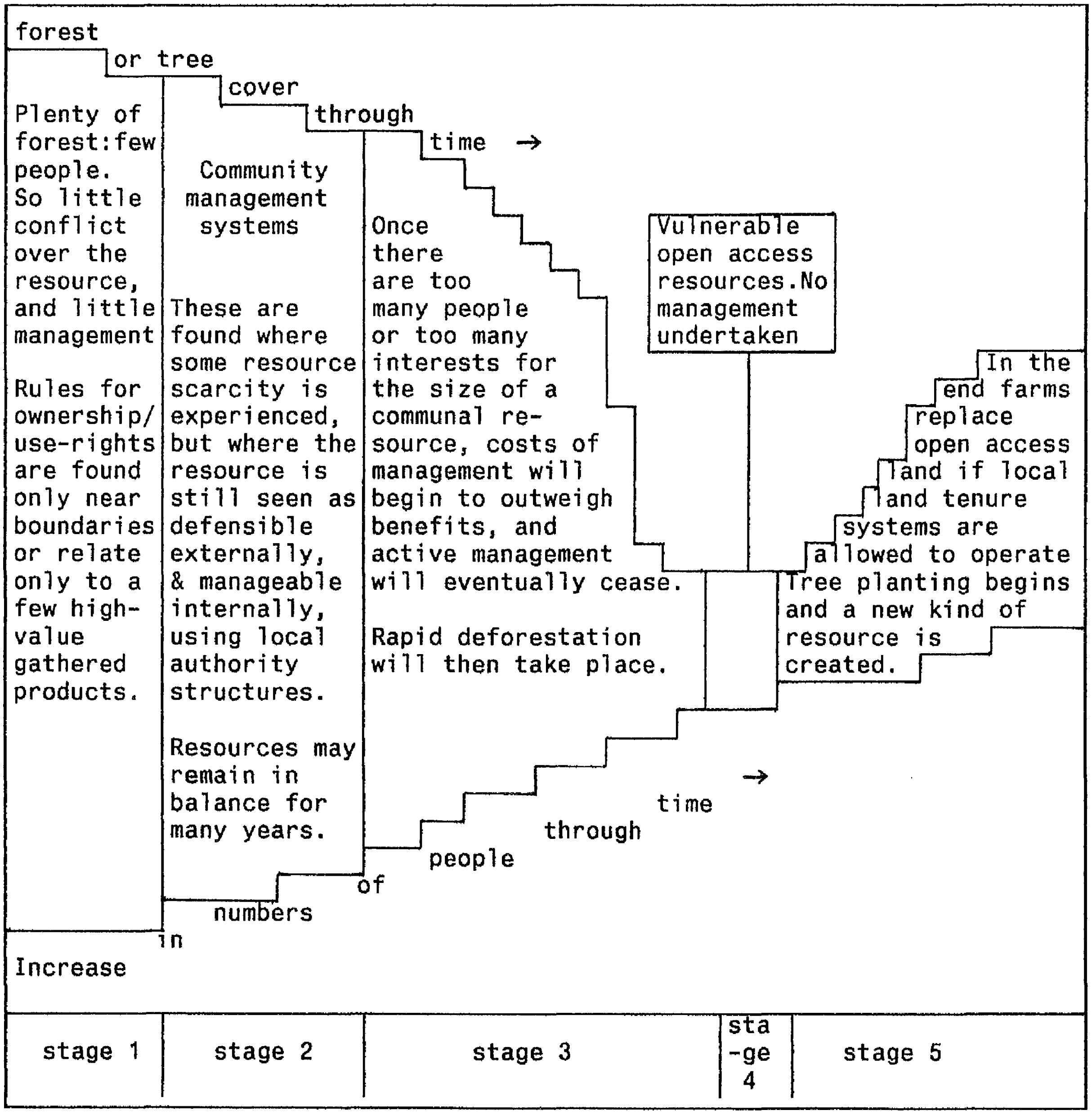


Figure 4.1 Indigenous Forest and Land Management - a model that can be used to predict how people will manage common areas depending upon the state of the forest resource. Indigenous forest management systems begin for selected products and areas in stage 1, gradually intensify and then break down as pressure on the resource increases from stages 2 to 4, and then redevelop to manage a new, intensive use of individually planted and maintained land areas in stage 5 (after Shepherd, 1993).

forest resource. Indigenous forest management systems begin for selected products and areas (such as forest boundaries) in stage 1, and intensify in stage 2 as pressure on the resource begins to be felt, but it is still largely intact. In the Korup National park area in Cameroon where the forest is seen by villagers as being ample, there has been little intensive management by local people so far, but research indicates that large villages have gone further in elaborating rules than small ones (Shepherd, 1993b). The cooperative management systems gradually break down in stage 3 and rapid deforestation takes place as Common Property Resources become open access resources in stage 4. The processes represented in stages 3 and 4 are similar to the pattern of resource use initially put forward in Hardin's 'Tragedy of the Commons' article (1968) in which he described a free-for-all use of communal resources with individuals putting their own needs first and no thought of the eventual consequences of their actions. However, Shepherd suggests that if local land tenure systems can operate, the land becomes clearly identified farmland with individual ownership, and it is at this stage (stage 5) that tree planting and management once again become important activities. In a survey carried out on farms in western Kenya it was found that the proportion of land with planted trees increases with population density (Bradley, 1988). In areas with a low population density (200 km^{-2}) the land is largely under cultivation with some areas of bush remaining and few trees have been planted, whereas when the population density is high (500 km^{-2}) planted trees cover up to 30% of the land. In earlier stages where people clear forest or bush for cultivation, there is little incentive for tree planting as uncleared resources still exist nearby. However, as clearance continues it becomes more 'time-efficient' to plant and manage individual trees, than to carry out long expeditions for 'free' biomass or NTFPs (Shepherd, 1993a). As can be seen in this chapter, many of the conclusions that can be drawn from the questionnaire survey data, about tree use in the three villages, fit in with this model of forest use and management.

4.3 Results of the surveys

The surveys produced a great deal of data about trees and shrubs in the villages, farms and surrounding bush or forest, and their uses. In both main villages, one randomly selected representative from each occupied house was interviewed, forty-six in Abo Mkpang and sixty-nine in Igonigoni. In Abo Mkpang this was made up of forty male informants and six female, while in Igonigoni the division was thirty-five male informants and thirty-four female. In general the villagers of Abo Mkpang have knowledge of a greater variety of trees, especially those found in the forest or bush, than do those of Igonigoni. During the survey, sixty-eight species were mentioned by the Abo Mkpang community, while Igonigoni villagers mentioned fifty-seven species. This is probably due to the absence of forest around Igonigoni because of clearance for farmland, so that much of the knowledge of forest tree species has been lost. In the third village, Obiokpok (see 4.4), in an area of higher population density and almost no remaining secondary forest where a questionnaire survey was carried out (see 3.3), only thirty-four woody species were mentioned, almost all of which were located in home gardens or farmland. In previous studies it has been shown that indigenous knowledge about the use of gathered products can be lost over a relatively short time period. Doughty (1979) cites a number of examples of communities whose knowledge of plant use is declining, for example the younger members of the Tlokwa of the Kalahari were only able to recognise half of the two hundred and fifty gathered food items named by their elders. The influence of permanent agriculture, forest loss, access to markets and modern medical care can all contribute to a decline in indigenous technical knowledge about local species.

Tree planting around houses and elsewhere within the village is much more frequent in Igonigoni than in Abo Mkpang, with a greater variety of species being cultivated and the most valued type of trees for this location being those which produce fruit or edible leaves and many of which are introduced species. This indicates that in some aspects of resource management the Igonigoni villagers are beginning to move into stage 5 of Shepherd's model, but in other areas they remain firmly in stage 4, best illustrated by the lack of planted trees in farmland. In Igonigoni twenty-eight different species are planted around houses in the village, of which fifteen are fruit trees and five have edible leaves; whereas only sixteen species are planted in the village of Abo Mkpang, thirteen of which are fruit trees. In both villages, trees tend to be valued for products more frequently than for services, although as will be seen from the data, a number of species do have importance due to the particular services they provide. In Igonigoni eight species were noted as having a service value, and in Abo Mkpang five species were said to have service uses. However, other species noted primarily for products may also have secondary service uses which were not mentioned specifically during the survey, for example trees planted on farms for fruit production also provide valuable shade. Appendix F shows all trees mentioned during the survey using their local and botanical names, and their uses. It should be noted that the questionnaire only gathered information on a limited number of species and that many more are probably used in both villages. Almost all trees have some use, which was illustrated well when a sociological researcher asked the local name of a particular species of palm in northern Nigeria, to be told it is called the 'Useless palm' (Atte, pers.comm., 1994).

In an ICRAF survey of farmer preference in West Africa (ICRAF, 1994) the main use of 70% of the highest ranking woody species was for food and fruit, especially in Ghana and Nigeria where high population densities make food security more of an issue for farmers. This corresponds well with the survey data from this study, shown in **Appendix G**, where all the species noted during the surveys in Igonigoni and Abo Mkpang, and their ranking according to the number of times each species was mentioned, are listed. Overall, of the species which occupy the top ten rankings (eleven species), eight of these are valued for an edible product, fruit, seed or leaves, such as oranges, African pears or oil palm, while three are primarily timber species such as Iroko. This pattern persists in individual villages where in Abo Mkpang eight of the eleven most frequently mentioned species produce an edible product, and three are timber species; and in Igonigoni eleven of the top thirteen species are valued for food, while two are used for wood products. The same ICRAF farmer survey (ICRAF, 1994) revealed that *Dacryodes edulis* (African pear) is probably the most widely planted indigenous tree species in West Africa, reinforced by the data from this survey which revealed that *D. edulis* was the most mentioned species in Abo Mkpang, the seventh most mentioned species in Igonigoni, and ranked second overall. Many of the trees mentioned have multiple uses (**Appendix F**) and it was often not clear which of these was seen as the most important, especially as trees are often valued for different reasons by different people. For example, during the survey, very few trees valued for timber production were mentioned by women, who in contrast tended to emphasise the food value of the most prized species(see Appendix P for more tree tenure details).

Using a ranking system similar to that used by Becker (1984) in her study of food plant use in Northern Kenya, it is possible to produce a diagram which shows the pattern of occurrence of the species in the three study villages (Figure 4.2). Eighteen species were mentioned in all three sites, eleven of which are food producing species. The number of species named only in one study site can be taken as a measure of plant diversity in that area and this corresponds well to local environmental conditions. Abo Mkpang, surrounded by high forest, has the greatest plant diversity, and Obiokpok, surrounded almost completely by farmland, has the least.

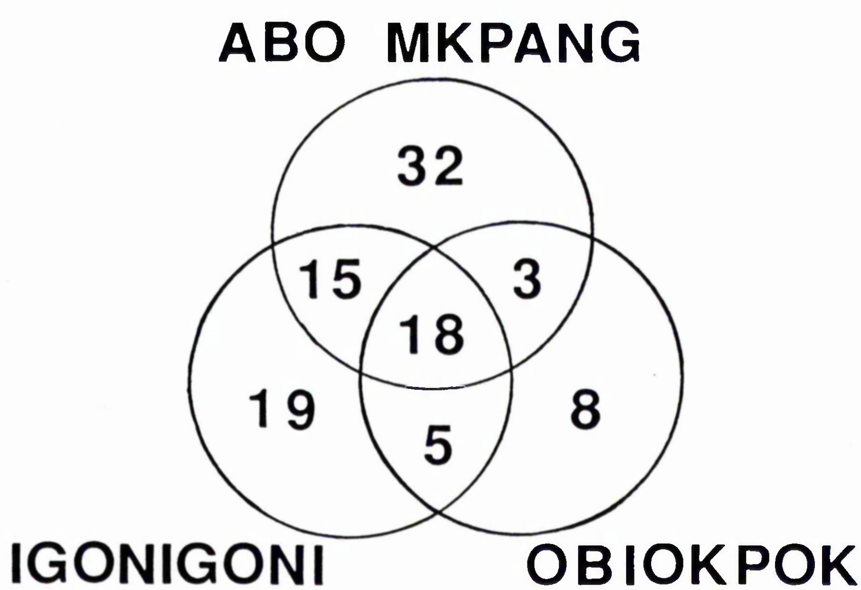


Figure 4.2 Distribution of occurrence of the one hundred woody species mentioned in surveys in three villages in south east Nigeria which is an indicator of species abundance in the three locations (Own data: 1992).

The locations of trees occurring in the survey are shown in **Appendix H.** Most of the timber trees mentioned were said to be located on farm or plantation land, often left there when the land was initially cleared for cultivation, or planted by the farmers or their family. Although these species also occur in the bush or forest, the ownership of wild trees is not clear cut, whereas farmers can fell trees on their own land as they wish. This may account for the greater emphasis being placed on timber trees in farm or plantation land, than those in the forest.

The different intensity of management of trees, both wild and cultivated, becomes evident in the following presentation of the questionnaire data. In Abo Mkpang which is surrounded by largely intact tropical high forest, a greater variety of species are used, but few are planted or actively managed. However in Igonigoni, where little bush remains, more planting of trees around houses takes place and in Obiokpok complex management systems and a new tree-based resource have been developed in the form of home gardens. This is indicated primarily by the larger number of exotic species mentioned during the surveys in Igonigoni and Obiokpok, and the greater number of species planted within the villages themselves. Data obtained during surveys in the main study villages, Abo Mkpang and Igonigoni, are presented in the following sections in both text and tables.

4.3.1 Fruit trees

As has been suggested above, the most important and highly valued tree species in both Igonigoni and Abo Mkpang are fruit trees, and several of those mentioned in the survey are exotic or naturalised species, such as *Mangifera indica* L., *Psidium guajava* L. and *Persea americana* Mill., rather than indigenous. However, indigenous species such as *Dacryodes edulis* (Figure 4.3), *Canarium schweinfurthii* Engl. and *Dialium guineense* are also prized, but these are planted less frequently, and are instead often allowed to remain when an area of forest or bush is cleared for cultivation. This occurs more frequently in farms around Abo Mkpang as the vegetation cleared is usually primary or mature secondary forest and mature trees of useful species are often present.

Figure 4.3 *Dacryodes edulis* (African pear) in fruit, July 1993, Abo Mkpang, Cross River State (Photo: the author).

In Abo Mkpang, small tree nurseries are often established on farm plots so that fruit trees such as *Mangifera indica*, *Dacryodes edulis*, and *Citrus* spp. can be grown from seed and planted out into the farm, where as in Igonigoni, fruit trees seem to be more frequently cultivated around houses in the village. In Cameroon, Shepherd (1993b) found that the planting and protection of fruit trees such as *Irvingia gabonensis*, *D. edulis*, *M. indica* and *Citrus* spp. on farmland, enriches the secondary forest regrowth, and is often the first step in the development of a local forest management strategy.

Table 4.1 Fruit trees of Abo Mkpang.

Species	Fruit	Location[1]
Anacardium occidentale	Cashew	Farm,house
Canarium schweinfurthii	Slave pear	Farm
Carica papaya *	Pawpaw	House
Citrus spp.	Orange,lime,tangerine	Farm,house
Cola lepidota	Monkey kola	Farm,forest
Cola pachycarpa	Fruit	Farm,forest
Dacryodes edulis	African pear	Farm,house
Elaeis guineensis	Oil palm	Farm,house,forest
Mangifera indica *	Mango	Farm,house
Persea americana *	Avocado pear	Farm,house
Psidium guajava *	Guava	Farm,house
Syzygium malacensis	'Apple'	Farm,house
Terminalia catappa *	Indian almond	House

* Exotic or naturalised species

In both Igonigoni and Abo Mkpang, fruit is an important supplement to the diet, especially for children, in terms of the provision of vitamins and minerals which are often lacking from the staple foods. Different fruits are available at different times of the year, for example mango

[1] In all tables in Chapter 4, farm is used in this column to denote both food farm and plantation. Both the terms forest and bush refer to currently uncultivated land.

and avocado pears from March to May, *Dacryodes edulis* from May to August, oranges from September to December, and pawpaw all year, so there is always some fruit in season and easy to obtain. It can be seen in Tables 4.1 and 4.2 which show the locations and species of trees in and around the two villages, and that a greater variety is planted in Igonigoni than in Abo Mkpang.

Table 4.2 Fruit trees of Igonigoni.

Species	Fruit	Location
Anacardium occidentale	Cashew	Farm,house
Annona muricata *	Soursop	Farm,house
Annona squamosa *	Sweetsop	House
Canarium schweinfurthii	Slave pear	Farm
Carica papaya *	Pawpaw	House
Citrus spp	Orange,tangerine	Farm,house
Cola rostrata	Monkey kola	Farm
Dacryodes edulis	African pear	Farm,house,bush
Dialium guineense	Velvet tamarind	Farm,bush
Elaeis guineensis	Oil palm	Farm,house,bush
Mangifera indica *	Mango	Farm,house,bush
Psidium guajava *	Guava	Farm,house
Spondias mombin	Hog plum	House,farm
Syzygium malacensis	'Apple'	House
Terminalia catappa *	Indian almond	House
Uvaria chamae	'Berry'	Farm,bush

* Exotic or naturalised species

Income derived from the sale of fruit is minimal in Abo Mkpang, whereas in Igonigoni, which has access to a number of weekly local markets, it is a useful addition to many households as oranges, mango, guava, African pear and Velvet tamarind are regularly sold. However as fruits are usually low cost items in markets, and there is little chance to add value through processing at village level, there is little incentive for people to produce such fruits more intensively for commercial purposes, and so fruits are only sold on a casual basis if trees produce a crop which is surplus to household requirements. Table 4.3 below gives an indication of prices obtained for some fruits in local markets.

Table 4.3 Fruit prices in local markets around Igonigoni (source: own data, 1992-1993).

Fruit	Unit of sale	Price per unit*
Orange (unpeeled)	3 or 4 fruits	N 1.00
Orange (peeled)	2 or 3 fruits	N 2.00
Mango	4 or 5 fruits	N 1.00
Guava	Bowl of 20 fruits	N 5.00
African pear	5 to 10 fruits	N 5.00
Velvet tamarind	170 g milk tin full	N 1.00

* N70 = £1 (parallel rate March 1994)/Daily labourer wage N50.

4.3.2 Edible seeds

Many of the most valued tree species mentioned in the survey are those producing edible seeds, or seeds from which edible extracts can be made (Tables 4.4 and 4.5), important in diversifying and adding flavour to the local daily diet. It is these species, especially in Abo Mkpang, which bring in a great deal of income to the village. *Irvingia gabonensis* (bush mango) (Figure 4.4) is an excellent example of this where the whole village is involved in the collection and processing of the seeds for sale and domestic consumption. It is so valued that many farmers raise seedlings of *I. gabonensis* and plant them on their farms, even if they plant no other trees. *I. gabonensis* in fact has two varieties (Okafor, 1980), var. *gabonensis* which fruits during the rainy season (April to September) and var. *excelsa*, which fruits in the dry season (December to March). The bush mango is therefore an important, year round, income supplement for many of the villagers. The fruits are collected from forest, fallow and farm trees, and allowed to rot so that the flesh is easily removed. The seed is then taken out of the fruit, cut in half, and the cotyledons removed for sale. The work is time consuming, but because of the high prices obtained from the processed bush mango, it is seen as a good investment. In some areas bush mango is stored for use or sale out of season by adhering the rotting fruits to the mud walls of houses and letting them dry there.

Figure 4.4 *Irvingia gabonensis* - one of the most important NTFP producers of the high forest zone in south east Nigeria, Abo Mkpang, Cross River State, June 1993 (Photo: the author).

In Abo Mkpang, the processed bush mango is usually purchased in bulk by buyers who come to the village, and is then transported by them to be sold in markets throughout Cross River State, for use in making a very popular soup dish. Okafor (1990) states that there are no reliable estimates of income earned by owners/producers of *Irvingia gabonensis* and that they vary from N123.00 per tree per annum (Obi, 1985 cited in Okafor, 1990) to N560.34 per tree per annum (Martins, 1987 cited in Okafor, 1990). A survey carried out in 1989 (Holland *et al.*) found that annual incomes from bush mango collection per household in villages surrounding the Cross River National Park ranged from N100 to N8500 with an average of N1795. The figures refer to the harvest of bush mango in 1988 which was said not to be a high yielding year although prices may have been slightly higher than usual due to scarcity, so in general incomes from this activity can be expected to be higher. During the current study, prices from N200.00 to N350.00 per large basin of bush mango were quoted, and most households are able to produce many basins each season. In a recent survey (CRSFP(ODA), 1994) it was found that 89% of the bush mango collected in Cross River State is sold rather than used in the household. Whatever the true value of this product, however, it is seen that it can make a significant contribution to household incomes.

Bush mango is seen locally as such an important species that studies have been carried out on improving propagation and grafting techniques. Okafor (1978) has successfully propagated *Irvingia gabonensis* by budding, and fruiting of these trees has been recorded within four years. Complementary nursery studies have also been carried out on this and other indigenous edible species.

Table 4.4 Edible seeds of Abo Mkpang.

Species	Seed use	Location
Baillonella toxisperma	Oil	Farm,forest
Brachystegia eurycoma	Soup	Farm,forest
Cocos nucifera	Coconut	Farm,house
Cola acuminata	Chewing(social)	Farm,house
Elaeis guineensis	Oil	Farm,house,forest
Garcinia kola	Chewing	Farm,forest
Irvingia gabonensis var.*gabonensis*	Soup	Farm,house,forest
Irvingia gabonensis var.*excelsa*	Soup	Farm,house,forest
Parkia bicolor	Soup	Farm
Parkia biglobosa	Seasoning	Farm
Poga oleosa	Chewing	Farm,forest
Ricinodendron heudelotii	Seasoning,chewing	Farm,forest
Tetrapleura tetraptera	Soup, porridge	Farm,forest
Theobroma cacoa	Beverage	Farm,forest
Triplochiton scleroxylon	Soup	Farm

Some of the edible seeds have great traditional significance, such as kola nut (*Cola acuminata* (P.Beauv.) Schott & Endl.) and bitter kola (*Garcinia kola* Heckel) which are offered to visitors to the house and chewed at social occasions and meetings. These also provide important additions to domestic income as a small quantity can be carried to market and sold, before goods required by the household are purchased.

The use of some seeds is becoming less frequent due to the difficulties of processing. This is illustrated well in the case of *Baillonella toxisperma* Pierre seeds from which a valuable oil for cooking is extracted. The process of extraction involves boiling the seed pulp and squeezing it by hand while it is still hot in order to obtain maximum oil production. This causes the hands to become very sore, and although a high price can be obtained for the finished product, N100 or more per litre, people are now less willing to go to these lengths to obtain the oil. As a gift to Abo Mkpang village for their hospitality during the fieldwork period, the author designed and had built a press with which to produce *B. toxisperma* oil without injuring the hands in the process (Figure 4.5). It was felt by the community that the press would enable use to be made of this valuable NTFP once more.

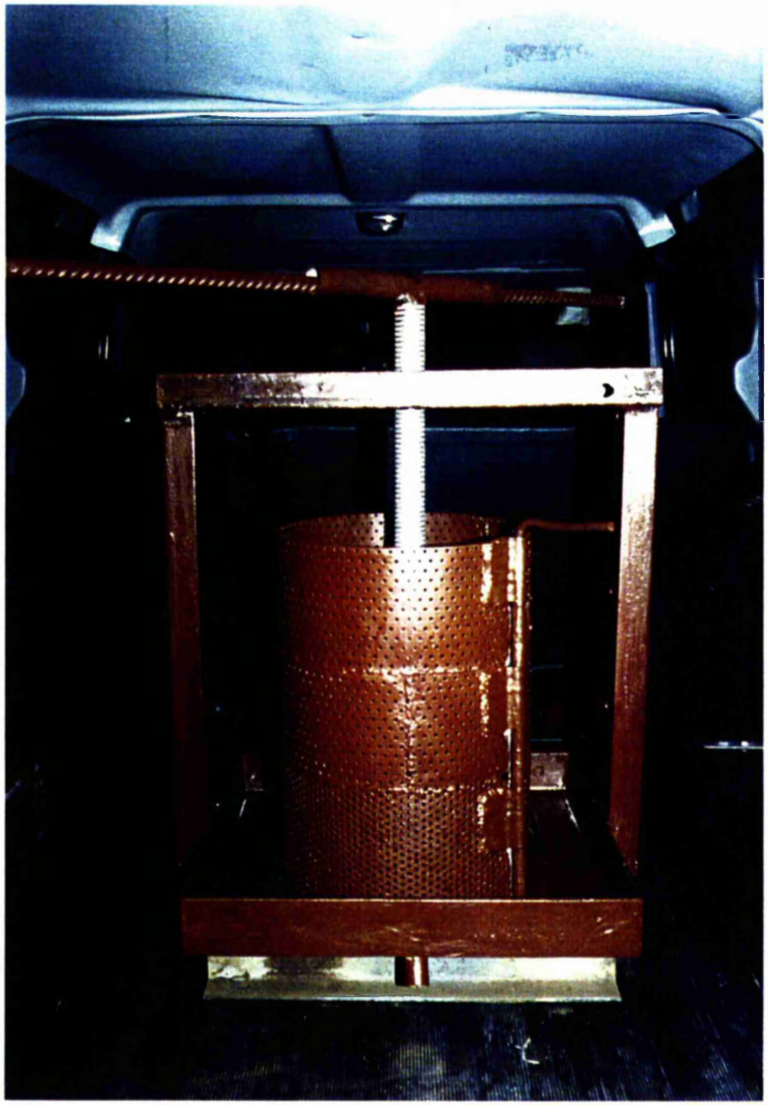


Figure 4.5 The press designed and built for Abo Mkpang community for easier extraction of valuable *Baillonella toxisperma* oil, June 1994 (Photo: R.Dunn).

The most important edible seed tree in Igonigoni is *Elaeis guineensis*, the fruits/seeds of which produce palm oil, an important ingredient for many local dishes and throughout the southern regions of West Africa.

Longhurst (1985) estimates that in Sierra Leone palm oil provides 14% of the total energy intake, and points out that it is the primary source of Vitamin A. In south eastern Nigeria, Nweke *et al.* (1985) estimated that 89% of households consume palm oil regularly. Many of the families in Igonigoni own an oil palm plantation which is an important source of supplementary income, the palms either being the 'wild' variety, or improved high yielding varieties provided by the Department of Agriculture and known as 'Agric. palms'. The palm fruits are harvested in bunches when ripe, and then, by a process of heating and pressing carried out at a communal oil palm processing area in Igonigoni village, the oil is obtained (Figure 4.6). The palm oil is either consumed domestically, sold by individuals at local markets, or occasionally sold to buyers who come to the village to purchase in bulk in order to sell it elsewhere in Nigeria.

Table 4.5 Edible seeds of Igonigoni.

Species	Seed use	Location
Cocos nucifera	Coconut	Farm,house
Cola acuminata	Chewing(social)	Farm,house,bush
Elaeis guineensis	Oil	Farm,house,bush
Garcinia kola	Chewing	Farm,house
Irvingia gabonensis var.*gabonensis*	Soup	Farm,bush
Irvingia gabonensis var.*excelsa*	Soup	Farm,bush
Parkia bicolor	Soup	Farm
Pentaclethra macrophylla	Chewing,soup	Farm,bush
Theobroma cacao	Beverage	Farm
Triplochiton scleroxylon	Soup	Farm

Palm oil is an important ingredient in many Nigerian dishes, and adding value by processing the oil is thought by villagers to be a good use of time as palm oil sells for from N20 per litre and there is always a ready market for it. Once the oil has been extracted from the fruits, the palm nut is roasted and the kernels eaten as a snack food. The shells of the palm nuts are also used, and are spread on the ground immediately around houses to stop the area becoming too muddy during the wet season.

Figure 4.6 Palm oil processing: a family activity, Igonigoni, December 1992, Cross River State (Photo: the author).

4.3.3 Medicinal trees

Many of the trees already mentioned also have medicinal uses, but there are some trees which are valued purely for their medicines. In many cases people are reluctant to divulge information regarding medicinal trees and plants as much of the knowledge is felt to be secret and is often supposed to be known only by traditional medicine practitioners. Therefore there are many more species used to treat a wide range of illnesses than are indicated in Tables 4.6 and 4.7 below. The villagers of Abo Mkpang tend to have a wider general knowledge of species and their medicinal uses than the people of Igonigoni. Two possible reasons for this are that there is no medical facility in Abo Mkpang so people are heavily reliant on traditional medicines, and access to the forest is easy for gathering medicinal plants. In Igonigoni, however, there is a medical centre and the surrounding bush is very degraded with only a few of the useful medicinal species remaining.

Table 4.6 Medicinal trees of Abo Mkpang.

Species	Part	Medicinal use	How*	Location
Alstonia boonei		Chest pains		Farm
Azadirachta indica	Leaves	Fever(malaria)	D	Farm,house
Barteria nigritana		Madness		Farm
Calpocalyx dinklagei		Fever		Farm,forest
Canarium schweinfurthii	Tree	Scares witches	S	Farm
Cylicodiscus gabunensis	Bark	Fever,cough	D	Farm,forest
Enantia chlorantha	Bark	Malaria	D	Farm,forest
Ficus exasperata	Leaves	Ringworm	T	Farm
Lophira alata	Bark	V.D.	D	Farm,forest
Morinda lucida	Leaves	Fever	D	Forest
Parkia biglobosa	Bark	Cough	D	Farm
Pterocarpus osun	Latex	Slows labour		Farm,forest
Pycnanthus angolensis		Piles	T	Farm
Rauvolfia vomitoria	Root	Cold,cough	D	Farm
Xylopia quintasii		Fever		Farm
Zanthoxylum gilletii	Stem	Tooth ache	T	Farm

* D = decoction
S = spiritual
T = topical application (rubbing, etc.)

Trees are generally not planted purely for medicinal purposes, but are either planted for another product or service, and the medicinal value is secondary, or the medicinal ingredients are gathered from naturally occurring trees in farm, fallow, bush or forest. One possible exception is *Azadirachta indica*, commonly known as neem or *dogoyoro*, which is highly prized as a malaria treatment and is often planted in villages and on farms. Many of the species are used in combination to create medicines to treat certain illnesses, either by topical application or by ingestion. Others are used in a more spiritual way as part of traditional healing procedures, one example from Abo Mkpang being *Canarium schweinfurthii* which is said to scare witches away and thus can provide protection from them. *Barteria nigritana* which is used to cure madness, is also used by the local juju courts to extract confessions from individuals of crimes committed. The species has a symbiotic relationship with a type of ant which has a very painful sting, and suspects are tied to the tree and bitten by the ants until they confess.

Table 4.7 Medicinal trees of Igonigoni.

Species	Part	Medicinal use	How*	Location
Alchornea cordifolia	Leaves	Snake bite	D/P	Farm,bush
Anthocleista djalonensis	Roots	Fever		Farm,bush
Azadirachta indica	Leaves	Fever(malaria)	D	Farm,house
Baphia nitida	Leaves	Rashes	O	Farm,house
Dialium guineense	Bark	Cracked hands	O	Farm,bush
Nauclea latifolia	Lvs&rt	Yellow fever	D	Farm
Pterocarpus mildbraedii		Fever		Farm,house
Spondias mombin	Leaves	Cough,coagulant	D/P	Farm,house
Uvaria chamae	Root	Fever	D	Farm,bush

* D = decoction
P = poultice
O = ointment

4.3.4 Timber trees

The people of both Abo Mkpang and Igonigoni have a good knowledge of the different properties of many of the timber species. Depending on the strength of different timbers they are used accordingly, such as for roofing timbers, ceiling battens (*Pycnanthus angolensis*), door and window frames (*Brachystegia eurycoma* Harms, *Terminalia* spp.) and furniture. People are also generally aware of those species which fetch a high price if marketed.[2] Due to the proximity of the forest, large timber trees are much more easily available in Abo Mkpang than in Igonigoni, and a wider variety was mentioned by Abo Mkpang villagers during the survey. These data are perhaps the most indicative example of the degradation of the bush land surrounding Igonigoni where few timber trees remain, and those that do are generally too small to be harvestable as the bush is so recently disturbed and therefore immature. Although farmers are supposed to obtain permits from the Forest Department even to fell trees for domestic use, in practice this rarely occurs as forestry field staff are often not available or do not have the transport necessary to reach many of the villages. Tables 4.8 and 4.9 show those species that were mentioned, but this is by no means an exhaustive list as a very wide range of timbers is used.

Table 4.8 Timber trees of Abo Mkpang.

Species	Location	Use
Alstonia boonei	Farm	Facing boards
Baillonella toxisperma (Mimosop)	Farm,forest	Building/furnit.
Brachystegia eurycoma	Farm,forest	Construction
Diospyros mespiliformis (Ebony)	Farm,forest	Carving
Hallea ciliata	Farm	Furniture
Lophira alata (Ironwood)	Farm,forest	Wooden bridges
Lovoa trichilioides (Cedar)	Farm,forest	Furnit./door/win.
Milicia excelsa (Iroko)	Farm,forest	Furniture
Nauclea diderrichii (Opepe)	Farm,forest	Door/win. frames
Parkia biglobosa	Farm	Minor building
Petersianthus macrocarpus	Farm	Roofing
Pterocarpus osun (Camwood)	Farm,forest	Canoes/roofing
Pycnanthus angolensis	Farm	Ceiling battens
Terminalia ivorensis (Afara)	Farm,forest	Roof/construction
Terminalia superba (Afara)	Farm,forest	Minor building
Triplochiton scleroxylon	Farm	Roofing
Uapaca heudelotii	Farm	Minor building

[2] These are generally Tariff Classes 1 & 2 as defined by the Cross River State Forestry Department, a full list of which appears in Appendix I.

Table 4.9 Timber trees of Igonigoni.

Species	Location	Use
Alstonia boonei	Farm,bush	Facing board
Brachystegia eurycoma	Farm	Construction
Gmelina arborea	Farm	Const/matches
Klainedoxa gabonensis	Farm,bush	Construction
Lophira alata (Ironwood)	Farm,bush	Bridges
Milicia excelsa (Iroko)	Farm,bush	Furniture
Parkia bicolor	Farm	Minor constr.
Pterocarpus osun (Camwood)	Farm,house,bush	Canoe/roof
Terminalia spp. (Mahogany)	Farm,bush	Construction

4.3.5 Trees in farming

Trees are used in farming in both Abo Mkpang and Igonigoni, but there is a wider knowledge and more varied use in Abo Mkpang, where particular trees are valued for their usefulness in farming systems. Initially in both Abo Mkpang and Igonigoni the biomass from trees along with other vegetation provide nutrients for the crops after the farm plot has been cleared and burned. In Abo Mkpang this is often from primary forest where there is a large volume of biomass to clear and burn for each farm plot as 76% of respondents stated that they acquire land by clearing new areas of forest. A number of trees were mentioned as being good for maintaining soil fertility, including *Pycnanthus angolensis*, *Parkia bicolor*, *Musanga cecropioides* (Figure 4.7) and *Alstonia boonei* De Wild., and are often left on the farms when the bush or forest is cleared for planting (Table 4.10). Only 50% of respondents mentioned that they do anything to actively maintain soil fertility - fallow, compost and fertilizer being the methods noted. Trees are often left on farms to act as windbreaks, especially on plantain and banana farms which are often damaged in the high winds occurring at the beginning and end of the rainy season, and for shade, both for some of the crops, for example cocoa (*Theobroma cacao* L.), and for the farmers themselves when they are

Figure 4.7 *Musanga cecropoides*: said to improve soil fertility if present on farm or fallow, Igonigoni, July 1993 (Photo: the author).

working in the farm plots. Many other trees are also present on farms, primarily for the products they provide as discussed in previous sections, but farmers often mentioned secondary advantages such as shade and soil improvement. When they are young, some trees (for example *Mangifera indica* and *Ricinodendron heudelotii*) are used as live stakes for supporting yam vines (Figure 4.8), while long rotation timber trees, such as *Milicia excelsa*, *Terminalia ivorensis* and *T. superba*, are frequently planted to indicate farm boundaries as they take many decades to mature and will therefore remain as markers for a long time.

Table 4.10 Trees in farming in Abo Mkpang.

Species	Agricultural use
Albizia zygia	Increase fertility
Alstonia boonei	Increase fertility
Brachystegia eurycoma	Increase fertility
Bridelia spp.	Increase fertility
Harungana madagascariensis	Live stake
Hylodendron gabunense	Live stake
Mangifera indica	Live stake
Musanga cecropioides	Increase fertility
Newboldia laevis	Live stake
Parkia bicolor	Increase fertility
Pycnanthus angolensis	Increase fertility
Ricinodendron heudelotii	Live stake

In Igonigoni, although there is a good knowledge of the ability of some tree species to improve the soil and therefore crop yields (Table 4.11), this conflicts with the widespread feeling that all 'bush' (ie. *all* vegetation from the fallow period) must be cleared and burnt in order for the farm to be successful. This belief persists throughout the cropping season, with coppice shoots of many woody plants being cut back at each weeding, so that eventually only species which can survive this treatment, for example *Dialium guineense*, are present in the fallow

Figure 4.8 A young *Ricinodendron heudelotii* being used as a live stake for yam cultivation, Abo Mkpang, November 1993 (Photo: the author).

vegetation. About 50% of respondents in Igonigoni stated that they do nothing to maintain or improve soil fertility on farmland, while the remainder mentioned that burning, compost and fallow are used alone or in combination. Only one of the respondents mentioned clearing forest as being a source of acquiring new farm land, the remainder own, rent, borrow or inherit land that has already been cultivated and so the volume of biomass available for burning and the release of nutrients is often small. A few prized species, usually fruit trees or oil palms, are allowed to remain on the farms, often at the boundaries, and even these may be severely pruned when the fallow vegetation is first cleared. Very little planting of trees takes place on farms around Igonigoni, but some trees are used as boundary markers for farms, while others, especially *Spondis mombin* L., are used as live stakes for constructing yam barns which help to keep the yams cool so they can be stored for a long time. Some species are grown close to farms to be cut as yam stakes, the most common example being *Bambusa vulgaris* Schrad. ex Mendel (bamboo) (Figure 4.9).

Table 4.11 Trees in farming in Igonigoni.

Species	Agricultural use
Bambusa vulgaris	Yam stakes, markers
Brachystegia eurycoma	Increase fertility
Dialium guineense	Increase fertility
Dracaena arborea	Boundary marker
Musanga cecropioides	Increase fertility
Parkia bicolor	Increase fertility
Spondias mombin	Live stake

Due to the current land scarcity in Igonigoni which has led to a high proportion of farmers having to rent or borrow farm land, the progression from stage 4 to stage 5 of Shepherd's (1993) model is likely to be a slow one. The current land tenure situation does not encourage the planting of trees on farmland so it would seem that it will be many years before a gradual shift in land tenure laws allows the development of a new kind of tree-based resource to begin around Igonigoni.

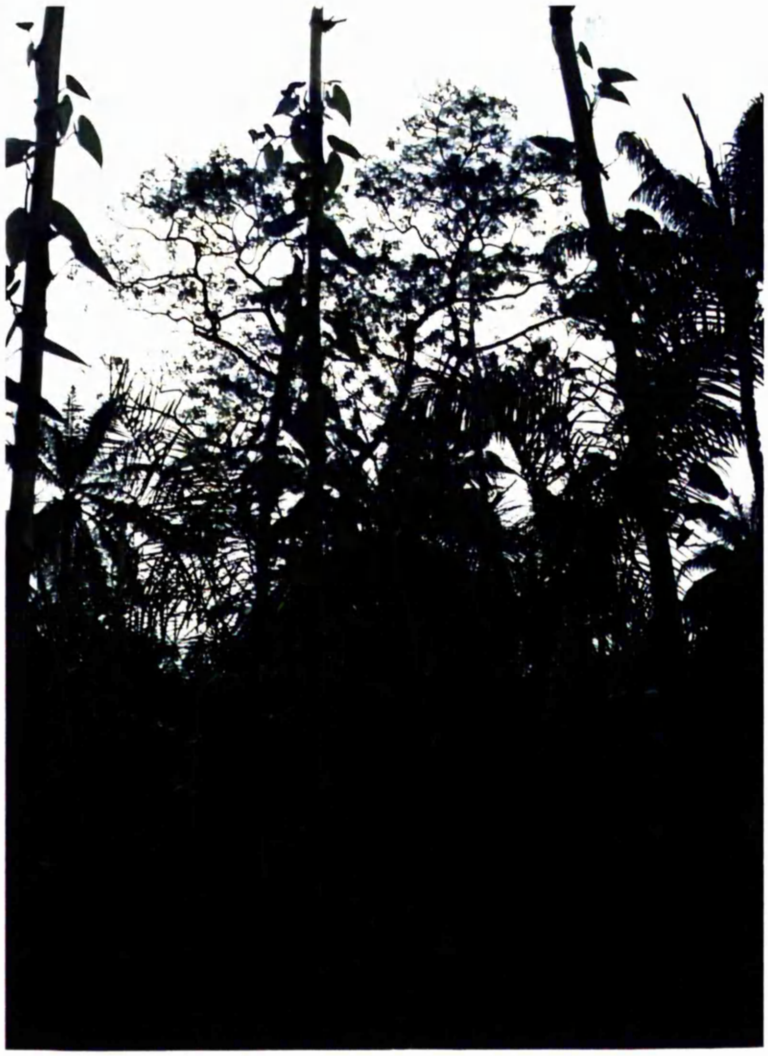


Figure 4.9 Bamboo (*Bambusa vulgaris*): a good source of stakes, essential for growing yams, Igonigoni, September 1993 (Photo: the author).

4.3.6 Amenity trees

In both Abo Mkpang and Igonigoni, trees are often planted in the village for shade and/or decoration. One of the most common shade trees in the study villages, which is frequently planted in chiefs' compounds throughout the region as a village meeting point, is *Terminalia catappa* L. whose branches grow perpendicular to the stem in layers, making a perfect shade canopy. Other trees commonly planted near to houses are known as 'Thunder' trees, *Hura crepitans* L. (Figure 4.10) and *Croton zambesicus* Meull.Arg., as they are said to attract lightning so that it does not hit the house.

Figure 4.10 The thunder tree (*Hura crepitans*): a lightning conductor and a shade tree frequently planted in villages, Abo Ogbugante, Cross River State, April 1993 (Photo: the author).

As can be seen in Tables 4.12 and 4.13, a greater variety of amenity trees is planted in Igonigoni, often along the village road or in home compounds, purely for decorative purposes.

Table 4.12 Amenity trees in Abo Mkpang.

Species	Use
Azadirachta indica	Decoration
Hura crepitans (Thunder tree)	Lightning conductor
Terminalia catappa	Shade tree

Table 4.13 Amenity trees in Igonigoni.

Species	Use
Azadirachta indica	Decoration
Croton zambesicus (Thunder tree)	Lightning conductor
Delonix regia (Flamboyant)	Decoration
Hura crepitans (Thunder tree)	Lightning conductor
Plumeria rubra (Frangipani)	Decoration
Terminalia catappa	Shade tree

4.3.7 Trees with edible leaves

The leaves of some tree species are edible and most of these are used to prepare soup which is eaten with *garri* (fermented, ground and dried cassava mixed with water to form an 'instant' staple with a doughy consistency), pounded yam, or rice. Some leaves are eaten raw as with *'Ogba'* (*Daniellia oliveri*) in Igonigoni which is eaten with fried yam.

The leaves are sometimes preserved for storage by drying, for example in Abo Mkpang where the leaves of *Albizia zygia* are boiled and dried and can then be stored for many months. In both villages it is during the dry season, when many trees produce a flush of young leaves, that most of the edible leaves are consumed. The leaves of fewer tree species are eaten in Abo Mkpang than in Igonigoni, probably because the former is still located very close to the forest where much more highly prized leaves such as *Afang* (from the climber *Gnetum africanum*) and 'hot leaf' (*Piper guineese* Schum. & Thonn.) can be collected easily. The trees with edible leaves that were mentioned in the survey are shown in Tables 4.14 and 4.15.

Table 4.14 Edible leaves of Abo Mkpang.

Species	Use	Location
Albizia zygia	Soup	Farm,forest
Ceiba pentandra	Soup	Farm

Table 4.15 Edible leaves of Igonigoni.

Species	Use	Location
Adansonia digitata	Soup	House,bush
Ceiba pentandra	Soup	Farm,house,bush
Daniellia oliveri	Raw with yam	Farm,bush
Ficus spp	Soup	House
Glyphaea brevis	Soup	Farm
Pterocarpus mildbraedii	Soup	Farm,house
Pterocarpus osun	Soup	Farm,house,bush
Pterocarpus spp.	Soup	Farm,house,farm
Vitex spp	To eat with yam	Farm,bush

4.3.8 Miscellaneous tree uses

In both Abo Mkpang and Igonigoni, many other uses were listed for trees and tree products. In Abo Mkpang especially, the forest was seen as a 'supermarket' where most domestic needs were catered for (Table 4.16). For example two types of pillow filling ('cotton') from *Funtumia africana* (Benth.) Stapf. and *Ceiba pentandra* L.(Gaertn) were mentioned, and *Momordica angustisepala* Hutch & J.M.Dalz. is used to make sponges for bathing with. Species such as *Randia* spp., *Uapaca heudelotii* Baill.

and *Uvaria chamae*, that can be used as chewing sticks, the local equivalent of a toothbrush, were often mentioned in both villages. Recreational activities such as games and wood carving are also catered for.

Table 4.16 Miscellaneous trees of Abo Mkpang.

Species	Use	Location
Albizia zygia	Whistles(pods)	Farm,forest
Bambusa vulgaris	Benches,poles	Forest
Ceiba pentandra	Pillow filling	Farm
Diospyros mespiliformis	Carving wood	Farm,forest
Elaeis guineensis	Palm wine	Farm,house,forest
Eremospatha hookeri	Cane(rope)	Forest
Funtumia africana	Pillow filling	Farm
Funtumia elastica	Latex	Farm
Funtumia spp	Carving wood	Farm
Hallea ciliata	Wrapping leaves	Farm
Laccosperma secundiflora	Cane(stick)	Forest
Momordica angustisepala	Sponge	Forest
Newboldia laevis	Fence	Farm
Randia spp.	Chewing stick,axe handle	Farm,forest
Raphia hookeri	Roofing,palm wine	Farm,forest
Rauvolfia vomitoria	Catapult	Farm
Uapaca heudelotii	Chewing stick, charcoal	Farm

In Igonigoni (Table 4.17), one species, *Crescentia cujete* L. (Figure 4.11), provides calabashes which, once dried, are used as water containers and drinking vessels. One important species in Igonigoni is *Dialium guineense*, which, because it is quite hard, is used to make pestles, necessary for producing pounded yam, and for pounding palm fruits for palm oil production. In the two villages, palms, both *Elaeis guineensis* (oil palm) and *Raphia hookeri* Mann & Wendlend (raphia palm), are tapped to produce palm wine (Figure 4.12), and *Raphia hookeri* is used to produce the thatch used for many roofs (Figure 4.13 and 4.14), known in the villages as 'local zinc'. The thatch is also taken to local markets around Igonigoni and sold.

Table 4.17 Miscellaneous trees of Igonigoni.

Species	Use	Location
Bambusa vulgaris	Benches,poles	Farm,bush
Baphia nitida	Live fence	Farm,house
Raphia sudanica	Roofing	Farm,bush
Baphia spp.	Chewing stick	Farm,bush
Ceiba pentandra	Pillow filling	Farm,house,bush
Crescentia cujete	Containers	Farm,house
Dialium guineense	Pestles	Farm,bush
Dracaena arborea	Yam barn	Farm
Elaeis guineensis	Palm wine	Farm,house,bush
Ficus spp.	Shrine tree	House
Glyphaea brevis	Chewing stick	Farm
Pterocarpus osun	Cosmetics	Farm,house,bush
Pterocarpus soyauxii	Canoe & paddle	Farm,bush
Raphia hookeri	Roofing, palm wine	Farm,bush
Uvaria chamae	Chewing stick	Farm,bush

Figure 4.11 The fruits of *Crescentia cujete*, the calabash tree, are dried and used as containers, especially popular as bowls from which to drink palm wine, Igonigoni, November 1992 (Photo: the author).

Collection of firewood was mentioned frequently in Igonigoni where, due to a lack of bush and mature fallow in the surrounding area, it is becoming scarce. Particular species were not generally noted as being favoured as firewood, although bamboo (*Bambusa vulgaris*) did appear to be popular, possibly due to rapid growth rates, and ease of cutting and carrying. Firewood was not mentioned at all in Abo Mkpang as a use for trees, probably because it is so easily obtained that it did not come to mind during the interviews.

Figure 4.12 *Raphia hookeri*: source of a popular local beverage, 'palm wine', delicious when consumed soon after tapping, and distilled in some areas to produce '*kai-kai*', Abo Mkpang, June 1993 (Photo: the author).

Figure 4.13 *Raphia hookeri* leaves are stripped from the stem in preparation for making thatch or 'local zinc' for roofing, Igonigoni, November 1992 (Photo: the author).

Figure 4.14 The leaves of *Raphia hookeri* are 'sewn' together to form thatch, a cheap and waterproof roofing material, Abo Mkpang, June 1993 (Photo: the author).

4.4 Tree use in Obiokpok

Obiokpok in Akwa Ibom State, was selected as the third study village and sampled using the questionnaire survey described in **3.4.5**. As outlined in **Chapter 2**, demographic pressure in this area has been severe for many decades, and as a result there is very little surplus land available; even degraded secondary bush is uncommon. Instead, almost all available land is part of an intensive farming system which has had to develop in order that food demands can still be met in a climate of intense pressure for land. An important aspect of the farming systems which have evolved, is the use of trees and shrubs in intensively farmed homegarden areas found around each household. Therefore, although there are few naturally occurring trees in the area, there is a very wide variety of tree and shrub species, both indigenous and exotic, which are planted and used as part of the homegarden systems, helping to keep them sustainable and to maintain productivity. The woody species also provide important dietary supplements such as fruit and leaves, which are not available from secondary bush or high forest as in the rest of the study area.

The homegardens or compound farms which have developed, described in detail in **Chapter 2**, comprise numerous multipurpose woody species in intimate multistorey associations with annual crops and, in some cases, livestock (Okafor & Fernandes, 1987). **Appendix J** shows the wide variety of woody species which occur as part of these homegarden systems (thirty-four species were commonly mentioned during the questionnaire survey), and Figure 4.15 is an example of the structure of part of one such homegarden in Obiokpok.

Key

O.P. Oil palm (*Elaeis guineensis*)

A.P. African pear (*Dacryodes edulis*)

O. Orange (*Citrus* spp.)

P. Pawpaw (*Carica papaya*)

A.B. African breadfruit (*Treculia africana*)

B. Banana/plantain (*Musa* spp.)

Y. Yam (*Dioscorea* spp.)

M. Maize (*Zea mays*)

B.L. Bitter leaf (*Vernonia amygdalina*)

G.E. Garden egg (*Solanum aethiopicum*)

Figure 4.15 Part of a homegarden in Obiokpok, showing some of the multistorey structure common to many compound farms.

4.5 Changing patterns of forest resource management with decreasing forest cover

As outlined in 4.2 and illustrated in Figure 4.1 (Shepherd, 1993), the change of intensity of active management of communally owned forest resources seems to be strongly influenced by pressure of use on the forest resource. It can be seen that the data collected from the two main study villages and one minor study village, illustrate this progression well.

The presence of largely intact high forest around Abo Mkpang, and the village's isolation and lack of access to markets, means that people generally gather many of their daily necessities from the forest, and from trees on farm land and around the houses. It is generally taken for granted that the forest will provide what people require, and even in cases of sickness, its resources are turned to first before considering 'modern' or commercial alternatives. Within the community, there are no restrictions on collecting products from primary forest, but non-indigenes are not allowed to gather products from the forest, and must instead buy the products from indigenes. On land that has previously been farmed and therefore is 'owned' by individuals, only the land owners have use-rights to the land and its products. The situation that exists in Abo Mkpang would therefore seem to be well represented by stage 1 in the diagram.

In Igonigoni which is less isolated and has very little forest in the vicinity of the village, there is much more reliance on markets for everyday needs. However there is still a tradition of using trees, and because of the lack of 'bush' and therefore easily accessible tree products, some trees are planted in and around the village. Tree planting on farms is still limited in Igonigoni, in many cases because due to land pressure, farmers have to cultivate borrowed land rather than their own farms, and they therefore have no tree planting rights. Pressure on the little remaining natural bush is great, and the area is rapidly becoming more degraded as fuelwood, building poles, medicines and so on are collected from the only areas available to the villagers. Igonigoni would seem to have moved from stage 3 to reach stage 4 in recent years, and as yet, change has been too rapid for villagers to adapt their activities in order to cope with the new situation.

In Obiokpok, the planting of trees and shrubs, and the continued use of trees and tree products has evolved further, a situation well represented by stage 5 in the diagram, as there is no longer any bush available to the villagers, from which to collect many of the tree products. The land tenure system is such that all individuals own farmland in and around the village, and this is intensively managed, especially those areas directly around the houses where much tree planting has taken place. Inhabitants of Obiokpok have very limited access to natural forest or bush areas, and yet the use and management of trees is an important aspect of their farming and survival strategies which have had time to evolve and create a new kind of resource.

Shepherd's model suggests that people will not develop intensive management strategies for commonly held resources until the situation is such that without these strategies the resource becomes severely degraded. The resource degradation, once begun, however, often occurs too rapidly for management systems to be developed and put into practice in time to save the resource. This is illustrated by the situation in the study villages. In Abo Mkpang there are no real management strategies for the communally owned forest because, as yet, pressure has not been severe enough to be deemed by the community to have reached a worrying level. In Igonigoni, the process has moved further and the pressure on the resource has been so great and so rapid that there has been no time for appropriate management practices to evolve. Even now when little common bush remains, there is no comprehensive management system in practice aiming to minimise further damage. In Obiokpok the process has continued to the last stage, the pressure on common resources has led to individuals planting and managing trees in intensive agricultural systems and thus developing a new resource.

4.6 Conclusions

Presentation of the village survey results and consequent discussion has led to the following conclusions being noted for this chapter:

- Woody species are important providers of food and other products, for domestic consumption and/or sale in many rural communities in the South generally, and in the study area in particular.

- Knowledge and use of woody species is greater in Abo Mkpang, a village in a heavily forested area, than in Igonigoni, a village situated in derived savanna.

- Planting of trees in the village and around houses increases with population density, little being done in Abo Mkpang, more being carried out in Igonigoni, while in Obiokpok tree planting in the village has created a new resource.

- Development of communal resource management strategies takes place as pressure on the resource increases, a process which is illustrated well by the research data.

CHAPTER 5

Four selected indigenous woody species and their potential role in agroforestry.

5.1 Introduction

The selection of the four species, *Albizia zygia*, *Dialium guineense*, *Ricinodendron heudelotii* and *Uvaria chamae*, for detailed study during the fieldwork period was based on a number of factors discussed in 3.5. This chapter begins with taxonomic and general descriptions of the study species (**Sections** 5.2 to 5.6), which are based on information found in the literature, so the detail available about each varies, as more work has been carried out on some of the species than on others. Following this, in **Sections** 5.7 and 5.8, is a presentation of the field data collected for each species, which includes the results of the germination trials and monthly observations of sample trees, and a discussion comparing these data with those documented by other authors. Particular attention is paid to the morphological and physiological data (especially phenology) which might aid in the selection and development of agroforestry systems appropriate to each species. The chapter concludes with a brief discussion of the agroforestry and agricultural potential of the four study species (**Section** 5.9).

5.2 *Albizia zygia* (D.C.) J.F.Macbr. (Syn. *Albizia brownei* Oliv.)

5.2.1 Distribution

This species has been described by many botanists and foresters (eg. Taylor, 1960; Irvine, 1961; Savill & Fox, 1967; Hall & Swaine, 1981;

Keay, 1989) and is widely distributed throughout tropical Africa, being common in much of West and Central Africa. It is found in both primary and secondary high forest (Irvine, 1961; Keay, 1964; Hawthorne, 1990), and in savanna areas (Lely, 1925; Aubréville, 1950; Nielsen, 1965; Lind & Morrison, 1974; Boulvert, 1980) the composition of which are outlined in 2.3.3. *Albizia zygia* is particularly common in secondary forest (Aubréville, 1950; Adjanohoun, 1964) along with *A. adianthifolia* and *A. glaberrima* (Taylor, 1960); and in farm bush areas (Savill & Fox, 1967; Nielsen, 1965).

5.2.2 Habit

Albizia is a pantropical genus of about one hundred and fifty species occurring in forest, woodland and wooded grassland (Friis, 1992), named after Albizi, an Italian naturalist (Neilsen, 1965). *Albizia zygia* belongs to the Mimosaceae. It is variously described as a large savanna tree (Lely, 1925; Lind & Morrison, 1974) and a small to medium sized forest tree (Keay, 1964; Savill & Fox, 1967) reaching a height of approximately 20-24 m and a diameter of 0.80 m (Thikakul, 1985; Keay, 1989). As with all other Nigerian *Albizia*s, *A. zygia* has a distinctive architectural pattern, illustrated in Figure 5.1, of ascending, widely spreading, crooked branches and an open crown more or less flat (Keay, 1964). The bole, short and rarely straight (Kunkel, 1965), with greyish and usually fairly smooth bark, sometimes has well developed buttresses in larger specimens (Irvine, 1961; Keay, 1964), but in smaller trees these are just root spurs (Taylor, 1960).

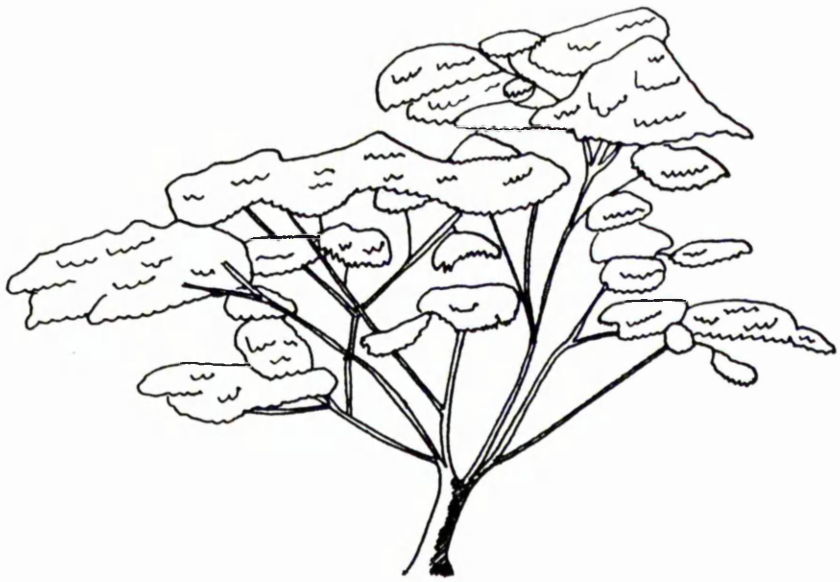


Figure 5.1 Distinctive architecture of *Albizia zygia* with low branching, and a flat, widely spreading, open crown.

5.2.3 Botany

The leaves of *A. zygia* are very distinctive, alternate and bipinnately compound (Taylor, 1960) with one to three pairs of large, opposite pinnae, the upper ones usually being the longest (Savill & Fox, 1967). The pinnae have two to five pairs of entire, obovate to rhombic sessile leaflets, and the terminal pair is the largest (Figure 5.2 and 5.3). The leaflets are asymmetric at the base (Hawthorne, 1990), with the midrib, slightly pubescent on the underside, not quite central. The petiole is 4-12 cm long, stout and has a prominent gland at the base (Thikakul, 1985). The leaflets vary in size from 1.5-8 cm long and 1-4.5 cm wide. Flowers are white to reddish, slightly hairy with a long red staminal tube (Savill & Fox, 1967). Pods are papery and brownish when mature, 10-20 cm long and 2-3.5 cm wide, containing ten or more small dark brown seeds with a prominent 'horse-shoe' mark.

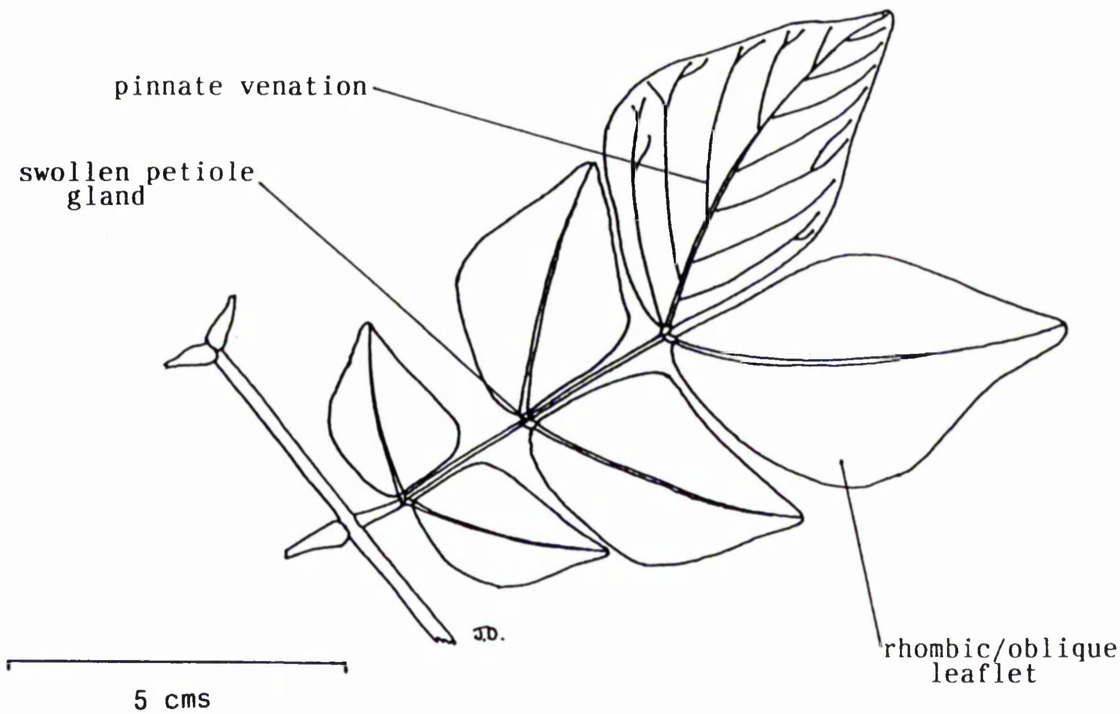


Figure 5.2 The leaf structure of *Albizia zygia*.

5.2.4 Ecophysiology

A. zygia is a light-demander which can germinate under the shade of young secondary growth, but rarely becomes established under a mature canopy (Hall & Swaine, 1981; Hawthorne, 1995) and is capable of rapid growth in its early life (Taylor, 1960). In Ghana, Schmitt and Adu-Nisah (1993) found the regeneration of *Albizia* species in mature forest to be good, there were many specimens of less than 50 cm in height, but most of the seedlings appeared to die off once the height of 1 m had been reached. This reinforces the idea that *A. zygia* needs light, especially for its progression from seedling to young tree. It has been described by Lind & Morrison (1974) as both a coloniser and a climax species in Uganda. This trait was also illustrated by Hall and Swaine (1981) in Ghana who showed that *A. zygia* was present, but in low numbers, for the

Figure 5.3 The distinctive, rhombic shape of *Albizia zygia* leaflets on a coppiced tree on farmland in Abo Mkpang, June 1992 (Photo: the author).

first three years of recolonisation from seed of a large clearing in upland evergreen forest. However, it quickly became one of the dominant species, along with *Funtumia africana* (Benth.) Stapf., *Terminalia ivorensis* and *Chlorophora* spp., as the short-lived pioneers such as *Musanga cecropoides* died off and the taller, longer-lived species formed the more mature secondary forest.

Although *A. zygia* is said to have a relatively long life span (Schmitt, pers.comm, 1994) very few mature specimens were found in the forest and bush surrounding the two study villages. When asked about fruiting/seeding patterns for the species, many farmers denied that *A. zygia* produces seed, and argued instead that it 'just comes up' (vegetative regeneration) in farm and fallow land. A similar pattern is described in Ghana (Anim-Kwapong & Teklehaimanot, 1995) where a study of abandoned cocoa farms revealed that regeneration of *A. zygia* from seed appeared to be of little importance whereas vegetative regeneration was found to be a major mechanism of secondary succession.

A. zygia is a legume tree species, and studies in Guinea-Bissau (Wester & Hogberg, 1989) reported finding Rhizobium-type root nodules. According to compilations of reports on root nodulation, nodules had not previously been observed, occurring naturally, in this species.

5.2.5 Indigenous knowledge

A. zygia is well known by villagers, and its local Boki name is *kanpun.* Much of the botanical information presented above is generally known, although may be described in different ways, and additional information gathered during the village survey follows in this section. Farmers in

Abo Mkpang recognise that *A. zygia* and *A. adianthifolia* belong to the same family, and in some cases the author was told that the smaller-leaved *A. adianthifolia* was a young *A. zygia* plant. There was also a theory presented which accounted for *A. zygia* being so common in farms and compounds. For those who believe seed is produced (see 5.2.4 for conflicting view), it is thought to be very light and therefore widely distributed by the wind. There was considerable debate as to whether *A. zygia* is good for the soil, some stated that it makes the land infertile, but a majority felt it had a positive effect on their farms. Further discussion of this takes place in 5.9.

5.3 *Ricinodendron heudelotii* (Baill.) Heckel (Syn. *R. africanum* Muell. Arg.)

5.3.1 Distribution

This species is widely distributed in Africa and is said to be present throughout the Guineo-Congolon Region (Irvine, 1961; Hall & Swaine, 1981), a broad band north and south of the equator which extends from Guinea in the west through Zaire to Uganda and Tanzania in the east, with a break between Ghana and Nigeria (White, 1983). The affinity between the Indian Ocean Coastal Belt and the Guineo-Congolon Region is much less than has previously been supposed (White, 1979), but there are several species common to both areas, and some such as *Ricinodendron heudelotii* show wide disjunctions (White, 1983). It is found occasionally in primary high forest, but its highest frequency is in secondary forest (Taylor, 1960; Irvine, 1961; White, 1983; Hawthorne, 1990; Riddoch *et al.*, 1991; Musoko *et al.*, 1994) and farm or fallow clearings (Taylor, 1960; Savill & Fox, 1967; Letouzey, 1982). Work by

Hawthorne (1995) indicates that the greatest number of stems per hectare of this species occurs along rivers located in drier forest areas. An inventory of forest in Cross River State (Dunn *et al.*, 1994) revealed that *R. heudelotii* is one of the twenty most common high forest species in size classes 70-89 cm diameter and >90 cm diameter, and ranks ninth overall.

5.3.2 Habit

Ricinodendron heudelotii, or the groundnut tree, belongs to the Euphorbiaceae. It is a large, short buttressed tree when mature (Irvine, 1961; Hall & Swaine, 1981) attaining a height of approximately 35 m (White, 1983), but can reach up to 50 m high (Keay, 1989). From early in its life, within the first two to three years, it has a distinctive architecture which makes it easily recognisable from a distance (Figure 5.4). The bole is often twisted with whorled, horizontal (especially in young trees, (Keay, 1989)) branches rising in layers (Hawthorne, 1990) and forming a spherical crown (Thikakul, 1985). The bark is dark grey, scaly and shaggy looking (Taylor, 1960).

5.3.3 Botany

The leaves of *R. heudelotii* are alternate and palmate, usually with five sessile leaflets (Taylor, 1960) and a petiole of approximately 10-20 cms long (Thikakul, 1985). The leaflets are obovate, about 10-20 cms long and 5-10 cms broad at the widest point, caudate and denticulate (Figure 5.5). Black glands are prominent along the margins. The leaves of young seedlings are single, cordate and crenate (Figure 5.6). The flowers are white, bell-shaped and fall readily. The fruit is a drupe, three-lobed

(Hall & Swaine, 1981), flattened at the apex and at the base, and about 3.5 cm long and 4.5 cm in diameter (Figure 5.7). It is indehiscent, green and then yellow and fleshy, containing three black seeds, pitted on the surface, flattened on one side, approximately 2 cm long and 1.8 cm across the flat face.

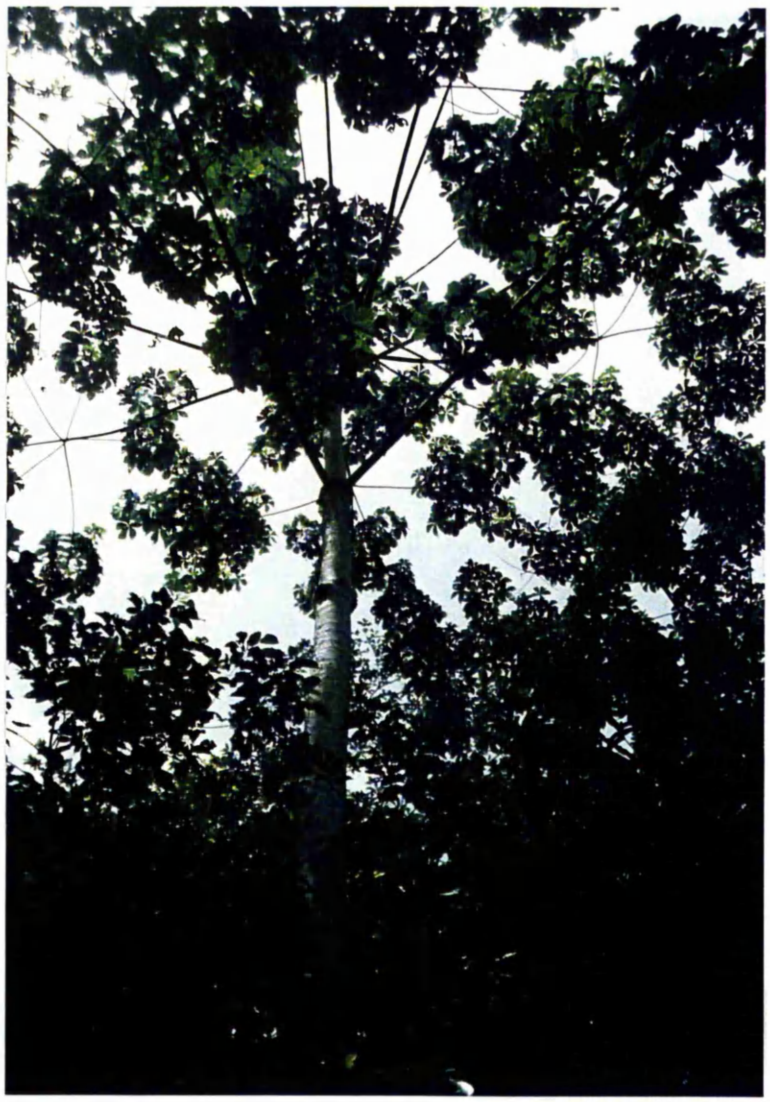


Figure 5.4 The distinctive architecture of a *Ricinodendron heudelotii* tree, Abo Mkpang, Cross River State, May 1993 (Photo: the author).

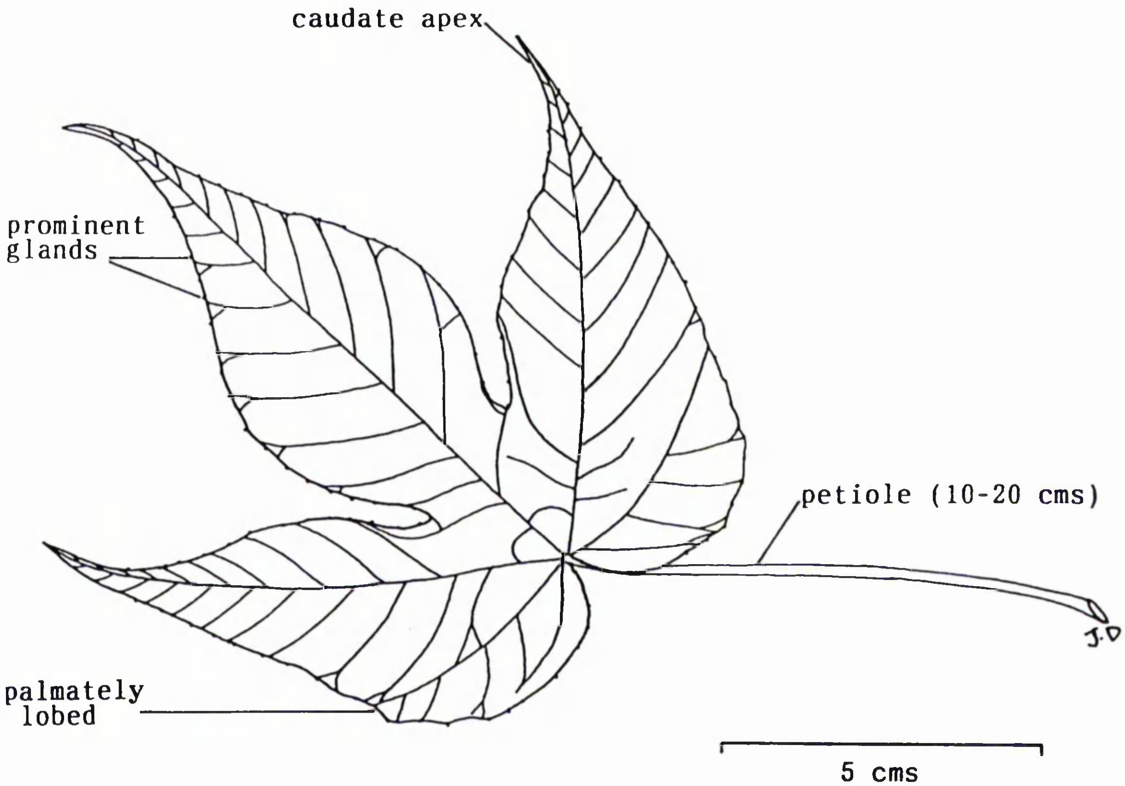


Figure 5.5 Mature leaflet of *Ricinodendron heudelotii*.

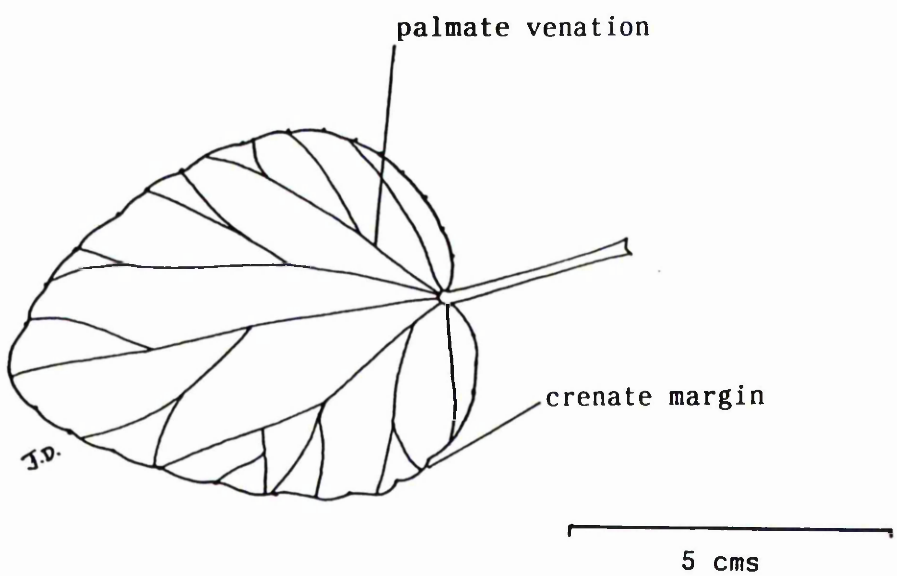


Figure 5.6 Young leaflet of *Ricinodendron heudelotii*.

5.3.4 Ecophysiology

R. heudelotii is a light-demander only able to regenerate in gaps (Taylor, 1960; Hall & Swaine, 1981) which it does very effectively to be one of the commonest seedlings in more open areas and is absent from shaded understorey (Hawthorne, 1995). Often the seedlings are grouped in threes, the product of an entire fruit (Taylor, 1960), and they progress rapidly where they have plenty of overhead light. *R. heudelotii* seeds are stimulated to germinate by exposure to the sun (Macgregor, 1934), although seedlings are then subsequently helped by partial shade, because over-exposure encourages leaf-curl (Hawthorne, 1995). The species is extensively distributed throughout semi-deciduous, semi-evergreen and wetter forest types, but is usually only found in secondary forest (White, 1983). *R. heudelotii* is said to have rapid growth attaining a height of about 10 m in four years (Taylor, 1960). Increment studies in the semi-deciduous Mayumbe forest in Congo (Hombert, 1958) showed it to have one of the fastest growth rates with a mean annual increment of >2 cm. It is a pioneer species in the group which takes over from such rapid invaders as *Musanga cercropioides* to form mature secondary forest (White, 1983; Riddoch *et al.*, 1991), but can also readily regenerate abundantly on abandoned farmland. It is not, however, a long-lived tree and dead standing specimens are not uncommon (Taylor, 1960). *R. heudelotii* also shoots readily from a stump or the bole of a fallen tree. Recent work (Musoko *et al.*, 1994) in Cameroon, has identified *R. heudelotii* as one of the species found abundantly in secondary forest and known to form vesicular-arbuscualr mycorrhizal associations. In the soil conditions common to much of the tropics, that is acidic, nutrient poor, clayey utisols, plant performance is strongly dependent upon the establishment of these associations, and this may, in part, explain the ability of this species to colonise an area so effectively.

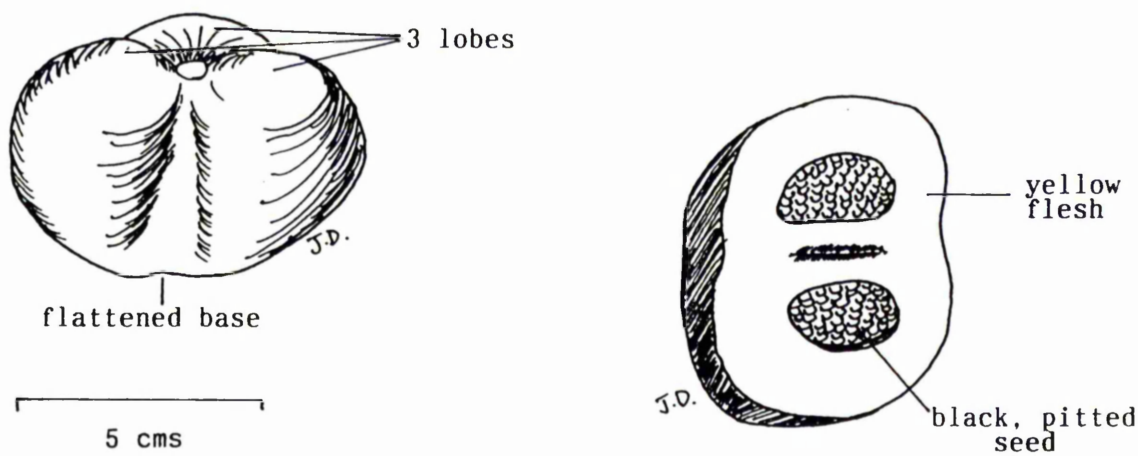


Figure 5.7 Fruit of *Ricinodendron heudelotii* - whole and in cross-section.

5.3.5 Indigenous knowledge

R. heudelotii is well known by the people of Abo Mkpang and they recognise different parts of the tree which have related Boki names. *Bokpasi* refers to the tree itself as a species name, but also to the bole. *Okpasi* is the name given to the fallen fruit, and *Nguge* is the term used for the seed. Although *Nguge* is sometimes used as a spice by the villagers, it is more greatly valued for its sale value to Cameroonians who prize it as a food (see 5.6.2 below), and it is said that a small cup of the seeds can be sold for N100.

There was some discussion by the villagers about the possible alleopathic effects of *R. heudelotti*. It was stated that it does not allow other trees to grow near it, and that if palm wine is tapped from a palm tree growing close to *R. heudelotii*, then the wine will not be sweet. No reference to this has been found in the literature.

5.4 *Dialium guineense* Willd.

5.4.1 Distribution

Dialium is a genus of about thirty-five species, distributed in the tropics of the Old World, mostly in Africa (Friis, 1992). *Dialium guineense* is the commonest and most widespread *Dialium* in Nigeria (Keay, 1989). It has been studied and described by many botanists and foresters as a multipurpose tree of the West African Guinean forest zone (eg. Taylor, 1960; Hall & Swaine, 1981; Hawthorne, 1990; Todd-Bockarie & Duryea, 1993). It typically grows in fringing forest, dense savanna and riparian forest ranging from Senegal to Sudan, along the southern boundary of the Sahel (Szolnoki, 1985). In the study area *D. guineense* is common in the derived savanna bush which is thought to have developed due to pressure on the land from agriculture, described in 2.3.3, and is essentially a tree associated with the lower rainfall parts of the high forest (Taylor, 1960).

5.4.2 Habit

Dialium guineense, or the velvet tamarind tree, belongs to the Caesalpiniaceae. It is a small to medium-sized tree reaching a height of approximately 20 m, often with a short, slender bole, low branching and a dense leafy crown (Hall & Swaine, 1981; Keay, 1989) (Figure 5.8). The bark is smooth and grey. It often appears on farm or fallow land as a low, bushy shrub (Figure 5.9) due to its capacity to regenerate well from a stump after repeated cutting and/or burning during farm clearing.

Figure 5.8 A mature, single-stemmed *Dialium guineense* in farm land, Igonigoni, Cross River State, September 1993 (Photo: the author).

5.4.3 Botany

The leaves of *D. guineense* are alternate and imparipinnate, with a common stalk 5-13 cm long (Keay, 1989) (Figure 5.10). They usually consist of two pairs of opposite leaflets and a terminal one, the lower pair being somewhat smaller. The leaflets are elliptic to lanceolate,

Figure 5.9 Bushy *Dialium guineense* shrub growing in young fallow, Igonigoni, Cross River State, January 1993 (Photo: the author).

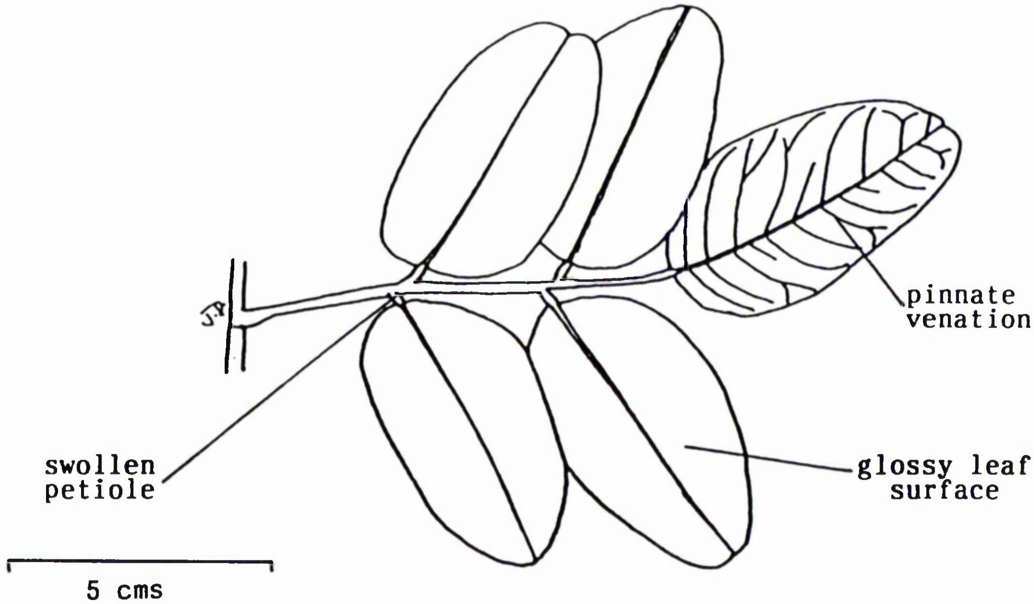


Figure 5.10 Structure of *Dialium guineense* leaves.

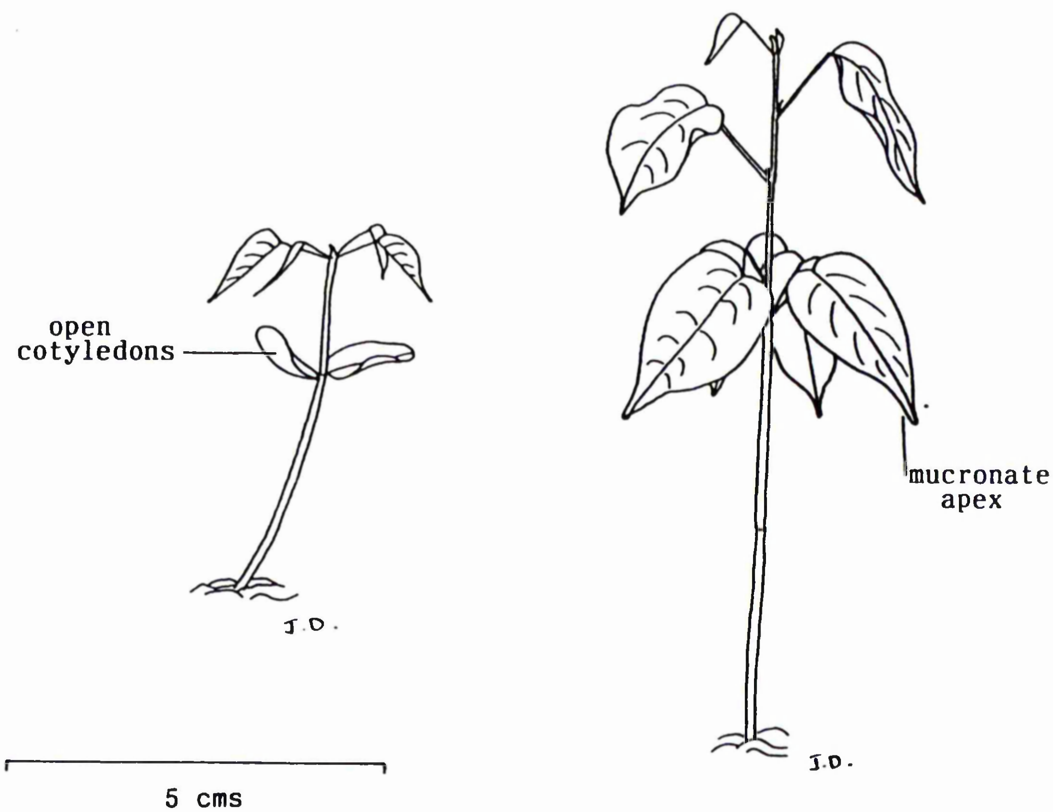


Figure 5.11 Seedlings of *Dialium guineense*.

being 3.5-10 cm long by 2.5-5 cm broad, and entire. The petiole is short, slightly swollen and pubescent. The leaflet is leathery, smooth and glossy above, and sometimes lighter in colour and finely hairy beneath with the venation prominent (Taylor, 1960). The leaves of young seedlings are single, cordate and entire (Figure 5.11). Flowers are brownish cream, in large terminal or occasionally axillary panicles up to 30 cm long. Fruits are usually profuse and small, black, velvety and very conspicuous and distinctive. Each fruit has a stalk about 6mm long, and a small collar near the apex (Figure 5.12). The shell is brittle, enclosing 1, or rarely 2 seeds, embedded in an orangey-brown, dry, sweet, edible pulp.

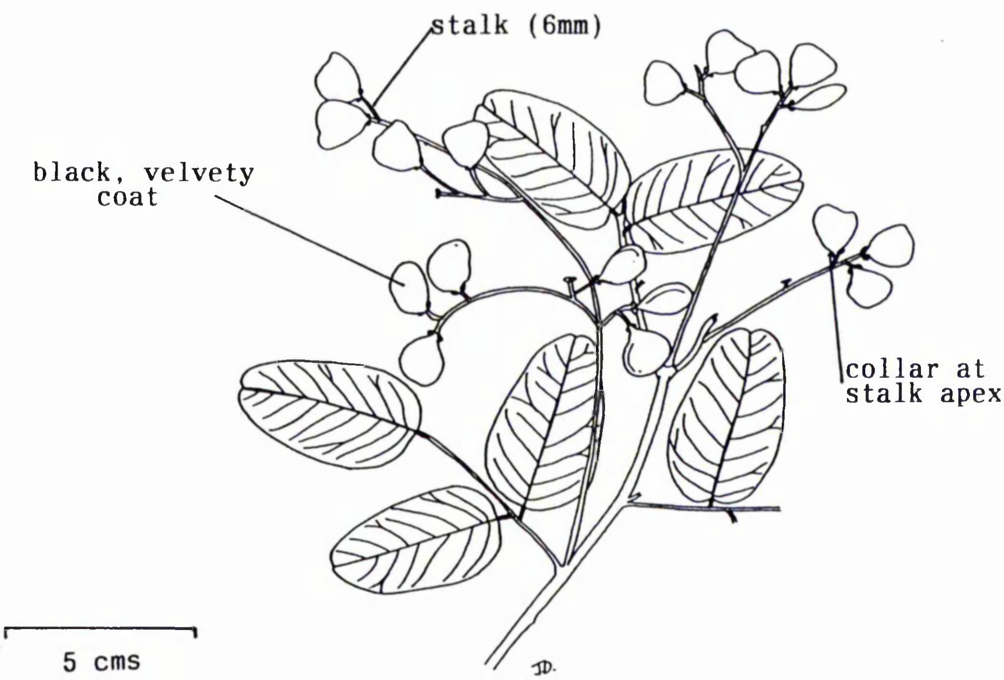


Figure 5.12 The velvety fruits of *Dialium guineense*.

5.4.4 Ecophysiology

D. guineense regenerates in shade (Hall & Swaine, 1981) but is slow to become established (Duguma *et al.*, 1994), and is often found as an understorey tree in dense savanna forests (Savill & Fox, 1967). A study in semi-deciduous forests in Côte d'Ivoire revealed that it is one of the three most common tree species in this forest type (Devineau, 1991). Its seeds are dispersed by elephants, birds, monkeys and humans when they eat the fruit pulp (Todd-Bockarie & Duryea, 1993). In the author's experience they are a food highly prized by chimpanzees, drills, and children in south east Nigeria. *D. guineense* has fast regrowth and recovery after coppicing and/or burning and is able to survive many such treatments. It burns fiercely producing a fine ash when fires are set to clear farms, and as such is highly valued in fallow regrowth by farmers in Sierra Leone (Richards, 1985). Trees of all sizes of this species are more abundant in burnt than in unburnt forest in Ghana (Hawthorne, 1994). Duguma *et al.* (1994) showed that it has very high coppicing ability. Trees which were cut and/or burnt in the study area quickly recovered, either by shedding the burnt leaves and growing new ones, or by growing many coppice shoots from the stem or base (Figure 5.13 and 5.14).

5.4.5 Indigenous knowledge

Ehane, the local Igonigoni name for *D. guineense*, is well known and was mentioned in 61% of the interviews carried out in the study village and was said to be abundant in the area. It is widely accepted as being a tree that is good for the soil, and its presence on a farm is reported to improve crop production. However, because of the dense, bushy crown which develops on larger trees, these are often severely pruned before planting so that shade does not effect crop growth. There are many different local uses for this species, as shown in 5.6.3.

Figure 5.13 Fire-damaged *Dialium guineense* tree which dropped its leaves soon after burning, and produced a new crown, in recently cleared farm land, Igonigoni, Cross River State, January 1993 (Photo: the author).

Figure 5.14 New coppice shoots of cut and burned *Dialium guineense* in farm land, approximately six weeks after clearing, Igonigoni, April 1993 (Photo: the author).

5.5 *Uvaria chamae* P.Beauv.

5.5.1 Distribution

This species rarely appears in forestry-based literature as it is only a small tree or shrub, and therefore until the recent inclusion of the NTFP value of forests in some foresters thinking, it was seen to have little worth. It does however appear in texts which examine the multiple uses of woody species, such as Irvine (1961) and Abbiw (1990), and in general flora (Neilsen, 1965). In West Africa, *U. chamae* is widely distributed, and is also said to occur in some parts of east and central Africa (Verdcourt, 1971). It is found in fringing forest, drier parts of the high forest, and in savanna and coastal areas (Irvine, 1961; Neilsen, 1965).

5.5.2 Habit

U. chamae, a member of the Annonaceae, is said by Verdcourt (1971) to form, together with its relatives, a superspecies in which most of the component parts are easily recognisable. However, in some cases small, local populations show characters more typical of other component species. It is suggested that more work is needed to clarify the taxonomy of this genus. In West Africa, *U. chamae* is a shrub, sometimes climbing, or small tree up to 4 m in height (Irvine, 1961; Neilsen, 1965). In the study area, the most common habit was as a shrub, branching from very close to the ground with straight branches (Figure 5.15). Its bark is smooth and brown to grey in colour.

5.5.3 Botany

The leaves of *U. chamae* are alternate, elliptic, mucronate and entire (Figure 5.16). The leaf surface is shiney and glabrous, with 10-12 pairs of obvious, pinnate, lateral nerves (Irvine, 1961). The flowers are fragrant, yellowish-brown with six petals which rot easily and are borne directly on the woody branchlets. The fruits are brown and hairy turning yellow when ripe, and are borne in bunches (Figure 5.17). The name *Uvaria* comes from the Latin for a grape, referring to the fruit clusters (Neilson, 1965). The seeds, small, brown and hard, are surrounded by a sweet, edible pulp.

Figure 5.15 A young, shrubby *Uvaria chamae* individual which shows the most common habit of this species in the study area, Igonigoni, Cross River State, July 1993 (Photo: the author).

5.5.4 Indigenous knowledge

Although this species, known locally as *Roverizoi*, is widely used, mainly for medicinal purposes, local people seem to know little about its biology. It is thought to make the land around it fertile, and as such is allowed to remain on farmland, but is cut severely during the growing season and regenerates during fallow periods.

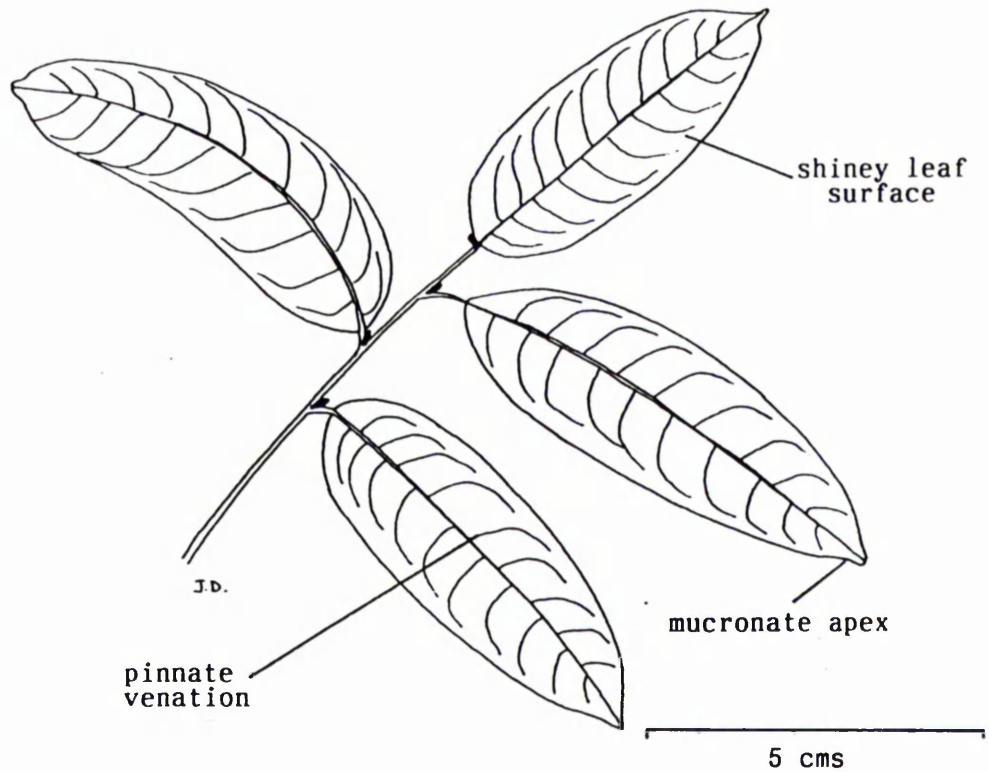


Figure 5.16 Structure of *Uvaria chamae* leaves.

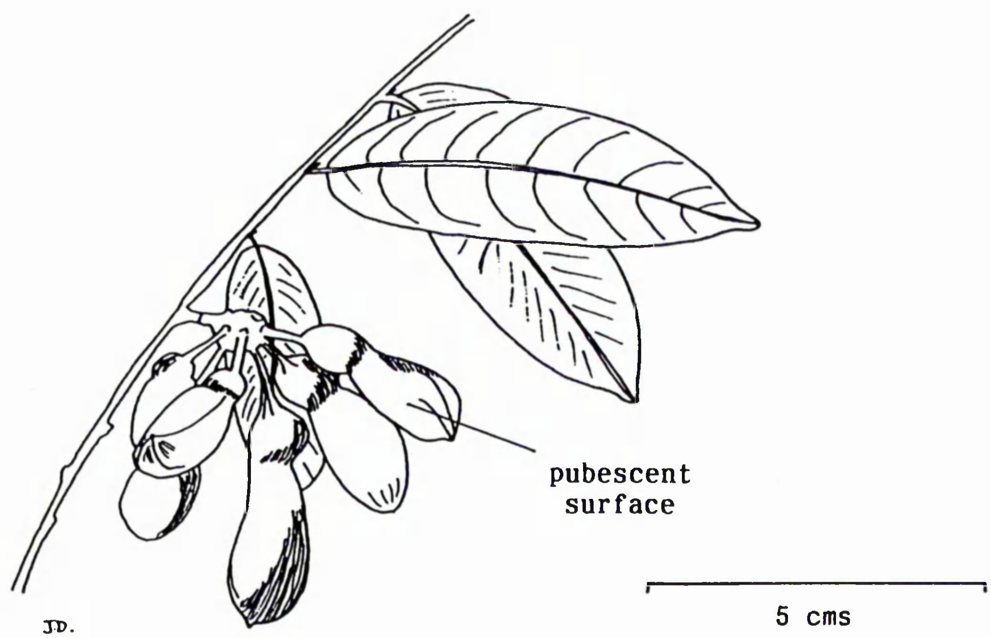


Figure 5.17 Fruits of *Uvaria chamae*.

5.6 Uses of the 4 species

The following are lists of the uses of the four species in West Africa, compiled both from the literature and from data collected during village surveys and PRA meetings (see **3.4** and **6.3**). A full discussion of the use of all the woody species mentioned during the surveys appears in **Chapter 4**.

5.6.1 *Albizia zygia*

There are many African *Albizias* and the timbers of those occurring in West Africa are mainly divided into 'light' and 'heavy' kinds, the latter being the more durable (Irvine, 1961). The sapwood of *A. zygia* is white to yellowish and fairly wide, while the heartwood is dark brown with a pink tinge. Though the light timber is rather slow to dry, it works and finishes well with a fairly fine grain, and is said to be resistant to fungii. It is sometimes harvested for domestic use but it is rarely sold and is only in Timber Class 2 in Nigeria (**Appendix** I) and Class 3 in Ghana. However, in the Gambia it is classed as one of the eighteen major timber species (Gotz, 1983).

The timber and non-timber uses of *A. zygia* are many. Abbiw (1990) lists over fifteen uses in Ghana, Dalziel (1937) described six uses in Nigeria, and social surveys in the two study villages revealed three uses. In Abo Mkpang one of the major uses of *A. zygia* is as a vegetable. Fresh, new leaves are picked, ground and boiled well and then mixed with ground *R. heudelotii* seeds, palm oil and fresh fish to make a delicious soup. This and other uses for the species, and their sources, are shown in Table 5.1 below.

Table 5.1 Timber and non-timber uses of *Albizia zygia*.

CATEGORY	USE	SOURCE*
Timber	Veneer/plywood	Abb
	Planks/doors	Dal
	General building	Abb,Dal
Medicinal	Inc. appetite - tonic from bark	Abb
	Roots in food - treat cough	Abb
	Roots - smelling salts	Abb
	Leaf tea - bath/beverage - fever	Abb
	Stem decoction - laxative	Abb
	Leaf decoction - bath - rheumatism	Abb
	Topical application - scabies	Abb
	Powdered bark - yaws	Abb,Dal
Food	Leaves (fresh or dried) - soup	Abb,Dal,Sur
Agricultural	Increase fertility	Sur
	Silk worm host	Abb,Dal
Miscellaneous	Pestles	Abb
	Gum	Abb,Dal
	Fuelwood/charcoal	Abb
	Dry pods - childrens' whistles	Sur

* Abb - Abbiw, 1990
Dal - Dalziel, 1937
Sur - Village surveys

5.6.2 *Ricinodendron heudelotii*

The timber of *R. heudelotii* is white and very soft (Hall & Swaine, 1981; Keay, 1989), light, not durable and liable to stain (Taylor, 1960). It is however highly prized as a carving wood by the Luba in Congo where a study showed that 70% of such articles recorded were made of *R. heudelotii* (Deschamps, 1974). In Cameroon the species is valued for its seed which is used as a soup thickener or to extract oil for cooking. Malleson-Amadi (1993) states that it provides a large proportion of village income, especially to women, in the communities around Korup National Park. It also has a wide range of medicinal uses. The timber and non-timber uses of *R. heudelotii* are listed in Table 5.2.

Table 5.2 Timber and non-timber uses of *Ricinodendron heudelotii*.

CATEGORY	USE	SOURCE*
Medicinal	Root decoc. enema - diarrhoea	Abb
	Leaf infus. lotion - conjunctivitis	Abb
	Root + salt + pepper - laxative	Abb,Irv
	Leaf tea - bath/beverage - fever	Abb
	Bark infusion prevents abortion	Abb,Fak
	Pounded bark - topical - elephantitis	Abb,Irv,Fak
	Bark decoction - wash - gonorrhoea	Abb,Irv,Fak
	Bark infusion - relieve labour pain	Irv,Fak
	Leaves to draw porcupine quills	Sur
Food	Wood ashes as salt	Abb,Irv
	Seeds - soup thickener	Mal
	Seeds boiled and eaten	Irv,Sur
	Seasoning - 'local Maggi'	Sur
	Seeds - cooking oil	Sur
Agricultural	Live fence	Irv
	Yam stake - live or cut	Sur,Irv,Kea
	Green manure - seed cake	Abb,Irv
Miscellaneous	Carving - stools, masks, bowls, spoons	Abb,Irv
	Drums	Abb
	Seeds - rattles/game counters	Abb,Irv
	Wood ash - soap	Abb,Irv
	Oil - varnish	Abb,Irv
	Used in war to tie prisoners to	Sur

* Abb - Abbiw, 1990
Fak - Fakankun & Loto, 1990
Irv - Irvine, 1961
Kea - Keay, 1989
Mal - Malleson-Amadi, 1993
Sur - Village surveys

5.6.3 *Dialium guineense*

D. guineense is a truly multipurpose tree species valued by many for a large number of uses. The name *Dialium* is from the Greek 'to destroy', referring to the ancient use of the plant against bedbugs (Neilsen, 1965). Adekunle (1971) listed it as one of the five best known fruits in Nigeria, and in both urban and rural markets in Cross River State they are sold for N1.00 for a heaped 170g milk tin. It is a good fuelwood and charcoal (Abbiw, 1990), and as such is valuable in areas, such as derived savanna, where natural fuelwood sources are under pressure. The wood is hard, heavy and pinkish brown, and is not readily attacked by termites; and the heartwood is suitable for turnery and cabinet making (Irvine, 1961). A study of lesser known timber species (Brown, 1977) showed that *Dialium* spp. are resistant to marine borers. The many timber and non-timber uses of the species are listed in Table 5.3 below.

Table 5.3 Timber and non-timber uses of *Dialium guineense*.

CATEGORY	USE	SOURCE*
Timber	Furniture	Irv
	Building poles	Irv
	Bridge construction	Got
Medicinal	Boiled shoots with food - fever	Abb
	Bark decoction - gargle - sore throat	Abb,Irv
	Bark decoc. - mouthwash - toothache	Abb,Irv
	Leaf decoction - eye ointment	Dal,Irv
	Bark decoc. + spices - stomach ache	Abb,Irv
	Leaf decoction - tumours	Abb,Irv
	Fruit pulp - diarrhoea	Abb,Irv
	Leaf juice - labour pains	Abb,Irv
	Powdered leaf + food - oedemas	Abb,Irv
	Bark - lotion for cracked hands	Sur
Food	Fruit - rich in Vit. C	Abb,Irv,Sur
	Fruit pulp + water - beverage	Abb,Irv,Oka
	Leaves as vegetable	Szo
Agricultural	Ash production	Ric
	Yam stakes	Oki
	Increase fertility	Sur
	Mulch	Von
	Hedgerow/windbreak	Von
	Fodder	Oki,Lar
Miscellaneous	Fuelwood	Abb,Irv,
	Charcoal	Abb,Sav
	Chewing stick	Abb,Dal,Irv
	Pestles	Abb,Irv,Sur
	Tool handles	Abb,Oki,Sav
	Gum/resin - illuminant	Abb,Irv
	Utensils	Irv,Oki
	Seeds for beadwork	Abb

* Abb - Abbiw, 1990
Dal - Dalziel, 1948
Got - Gotz, 1983
Irv - Irvine, 1961
Lar - Larbi *et al.*, 1993
Oka - Okafor & Fernandes, 1987
Oki - Okigbo, 1976
Ric - Richards, 1985
Sav - Savill & Fox, 1967

Sur - Village surveys
Szo - Szolnoki, 1985
Von - Von Carlowitz, 1986

5.6.4 *Uvaria chamae*

This species rarely reaches a large enough size for the wood to be of any use. It is therefore not used as a timber species, and only rarely are wooden items, such as paddles (Irvine, 1961), made from it. Its major use is as a medicinal plant, and all parts are used in various ways to treat a wide range of ailments. The uses of *U. chamae*, and their sources, are shown in Table 5.4.

Table 5.4 Non-timber uses of *Uvaria chamae*.

CATEGORY	USE	SOURCE*
Medicinal	Root bark powder as snuff for catarrh	Abb,Irv
	Root extract - enema for diarrhoea	Abb
	Root bark + spices - boiled - jaundice	Abb,Irv
	Root - tonic - blood/bleeding probs.	Abb,Irv
	Fruits - blood tonic	Sur
	Root bark - piles	Abb,Irv
	Juice root/stem - cuts/wounds	Abb,Irv
	Root drink - fever	Abb,Irv,Sur
	Root tea - abdominal pains	Abb,Irv
	Root juice in eyes - malaria	Sur
	Ground root - rheumatism	Sur
Food	Edible fruit - eaten & sold	Abb,Irv,Sur
Agricultural	Increases fertility	Sur
Miscellaneous	Paddles	Irv
	Fuelwood in savanna areas	Abb
	Split twigs/stems - baskets	Abb
	Chewing sticks	Sur

* Abb - Abbiw, 1990
Irv - Irvine, 1961
Sur - Village survey

5.7 Germination trials

The methodologies of the germination trials carried out for *R. heudelotii*, *D. guineense* and *U.chamae* are described in detail in 3.6.1. Due to anticipated problems of seed availability for *A. zygia*, germination trails for this species were carried out in Ghana in 1989/90 with seed collected from a tree located near a large village in the high forest zone. A protected nursery site was constructed in the shade of a large flamboyant tree (*Delonix regia* (Hook.) Raf.) and one hundred and ninety-eight polypots filled with a mixture of topsoil, sand and compost in the ratio of 3:1:1 were placed inside. The seeds, which are small with a hard coat, were pre-treated in one of three different ways:

a) No treatment;

b) Soaking in hot water for five minutes, and then in cold water for twenty-four hours; and

c) Nicking the seed coat with finger nail clippers.

Two replications of thirty-three pots for each treatment were prepared and observed daily to note germination. After six weeks of observation no seeds treated by soaking had germinated, whereas 32% of the nicked seeds and 26% of the seeds with no treatment germinated. However, survival of the germinated seedlings was better in those whose seeds had received no treatment at 78%, with 65% of 'nicked' seedlings surviving.

R. heudelotii produces fairly large seeds with a very hard coat, therefore the treatment used for this species was to tap the seed gently with a hammer to crack the seed coat. Fifty treated seeds and fifty untreated seeds were planted in polypots as described in 3.6.1, and observed daily to note germination. Of the treated seeds, 40% germinated three weeks after planting and seedlings initially grew fast, but most were then badly attacked by snails or insects so survival was low at 6% The untreated seeds did not germinate until six months after planting, when 46% germinated over a period of four to five weeks (Figure 5.18). The seedlings grew fast, an average of 42.1 mm per week, and the survival rate was high at 98%.

Figure 5.18 *Ricinodendron heudelotii* seedlings in germination trials in Calabar, Cross River State, April 1993 (Photo: the author).

Treatment of *R. heudelotii* seeds by cracking accelerated germination so that it occurred three weeks after planting. However, the seedlings did not survive after initially growing well, probably due to adverse conditions present from germinating at the wrong time of year. Natural regeneration of *R. heudelotii* occurs six months after the fruits have fallen (Taylor, 1960), when the correct environmental conditions exist.

Those seeds which were untreated and germinated six months after planting, at the same time of year as they would in the forest, had a very high survival rate. Therefore, although treatment was seen to speed up germination, it is better to plant untreated seeds for the production of healthier seedlings. This was confirmed by farmers in Abo Mkpang who stated that they plant *R. heudelotii* seeds when the fruits have rotted, and wait until they germinate naturally, which takes a long time.

D. guineense seeds have a hard coat, and the treatment used for these was soaking in cold water for twenty-four hours before planting. Fifty treated and fifty untreated seeds were planted in polypots and observed daily to note germination. Both the treated and untreated seeds germinated between one and ten weeks after planting to produce seedlings with a distinctive leaf shape and pattern (see 5.4.3), both treatments with 46% germination. Survival rates were also similar, 86% for treated seeds and 82% for untreated seeds, but growth was faster for treated seeds (an average of 4.3 mm per week) than for untreated seeds (an average of 2.9 mm per week).

Todd-Bockarie and Duryea (1993) carried out seed pretreatment experiments for *D. guineense* and concluded that nicking and immersion in concentrated sulphuric acid are the best pretreatment methods for improving percentage germination, and that nicking is the most appropriate treatment to use at individual farmer or village nursery level.

The treatment used for *U. chamae* was also to soak the seeds in cold water for twenty-four hours. Fifty treated and fifty untreated seeds were planted and observed as before. For the treated seeds, 72%

germination occurred approximately six months after planting, over a period of six weeks, with a survival rate of 88%. The untreated seeds took longer to germinate, between six and nine months, and only 32% germinated with a survival rate of 76%. Growth was again slow, but faster than *D. guineense*, with an average of 5.4 mm per week for untreated seeds and 4.9 mm per week for treated seeds.

The treatment of soaking appeared to make little difference to the germination and survival rates of *D. guineense* in this experiment, and previous studies suggest that nicking or soaking in acid are more effective in improving percentage germination in this species. Growth rates for the seedlings were slow for both treated and untreated seeds, and it may be that vegetative propagation is a better way of establishing *D. guineense* for use in farming systems as growth rates may be faster earlier, suggested by the excellent coppicing ability of the species as discussed in 5.8.2 below. Further work is needed to determine the best way of establishing *D. guineense* on farm and fallow land.

Soaking *A. zygia* seeds produced no germination, the temperature of the water used initially was probably too hot for too long. Nicking produced a higher germination percentage, but a lower survival rate than untreated seeds, and it would seem that this is the most appropriate treatment to use for this species. Soaking *U. chamae* seeds produced a much higher germination percentage than was achieved with untreated seeds. It also produced more uniform germination over time, occurring over a period of about two weeks, rather than the three months over which germination was spread for untreated seeds. However growth was slower in seedlings from treated seeds than from untreated seeds.

Vegetative propagation may also be a better option for *U. chamae,* but more work needs to be carried out in this area.

Due to the long period over which germination took place for *R. heudelotii*, *D. guineense* and *U. chamae*, it was possible to treat the data from the trials in two ways. The first method was to calculate an average height of all seedlings for each week, starting when the first germinations took place, so that n (number of seedlings) is variable (n=v) as for example, only four seeds germinated in week one, twelve germinated by week three, and twenty-three by week five. The second method was to calculate the average height for seedlings in their first week, and following weeks of growth, so that n is constant (n=c), but heights from different calendar weeks are used to calculate an average. It is suggested that the second method produces a truer curve, as n is constant, so abnormally small or large numbers have the same effect on the averages throughout, rather than having a greater effect on averages of heights of fewer seedlings as in the first method. Both curves are shown, however, for *R. heudelotii* in Figure 5.19, for *D. guineense* in Figure 5.20 and for *U. chamae* in Figure 5.21.

Selected seedlings of the three species were planted out twelve weeks after germination and their growth recorded, the results of which are summarised in Figure 5.22. Of the three species, *R. heudelotii* performed the best, the seedlings were much larger than the other two species and continued to grow quickly after planting, developing into healthy saplings (Figure 5.23), while *D. guineense* and *U. chamae*, small when planted out, grew slowly.

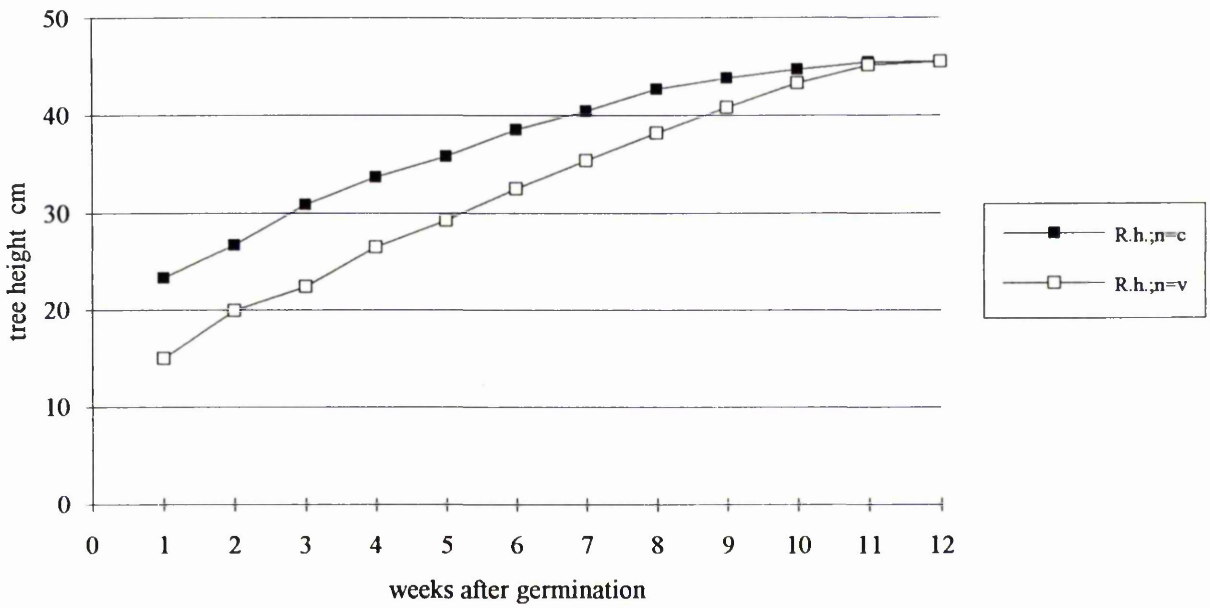


Figure 5.19 Growth curves for *Ricinodendron heudelotii* germination trials carried out in Calabar, March to May 1993, calculated using two different methods: one where average height is calculated for seedlings present each week (n=v), and the second where average height is calculated by week after germination for each individual seedling (n=c).

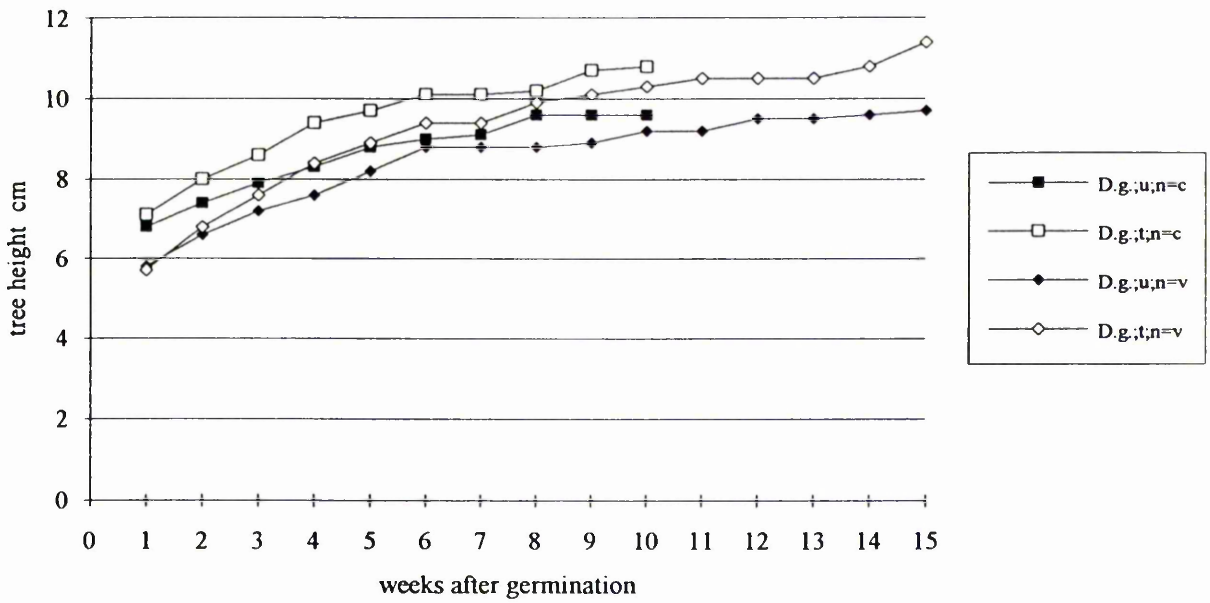


Figure 5.20 Early growth rates, March to May 1993, for *Dialium guineense* seedlings of treated (t) and untreated (u) seed, calculated using two methods: one where the number of seedlings in each week is constant (n=c), and the second, calculating averages by calendar week rather than by week of growth, where the number of seedlings is variable (n=v).

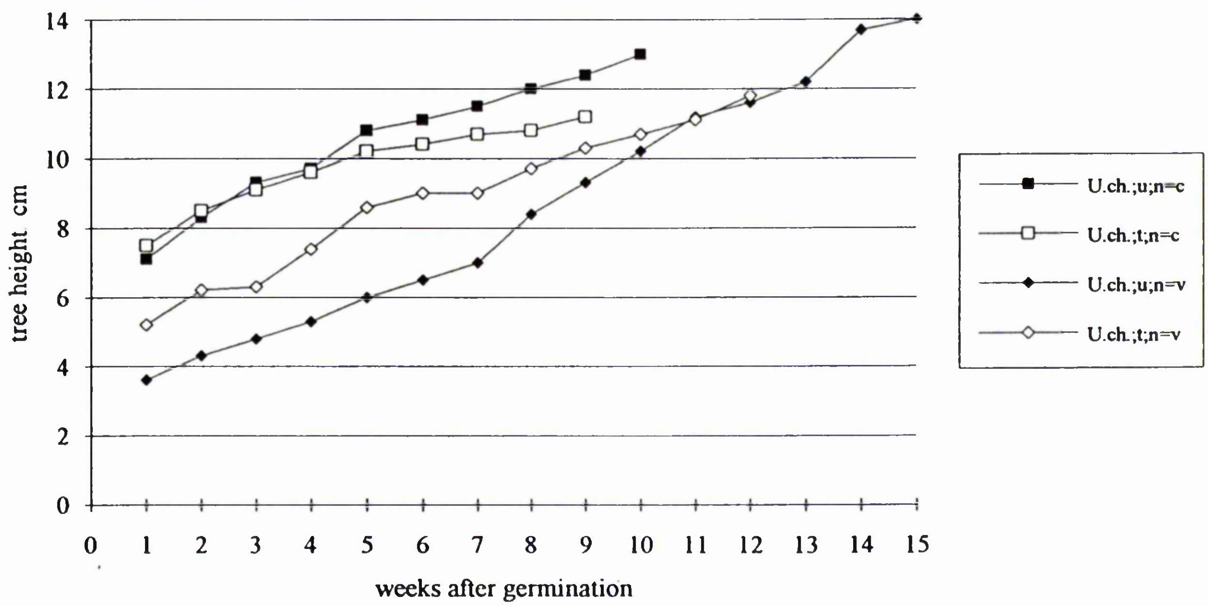


Figure 5.21 Early growth rates, March to May 1993, for *Uvaria chamae* seedlings of treated (t) and untreated (u) seed, calculated using two methods: one where the number of seedlings in each week is constant (n=c), and the second, calculating averages by calendar week rather than by week of growth, where the number of seedlings is variable (n=v).

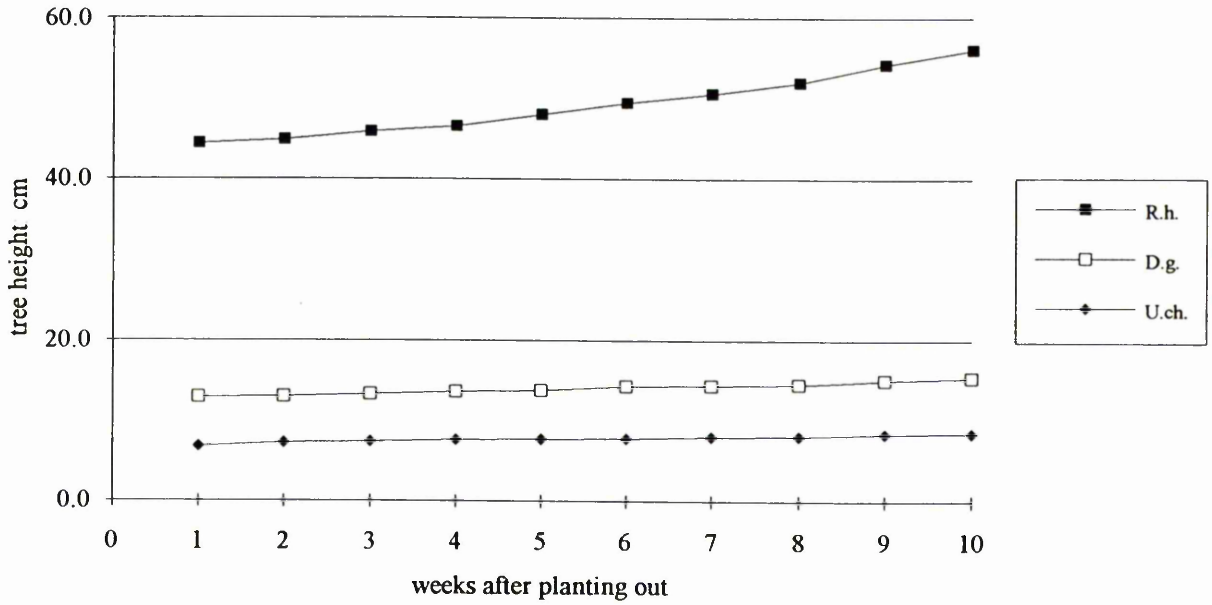


Figure 5.22 Average growth rates of *Ricinodendron heudelotii*, *Dialium guineense* and *Uvaria chamae* for ten weeks after planting out, Calabar, June/July 1993 (Source: own data).

Attempts were made to set up some village germination trials, but these proved unsuccessful as farmers felt that it is easier to transplant wildings of most species than to germinate them from seed. There are exceptions to this, and these are usually species such as *Dacryodes edulis* and *Irvingia gabonensis* which are highly prized and therefore not easy to find in the bush. For such species farmers establish small nurseries, often with only five to ten plants, and seedlings are transplanted onto farm or fallow land.

No experiments of vegetative propagation of the four species were carried out during this study, but some work has been carried by other researchers. Okafor (1985) has propagated *D. guineense* by budding stem cuttings, and fruiting has been recorded within two years, and Larbi *et al.* (1993) have successfully raised *D. guineense* plants in a nursery from cuttings and used them as hedgerows in the field. *R. heudelotii* has been easily rooted in low-technology, high humidity polythene propagators in Cameroon, with 75% of cuttings rooting by day twenty-one (Leakey *et al.*, 1990). There is a need for more work to be carried out on the vegetative reproduction of these species, especially for those which grow slowly as seedlings, but respond well to coppicing once established, such as *D. guineense*.

Figure 5.23 *Ricinodendron heudelotii* seedling thriving after planting out, Calabar, Cross River State, August 1993 (Photo: the author).

5.8 Field observations

Botanical field data collection was an important part of this study, the methodologies of which are discussed in detail in 3.2.3 (selection of the study trees) and 3.6.2. A summary sheet was made on which to record the information collected for each study tree and can be seen in Appendix K.

5.8.1 Location and habit of study trees

A large proportion of the study trees of *A. zygia* (45%) and *D. guineense* (68%) were located in farm or recent fallow land, with some in secondary bush (34% of *A. zygia* and 23% of *D. guineense*) and fewer in more mature secondary forest (21% of *A. zygia* and 9% of *D. guineense*). In the case of *R. heudelotii* most examples were situated in mature secondary forest (57%), with fewer in secondary bush (13%) and farm or recent fallow (30%). The *U. chamae* study trees were fairly evenly distributed through the three vegetation types with 30% in farm or recent fallow, 35% in secondary bush and 35% in forest.

The habit and age of the study trees varied, generally according to species and location. The most homogenous group was *R. heudelotii* where all study trees were single stemmed, 91% with a high branching, layered crown made up of 48% mature trees and 43% young trees, while 9% were seedlings. The age distribution of *A. zygia* was 39% mature trees, 52% young trees and 9% seedlings. Habit varied within the mature and young trees, with 57% being coppiced trees and 34% single stemmed with a flat spreading crown. The high proportion of coppiced trees corresponds to the large number of *A. zygia* specimens located on recent or current agricultural land, where trees are usually cut when clearing the area for cultivation. The seedlings were single stemmed with few leaves and occurred in fallow areas. None of the *D. guineense* study trees were seedlings, the sample being made up of 57% mature trees and 43% young trees. Most of the study trees had been cut at some point in their growth (80%) resulting in 57% low coppiced trees, and 43% single stemmed trees with a bushy crown, half of which did not appear to have been severely pruned at any time. The age of the *U. chamae* trees was distributed as 30% mature, 61% young and 9% seedlings, with all the mature and young trees having evidence of recent or old coppicing or pollarding (91%). The high incidence of cutting of *D. guineense* and *U. chamae* can be explained by the fact that they were mostly located in farm or fallow bush which had been cleared at some stage in the past, indicative of the scarcity of land which is present in and around Igonigoni village.

5.8.2 Growth rates of study trees

Each of the study trees was measured monthly and its growth or treatment (ie. pruning, felling, etc.) recorded. Where possible, in the case of seedlings or newly coppiced trees, the height of the leading shoot was measured. In cases where this was inappropriate, girth measurements were taken instead.

Some *A. zygia* trees had height measurements taken and some had girth measurements. The average height increase was 27.9 cm per month, with a range of 6.8-46 cm per month. Average girth increase was 0.6 cm per month, with a range of 0.1-1.5 cm per month. The trees which displayed the fastest growth rates, both of height and girth, were those which had been coppiced recently, located in open areas. In contrast, those trees in heavy shade had much slower growth. Some of the study trees were affected by an infection causing burrs or lumps to form on the leaves and stems of the leading shoots, and this appeared to adversely affect growth rates.

Of the *R. heudelotii* trees, eight were mature single-stemmed specimens with a girth of over 150 cm. The growth rates of these trees was not measured as it was felt that noting increases of trees this size was not relevant information with respect to their use in farming systems. Instead phenological and other observations were made and noted. Most of the trees that were measured had girth increase noted, an average of 0.96 cm per month with a range of 0.2-1.7 cm per month. Growth was fastest in young trees in open farmland or immature fallow, with very slow growth occurring in heavy shade and swampy areas. Seedlings growing under the forest canopy had an average height increase of 4.35 cm per month, very similar to growth rates noted during germination trials (5.7 above). Only one of the study trees was coppiced towards the end of the field research period, a fairly mature tree cut off at about 1.5 m, and coppice regrowth appeared to be very good.

Both height and girth measurements were taken for *D. guineense* specimens, depending on their habit and treatment by farmers. Girth measurements were taken for the larger, usually single stemmed trees and the average increase per month was found to be 0.36 cm. Height measurements were taken for younger specimens, and for those which had recently been coppiced, and the average increase per month was 21.7 cm. Growth was faster in the first few months after coppicing, and then slowed. *U. chamae* had slower growth rates with and average of just 0.1

cm per month girth increase and 16.0 cm per month height increase. The response to coppicing was not as great as in *D. guineense*, but there did appear to be slightly faster growth rates just after coppicing.

Soil samples were taken from three different sites, current farmland, recent fallow and older fallow at each of the two villages and analysed at the University of Calabar. The results are listed in Table 5.5. The texture of all samples is typical of soils of this area. The organic matter content and organic carbon was highest in the soil from the older fallow category in both villages, but was least in the farm soil from Igonigoni and in the recent fallow soil from Abo Mkpang. This may be explained by the fact that due to longer fallows in Abo Mkpang, the soil has time to rebuild its organic content before being cultivated again so farm soil takes longer to become depleted, whereas in Igonigoni reduced fallows mean that there is a steady decline in soil quality and farm soil has a low organic matter content at the start of the cultivation period.

Table 5.5 Results of analysis of soils from farm, recent fallow and older fallow sites in Abo Mkpang and Igonigoni, collected May 1993 (Source: own data, University of Calabar).

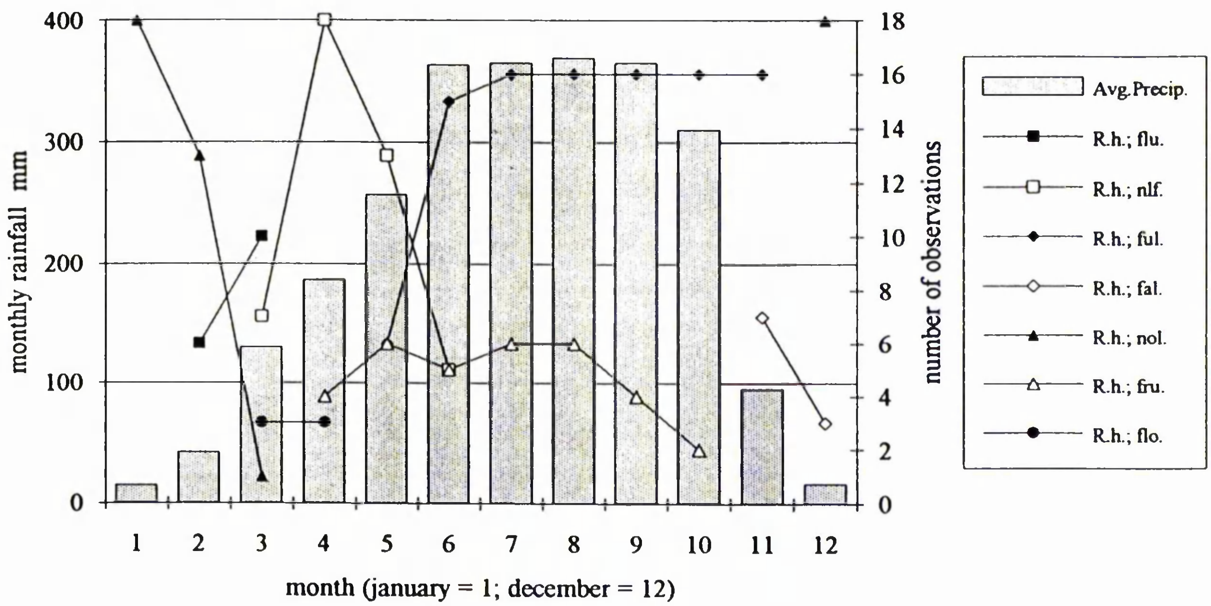
LOCATION	ORGANIC MATTER %	ORGANIC C %	TEXTURE
Abo Mkpang			
Farm soil	5.5	3.21	Loamy sand
Recent fallow	2.66	1.54	Sandy loam
Older fallow	8.97	3.45	Sandy loam
Igonigoni			
Farm soil	0.97	0.56	Sandy loam
Recent fallow	2.32	1.34	Sandy loam
Older fallow	4.27	2.47	Sandy loam

5.8.3 Phenology of study trees

The phenology of trees in tropical high forest areas is so complex that it is often difficult to see any pattern at all (Martin, 1991). One tree may be bearing fruit while another is flushing and yet another has started to flower, all of the same species. Studies would have to be carried out for many years to understand the seasonality, or lack of it, in rain forest trees. However, during the year of monthly field observations of the study trees, notes were made on the phenology of the four species in order to get some idea of their seasonal patterns, if any are exhibited. As has been described in 2.3.2, the study area experiences clearly defined wet and dry seasons.

Of the four species, *R. heudelotii* exhibited the most pronounced seasonality in the study area (Figure 5.24). Most of the study trees were leafless from December to February, losing their leaves at the beginning of the dry season, and produced new leaves from February to April. Flowers were present during March and April, and fruits were available in September and October. These findings are supported by descriptions of the species (Taylor, 1960; Thikakul, 1985). Other work has shown that a seasonal periodicity of wood formation in *R. heudelotii* exists in Nigeria, where the bulk of the wood is formed during the rainy season (Amobi, 1973) and there is a cessation of cambial activity during the dry season (Lawton & Lawton, 1971) forming annual growth rings.

A. zygia did not display any obvious seasonality with leaf flushes occurring throughout the year, and no examples of flowering and fruiting recorded. As a large proportion of the study trees of this species were cut during the year, new leaf growth was present at many different



LEGEND

Avg.Precip.	Average monthly rainfall
R.h.;flu.	Leaf flushing
R.h.;nlf.	New leaves
R.h.;ful.	Full leaf cover
R.h.;fal.	Leaf fall
R.h.;nol.	No leaves
R.h.;fru.	Fruiting
R.h.;flo.	Flowering

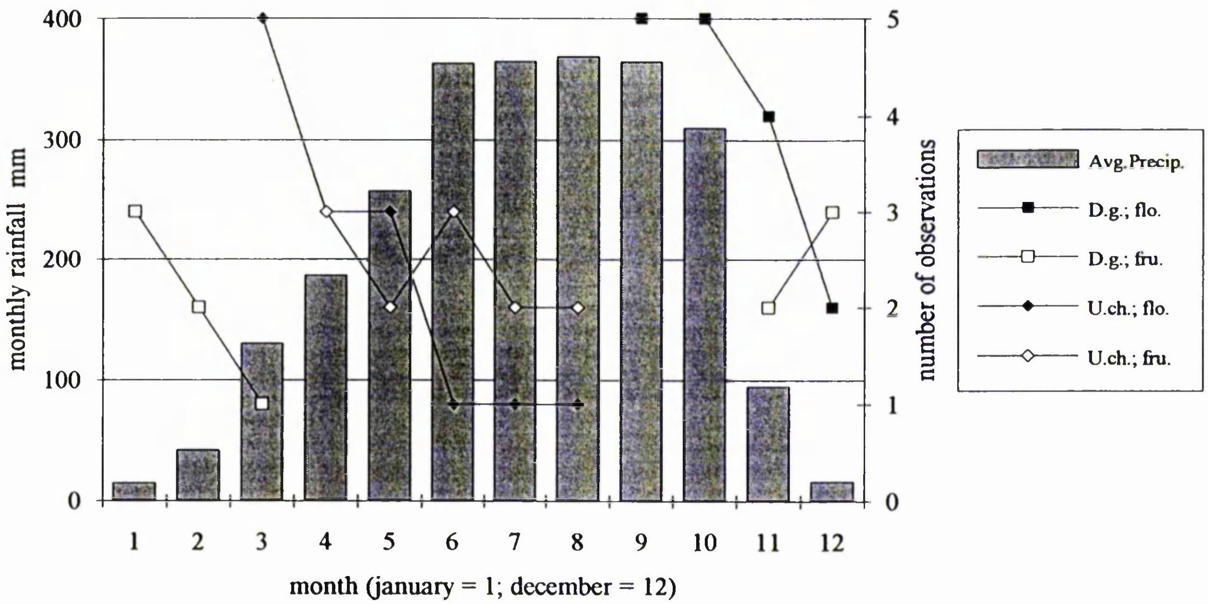
Figure 5.24 Phenology diagram for *Ricinodendron heudelotii* produced using biological data collected during field studies in Abo Mkpang, Cross River State from September 1992 to October 1993, against average monthly rainfall from data provoded by Ikom and Calabar Government Meteorological Offices for 1973 - 1993.

times. Some farmers reported that mature examples fruit in January, and this is supported by a number of descriptions of the species (Taylor, 1960; Irvine, 1961; Thikakul, 1985).

There was no apparent pattern of leaf fall for *D. guineense* and *U. chamae* which always had leafy crowns and evidence of new growth. Flowering and fruiting however displayed some seasonality, *D. guineense* flowered from September to December (Figure 5.25) and fruits were available from December to February (Figure 5.26).

U. chamae flowered from March to July with fruits available from April to August (Figure 5.26). These seasonal patterns are supported by the literature (Taylor, 1960; Irvine, 1961; Keay, 1989).

Figure 5.25 *Dialium guineense* in flower on farm land in Igonigoni, Cross River State, September 1993 (Photo: the author).



LEGEND

Avg.Precip. Average monthly rainfall

D.g.;flo. *Dialium guineense* flowering

D.g.;fru. *Dialium guineense* fruiting

U.ch.;flo. *Uvaria chamae* flowering

U.ch.;fru. *Uvaria chamae* fruiting

Figure 5.26 Flowering and fruiting patterns displayed by *Dialium guineense* and *Uvaria chamae* in Igonigoni, Cross River State from September 1992 to October 1993, against average monthly rainfall from data provoded by Ikom and Calabar Government Meteorological Offices for 1973 - 1993.

5.9 Agroforestry potential of the four study species

The information gathered in this and previous studies provides a basis from which to assess the suitability of the four study species for use in the development of agroforestry systems for the study area. Two of the most common problems that farmers experience in many parts of this region are declining soil fertility and reduced access to farm land (see 6.3, 6.4 and 7.2.1). It would therefore appear that there is a role for the use of woody species in aiding the development of more intensive and sustainable agricultural systems, both by the improvement and maintenance of soil conditions and through the provision of products such as fruit, fodder, seeds, poles, etc. to rural households. In this section the agroforestry potential of each of the study species is discussed, and some agroforestry systems in which they could be used are put forward. The suggested technologies are not presented to the villagers at any stage in the work, but are used instead to illustrate some of the potential uses of just four indigenous woody species, bearing in mind the wealth of potentially useful species that exists in the study area.

During field observations, *A. zygia* was found to be common in much of the farm and fallow land surrounding Abo Mkpang, and it exhibited good coppicing ability and growth rates. It has an open, leafy crown throughout the year so is useful for the provision of partial shade and some protection of the soil from heavy rainfall. Recent studies in Guinea-Bissau (Wester & Hogberg, 1989) have shown that *A.zygia* is capable of nodulating, which implies that it has the potential to improve soil fertility as a nitrogen fixer. The germination and early growth of *A. zygia* was not very good in trials, and it is suggested that vegetative reproduction of this species may be a more effective way of producing enough plants for use in establishing more intensive farming systems. Work on the performance of seedlings transplanted from fallow land and the establishment of *A. zygia* by cuttings needs to be carried out in order to test this theory. It is suggested that this species would be most useful as a supplier of green manure/mulch for farmland due to its capacity for fast regrowth after coppicing. As it has an open crown, it is a suitable species for interplanting, either in rows or more randomly dispersed as the shade produced would probably not greatly affect crop production, and may in some cases improve it by maintaining soil moisture during dry periods. *A. zygia* would also be able to provide useful poles when areas are cleared after fallow periods.

Most of the *R. heudelotii* specimens studied were single stemmed, often mature, trees, therefore little was seen of the coppicing ability of this species, but one example, cut towards the end of the study period, appeared to show very rapid regrowth. In a study carried out in Zaire, *R. heudelotii* was one of the species identified by the local Dumi people as being capable of regrowth following cutting, and was also resistant to bush fire and insect attack (Sabiti *et al.*, 1992). During the same study, in trials to evaluate its use as live fence posts, the species had very low resprouting rates (7.7%) which indicates that production of *R. heudelotii* plants by cuttings is not a viable option. However, as germination percentages from seed were high and growth and survival rates were also good, this would seem to be a better way of providing planting stock for any agroforestry systems. A study carried out to assess a number of potential browse species indicate that *R. heudelotii* could be a good source of livestock feed due to the nutrient composition and digestibility of the leaves (Asiegbu & Anugwa, 1988), and Lal (1991) agrees with this view. It is also a potential provider of dietary variation and additional income to rural families with the eating or sale of the seeds. The alleopathic effects of the species suggested by some of the villagers in Abo Mkpang, need to be investigated. It is suggested that because of its potential size and these possible effects, use of *R. heudelotii* as part of an agricultural system may be best achieved by planting it on farm boundaries for the provision of fodder, food, shade and timber.

Field observations and villagers' reports of *D. guineense* indicate that it is a species with great potential for inclusion in agroforestry systems. Although growth rates for seedlings appeared to be slow, once established this species is extremely resilient and grows back very quickly after cutting and/or burning. This and the soil improvement properties of *D. guineense* are valued by many farmers and it is already present in many farms. Analysis of a natural fallow system in south east Nigeria in which *D. guineense* was one of the dominant species indicated that soil pH, organic carbon, total nitrogen and extractable phosphorous increased with fallow length (Akobundu *et al.*, 1993). It is concluded that this fallow system is a potential means of restoring soil fertility through litterfall and pruning application. A study of the release of nutrients during leaf decomposition revealed that *D. guineense* significantly increased soil exchangeable Ca and Mg, Ca release being highly correlated with N release (Tian *et al.*, 1992). Work carried out by Larbi *et al.* (1993) in south eastern Nigeria suggests that this species is also useful for fodder production, and Lal (1991) highlights it as a species well adapted to acid soils. It is therefore suggested that this species could be included in a wide range of agroforestry systems for product and/or service uses as a single stemmed or coppiced tree.

U. chamae is evergreen and usually develops as a bushy shrub in farm and fallow land. Although growth rates appear to be relatively slow, it is suggested that this species would be useful in the reduction of soil erosion, both as a soil binder in the form of small bushes on farm boundaries, and as mulch. Soil improvement properties were reported by villagers, and further work should perhaps be carried out to examine these claims. One of the most important reasons for the inclusion of *U. chamae* on farms would be the provision of its many medicinal products in an area where natural bush is becoming scarce of severely degraded and so access to such products is becoming difficult.

The results of the social and biological surveys carried out in the two main study villages indicate that there is a wealth of local knowledge and indigenous species that can be employed in the development of improved farming systems. Due to the multipurpose and resilient nature of *D. guineense* it is concluded that, of the four species studied, it has the most potential for successful integration into such systems.

5.10 Conclusions

The following conclusions can be drawn from the examination of the taxonomy and agroforestry potential of the four study species:

- *Albizia zygia* is a widely distributed species which is a light demander, common in farm and fallow land, and with good coppice regrowth.

- *Ricinodendron heudelotii* is the largest tree of the four study species, widely distributed in farm, fallow and secondary forest, is highly seasonal, and has good germination and growth rates.

- *Dialium guineense* is common in areas with short fallows due to its ability to survive repeated cutting and burning with good coppice regrowth, and is said to be a soil improver.

- *Uvaria chamae,* the least well-known of the four species, is a shrubby tree which grows slowly but has good coppicing ability and is highly valued for its medicinal products.

- Germination from seed is possible for all four species, but best for *Ricinodendron heudelotii,* and vegetative propagation trials should be carried out for *Albizia zygia*, *Dialium guineense* and *Uvaria chamae.*

- *Dialium guineense* is the species which appears to have the greatest potential for integration into improved farming systems.

CHAPTER 6

'Helping farmers to help themselves': PRA and other techniques for rural development.

6.1 Introduction

This chapter is primarily a description of how participatory research methods were used in the two study villages during the last stage of the field work to try and develop ways of addressing some of the most pressing local problems. It begins with an outline of the programmes for the village meetings in **Section 6.2**, followed by detailed reports and discussions of the meetings in each of the villages (**Section 6.3 & 6.4**). A narrative style is used for the meeting reports in an attempt to convey the way in which the meetings developed individually. Finally, in **Section 6.5**, there is a discussion of some of the problems which occurred and the ways in which this experience could be used to encourage more productive meetings in the future.

6.2 PRA in the study

Biggs (1989) suggests that the level of participation by local people depends on the primary research activity to be carried out. Due to the nature of the present study, that is as part of the requirement for writing a doctoral thesis, the overall direction of the research could not be totally farmer-led. However, important decisions were made by the communities involved at different stages during the research so that it was as relevant to the local situation as possible, and this is shown throughout **Chapter 3**. The final stage of the research was the one in which the villagers were able to participate most fully, and it is this stage that is discussed in the following sections.

The most important participatory part of the research was the sharing of results from the biological trials with the villagers, and an attempt to work together with them, using the data, to develop solutions to some of their farming problems. During the final biological data collection visit to each village, a date was agreed for the following month on which to hold the first set of village meetings to begin discussions of the data. Meetings were held in the village hall during late afternoon and evenings so that anyone who wished to was able to attend. The timing of the meetings ensured that people had returned from their farms and could prepare and eat their evening meal, especially important for encouraging attendance by the women who are busy with household chores and farming for most of the daylight hours. A generator, or fuel for the community generator, was brought to the villages so that discussions could continue for as long as necessary into the night. Meetings were conducted in the local language so that all participants could gain a full understanding of the proceedings, with an interpreter being used where necessary.

6.2.1 Presentation of results of biological trials

The first task of the participatory meetings was to explain fully why the work was being carried out. Many of the villagers were already aware of the reasons for the research, but in order to clarify any misunderstandings about the purpose of the work, and to inform those who were not already aware, a full explanation was given. Emphasis was placed on the fact that the research was being carried out independently and that the researchers were not connected to any Nigerian government institution. This is important as many people are wary of giving information about agricultural production to government officials for fear of taxation increases. It was also stressed that the most valuable source of information for the work was the villagers themselves. A suggested agenda for the meetings was presented at this time, and the dates for follow-up meetings were agreed upon.

In order to engender a greater feeling of participation by the villagers early on in the meetings, as suggested by Atte (1994), they were then asked to help further with the research by producing charts showing the estimated average number of rain days per month, and farming calendars outlining the main tasks to be carried out during each season, which are shown as Figures 6.2, 6.4, and 6.5 in section 6.3. These were used to augment the data already collected from local meteorological offices (Figure 6.3).

The next stage was to present the results of the biological surveys, and germination and growth trials. This was done using wall charts which displayed the results for each of the selected species (Figures 6.6, 6.7, 6.9 and 6.10), and through detailed explanation. At all times questions from, and discussions between, the villagers were encouraged, and this was emphasised when the research data had been presented and participants were asked to contribute any other knowledge about the species in question. This section of the meetings was recorded on video so that the researchers could be fully involved in discussions rather than taking notes, and for possible future use in training field workers about similar methods.

6.2.2 Problem solving

There then followed a presentation of all the farming problems mentioned by villagers during the questionnaire survey stage, and the addition of any that it was felt had been missed by the interviews. Lists were made of these problems, shown in Tables 6.1 and 6.2, and through discussion, those which could only be solved by capital input or by measures beyond the communities' control were eliminated. By way of an introduction to the problem solving sessions and mainly as a catalyst to creating discussion by the villagers, a slide show which outlined different uses of trees in farming systems, both traditional/indigenous and modern/scientific, was presented. This aimed to show the versatility of trees as part of the agricultural process, but purposely did not include any examples of the species under discussion so that participants were able to develop their own potential alternative uses for the species. Most of the slides shown were taken in Nigeria and Ghana (although a few were from Sri Lanka), so that people could relate to and understand the farming systems being shown. A list of the slides used during this presentation is found in **Appendix L.**

Participants then divided into small groups to work on trying to develop ways of alleviating some of the local agricultural problems using trees and shrubs, the selected study species in particular. The aim was for groups to present their ideas to the other participants at future meetings so each set of suggestions could be discussed in an open forum.

During all village meetings, notes and video film were taken in order that the proceedings were recorded as fully as possible. The video film is important as a training tool to help field workers understand more fully the methodology being developed by this work. There follows a description of the meetings in each of the two main study villages, Abo Mkpang and Igonigoni. Due to the nature of this part of the study, much of the information appears as it was heard during the meetings, and it is felt that this descriptive use of the data is the most interesting way of presenting it. The 'un-scientific' use of data is becoming more common when reporting and analysing this kind of participatory research, and is yet to be accepted in many 'traditional' scientific circles as a viable way of documenting the results from such work. Thrupp and Uquillas (1994) illustrate the difficulties that many development professionals have with accepting this approach to data collection and use in a short play during which a researcher is interviewed by his/her administrative superior regarding the lack of quantitative analysis, regression models, sample frame and cost-benefit analysis in a research report and development project proposal. It can perhaps be argued that if a need and the ideas for addressing that need come from a community, then the villagers themselves have already carried out such things as cost-benefit analysis as part of village life, so formal statistical analysis is not necessary.

Although it was planned that both sets of meetings should proceed along the same lines, it soon became apparent that it would be more useful to let the agenda of each meeting evolve more naturally. Therefore, it will be seen from the following descriptions that the meetings in the two villages took slightly different courses.

6.3 Participatory meetings in Abo Mkpang: 12/13th November, 1993

The date and time for the village meeting had been arranged a month in advance, but it was not possible to begin the PRA exercise until the evening due to a number of village administrative delays. The first meeting therefore began at 8.00 pm.

The meeting was opened by the village chief, Chief Eban. It was noted that there had been a great deal of information gathered from the members of the community so the research team had an opportunity to learn from them. However it was now the time for the researchers to collaborate with the community to reach an understanding of the results of the research, and to work together to try and solve some agricultural problems.

In order that everyone understood clearly the aims of the research, an explanation was given of the work using a wall chart and with the help of an interpreter. This introduction was also used to outline what would be done in this and following meetings, and to gain general agreement for the suggested agenda.

Following this, participants divided into smaller groups and constructed either a rainfall chart, or a farming calendar. Rainfall charts were made by dividing a large piece of paper into twelve, and using beans or maize to represent the average number of rain days occurring in each month (Figure 6.1). Much discussion took place and agreement was reached at the end of the session that fair representations of local rainfall patterns had been produced.

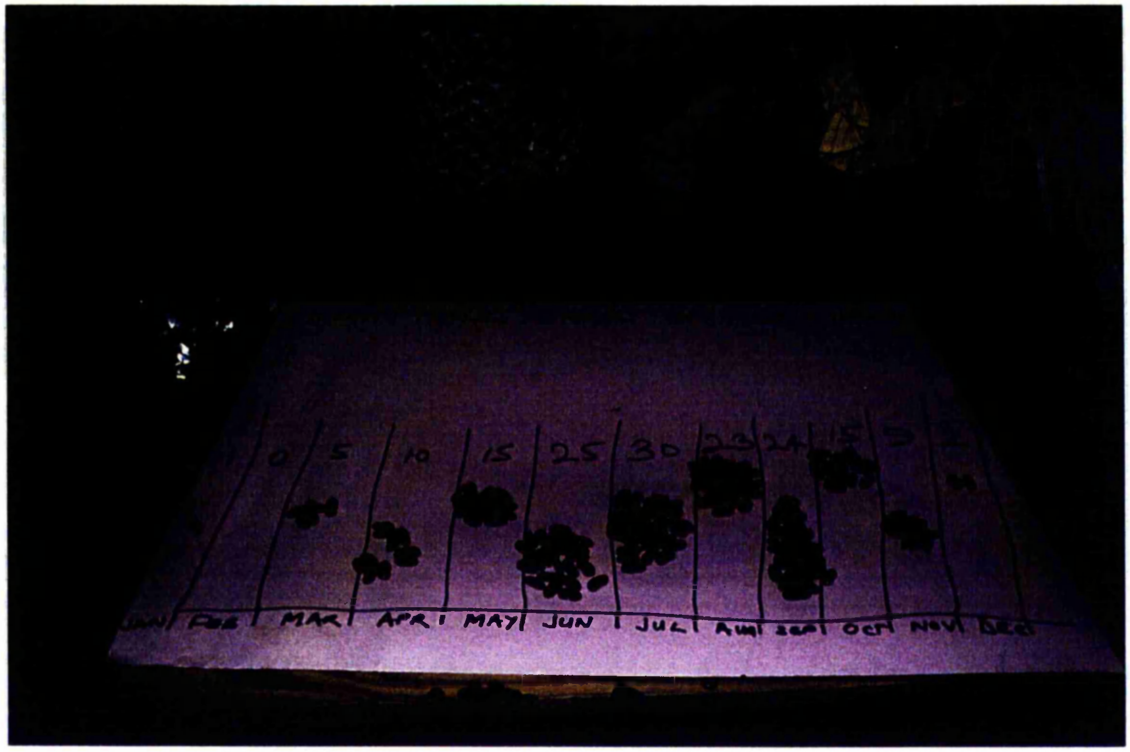


Figure 6.1 One of the charts produced by community members in Abo Mkpang, showing the estimated average number of rain days for each month (Photo: the author).

Figure 6.2 shows an average of the three rainfall charts that were produced, differences between each one were very small. The patterns of rainfall described by the farmers of Abo Mkpang correspond closely to the data obtained from the Meteorological Offices in Calabar and Ikom (Figure 6.3), but the community appeared to over-estimate slightly the number of rain days in the wettest months, and to under-estimate the number of rain days in the driest months. This may be partly explained by two possible reasons, the first being that the rainfall pattern for Abo Mkpang is slightly different from that of Ikom and Calabar, and the second that the meteorological office count a day that has had only 0.3 mm of rainfall as a rain day, and the quantity of rainfall taken by the

DRY SEASON — WET SEASON — DRY SEASON

No. of rainy days

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	5	10	15	25	30	23	24	15	9	2

Figure 6.2 Average of the three rain days charts produced by Abo Mkpang villagers, November 1993.

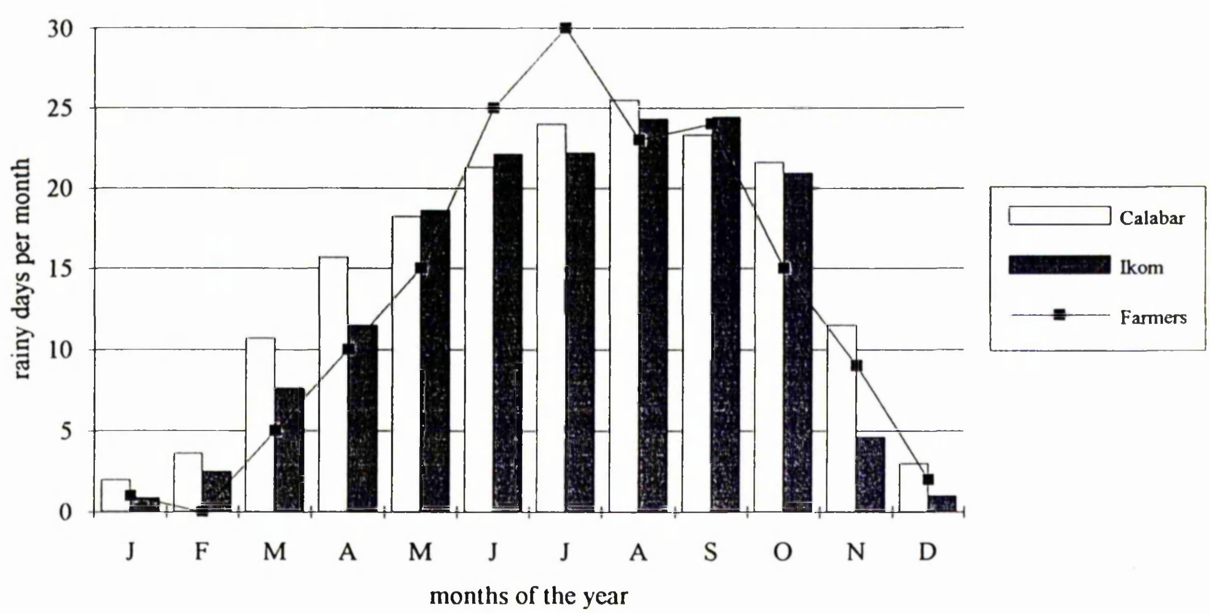


Figure 6.3 Comparison of Abo Mkpang farmers' estimates of average number of rain days per month against average number of rain days per month recorded from 1973-1993 by Calabar and Ikom meteorological offices.

community to mean a rain day may have been higher. However, by conducting a *t*-test (Wilcoxon's test for pairs of data) on the two sets of data it can be shown that there is no significant difference between farmers' estimates of the usual number of rain days per month and the median number of rainfall days per month recorded in Ikom and Calabar (T= 24.5). This result suggests that for the purposes of agricultural production, use of local knowledge to produce an average rainfall pattern can be as effective as intricate data collection producing accurate climatic records. For the production of the farming calendar one group of women and one group of men were formed. Again much heated discussion took place and the resulting calendars are represented in Figures 6.4 and 6.5.

The meetings were planned to continue the following afternoon, but very heavy rain prevented the session beginning until 7.45 pm as no-one could be heard speaking in the village hall over the noise of the rain on the corrugated iron roof. At the start of this session the information that had been collected during field studies about the two study species, *Albizia zygia* and *Ricinodendron heudelotii*, discussed in full in Chapter 5, was presented. Representations of the wall charts used to display the data are shown in Figure 6.6 and Figure 6.7. A request was made for participants to add any further information regarding the two study species. This was met with some enthusiasm and many additional facts were contributed, and are listed below:

Albizia zygia

a) A few people had seen trees mature enough to bear seeds, but these are rare;

b) The trees bear seeds in the dry season in long pods;

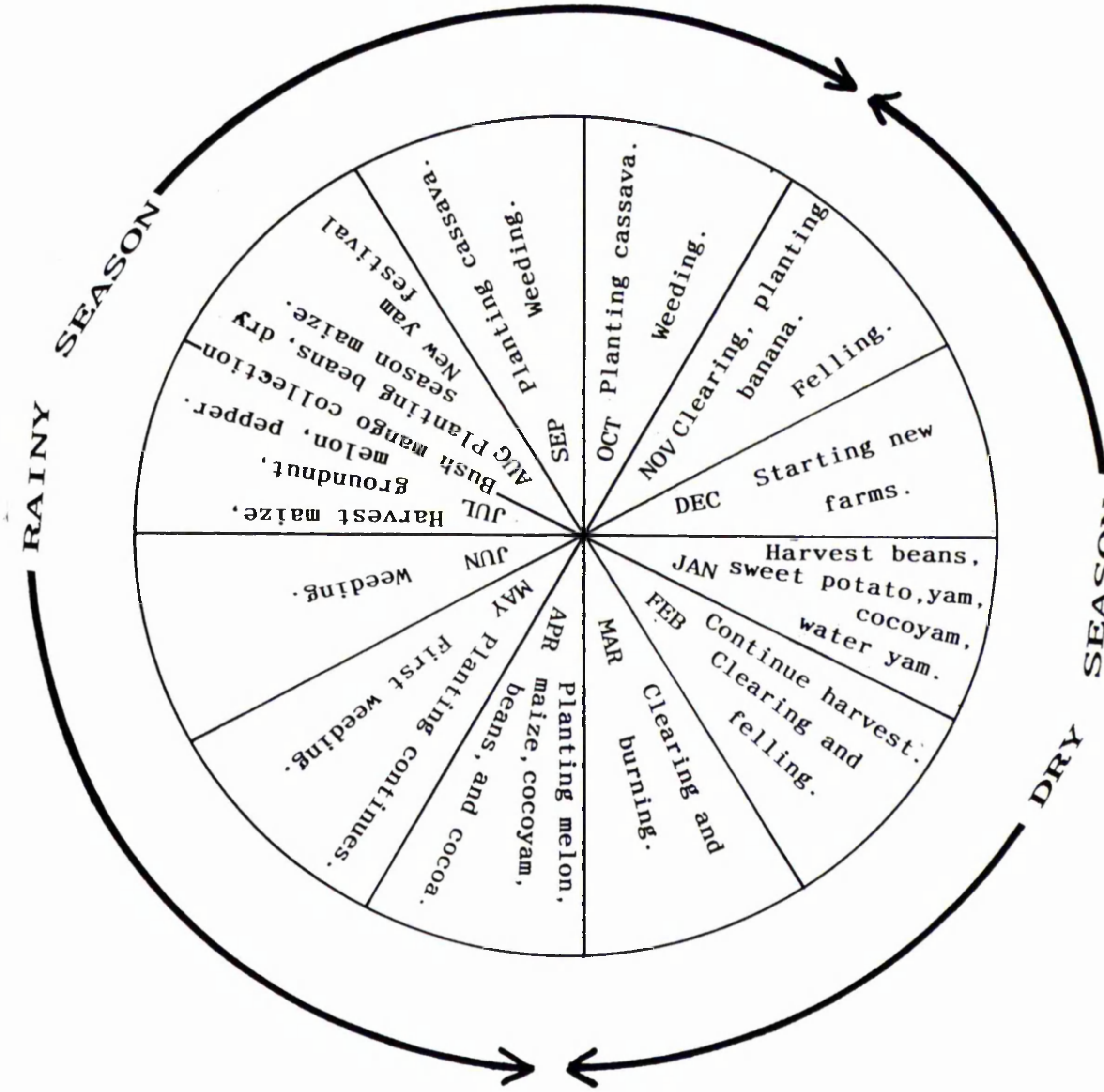


Figure 6.4 Representation of the farming calendar produced by a group of women during participatory meetings in Abo Mkpang village, November 1993. The layout and structure of the chart was determined by village women with no input from the researcher.

JAN	Clearing of the bush to make new farms.
FEB	Felling large trees.
MAR	Bush burning.
APR	Planting of heaps.
MAY	Rains start - crops such as maize, beans, okra, planted.
JUN	Weeding. End of June start to harvest maize.
JUL	Bush mango collection/processing.
AUG	Harvesting yams, and transplanting economic crops (cocoa, oil palm)
SEP	Planting plantain, banana, cassava.
OCT	Planting cassava and oil palm.
NOV	Early clearing of new farms.
DEC	Planting of heaps (yam and some vegetables) and harvesting yams, banana, cocoyam.

Figure 6.5 Representation of the farming calendar produced by a group of men during participatory meetings in Abo Mkpang village, November 1993. The layout and structure of the chart was determined by village men with no input from the researcher.

KANPUN
(Albizia zygia)

GROWTH

Height
(35.2 cm)

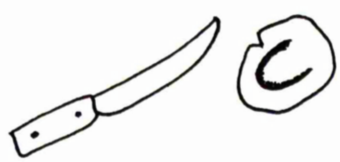
This much
each
month.

Girth
(0.6 cm)

This much
each month.

GROWING FROM SEED

Seeds are only found on some older trees (inside old bush). They will grow easily if you cut the outside skin before planting them.



USES

- If the stems are cut, they grow again very quickly so it is good to use for mulch or green manure.
- Wood makes good charcoal.
- Young leaves are used to make soup.

ARE THERE ANY OTHER USES?

Figure 6.6 Representation of the *Albizia zygia* information wall chart used in village meetings in Abo Mkpang, November 1993.

BOKPASI
(Ricinodendron heudelotii)

GROWTH

Height
(3.9 cm) This much each month

Girth
(0.9 cm) This much each month

GROWING FROM SEED

Remove the seed from the fruit and plant it when collected. Leave it and at the beginning of the rainy season the seed will start to grow and produce a healthy, fast-growing seedling.

USES

- Leaves are good for fodder.
- Good shade tree
- Seeds in soup or cooked as a snack food.

ARE THERE ANY OTHER USES?

Figure 6.7 Representation of the *Ricinodendron heudelotii* information wall chart used in village meetings in Abo Mkpang, November 1993.

c) Children use the pods to make whistles;

d) Fresh leaves are used in the dry season, ground and boiled together with *Ricinodendron heudelotii* fruits, palm oil, fresh fish, salt and pepper to make a very good soup;

e) There was some debate as to whether the tree is good or bad for the soil. A few farmers said it should be cleared from farms as the water that drops from the tree is poisonous to the soil, while others stated that it was fine to leave on the farm; and

f) *A. zygia* is not a good timber tree.

Ricinodendron heudelotii

a) Local language (Boki) distinguishes between different parts of the tree - *bokpasi* is the tree itself and the trunk, *okpasi* is the fallen fruit and *nguge* are the seeds;

b) The seed is often used as flavouring in soup ('local Maggi');

c) In Cameroon it is much more prized (to make oil) and a small cup of the seeds can be sold for 100 Naira or more;

d) If you get porcupine quills in your leg, some of the leaves tied onto the wound will help to draw the spikes out;

e) It is a good tree for using in war, it is possible to use the wood to make restraints ('native chains') to hold prisoners;

f) It does not let other trees grow next to it;

g) If an oil palm tree growing next to a *R. heudelotii* is felled and tapped, the palm wine obtained will not taste sweet; and

h) It survives burning very well.

It became evident during this stage of the meeting that much more was known about the two study species than was originally gleaned from the questionnaire data. This in turn suggested that if other species were presented to groups in a similar way, then a great deal more information about them could be obtained. It may therefore have been an improvement on the technique used in this study, to have held participatory meetings such as these during an earlier information gathering stage. With more ethnobotanical information about the study species on the short list for detailed study, it may have been easier to make a better choice with regard to their potential application in agricultural intensification. This illustrates that greater benefit may be gained from local participation, the earlier in the research or development programme it occurs as illustrated by many such as Dunn *et al.* (1996), Harrison (1987), and Hoskins (1994).

The next stage of the second meeting was the presentation of a list of all the farming problems that had been mentioned during the questionnaire survey, and the addition of any points which the community felt were important and had been excluded. Through general discussion, those problems which it was felt could only be solved by inputs of capital or by measures beyond the community's control, were divided from those which the community felt they had the power to address. The resulting list is shown below as Table 6.1. While dividing the list into two categories, the researcher played the part of facilitator, asking questions which encouraged discussion and the consequent inclusion of some problems in the section towards which action could be taken. For example, the issue of having no chainsaw for farm clearing was seen as being a problem of lack of capital, but after some debate it was decided that trees need not always be cleared from new farm land so a chainsaw would only be needed occasionally to remove large trees or to produce timber, and could therefore easily be borrowed for a short time from someone else in the village.

Table 6.1 Common farming problems in Abo Mkpang.

Problems that can be addressed	Problems beyond community control
No fertilizer.	No tools/processing machines.
No chainsaw available to fell trees when clearing farmland.	No storage facilities for produce.
Soil quickly becomes infertile.	No money to pay labour.
Available land reduced by development of National Park.	Wild animals destroy the cassava.
Wind destroys banana/plantain.	Thieves steal produce.
Insects attack pumpkin/cassava.	Road access is bad so it is difficult to transport produce.
Fires set to clear land often burn crops in adjoining plots.	No access to technical advice/HYVs.
Erosion washes away soil/crops.	Disease on cassava, cocoa and yams reduce yields.

Finally a slide show of different ways of using trees in farming was presented as described in 6.2.2. Each new slide was received with many minutes of questions and discussion so that the session continued until very late, and much of the intended problem solving took place at this stage with no other prompting needed. The following questions and comments were noted during this stage of the meeting:

a) *Kanpun* (*Albizia zygia*) always comes up quickly in fallow land;

b) Fruit trees found on a farm plot are rarely cut down, and many species such as *Dacryodes edulis*, *Irvingia gabonensis* and *Citrus* spp. are planted;

c) If there are many trees on the farm, will enough sunlight be able to reach the crops to make them grow properly? The general concensus being that sunlight was not a limiting factor so there would be enough provided the trees did not give very heavy shade, and could be pruned to avoid this;

d) A problem with burning the farm is that it often causes bush fires, but it is the way to get the fallow goodness quickly into the soil;

e) Large trees are often left standing on farm plots because if they are tall the crowns do not cause too much shade and it is expensive to hire a chainsaw and hard work with an axe to cut them down; and

f) One way of reducing the problem of theft from farms would be to have the plots close to the village so that they were visited more often. Can using trees mean that the same plot can be farmed for some years so farmers do not have to keep moving to new land which is now far from the village?

At the end of the meeting, attempts were made to arrange a follow-up session, but the general feeling among the villagers was that this would not be useful. Much of the discussion regarding the use of trees in local agricultural systems had already been covered during the slide show so the researchers also agreed that a further meeting would not produce useful results. However, some of the participants stated that they would be trying out some different trees and management techniques on their farms now that they felt more confident after the wide discussions that had been held. Enthusiasm among the participants for further meetings was beginning to wane. This would seem to be one of the major faults with such a long research period, that the novelty of the research and researcher had largely worn off by this stage due to familiarity, and therefore people were less willing to give up more time for the continuation of the group research process, although some wanted to continue it on an individual basis on their own farms. This and other problems of the participatory stage of the research are discussed in greater detail in 6.4. Thus, although discussion was started about the agroforestry potential of the two species, no attempt was made to develop systems which made use of the trees or to plan trials for the whole village. The potential uses for *Albizia zygia* and *Ricinodendron heudelotti* in addressing some of the agricultural problems of Abo Mkpang are discussed in 5.9.

6.4 Participatory meetings in Igonigoni: 23rd November & 17th December, 1993

The first meeting in Igonigoni began at 7.15 pm, later than originally agreed due to the town crier announcing the meeting late. While waiting for everyone to gather, some of the participants (mostly women) constructed a rain days chart using chalk and soya beans on the floor of the village hall (Figure 6.8). This was also a good way of introducing debate and discussion as a theme for the rest of the meeting.

A brief opening speech was made by the chief of Igonigoni, Chief Michael Ewara, asking especially for the co-operation of everyone present to try and work hard to make up time lost due to the late start. This was followed by an introduction to the research, as in Abo Mkpang, once again emphasising no attachment to any Nigerian government institution, and the importance of the villagers in the research process. An attempt was also made to establish an agenda and time table for the next meeting.

Figure 6.8 Some of the Igonigoni villagers constructing a chart using chalk and beans, showing the average number of rain days per month, November 1993 (Photo: R.Dunn).

The next stage of the meeting was the presentation of the data obtained in the biological studies about the two study species, *Dialium guineense* and *Uvaria chamae*. This was carried out in the same way as in Abo Mkpang and representations of the wall charts used are shown as Figures 6.9 and 6.10. Participants were then asked to contribute any other information or comments about the study species. This task was carried out with

EHANE
(Dialium guineense)

GROWTH

Height
(19.4 cm)

This much
each month.

Girth
(0.6 cm)

This much
each month.

GROWING FROM SEED

It is easy to grow Ehane, but only about half the seeds that you plant will grow. So if you want about 10 trees you should plant about 20 seeds. The small trees grow slowly, but when they are bigger and have strong roots they grow fast.

USES

- Fruits are eaten and sold.

- Stem makes good pestles.

- Good firewood, burns with strong heat.

- Good mulch/green manure

    - grows fast when cut
    - survives burning.

ARE THERE ANY OTHER USES?

Figure 6.9 Representation of the *Dialium guineense* information wall chart used in village meetings in Igonigoni, November 1993.

ROVERIZOI
(Uvaria chamae)

GROWTH

Height
(15.2 cm)

This much
each month.

Girth
(0.5 cm)

This much each month.

GROWING FROM SEED

If Roverizoi seeds are soaked in cold water for a whole day before planting, then most of them will grow. You may have to wait some months before they come up, and the small trees grow slowly.

USES

- Chewing stick.
- Edible fruit.
- Medicine for fever.
- Always has leaves so good soil cover to reduce erosion.
- Mulch/green manure.

ARE THERE ANY OTHER USES?

Figure 6.10 Representation of the *Uvaria chamae* information wall chart used in village meetings in Igonigoni, November 1993.

great enthusiasm and much debate ensued, and the points that were made are listed below:

Dialium guineense

a) Dead wood ground up and mixed with oil is used to apply to fractures to help them heal efficiently;

b) Fresh bark can be applied to injuries to help reduce swelling;

c) Plants growing close to the tree do very well, and it is thought to make the soil fertile (Figure 6.11);

d) If the tree is big it will produce too much shade to allow the crops to grow well, therefore it must be pruned before crops are planted;

e) A solution made of the red fruit pulp and water is good for relieving stomach pain; and

f) Bees favour the flowers of the tree for honey production.

Figure 6.11 Cassava appears to grow better near *Dialium guineense* than on the rest of the farm, Igonigoni, November 1993 (Photo: the author).

Uvaria chamae

a) Bark scraped from the roots can be squeezed for the juice, and this is applied to the eyes for alleviating malaria fever;

b) The fruits are said to act as a blood tonic if many are eaten;

c) A decoction of the roots is used to treat fever;

d) The land around these trees is made fertile by their presence and crops such as cassava do extremely well; and

e) Scraped and ground roots can be used to treat rheumatism.

This was followed by producing a list of farming problems experienced by the community as mentioned during the questionnaire survey and which are shown below. Any necessary additions were made, and those problems which could only be solved through capital inputs or by measures beyond the control of the villagers, were separated from those which could be addressed (Table 6.2).

Table 6.2 Common farming problems in Igonigoni.

Problems that can be addressed	Problems beyond community control
Severe shortage of land.	No money to buy new planting stock (yams).
Labour shortage at clearing time	Low prices obtained for produce.
Expensive to rent other land.	No money for tools.
Land infertile so yields poor.	Crops destroyed by wild rodents.
No fertilizer supplies.	Early flooding on the river farms destroys groundnuts and cassava.
Insect attack on some crops.	
Lack of materials eg. yam stakes and boundary markers.	
Not enough land for long fallow.	

The final stage of the meeting was to present the slide show detailed in 6.3 with a view to participants developing some of their own ideas about ways of alleviating some of the local agricultural problems. Participants were divided into groups, by 'age-grade'[1] as suggested by the community, and each given note books in which to record their potential solutions to some of the farming problems. The slide presentation was enjoyed by all participants, with much discussion taking place as each new slide was shown. At the close of the session, a date was agreed for the follow-up meeting to be held.

The next meeting was arranged for the following month and aimed to examine the solutions to farming problems suggested by the different 'age-grades'. However, after being greeted on arrival at the village and all seeming to be set for a meeting, much later, just before the meeting was due to start, we were informed that there was both a bachelor party and a burial taking place that evening. As a result very few people were available to come to the meeting. Therefore it was agreed that the following morning, 'age-grade' groups would come individually to discuss their solutions. This did not allow for group discussion of the potential agricultural innovations, but under the circumstances it seemed to be the best solution.

Very few of the solutions suggested made use of trees in any way, the majority appearing to be repeats of what had been learnt in agricultural science at school and emphasised the use of capital inputs such as

[1] Villages are divided into age-grades which comprise people born during the same years, each of which has a name chosen by the members eg. Naira, Ruku, Bright, Elders, Independent. Age-grade members have a strong affiliation to each other and will always give help if possible during times of trouble.

fertilizer, pesticides and HYVs. The few solutions that did make use of trees are listed below:

a) The use of the leaves of some tree species was suggested for making compost to combat the problem of soil infertility. *Dialium guineense* was mentioned frequently as being a good tree for the soil, and it is this species that was suggested as the source of the biomass with which to make the compost;
b) Fruit trees are commonly planted around farm boundaries, and it was suggested that these might also be useful in providing shade for farm workers during rest periods;
c) Planting of trees around farm boundaries could provide a source of poles for use as yam stakes or field boundary markers;
d) Creating a live fence around farm plots with small gaps in it containing traps would help to reduce damage to crops caused by rodents; and
e) The use of tree shade and leaf litter was mentioned to reduce soil temperatures and maintain higher moisture content especially during the dry season.

During a full discussion following the presentation of the solutions during a village meeting, it would have been possible to expand on these and to begin to develop practical steps for farmers to carry out. For example the idea of making compost could be expanded to include weeds cleared from the farm so that it was not always necessary to burn the plot, thus reducing damage to the soil structure, nutrient run-off during the first rains and damage to trees left in the farm. However this chance did not arise so these early suggestions could not be developed in a group situation. The feeling that was obtained overall was that there is still a strong belief in this area that trees and farming do not mix, and that all trees should be cleared from farms or they shade out crops. Although most people acknowledge the soil improving properties of some trees, such as *Dialium guineense*, this knowledge seems to be overidden by the former idea that trees should not be included as part of an agricultural system. There are few detailed examples of farmers and other rural people deliberately experimenting with woody species (Ayling, 1991), although Clawson (1984) suggests that the more adverse the environment, the more farmers tend to value experimentation. Therefore in the study area in the future there may be more attempts by farmers to adapt their farming systems to the increasing pressure for farmland, and this may involve the use of woody species. Further discussion of the potential uses of *Dialium guineense* and *Uvaria chamae* in addressing some of the agricultural problems of Igonigoni takes place in 5.9.

6.5 Problems encountered during PRA meetings

During the course of the meetings in both villages, a number of problems were encountered which need to be examined with respect to using the experience in helping to design a research and extension framework for use by local field workers as detailed in **Chapter 8**.

The first problem that became evident during the participatory meetings was that although familiarity was a great help during the initial data collection period, once it came to the final stage of the work, people had begun to become bored with the research and therefore began to lose interest in participating fully in the meetings. This is a problem mainly connected with this particular study because in order to allow the villagers to participate fully in the selection of species to be examined and that enough data was collected systematically to allow a good understanding of farming systems and the use of trees, a full questionnaire survey had first to be carried out. Then, in order that the biological surveys were meaningful, measurements had to be taken for at least a year. This meant that the researchers were in the village for a few days each month and thus were a familiar sight and became well known. Also there was no obvious conclusion or advantage of the research apparent to the communities for a long time, again a problem associated with the nature of this particular study.

The second problem was the time factor. As the participatory meetings had to be carried out at the end of the fieldwork period, this left little time in which to organise additional meetings if they were found to be necessary. This meant that when situations arose such as other meetings being called even though a date had been prearranged for the PRA meeting, heavy rain, burials, late announcement by the town crier, and other problems commonly encountered during rural field research in the South, it was difficult to reschedule meetings so they had to be held until late at night in order to cover what had been planned.

One further problem which occurred in both Igonigoni and Abo Mkpang was that once the proposed agendas for the meetings had been announced and it was evident that a slide show was to be presented, many children arrived at the meetings (hoping for a film show) and much time was wasted either getting them to be quiet or to leave so that the limited time available could be used efficiently. It was noted that meetings were often dominated by certain individuals and that certain sections of the community, for example many of the women, had to be greatly encouraged before they contributed any of their thoughts or ideas.

In Abo Mkpang where fuel was provided for the community generator, instructions given by the Chief to turn off the generator at the end of the first meeting were ignored and it was run until late into the night. This meant that there was little fuel available for the next evening's meeting, and it was especially important for the showing of the slides, so time pressures were felt throughout the second session, although it was possible to complete the slide show.

As was expected in carrying out field work in rural West Africa, numerous problems did occur, some of which were unavoidable, and all of which have to be taken into account when developing the research experience to produce a framework that will be useful to local field staff in implementing participatory agroforestry projects in the area. It is therefore valuable to have outlined the main problems so that they can be addressed in **Chapter 8** when the research results and experience are used to develop a framework for local field staff to use in helping farmers to develop more sustainable farming systems. Overall it is felt that the participatory meetings stage of the work was successful, revealing the potential of four species to improve farming systems and testing a methodology for gathering such data.

6.6 Conclusions

The following conclusions can be drawn from this section of the study:

- The village meetings' stage was the part of the study which had fullest participation by the communities of Abo Mkpang and Igonigoni.

- Group discussions can be a good supplementary source of information when used in combination with preliminary individual interviews.

- Indigenous knowledge about some environmental factors, such as the average timing and number of rain days in the wet and dry seasons, is often accurate enough to be of use when modifying farming systems.

- Once again, of the four study species, *Dialium guineense* appeared to have the greatest potential for inclusion in agroforestry systems.

CHAPTER 7

Agroforestry, extension and forest conservation in south east Nigeria.

7.1 Introduction

The first part of this chapter (Section 7.2) is a four-part summary of the main results and analysis from the thesis. It is presented in the form of answers to the questions posed at the beginning of Chapter 1. Following this, in Section 7.3, there is an examination of the changing role of foresters and a discussion of the recent trends which have meant that methods of research and extension used in agricultural projects, and related issues such as farmer participation, are now necessarily becoming part of the skills needed by forestry professionals in the South. Section 7.4 is a review of the current extension activities being carried out by such institutions as CRSFP, CRNP, the Forestry Department and the Cross River State Agricultural Development Project (CRADP). A discussion of the appropriateness of such activities in view of the current forestry, conservation and agricultural climate in the state and the recent debate on developments in forestry and agricultural extension, is also presented.

7.2 The results of the study

7.2.1 Intensification of agriculture

Is there a need for the intensification of agriculture due to recent changes in land-use patterns and an increase in the farming population?

There has recently been much activity in Cross River State in the area of forest conservation and management. This has occurred after a long period of relative inactivity by Forestry and Wildlife officials, due mainly to lack of funding for these departments. The recent increase in activity which has led to the redefining and demarkation of old reserve boundaries and the establishment of the new National Park, has in effect caused a large reduction in land available for agriculture and the collection of forest products, in a very short space of time.

In 1991 Cross River National Park (CRNP) was formed by Federal Decree No.36 after a five year 'preparation' period known as the Cross River National Park Project. The project was initially managed and supported by the World Wide Fund for Nature (WWF) which receives much of its funding from ODA. This project is now continuing as two separate programmes, the Okwangwo division of the CRNP funded by WWF and the European Development Fund (EDF), and the Oban Hills division of the CRNP jointly funded by the EDF and Kreditanstalt für Wiederaufbau (KFW) and managed and staffed by Hunting Technical Services. The formation of the CRNP has had a major impact on those communities located in the support zone adjacent to the park and may have an even greater effect in the future as the project becomes properly established and policing of the park boundaries begins in earnest. Large areas of forest, and therefore potential farm land, have been included in the CRNP which has caused an artificial and rapid decrease in available land and in legal access to forest products. Of the 731 400 ha of tropical high forest in Cross River State, 335 000 ha (46%) has been nominated as National Park, of this 275 000 ha was previously in Forest Reserve and 60 000 ha was Community Forest (Dunn *et al.*, 1994). Approximately 20 000 ha of the National Park is classified as non-forest area.

The loss of access to forest by local communities has been compounded in some areas by CRNP staff being unclear about which areas are included in the park, and which are in the support zone, and so confusing the regulations which apply in both areas. One example experienced during fieldwork in Abo Mkpang, a village situated in the support zone of the Okwangwo division of CRNP, was the village Chief being sent a letter by CRNP staff detailing a number of violations by members of the community - making a small farm, collection and processing of bush mango, and hunting of red deer - and informing him that future violations would be dealt with severely (Chief Eban, pers. comm., 1993). However, the area of forest in which these activities had been discovered is not part of the National Park, so CRNP regulations do not apply and CRNP staff have no jurisdiction over it. The community was very aggrieved by this because they all felt that CRNP have taken so much forest without yet offering realistic alternative means of livelihood to the communities. Some attempts have been made to develop fish ponds or a piggery in a few of the Support zone villages, and women's groups have been encouraged to establish joint cassava farms. However from observations made in the field and through discussions with the villagers it is evident that these projects are not successful in that they are not really wanted by the people and appear not to have been developed in such a way that they will quickly become self-sustaining.

In March 1991 the Cross River State Forestry Project, an Overseas Development Administration (ODA) funded activity, was initiated. Its main aim was to support the Forestry Department, both financially and technically, in its normal activities with a view to the Department becoming self-supporting in the future (ODA Project Document, 1991). This has meant a huge increase in activity by the Forestry Department in Cross River State which, up until the inception of the CRSFP, was virtually at a standstill due to an almost complete lack of funding (Otu, pers. comm., 1992, and Forestry Department Annual Reports). Although this has not lead to the formation of new Forest Reserves, it has meant that the enforcement of Forestry laws has increased so there is less opportunity for encroachment of farms into existing Forest Reserves. However, as part of a management strategy being developed for Cross River State, the CRSFP is also attempting to hand the control of many protected forest areas over to communities to manage in a sustainable way for non-timber forest products and timber production. Relevant extracts from the Strategic Management Plan are shown in **Appendix M.** This will not enable the land to be used for agriculture, but it is hoped that if communities are empowered so that they have control of what is harvested from the forest, they will value the resource more highly and make greater efforts to conserve it. This in turn may lead to communities developing more sustainable farming systems which reduce the need for new forest areas to be cleared for agriculture, a possibility which has been partially addressed by an agroforestry study carried out as part of the process of developing the

Strategic Management Plan (Dunn, 1994), but not addressed directly in the main SMP document (Cobham, 1994).

In areas which are not affected by the CRNP or the Forestry Department, due to there being little or no forest remaining, or in some swamp forest areas where due to political problems the Forestry Department are unable to operate, pressure for agricultural land is already being experienced. A CRSFP Inventory of Cross River State (Dunn *et al.*, 1994) calculated that 152 700 ha of forest has been lost in the state from 1972 to 1991, that is 17.3% of total forest area, and 91% of this loss is attributed to clearance for farming. During this study the situation of land shortage was found to exist in Igonigoni which is in the derived savanna zone where, due to increasing pressure for farm land, fallow periods are being reduced (see below) and as a result yields and quality of the crops are falling. Land pressure in areas such as this appears to have occurred due in part to natural population increase and partly due to immigration from neighbouring, more densely populated states (Cobham, 1994) mainly as a result of the construction of a bridge over the Cross River in 1976. Christiaensen *et al.* (1995), in an analysis of small-holder farms, found that 63% of villages in eastern Nigeria had experienced out-migration due to land scarcity. The Cross River had previously cut Cross River State off from the rest of Nigeria (anecdotal evidence only from questionnaire surveys and discussions with Forestry Department and CRNP staff, 1992-1994) and increased access from neighbouring states has in turn led to the degradation of farmland, bush and forest.

Therefore, the answer to the first of the questions of this section is that there appear to have been land use changes and population increases in the study area which have in turn increased the pressure for agricultural land. This conclusion has been drawn both by observation in village farming areas, especially around Igonigoni where there is evidence of soil degradation, from information gathered by CRSFP, and from the questionnaire data and discussions with villagers (3.4.6 and 3.3). This in turn has meant that there is a need for agricultural intensification to try to combat falling soil fertility levels and increase production so that it can support the communities which are affected by the land shortages, and reduce forest loss from clearance for new farmland.

Is this need (agricultural intensification) perceived by the local people?

The shortage of agricultural land is acknowledged by the local population, either through complaints about shortened fallow periods in areas with no forest, or by having farms sited further and further from the village in forested areas. In Igonigoni 83% of respondents stated that farm land was scarce, and 83% mentioned that fallow periods are now shorter, being between zero and four years rather than between four and fifteen years as was previously the case (see 3.3.2). In Abo Mkpang, although because of the proximity of large areas of intact high forest the pressure for farm land is not as severe, most people mentioned the CRNP as being a major cause in the reduction of available farm land, and 22% complained of lowering fertility levels due to shorter fallows. Some stated that farms were now sited large distances from the village making them vulnerable to theft as they are visited infrequently by the farmers, and reducing time available for farm work and making the carrying of produce to the village difficult due to the long distances to be covered (see 3.3.1). This is a complaint that was heard by the author in a number of other villages in the state which are located close to relatively intact high forest.

There is also awareness that something needs to be done to combat the land shortage, the feeling in Abo Mkpang being that the problem of lack of access to farm land is one that will arise in the future. As yet, however, there are few attempts by farmers to modify their farming methods, and even in Igonigoni where the problem is immediate, very little effort is being made to modify farming systems. During discussions about the major farming problems experienced by communities, lack of access to fertilizer was mentioned by 13% of respondents in Igonigoni and by 25% in Abo Mkpang. This desire for inorganic fertilizers was the only recorded response to falling soil fertility levels on farmland to have emerged from the communities, and from observation in the field, seemed to be the only way in which the problem was thus far being addressed.

Can the need be partly addressed by making use of indigenous trees?

This question was only partially addressed by the study and a great deal more work needs to be carried out to examine the potential of particular species selected by individual communities for agroforestry development. However, as shown in detail in Chapter 4, there is a huge fund of knowledge about trees and their many uses in the villages and with particular reference to agricultural intensification, either through soil improvement, and/or the provision of extra produce for domestic consumption and/or sale, a number of species appear to have the potential to contribute to improved farming systems. In Akwa Ibom where a complimentary questionnaire survey was carried out in one community, and where farmers have adapted to land shortages by developing seemingly sustainable, intensively farmed home garden systems, trees play a major part in the workings of these systems as outlined in 2.3.2, 3.3.3 and 4.4. The question of whether agroforestry as an alternative to the traditional long fallow will provide an answer to the problem of sustained annual cropping in the tropics is still unsolved (Young, 1987; Sanchez, 1987). However there are hundreds of successful agroforestry systems in the tropics (Budelman, 1991) and with the existing local knowledge of woody species in the study area there would seem to be great potential for the development of locally adapted systems which reduce the current problem of the shortage of land for agriculture. Therefore, with time and encouragement, it is hoped that the farmers of Cross River State will be able to make use of some of the many different potentially useful tree species to combat some of their agricultural problems.

7.2.2 Use of indigenous technical knowledge

Can farmers' existing knowledge about selected indigenous tree species make a significant contribution to the modification of farming systems?

As can be seen in Chapter 4, farmers in the two study villages have a great deal of indigenous knowledge about trees and their uses. Some of this knowledge relates specifically to the use of trees in farming systems (4.3.5), the most commonly stated examples being those species which improve soil fertility, or are used as live stakes or boundary markers. However the knowledge that exists about the many other species that are used can also contribute to the development of improved agricultural methods. Many different fruit trees are grown or harvested (4.3.1), and by adding these to farm land it will be possible to begin to develop more intensively farmed plots. Growing fruit trees also means that farmers have developed their own germination, nursery and establishment techniques which will be useful when exploring the use of other species for their farms. Development of such farming systems however often needs to be induced and accelerated with the help of extension agents working with the communities to harness the knowledge and to use it in the most useful directions as discussed in 1.5.

7.2.3 Germination and establishment of trees

Is germination and early establishment of the selected species easy enough to enable their use at village level? Is germination of the selected species by farmers already taking place?

In order to ascertain the ease of germination of the four selected species, simple germination trials were carried out, the results of which can be found in **Chapter 5**. All four of the selected species germinated easily, with treated *Uvaria chamae* having the highest germination percentage of 72%, and untreated *Ricinodendron heudelotii* having the highest survival rates of 98% of germinated seedlings for at least the period of the experiment. The germination techniques used were simple, using no chemical or complicated thermal pretreatment, and therefore easy to replicate in the villages. Many farmers already germinate and plant out a number of tree species, mainly fruit trees, so knowledge of germination and establishment techniques is already present in the communities. Those species which have in the past germinated naturally in the forest and bush are generally collected as seedlings and transplanted onto farms. Species which are now becoming scarce, due to changes in land use and the demand for more agricultural land, will have to be germinated by farmers in the future if they are to continue making use of them, and germination trials of the type executed for this study will be easy to carry out at village level so that the most appropriate germination and establishment techniques can be discovered.

7.2.4 Development of a framework for extension workers

Is it possible to develop a framework that can be used to guide an interactive development process between farmers and extension agents?

The end product of the research is a framework which aims to be used by extension workers to help communities develop more sustainable farming systems. Such a framework was formulated as described in Chapter 8, but has not yet been tested in the field. It is hoped that by making use of the experiences of this study in its development, that the framework is both appropriate and easy to implement, and that it will be tried in the field during the implementation of the Strategic Management Plan currently being developed by the CRSFP, and by other relevant agencies working in Cross River State.

7.3 Changing roles of foresters

Views of forestry extension have altered as the role of forests in development have changed over time, from being seen as a source of raw materials under government control to being integrated with indigenous agriculture providing rural people with a sustainable livelihood as well as having an environmental value (Arnold & Kanowski, 1993; van Gelder &

O'Keefe, 1995). At the same time, new approaches to agricultural extension are arising as there is a growing recognition that farmers are researchers and extensionists who have knowledge which the supporting institutions need and vice versa (Hoskins, 1994). There has also been a growing concern for small-scale producers who were largely ignored in early agricultural research and development projects in many areas of the South (Warren, 1989). Together these changes are combining to form a new attitude and approach towards the role of extensionists in rural development forestry and agriculture (Osborn, 1995).

Although much is being learnt from developments in agriculture, Anderson and Farrington (1996) point out a number of differences between agriculture and forestry that need to be borne in mind and adapted to accordingly. These include:

a) Forestry activities are usually on a longer time-scale than agricultural projects which can be for as little as one season;
b) Forestry usually deals with common property resources, although in the light of changing land use due to population pressure and the development of new, individually managed tree-based resources (see 4.2) this situation is changing;
c) For most people is not their primary activity, but may be an important secondary one; and
d) Forest products and services are still perceived generally as being of low value.

Traditionally, the interactions between foresters and rural populations have been limited to protection and policing of the forest resource, and to revenue collection (Falconer, 1987). For example, at independence in

Senegal, the forestry administration adopted a policy towards forest resources that was basically protection-oriented (Gueye *et al.*, 1994), a situation that was common throughout much of West Africa. As access to forest resources is reduced for rural populations through expropriation by the state (for example the development of a national park), privatisation and encroachment, over-use degrades those accessible resources that remain (Arnold & Kanowski, 1993). This in turn has led to a general trend towards greater reliance on on-farm resources (Shepherd, 1993a) and foresters have therefore had to redefine the areas in which they work to encompass agricultural activities in the form of social forestry and agroforestry. The balance between supplies from tree stocks off-farm and from managed and planted trees on-farm varies widely with agroecosystem and patterns of land use. In the humid tropics, much of the supply of forest products comes from areas of bush fallow or woodland in less densely populated areas, such as in Cross River State, and from the tree component of home gardens where pressure on the land is high, as is found in Akwa Ibom State. Farmer tree growing has therefore increased in recent years in a variety of agroecological and land use situations as the need for on-farm supplies of forest products becomes more pressing. Foresters will always need their professional forestry expertise, but specialisms within this will change over time, and the increasing need for agroforestry and NTFP knowledge in recent years as on-farm trees become more important is an example of this (Smith, 1994).

Because they require lower inputs of capital and labour than most other crops, and can provide a number of secondary products and services, trees can become an appropriate part of a farm system in many areas. Work in this area by institutions such as ICRAF and IITA has led to greater involvement by foresters in agricultural development, and thus the need to be equipped with many skills not previously thought to be necessary in forestry training.

The first generation of projects designed to stimulate and support private tree growing by farmers tended to develop tree growing as though it was isolated from many of the key agricultural and socio-economic influences on it (Arnold & Kanowski, 1993). Gradually projects began to develop with trees as part of an agricultural system, but there were still a large proportion of mismatches between intervention and needs. One of the major reasons for this has been poor communication with farmers due to a shortage of people trained in communication and extension skills, so that forestry extension programmes have tended to be top-down with a one-way flow of information and a hierarchical relationship existing between extension agent and client (Falconer, 1987). In contrast, foresters are now beginning to work together with agriculturalists to develop more appropriate and participatory extension systems which can make full use of rural people's skills and produce appropriate methods with which to combat some major forestry and agricultural problems.

For indigenous knowledge systems, such as the constant accumulation of ethnobotanical knowledge, to be mobilised as a resource to meet development goals, greater interaction is needed between the users of indigenous knowledge - rural residents - and specialists contracted to design, carry out and evaluate development projects (Alcorn, 1995). This is especially important with agroforestry because much knowledge about it is indigenous, not yet documented, and covers a wide range of species and environmental conditions. Formal agroforestry research has only managed to concentrate on a limited number of species and techniques, where as it is often possible to document many different indigenous agroforestry combinations in one geographical area. For example seventy-two different agroforestry combinations have been observed among Panamanian Kuna farmers (Castillo & Beer, 1983). An approach where the knowledge and experience of both farmers and researchers is combined, is more likely to generate technologies which meet farmers needs. Biggelaar and Gold (1995) recommended, after work in Rwanda, that future studies of endogenous knowledge systems combine qualitative and quantitative, participatory and formal data collection methods as they provide complementary perspectives on a complex reality.

The experience of the Senegalese forestry administration (Gueye *et al.*, 1994) illustrates well the process through which many forestry departments in the South, such as Cross River State Forestry Department, are now working. After independence in Senegal the forestry administration saw its role as one of protection, and intervention by foresters was basically of a paramilitary style. In the early 1970s, drought and desertification forced a change in attitude, drawing attention to the need to counter the environmental damage being done to the country's natural resources. The forestry service therefore increased its militarist response, and in time it became apparent that this action was inadequate. Thus from the 1980s, local populations were asked to collaborate extensively with the forest service and the previous repressive attitude gave way to a greater focus on local communities and their relationship with the forest. Initial attempts to gain community involvement were in the form of top-down commands, and the local population served as a voluntary workforce to implement programmes which, in their eyes, belonged to the forestry service.

However with the development of a more participatory approach, support from the government with changes in emphasis in forest laws reaffirming the private right of ownership of trees, and a programme of education for forestry officers, a partnership for sustainable forestry development is gradually being forged.

Traditionally, agricultural research and extension have tended to be two very separate aspects of a supposedly united approach (Manig, 1992). This conventional structure is described by Hoskins (1994) (Figure 7.1) as a process with separate research and extension continua that need to be joined by professionals working in the field. Research, focused in laboratories or on research station plots, is often based on a set of assumptions and may therefore not be relevant to the problems farmers face. In Indonesia a dwarf coconut palm which produced more fruit, matured earlier and was easier to harvest than local varieties, was developed without consulting farmers. The farmers however grew coconut palms as part of the upper storey in their homegardens, the new variety competed for space reserved for bananas and other crops and produced more shade. Earlier and increased fruit production was of little value to the household, better that the production was more limited over and extended over a longer period of time (Hoskins, 1987). Other examples of weak linkages between researchers, extensionists and farmers also exist, such as the case of rice farming in the Dominican Republic described by Doorman (1991). Without two-way communication farmers will not receive relevant ideas to address their problems, and researchers will not have the satisfaction of seeing their results provide useful support to farmers. Pure extension, for example the development of messages to flow from extension centres to farmers, is also a one way movement of information. There is rarely provision made within an extension

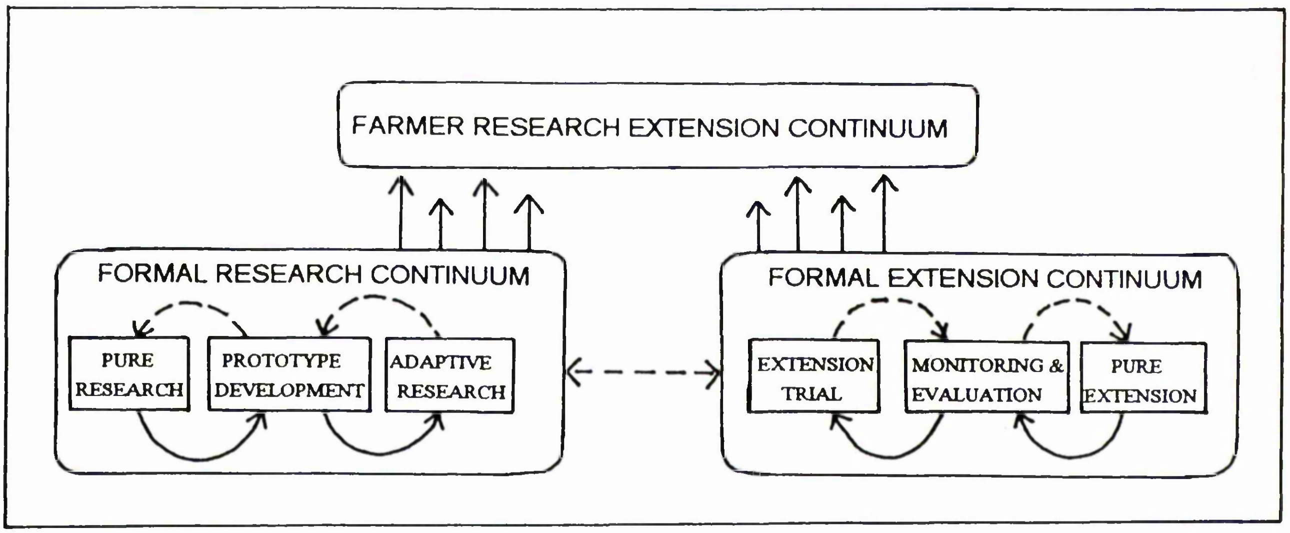


Figure 7.1 Traditional links between research and extension continua and farmers, where the flow of information is one-way, from researchers to farmers through extension agents (Hoskins, 1994).

programme to help farmers get messages to researchers and policy makers (Osborn, 1995). A recent survey of one hundred and eight agroforestry extension projects revealed that only 45% had some kind of impact evaluation, mostly looking at the number of trees planted, area under agroforestry, and so on, rather than at indicators of socio-economic or environmental impact (Scherr, 1992), so there was little opportunity, even in those projects with an evaluation system, for feedback from farmers to be collected.

However, as both research and extension are valuable development tools, Hoskins (1994) argues that the answer is not to do away with them, but to fill the gap providing a feedback to and from various points on the continuum. There must also be a melding of the formal research/extension continuum with the farmers own research/extension continuum to form a more effective partnership between farmers and field workers (Figure 7.2). During the 1980s, ICRAF developed a 'farming systems' approach to on-farm agroforestry research, based on the D&D methodology (see 3.4). However ICRAF researchers discovered that such consultative study embodies considerable limitations, summarised by Raintree (1994) as:

a) farmers and researchers often diverge in problem prioritization; and
b) farmers and researchers often have different strategies for agreed priority problems.

Gradually such problems are being addressed and partnerships are beginning to form as new research and extension programmes are experimented with. In the ICRAF Annual Report 1994, emphasis is placed on collaboration with farmers, especially with respect to the selection of species on which to carry out improvement breeding work. Some

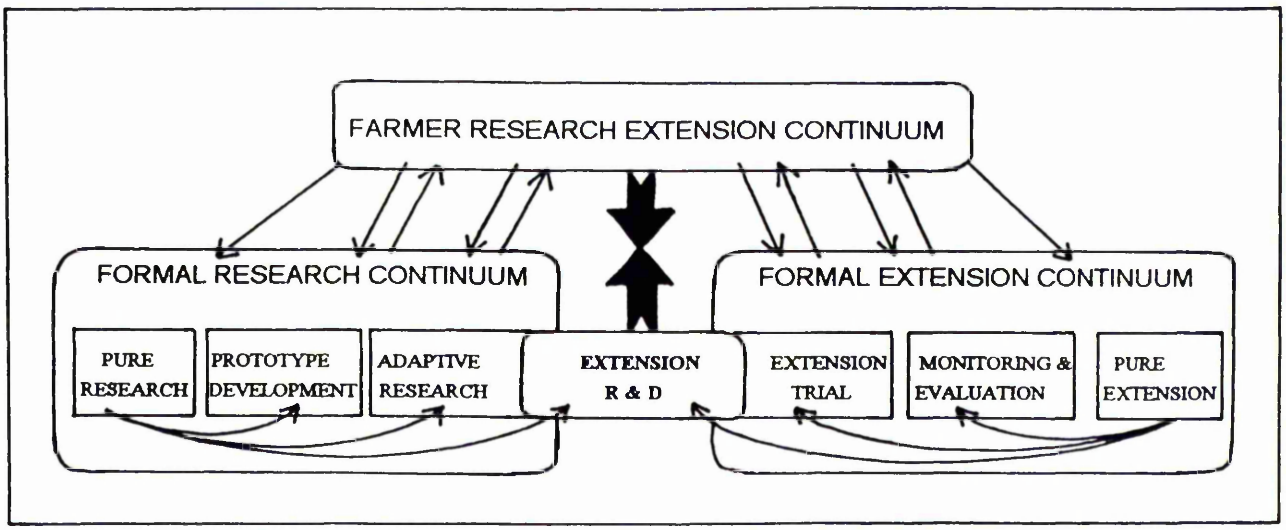


Figure 7.2 Research, extension and farmer continua linked together with two-way information channels in an attempt to create a system which produces 'client-led' solutions to local problems (Hoskins, 1994).

agroforestry technologies suggested by farmers have been established as trials, but the overall impression is that agroforestry research at ICRAF is still heavily controlled by research scientists and not by local people. Raintree (1994) states that it is doubtful whether any amount of improvement in the consultative approach can be a substitute for local participation from the outset of the research and development process, and the following examples illustrate ways in which collaboration is being achieved. In Kenya the Saradidi Rural Health Care Project has a strategy of collaborating with people from various villages to carry out agroforestry and to teach skills requested by the farmers. In Latin America, the Tropical Agriculture Centre for Research and Training (CATIE), has recently hosted for the first time a workshop in which farmers and researchers talked together about how they can work with each other more effectively (Hoskins, 1994). In eastern Africa a project supported by The Netherlands (Traditional Techniques of Microclimate Improvement) works with local PhD candidates who are members of local institutions to use indigenous technical knowledge and community participation to solve some of the locally identified agricultural problems (Stigter, 1995). Osborn (1995) describes an On-Farm Seed Project operated from 1987-1992 in Senegal and the Gambia which adopted a 'learning process approach' to seed development and dissemination. These are all recent initiatives and are still very much the exception, but will help indentify a better way forward so that research and extension can provide more relevant support to farmers and this in turn will be an effective tool in forest conservation and in reducing land degradation.

Individuals as well as institutions are becoming aware of the value of indigenous technical knowledge and innovation through experience in the field. One example from Vanuatu (Barrance, 1995) describes how a forester working on an ODA-funded project visited an area, reported to be suffering from a severe shortage of easily available fuelwood and from depleted soil fertility, to establish an *Acacia* demonstration plot to stimulate interest in a community woodlot project. It became evident on arrival that this would not be an appropriate solution to the problems, and that the villagers themselves were making their own efforts to respond to changing local conditions. These include a well-defined and intricate system of land tenure, and an emphasis on the use of perennials, particularly fruit trees, for a number of vital functions within both the villages and gardens. It was also noted that for any forestry interventions that were carried out, a wealth of alternatives exist to the few species normally favoured by foresters. Although as yet no solutions have been developed, foresters and villagers are now working closely together to address the local problems as the value of villagers' input and local information has been acknowledged.

7.4 Review of current agricultural and forestry extension practices in Cross River State

7.4.1 Extension activities of CRADP

The Cross River Agricultural Development Project (CRADP) was established in 1989 and is part of a country-wide programme of agricultural development, initiated in 1986 and described in 2.3. CRADP encompasses many different aspects of agricultural production such as food and cash crop production, animal husbandry, and fisheries, and related activities and areas such as women in agriculture, agro-processing, and storage. It tries to maintain strong links with other relevant government agencies such as forestry, agriculture and veterinary departments in an attempt to link them more closely with farmers' activities.

The main thrust of CRADP is the Unified Training and Visit System (T&V) of extension where extension agents attend training sessions each fortnight, and then extend the messages learned to the farmers during the following two weeks. The technologies to be learned and extended are generated by the Technical Services Department which carries out research in different areas of agriculture. This approach to extension has been widely criticised by many professionals in the South who disparage it as the 'talk and vanish' system (Rogers, 1989). Only a few evaluations of the effectiveness of the T&V system have been carried out. Mathur and Pandey (1983) conducted a study in Rajasthan, India and concluded "The farmers had unfavourable attitudes toward the system where as Village Extension workers had a neutral attitude." A more recent review of thirty-three extension projects plus a further seventy-six projects having an extension component, noted that the performance of the T&V system, outside favourable areas, has generally been weak (Farrington, 1994). Purcell (1993) lists the following factors which have contributed to the low success rates of T&V based projects:

a) returns to extension are high only if prices are right and complimentary services are available; frequently these conditions are not met especially in the more difficult environments; ?
b) inadequate understanding of farming systems and of farmers' opportunities and constraints commonly means that recommendations are inappropriate;
c) the number of relevant messages for difficult environments is limited, and without a steady stream of new technologies, the

marginal returns to successive visits diminish rapidly;

d) current extension models are generally too expensive to be maintained after outside finance is withdrawn;

e) the specific needs, opportunities and constraints faced by women farmers have generally been neglected; and

f) the 'contact farmer' mechanism rarely works as well as intended, and group organisation has rarely been a recognised component of extensionists' activities.

The T&V system of extension however continues to be used by agricultural extension agencies such as CRADP and is a good example of a pro-active, top-down approach to agricultural development. This is illustrated by an examination of the agroforestry programme currently being carried out by CRADP as part of the Unified Extension System. Agroforestry research trials, usually using exotic tree species such as *Leaucaena leucocephala*, are designed at the south eastern zonal headquarters in Umudike, Abia State. All ADPs in the zone then replicate the trials by recruiting farmers to try out the technologies and species in their farm plots. This is done in three stages as described by Atta-Krah and Francis (1987) and outlined below:

a) On-farm Research (OFR) stage - during which agroforestry trials are carried out by CRADP staff on farmers' land. All inputs and labour are provided by CRADP so the trial at this stage acts merely as a demonstration plot;

b) On-farm Adaptive Research (OFAR) stage - during which inputs are provided by CRADP, and land and labour are provided by the farmers who attempt to repeat the techniques shown in the OFR stage; and

c) Small Plot Adoption Technique (SPAT) stage - during which farmers are given no inputs and are expected to replicate the trials using their own resources.

Although the agroforestry programme officers state that the process is responsive to farmers' needs and therefore appropriate (Ateh-Abang, pers. comm., 1993), it can be argued that this is not the case. The research trials, using exotic species and formal management systems, are designed by researchers based outside the state, and then attempts are made to duplicate these exactly on farmers' land. The only input that the farmer has throughout the research process is to provide the land and labour necessary to conduct the trials. There is no point during the process at which farmers are encouraged to suggest inputs or innovations to try and modify the agroforestry systems to better suit local conditions. In fact if farmers do introduce modifications into the trials on their land, then the trial results are not used and the trial is counted as a failure because the original design was not copied exactly. This is a good example of the division between research, extension and farmers suggested by Hoskins (1994) and discussed in 7.3 above. It would seem that the existence of a programme such as CRADP is an ideal opportunity to begin to combine research, extension and farmer-innovation in the development of appropriate agroforestry systems, but as yet such advantage has not been taken of the situation.

7.4.2 Extension activities of CRSFP and the Forestry Department

Traditionally, forestry departments have played little or no part in extension work, instead limiting their contact with local people to acting as police monitoring reserve boundaries and timber production. In Cross River State even these activities were almost nonexistent for the years leading up to the inception of the CRSFP, and some villagers who were harvesting timber and farming in forest reserves said that they did not know where the forest reserve boundary was, and that they had not seen any forestry department staff for many years (Dunn pers comm, 1993). With the start of the CRSFP, one of the first tasks of the forestry department was to 'reclaim' the forest reserves which cover approximately 270 000 ha (Dunn *et al.*, 1994) by clearing and remarking boundaries and making the presence of forest department staff in the field a more common occurrence. However, it was felt by the project implementors that this could not be done in the traditional way, that is by excluding the local people from forest reserves merely by acting as forest guards, but that in order for there to be any success in managing forest reserves the local communities had to be involved.

The issue of involving local communities as soon as possible in forest reserve management was addressed in two ways. The first of these was a series of workshops for forestry department staff which attempted to get them to re-evaluate their roles. This was emphasised especially by discussions which concluded that the forestry department are custodians of the forest for the people of Cross River State so therefore the people should have a say in how the forests are managed and should benefit directly from them (Workshop Reports, 1991/2). Many meetings between villagers and forest department staff have since been held and much useful and lively discussion has taken place. The second action to be taken was that a review of timber tariffs was carried out and new tariff rates and laws were introduced that give a greater percentage of the royalties gained from trees being felled and NTFPs being collected to the communities which exist adjacent to the forest areas.

The most successful example of community involvement in forest management in Cross River State is a project that was initiated by some staff of the CRNP in two support zone villages of the National Park, but has been taken over by the CRSFP. The project started when a WWF funded volunteer spent nine months in the villages of Old and New Ekuri which are located in the support zone of the CRNP and control an area of approximately 30 000 ha of largely intact community forest. Initially the volunteer spent time helping the villagers to develop a road to the main highway, which is what they most wanted. The communities then requested help in using their forest for sustainable timber and NTFP production and the CRSFP was able to train a team of people from both Old and New Ekuri to carry out stock surveys in the forest and to therefore decide how many trees could be harvested each year without degrading the forest. The communities have since started to build bridges for their road, formed a co-operative to deal with the harvesting and sale of timber and NTFPs, and have selected some members who took part in a training course on the use of chainsaws for felling and conversion of timber. In this way control of the forest has remained totally in the hands of the communities and they have not had to sell out to a large timber company who would thoroughly degrade the area, in order to gain profit from their resource. The villagers also realise the tourist potential of such a project and plans are being made to build a guest house within Old Ekuri, adding one more side to a multifaceted community-led forest development initiative (Dunn *et al.*, 1996).

Other forest department extension activities are still very much in their infancy. Two senior forest department staff have attended an agroforestry training course at ICRAF in Kenya, and they, with the help of the author, have held a number of agroforestry and extension training sessions for forest department field staff. As a result, a number of Forest Charge Offices are now beginning to implement agroforestry or tree planting programmes which involve the forest officers acting as extension agents rather than as forest guards. In Obudu Forest Charge in the north of Cross River State, discussions with Igwo village have resulted in the development of a small agroforestry project initially using *Milicia excelsa*, *Elaeis guineensis* (oil palm), *Citrus* spp. and *Irvingia gabonensis* (bush mango) which were selected by the community. In Akpet Forest Charge a small nursery is being developed to produce tree and NTFP seedlings with direct involvement of local communities.

One of the major objectives of the CRSFP was to produce a Strategic Management Plan for the sustainable development, conservation and management of the forests of Cross River State. This involved a programme of data collection which included a forest inventory to estimate standing timber stocks, a survey of NTFP use in the state, and a number of smaller projects examining timber conversion methods and rates, agroforestry potentials and plantation status. A document was produced which contained recommendations of actions and guidelines for sustainable management of forests, based on community participation (Cobham *et al.*, 1994). Unfortunately, although a report on agroforestry activities in Cross River State was produced as part of the strategic management planning process, the plan includes very few suggestions for agricultural intensification as one of its solutions to the problem of forest loss in the state, even though one of the findings of the surveys was that 91% of forest loss between 1972 and 1991 has been due to clearance for farming. This is a good example of the problem highlighted by Budelman (1991) where forestry and agricultural activities are yet to be comfortably combined in the minds of many development professionals.

It would seem that agricultural intensification is not seen as a 'forestry solution' to deforestation, and therefore has not been addressed but rather has been left in the hands of the agriculturalists who may have different reasons for intensifying agricultural production.

7.4.3 Extension activities of CRNP

Agricultural and agroforestry development and extension were major components in the initial Cross River National Park documents, as part of an intensive rural development programme in the support zone of the park. The main objectives of the Support Zone Development Programme were:

a) to provide indirect compensation for the loss of access to the Park;
b) to improve traditional farming systems;
c) to educate the people in the principles of sustained-yield forest management; and
d) to involve the communities in the development of the Park.

(Caldecott *et al.*, 1989:38)

In the Land Evaluation and Agricultural Recommendations report (Holland *et al.*, 1989) details of proposed programmes are given and the major objective is stated as being to increase agricultural production without converting yet more land from forest. Details of a number of different options are given such as an agroforestry programme using alley farming, planted fallows and intercropping, development of small-holder oil palm and cocoa plantations, and livestock development. Throughout the plan emphasis is placed on the need to reduce forest clearance, the objectives and methodologies therefore being selected by the CRNP staff with no consultation with villagers in the Support Zone as to their needs and desires. For example, the plan for agroforestry interventions (Okafor, 1989) is based on a few methodologies and exotic tree species, centralised tree nurseries, and extension workers teaching farmers about agroforestry. In practice, little of the 1989 plans have been executed in the support zone, due to management and funding problems within the CRNP structure. The major thrust of the CRNP Support Zone programme so far, has been the raising of environmental awareness in the villages surrounding the National Park, through schools clubs, newsletters, magazines and workshops. The author contributed to the programme regularly, one example of this, a series of cartoon strips for *Pangolin* the quarterly CRNP magazine, is shown in **Appendix N.** The villagers are yet to receive compensation for the loss of access to large areas of forest and as such feelings within the support zone communities are currently ambivalent or even antagonistic towards CRNP.

Recent changes in the CRNP management structure, that is the division of the park into two the separately managed divisions of Oban and Okwangwo, have meant that many of the original rural development programmes have been revised. In the Okwangwo division the support zone villages have been grouped into cells of between three and five communities, each of which is served by a CRNP extension agent with a contact farmer in each village (Figure 7.3). The CRNP extension agents act as part of the CRADP system, that is they attend training sessions each fortnight and then extend the technologies or lessons learned during the following two weeks. The extension agents are therefore not acting in response to requests from communities or farmers, but are instead teaching messages chosen by the CRADP Training and Visit programme and which are the same throughout the state. No attempt has been made to respond to localised agro-environmental or socio-economic conditions or to take account of specific needs or requests of the farmers.

Figure 7.3 CRNP contact point sign on the main track entering Abo Mkpang village, Okwangwo Division, November 1993 (Photo: the author).

7.5 Which way forward for more successful agricultural change and forest conservation?

From the points of view of the forest and agricultural departments, CRSFP, CRNP and CRADP, agricultural intensification has the potential to address the major problems of increasing pressure for agricultural land and forest loss. Agricultural intensification could also address many of the more specific but related problems outlined by the villagers themselves such as reduction in fallow length, fields being situated further from the village and poor yields. However, as illustrated with the Ekuri project, outlined in 7.4.2, problems which are perceived by the villagers as being the most immediate, may not even appear on the development worker's list of concerns. It is therefore important that agriculturalists, foresters and conservationists are prepared to widen their skills to encompass sociology and rural development, and to become partners with, instead of teachers of, the villagers. Packages to be given to extension workers to dispense in communities should be produced in such a way that they are flexible and reactive to the communities' desires, rather than rigid and pro-active in nature as has been common in the past. In this way extension workers will have the tools which will enable them to be more receptive to the communities' most immediate needs, and be able to respond to them, at least in part. This should help the development of trust and confidence between communities and extension workers to take place, which will in turn make local people more receptive to ideas and assistance as they are offered. Projects should be perceived as dynamic in which research and extension are part of the same process, and as such should be a period of learning for both communities and extension workers who will eventually be able to combine both indigenous and formal scientific/technical knowledge to produce an extension package which is locally relevant. Osborn (1995:7) summarises this type of approach when discussing the extension methodologies used in Senegal and The Gambia in an On-Farm Seed Project:

> "...the participatory extension approach involves extensive dialogue with farmers to assess traditional production systems before modified practices or technologies are identified and proposed. The role of the extension agent is no longer merely 'technology transfer' but rather to facilitate a two-way exchange of information and priorities between the extensionist and farmers."

As can be seen in 7.4.1-3, the current methodologies employed in rural development in Cross River State are generally not flexible or participatory in nature, and have so far achieved only limited success, especially in the area of reducing forest loss. Unfortunately, as discussed in greater detail in **Chapter 8**, training, especially of junior staff (ie. those most likely to be working in the field) is not usually given funding priority. Therefore 'on the job training' should be an inherent part of any extension packages that are developed, and clear guidelines as to the approach required for the success of open-ended, participatory development programmes should be provided. It is to this end that a framework for use by field workers, and by planners and senior staff when constructing developement programmes, has been developed taking both current debate and personal field experience into account, and is shown in detail in **Chapter 8**.

7.6 Conclusions

Several conclusions can be drawn from this chapter, both about the current debate and consequent change of direction that is occurring in the field of agricultural and forestry research and development in the South, and, more specifically, about the current state of conservation and development projects in Cross River State.

- There has been an increase in pressure for agricultural land in recent years due mainly to immigration from neighbouring states and a reduction of available land area through Forest Department and CRNP activities.

- Although there is an awareness among local people of the changing situation regarding farm land, as yet few people in Cross River State are taking action to address the problems caused by such changes.

- The wide indigenous knowledge of species, technologies and local environmental conditions is an important source to be tapped during efforts to develop improved farming practices.

- Foresters, extension workers and conservationists are beginning to develop ways in which on-station research, on-farm research and extension programmes can be truly inter-linked and are thus more effective in adapting the rural situation to changing conditions.

- As yet few examples exist in Cross River State of the move towards greater participation, but early stages of some projects are promising.

CHAPTER 8

New ways forward for rural development and forest conservation.

8.1 Introduction

This chapter begins in **Section 8.2** with the presentation of a theoretical conclusion to the study in an attempt to examine the reasons why the research was carried out and to explain the direction that it took. This is followed in **Section 8.3** by a discussion of the need for simple, on-the-job training methods for field staff in forestry, agricultural and conservation projects. In response to this need, the development and description of a framework for use by extension workers in attempts to address problems experienced by local communities mainly as a result of increasing pressure for agricultural land, takes place. The chapter concludes with some points to be noted from **Chapter 8**, followed by some general conclusions, with special attention being paid to the practical applications of the results from this study.

8.2 Theoretical considerations

Throughout the thesis, one of the main ideas examined has been the move away from science-based and led agricultural research and development towards helping local farmers themselves to adapt current farming systems to suit the changing environment. The possibility of agricultural and forestry research and extension to be locally managed and farmer-run has been acknowledged for many years. Timberlake (1988:195) states that:

> "...the direction of Africa's agriculture can no longer come from Washington, Paris and London. It cannot even come from Lagos, Harare and Nairobi. It must be run largely by farmers, and by their organisations, with the help and support of the aid agencies and the governments and the research stations. This help must be delivered in small packages, rather than a few big dams and big plantations. And these packages must be delivered with great humility by people who work closely with farmers,people who do not mind when the packages are shaken up and rearranged and perhaps used in a way that the deliverers had not quite intended."

In 1980 Brokensha *et al.* brought together a set of case studies and argued the need for greater understanding of local knowledge in planning and implementing development activities. In 1989, after a meeting of some fifty natural and social scientists in 1987, the book *Farmer First: Farmer Innovation and Agricultural Revolution* was published (Chambers *et al.*, 1989) arguing that the approaches and methods of transfer of technology used in rural development projects do not fit the resource-poor farming of the South, and stressing the abilities of resource-poor farmers to innovate. Succeeding growth in the application of indigenous knowledge and skills to rural research and development is evident from the establishment of a number of international, regional, and national networked indigenous knowledge resource centres. Scoones and Thompson (1994) attribute some of the radical re-thinking of the role of farmers and professionals in agricultural research and extension, to the ideas put forward in *Farmer First*. Walker *et al* (1995) attribute the increase in activity in this direction to:

a) The demonstrable need to target research to client needs more effectively if the results of research are to achieve high rates of adoption;

b) A rise in the importance accorded to ethical issues relating to participation and power; and,

c) The recognition that indigenous knowledge, particularly in relation to agroforestry, may be a powerful resource in its own right and complementary to knowledge available from scientific sources.

What both arguments show however is that there has been a move in the last few years towards greater farmer participation in rural development, but key areas remain a challenge for research and development practitioners (Scoones and Thompson, 1994). A variety of approaches to better targeting research to client needs has been espoused, the defining feature of all of these being some form of interaction with target communities during project planning and implementation, and a focus on the resources and preferences of the target groups (Holden & Joseph, 1991). As yet, actions to move towards situations where local control is the norm are still few. However, as more development workers and writers become involved in this way of thinking and the debate is intensified, projects are beginning to have real community participation from the outset, rather than merely paying lip service to the idea of locally led research and development (eg. see 7.4.2).

In many cases the need for early local participation is realised, but full participation throughout the project does not take place and Scoones and Thompson (1994) stress that there is a danger that 'participation' becomes trivialized by glib generalisations and sloganeering. For example, Tonye *et al.* (1994) describe a project in Cameroon where input from the communities occurred at an early stage, in the form of household surveys gathering data on farming systems and agricultural constraints, but Walker *et al.* (1995) suggest that this kind of participation is essentially passive (ie. responding to requests for information) rather than active. The same can be said about the earlier stages of this study, where due to the nature of the intended end product, information collection took place after the major research direction had already been decided. In the Cameroon example (Tonye *et al.*, 1994), the species and technologies employed to address the agricultural constraints were selected and experiments designed by outside researchers. The only input from farmers later in the project appeared to be the use of their labour and land to carry out pre-designed experiments, and farmer-led innovations were not encouraged. In the CRADP example cited in 7.4.1, farmer involvement was only to provide land and labour for trials designed and managed by researchers.

In the past, the promotion of multipurpose trees and shrubs to meet people's immediate needs was often considered the key to effective action (Postel & Heise, 1988). Conventional approaches and methods however have often produced 'limited success' and introduced technologies of 'best bet' species have not been enough (Ayling, 1991). Foresters and agriculturalists working with small-scale farmers need to know what their clients want (if anything), what their objectives and goals are, how and why they use trees, how they make a living - to develop a 'user perspective' and see the issues through the farmers' eyes (Rocheleau, 1987). Raintree (1994) summarizes the attempts by agroforestry institutions to take account of this need with the development of on-farm agroforestry research in the early 1990s, and concludes that rigidly controlled experimental designs favoured by ICRAF and other formal agroforestry research institutions are likely to be too delicate and over-simplified to be of much use in on-farm research and would be best left to on-station researchers. The conclusion of this work is that on-farm research should be used to answer questions of 'how?' and 'why?' farmers are able to adopt certain technologies, therefore not allowing the actual development of the agroforestry systems to be in the hands of the farmers. Biggs (1995) however argues that research station activities should be used in combination with 'formal' social and natural science village-based research, and 'informal' selection, experimentation and other research activities of farmers, village artisans, etc. Mahlako (1993) states that agroforestry projects have to generate decisions on species, site function, arrangement, management performance and inputs for each new area and that localised research of this kind is most efficiently carried out in close collaboration with farmers.

An example of a long established agroforestry project, considered to be one of the most successful of its time, is a USAID funded project in Haiti (Bannister & Josiah, 1993). Although the project has evolved over the years to incorporate more elements of a continual 'learning process approach', there are still a number of criticisms which can be levelled at it which show that it was led very much by outsider professionals rather than by participating farmers. Farmers involved in the project, selected by the N.G.O. 'animators', were not the 'poorest of the poor' as that class has no land and all project interventions were designed to improve land productivity. The relationship between field staff and farmers appeared not to be that of colleagues working together to develop appropriate agroforestry interventions. Instead a list of agroforestry options, developed away from the project area, was presented to farmers, rather than them working with the technicians to develop locally appropriate agroforestry techniques. In summary, at the outset, the project had agenda-driven, top-down characteristics, but as it has progressed and more input from farmers has been included, the interventions have become more farmer-led. For example, many locally requested, indigenous tree species are now included in the range grown in project nurseries, rather than being limited to the ten exotic species that the project started with.

The need for participation and support from local people for the success of conservation projects, rather than development projects, is also being recognised. Berkmiller (1992) has produced a handbook for environmental education in which the importance of developing friendly and constructive relationships with communities before any conservation work begins, is emphasised; although the section is entitled 'The Local People Problem', so some negative attitudes or a feeling of superiority are also being put forward.

It is now widely accepted that farmers are constantly carrying out their own research in order to make best use of the changing environment and farming conditions (Richards, 1985, 1994; Dixon, 1990; Millar, 1994). For example, the Tiv of Nigeria continually evaluate new plants for ecological requirements, as well as suitability of food for local processing and diet (McCorkle *et al.*, 1988) and farmers of Sanando, Mali are always experimenting or adapting methodologies to cope with the high variability and unpredictability characteristic of this semi-arid area (Stolzenbach, 1994). In areas where change is occurring slowly, or took place a long time in the past, farmers have often adapted well in order that they can continue to produce enough food for their families. This is apparent in south eastern Nigeria where complex home garden systems have been developed by farmers in Akwa Ibom State to make best use of the now very limited land area available per family (Okafor & Fernandes, 1987), such as those found in Obiokpok during this study. In Indonesia, farmers have dedicated effort to successfully integrating agricultural systems with *Imperata* grasslands that agricultural extension agents claim can only be managed by removing the *Imperata* through the use of expensive inputs (Dove, 1987). In areas, such as many parts of the study area, where change is taking place too quickly for farmers to be able to develop more appropriate systems in time to alleviate the resulting agricultural problems, outside intervention is useful in accelerating the naturally evolving farming adaptations. However, throughout the process of research and development, sight should not be lost of the fact that it is the local people who are experienced and knowledgeable about their own areas, and that it is therefore they who should direct the research from the outset. Rural people, typically, have too little involvement in most projects, their first opportunity usually coming at the implementation stage (Hoare & Crouch, 1988). Even in farming systems research where one expects a good deal of farmer participation, farmers often end up as passive players (Farrington, 1989).

The move towards greater local participation is a slow process. Often staff of government institutions such as forestry and agriculture departments (eg. Cross River State Forestry Department) have received 'traditional' education, linked to Western science (Compton, 1989) and to wealth, power and prestige (Chambers, 1983), which reinforces established negative attitudes towards indigenous peoples and their knowledge (Slikkerveer, 1989; Warren, 1989). Many of these ideas are continually reinforced in the institutions themselves which carry out development programmes usually conceived within the framework of formal science and Western values, and staff need to become more receptive to new, participatory methods of research and development. This need for 're-orientation' is discussed by both policy makers and forestry practitioners (Smith, 1994). Brenes (1994) feels that the basic change to be made is that extension workers must become part of the communities in which they are working. This implies the need for great changes in the current way of thinking of many staff of government institutions in the South, not only with respect to equality or partnership between extension agent and farmer, but also with the integration of research work and extension into a single continuum.

In many cases re-training needs to take place for staff in government forestry (and agricultural) departments which do not have the funding available for extensive and costly education programmes where even many up-to-date courses are still based in 'formal science'. Kass *et al.* (1994) outline the CATIE agroforestry training experience which places great emphasis on formalised agroforestry research, and makes little or no mention in the curricula of related socio-economic aspects. However, at the Agroforestry Center for Sustainable Development in Mexico, great emphasis is placed on sociological teaching and courses include social equity considerations, participatory research and the importance of an interdisciplinary approach (Krishnamurthy & Rodriguez, 1994).

Due to frequent lack of access to re-training it is important that any participatory research tools developed are simple to follow and have clear guidelines enabling field staff with little or no training to use them effectively. Emphasis should be placed not on the methodology, but on the mind set required for such an approach to research and extension to be successful. In order that the experience gained during field research for this study is put to use, an attempt has been made to develop such a tool in the form of a framework to help local field staff initiate and guide agricultural development programmes where a need is felt.

8.3 Developing a participatory framework for field staff

The end product of this research is the development of a framework to be used by local field staff in starting up participatory agroforestry projects. A similar project has been undertaken by Nielson (1994) in Uganda where the aim was to develop a methodology in which techniques from both the social and natural sciences were applied in an attempt to utilise indigenous technical knowledge as much as possible in agricultural development. The hypothesis in the Ugandan study is that improving existing natural systems is often the safest and fastest way towards increased production and sustainability, and that indigenous knowledge is both comprehensible and usable. In a similar vein it is hoped that by making use of the experiences gained during this study, the resulting framework will be appropriate to the local situation and will therefore be adopted by the relevant agencies. Biggs (1995) cautions against the use of 'ideal' models and manuals for agricultural research, arguing that practitioners generally develop their own practices appropriate to local conditions. Bearing this in mind, therefore, the framework needs to be developed with enough flexibility and opportunities for two-way communication between communities and extension agents, and between extension agents and development institutions, to enable field workers and villagers to tailor projects specifically to the needs of the community and the agency with which they are working. In some cases it may be decided that outside 'scientific' research would aid the development of locally improved farming systems and this should be carried out in such a way that the integration of internal (local) and external ('scientific') efforts is effective in avoiding wasteful duplication of effort (Walker *et al.*, 1995). One example of scientific research complementing local development of agroforestry systems is described by Stewart and Blomley (1994). In the semi-arid zone of Kenya, over the last two to three decades in response to changing socio-economic conditions, farmers have developed an agroforestry system using indigenous technical knowledge. The main woody species in the system is *Melia volkensii* Gürke, used for timber and poles, honey production, fodder, fuelwood and medicine, but the major obstacle to the diffusion and wider use of the species is the difficulties encountered in propagation. It is suggested that this is one instance where formal research has the potential to enhance the success of a locally developed system.

8.3.1 Discussion of some research experiences with respect to producing a more easily implemented framework for field staff

So that some of the problems encountered during the research can be avoided, or at least taken into account in project plans, they need to be analysed and some solutions offered before the development of the framework is discussed in detail.

a) The first problem was that of the length of time spent carrying out the research which led to communities becoming over-familiar with the work and losing interest before much participatory action took place. The time spent on the initial questionnaire stage could be greatly reduced if a more PRA approach is used from the outset. Field staff could stay in the village for one or two weeks and in that time gather a great deal of information in an informal way. This could be analysed with the help of the villagers, and decisions made together with the communities about which species or technologies to look at in greater detail. In a project situation, the time spent carrying out biological trials could be shortened by reducing the importance of field measurements and relying instead on reports of tree performance from farmers. Some short-term trials could also be carried out to complement local knowledge, such as coppicing some trees in fields and measuring regrowth rates for two or three months. In addition village-based germination trials could be conducted and this data added to local knowledge about the germination potential of selected species.

b) The second problem of time pressures should be less relevant in the context of a project. At the outset no timetable should be pre-arranged so that work can continue at a pace governed largely by the community. The function of the field agent in this should be as a catalyst who is able to move the process along a little faster if it appears to be stagnating. This will be easier to do if there is no agenda that the field staff feel they have to comply to so they can act in response to the progress of the project rather than to pressures of targets set by outsiders. The pressures of time will be further reduced if the field staff are resident in the village, or very close by, for the duration of the project. This will also make them easily accessible for members of the community who have specific questions to ask or who are in need of technical advice.

c) The problem of many of the villagers losing interest in the project is less likely to arise if the research period is considerably shorter than that which took place in this study. Interest will probably be maintained for longer in the context of a development project where the end product of the work is to be practical solutions to farmers' problems, rather than a report or thesis, and where funding and materials are available to help introduce any new or modified technologies that the community have developed. The use of PRA methods of data collection and reporting will help to ensure that villagers feel progress is being made early on in the project with results shared and discussed from the outset, rather than recorded in an inaccessible project report at a later date.

d) During the formation of solutions to some of the agricultural problems and the development of appropriate technologies or management techniques, it may be useful to hold a number of meetings with smaller, socially defined groups first, such as women, elders and youth, before moving on to full community meetings. In this way there will be more chance for the less certain members of the community to voice their opinions and have them noted, before they are 'shouted down' in a larger gathering.

8.3.2 Introductory comments for the framework

The framework is intended for use by field workers who are based either in the village or community with which they are working, or close by with easy access to it. The framework is designed to act as a guide to field staff attempting to implement projects which will help alleviate some of the major agricultural problems in the region. The aim of most development projects in the study area is to ease pressure on remaining high forest by reducing the constant demand for new areas of farmland.

Most of the field staff involved in such projects have had 'traditional', 'normal professional' training where they have been taught skills and technologies which they then pass onto their clients in a teacher-pupil relationship. Apart from a few senior Forestry Department field staff who have been involved in an introductory PRA course, they have had little or no exposure to PRA ideas and methodologies. A more detailed discussion of current extension and development practices in the study area is found in 7.4. It is hoped that the framework will be able to emphasise some of the ideals behind PRA so that field staff are able to work in this way without undergoing expensive and therefore often unavailable training courses. Most important is the view that extension agents or field workers have of their role in the development process. Ho (1992) summarises this as follows:

a) The extension worker is not an instructor, but balances between being active (eg. promotion of alternative solutions) and supportive (eg. during the planning phase, leaving farmers to take their own decisions). S/he must know how to stimulate and motivate the desire to pursue, and avoid the imposition of pre-conceived solutions; and
b) The extension worker has to bear in mind that his/her presence is only temporary and therefore has to look for opportunities to gradually decrease the need to be present.

There are more extreme views of the role of extension agents. One approach, called the 'problem census', emphasises the role of the change agent as purely and simply a facilitator of group processes, with little or no role in providing access to external information (Couch, 1991). However, it is felt by the author that this may lead to many situations in which time is wasted as communities have to 're-invent the wheel', rather than being able to request information which would ease the development process. Therefore, although it is emphasised that extension workers should not force information onto the community, they should be able to be seen as a way of accessing any outside information deemed necessary by the villagers to aid their work.

A number of criteria need to be borne in mind when using the framework to address local agricultural problems, especially with respect to the need for the development and use of technologies to continue long after the projects' inputs of capital and personnel have finished. These criteria are outlined below:

a) Projects should aim to become sustainable in economic terms so that they can continue after field staff and/or funding are no longer available. Therefore technologies which require the purchase of inputs such as inorganic fertilizers, chemical pesticides or herbicides, or HYVs should be avoided. Emphasis should instead be placed on locally available resources. Due to the system of funding of government rural development programmes in Nigeria, where 75% of any project cost is to come from the Federal Government, short-falls often occur (Olanrewaju & Falola, 1992) so attention should be paid to using low cost resources from the outset if projects are even to get off the ground;
b) Technologies and management techniques should also strive to be ecologically sustainable and must therefore make use of renewable and locally available inputs such as biomass for mulch/compost, and labour;
c) In order that technologies are attractive to farmers there must be

attention paid in particular to the management systems developed so that labour demands are not increased, thus making the technology workable under current socio- economic conditions. Farmers have rejected introduced technologies (eg.for bench terrace establishment in Laos and Java, and lopping and mulching in hedgerow projects in the Philippines) because demand for labour, and therefore labour costs, were too high (Fujisaka, 1994); and

d) Technologies developed by field staff and communities should be as 'loose' as possible so that each farmer can adapt them to suit his/her specific needs. In this way, best use can be made of the farmers' local knowledge and innovative ability to meet his/her own requirements.

The framework should be used in as open-ended a manner as possible and the progress of projects molded to suit each village situation, acting only as a reminder to field staff of the importance of working in the spirit of PRA in partnership with the communities. As has been detailed in 3.2, PRA is more a way of thinking than an actual research methodology and can be used in many different ways. A recent community forestry project in Nepal used PRA methods both to discover what farmers knew about the trees, as well as to find out exactly what outside support would be the most useful. In this case the information and research requested was on coppicing of local fodder species, collection and storage of locally available seed, and fire and erosion control (Kattel, 1994). In the history of the development of PRA, the real basis of evolution has proven to be the staff of NGOs and some innovative government agencies, whose interaction with villagers has encouraged improvisations, adaptations and new inventions (Chambers & Guijt, 1995). It is with this continuing evolution in mind that the research has been carried out and a framework developed in such a way that field staff and communities can mold it to fit each situation as the process of participatory development progresses, Extension agents should be seen in the process as catalysts, providers of initial small-scale funding and as a source of technical information or advice if required. Two-way communication between the extension agent and the development agency is also important and regular meetings/discussions should be built into work programmes where appropriate, especially if it is felt that some formal 'scientific' research is required to clarify some aspect(s) of the process of agricultural systems improvement.

The major limitation with the framework is that it only attempts to encourage greater community input at village/extension worker level. This will only be successful however, if field staff have full support from their senior officers, which requires a change in thinking throughout the hierarchies of relevant departments, not just at field level. Institutional changes are also needed so that the freedom and flexibility necessary for the success of such methods are introduced, and targets, progress reports and associated 'normal' professional indicators are not required. It is felt that this is something that needs to be approached at government level through the formation of new natural resource management policies, but the issue not been addressed during this thesis.

8.3.3 A framework for use by field staff in the development of appropriate farming technologies with rural communities.

The methodology suggested in this section is divided into 5 stages and is summarised in Figure 8.1. This division is more for ease of

STAGE 1

Getting to know the community.
Information collection - interactive exercise led by the community to outline major problems and gather information on tree and shrub use.

STAGE 2

Presentation of findings from research by community members.
Discussion of problems to be addressed.
Selection by the community of tree/shrub species for further study. Opinions should be obtained from different sectors of the community.
Information gathering for selected species - pool all knowledge about the species such as uses, growth patterns, germination potential and methods and frequency, to form a picture of each of the species.
Obtain missing data through establishment of trials or refer to data sources - eg. germination trials, coppicing and regrowth measurements.

STAGE 3

Most pro-active stage for field worker.
Introduction of agroforestry concepts to the community to include discussions of local agroforestry systems and some examples of other systems which could be adapted for the local environment.
Small groups to attempt to develop agroforestry systems/methods to combat some of the agricultural problems.
Set up community record keeping system - monitor through Stages 4 & 5.
Community meeting for discussion of suggested agroforestry technologies, and selection of those technologies to be tried.

STAGE 4

Implementation of new farming technologies - in-full or in-part as appropriate, field staff to be available for any technical advice requested and to make careful reports of farm trials.
Setting up and co-ordination of meetings between farmers and the rest of the community to share information from trials.

STAGE 5

Adoption of technologies by other farmers, and further adaption to suit individual needs.
Return to Stage 4 for development of technologies for groups whose needs have not yet been addressed.

Figure 8.1 Framework for use by field staff in the development of appropriate agroforestry technologies with rural communities.

documentation than as a rigid pattern that must be adhered to by extension workers. The stages act merely as a guide, and many of the activities outlined in the framework can be carried out in a different order than suggested, or simultaneously, according to decisions made by the communities and the field staff as projects progress. The role played by the field worker during each period of the project is critical to the effectiveness of the methodology, and as such is clearly defined for each stage. A handbook has been developed to explain the theory and methodology of the framework and for use by staff as the main tool in the field (**Appendix O**).

Stage 1

The first stage of the process is an introductory and learning stage. The extension staff need to take this opportunity to explain fully to the communities that although the project aims to reduce the effects of some of their most pressing agricultural problems, it is the villagers themselves who will guide the research and development of the improved agricultural/agroforestry technologies and who will make the major decisions throughout the implementation of the project. In most cases there is little capital available for investment in such projects, and this should be made clear and that there is therefore a need to develop ways of using locally available resources (ie. local materials, labour and knowledge/skills).

During this stage it may become evident that the community feels they have a problem far more pressing than that of reduced agricultural yields or increasing pressure for farmland. It is important that the extension agent listens to this problem and makes efforts to help the villagers at least start to develop a solution. In this way the community feels that the extension agent is listening to them and will be far more open to help in developing new farming systems later in the project. In many cases the extension agent will be required to act as an organiser so that any self-help efforts made by the village are carried out in the most efficient way possible and to act as a mediator between the community and other parties such as government departments or funding agencies. In the Ekuri Project outlined in 7.4.2, the WWF volunteer initially helped the community to set up fund raising and planning for a road from the village to the highway, that the villagers felt they needed most and, with one of the village leaders, acted as a spokesman to arrange for donations of capital and road building materials to the Project. Once the road project was underway, the community asked the volunteer to help them develop a plan for harvesting their forest in a sustainable manner, which was the reason the volunteer had been sent to the Ekuri villages initially. Due to the trust and confidence that the village had developed in the field worker, and the fact that the villagers themselves had specified what assistance they needed, the community was very receptive to all help that was offered, and training and initial stages of the forest management project have been approached with great enthusiasm and therefore success.

During the first stage of a project the aim should be to collect as much information about tree and shrub use by the community, and about farming systems and their accompanying problems. This should be carried out as a PRA exercise with villagers leading the data collection and deciding what points need to be analysed with respect to developing appropriate agroforestry or other technologies. It is important that this stage does not continue for too long, and that a summary of all the findings is made immediately afterwards at a village meeting so that the community sees activity in the project at the earliest possible opportunity. Emphasis should be placed on prioritising those problems that the community feels need addressing immediately.

Stage 2

Part of the presentation of the findings from stage 1 will be a list of those tree species used in the village. From this list, the community is asked to select those species which they feel may be useful in addressing some of their most pressing problems. It is important that during the selection of species, the opinions of all relevant groups within the community are considered, as different species will be important to different people and a combination of species with multiple uses will give wider scope in the development of agroforestry interventions. For example, males and females may place emphasis on different species, while old women may value medicinal trees for traditional remedies more than younger women who may prefer to use modern medicines.

Once species have been selected for closer evaluation, the community should be encouraged to pool all information they have on their uses, growth patterns, disadvantages, germination potential and methods, and frequency in farm, fallow and bush or forest land. In this way a set of information is prepared about each of the selected species which can then be used in evaluating their potential for use in modifying current agricultural systems.

The role of the extension agent at this point in the process should be primarily to make detailed notes throughout village discussions and to seek clarification of information where necessary. Once all information has been gathered, the extension agent can then take a more active role in guiding the development of a simple research programme to fill in any gaps there may be. For example, it may be necessary to suggest the establishment of simple germination/propagation trials for those species which are not already grown by farmers, and of which seedlings are not easily available in the wild; or to study transplanting methods for wildings of those which have good natural regeneration. Other information also deemed necessary for the selection of potentially useful species, such as coppicing ability and the compatibility of the woody species with local crops can be obtained through indigenous technical knowledge and small-scale trials carried out by the community.

Stage 3

The beginning of this stage is the point of the process at which the extension agent should take the most active role as ideas for addressing some of the farming problems using woody species are discussed with the community. Most farmers will already be making use of trees in many different ways, but the task of the field staff is to encourage the community to examine the wider potential of trees with respect to making use of them specifically to alleviate some of their farming problems. Initially discussions should cover local examples of agroforestry, and then other ways of using trees can be gradually introduced. This can be done by way of posters, slide shows, study visits to other areas, or by other extension methods thought by the villagers and the field worker to be appropriate.

Following this, initially in small groups and later with the community as a whole, attempts should be made to begin to develop appropriate agricultural innovations. The extension agent must be careful at this stage only to act as a facilitator, arranging meetings and ensuring that all social groups have an equal chance to express their opinions, rather than to suggest various agroforestry technologies that he/she feels are appropriate. In this way the solutions will be locally generated and will therefore be more likely to be adopted and tried by farmers of the community. It may be that a number of technologies are developed and that different groups wish to experiment with different interventions. It may also be that only one or two farmers are prepared to risk experimentation in the early stages, in which case they should be encouraged to share their experiences with the rest of the community as the research proceeds. Again the extension agent should act merely as a coordinator and recorder of the results of field trials, rather than imposing outsiders' views on the situation.

Stage 4

This is the implementation stage during which farmers begin to try out the chosen technologies in-full or in-part, and to modify them according to their individual needs. Field staff should be available to give any technical advice when requested, but should not offer opinions unless sought by the farmers. It may be felt during this or the preceding stage that data from 'scientific' research may improve the understanding of particular aspects of the technologies being developed. Here the role of the extension agent should be to act on the wishes of the community and express the need for information on specific problems to the development agency or government institution, in the hope that relevant literature or research back-up can be provided.

The extension agent should make careful reports of the progress of the various local field trials, and should be responsible for coordinating meetings during which farmers are able to report their findings. It is during this and the final stage that the extension agent should attempt to hand over record taking to some members of the community. Supervision may be needed initially, but it is important that the villagers develop their own system of record keeping, compatible to their own requirements and that does not need the presence of the extension agent in order to be successful.

Stage 5

Although this is the final stage of the framework, together with stage 4, it should continue beyond the time limit of particular projects. It is during this stage that technologies which have been tried and appear to be successful, are adopted by other farmers in that or neighbouring communities, and where these technologies will be further adapted to take account of the new users' needs. The extension agent should still be available as a source of technical advice if requested, and should also note in detail the developments and innovations that are taking place in farms around the community. If during this stage the field worker feels that the needs of a particular group within the community have not been addressed with the development of the agroforestry technologies, attempts should be made to go back to those groups and work more specifically with them to develop appropriate technologies for trial.

8.4 Concluding remarks

This concluding section is in two main parts. The first presents a set of conclusions to be drawn from Chapter 8 itself, and the second is a conclusion for the study as a whole, discussing in particular the practical applications of the work.

8.4.1 Conclusions for this chapter

- The main thrust of this thesis has been an examination of the move towards greater participation by local people in research and development projects in the South.

- There is a great deal of debate by development professionals on this subject, but as yet only small amounts of activity in this direction are evident.

- One of the problems which is slowing moves towards more 'farmer-led' approaches to development, is the difficulties encountered in retraining staff of NGOs and government institutions and departments, due in great part to lack of funding.

- A final product of this study has been the development of a framework for use by field staff as a training and development tool during attempts to address some of the land pressure problems being experienced in the study area and in many other regions.

8.4.2 Final conclusions

Some farmer participatory research approaches have only offered farmers the chance to participate in the agricultural scientists' research projects, rather than providing the opportunity for true collegial learning (Scoones & Thompson, 1994). It is hoped that this situation is avoided by the framework which has been developed. So that it is able to aid local people to create potential solutions to agricultural problems which are easily adopted by many members of a community, the following demands need to be met by the project:

a) A long-term commitment is required at the outset of any project so that extension staff know they have the time and resources to implement the framework successfully. This is often difficult in government departments where staff are re-posted at regular intervals. It is especially important that field staff are allowed to remain in the communities, or at least make frequent and regular visits, during stages 4 and 5 of the work, even though it may appear to non-field project staff that they are no longer useful. The process of technology development and adoption needs full attention for a long introductory period so that it has a chance to gain momentum and can be self-sustaining;
b) Field staff should have the right mind set in order that they approach the community as a friend and fellow pupil, rather than as a senior official and technical expert who will teach the villagers new technologies. It is hoped that they can be so bound up in the action that their influence is seen as part of an interactive and empowering process, described by Cornwall *et al.* (1994); and
c) The technologies need to be developed to address those problems which

are seen by the community, and not by project staff, as being the most pressing.

In reality the chance for long-term commitment to a project rarely occurs in Nigeria where the inability of the country to pursue a project or programme to its logical conclusion because of political instability is the bane of development projects and programmes (Olanrewaju & Falola, 1992). Therefore it is hoped that by empowering communities from the outset of a project to attempt to address problems using local resources, more chance will exist for the continuation of projects under their own momentum if a break or an end in project support from government institutions or development agencies occurs. Where government or other agency support is limited and unstable, the people should be able to take charge of their own development (Cabrera & Murillo, 1995).

Field workers from different agencies may be tempted to emphasise problems which they or their agencies feel are the most important, and to introduce technologies which they think will best achieve the aims of the agency. This may be, for example, greater food production for an agricultural development agency, or reduced forest clearance for a conservation department. However this should be avoided as far as possible with field staff making the best use of their skills, acting only as support while the communities lead the development process.

Recent studies by Leach & Fairhead (1994) in Guinea suggest that the premise on which many development projects of the region are based, is flawed and that, contrary to common belief, forest cover is managed and actively increased by communities. As a result, long-standing land-use policy is argued to be causing savanna vegetation to recolonise the area by criminalising actions of local communities, such as setting up fire breaks and intensively farming the areas around the villages, which have in the past maintained and increased forest cover. It is important to allow the voice of the local communities to be heard from the earliest stage in project development so that efforts are directed appropriately by them. In this way a working environment is created which has the potential to make full use of farmers' local knowledge and the valuable resource of indigenous tree or shrub species to develop farming systems which address the right problems in a way which is appropriate to both socio-economic and environmental conditions.

One problem which has lead to low adoption rates of agroforestry technologies is the generally high labour requirements for the effective management of these systems. If farmers develop technologies themselves then they are able to take such factors into account and will be more likely to produce systems which are both socio-economically and ecologically appropriate. For example, this study was able to show that *Dialium guineense* is a local species which may be useful in addressing some of the problems of shortened fallows and decreasing soil fertility experienced by many farmers in the region. Farmers can be encouraged to experiment with each technology, growing as few or as many trees as they feel comfortable with and fitting them into their farming systems as appropriate.

Hopefully the continuing debate amongst development professionals will eventually mean that agencies respond directly to local communities in this way, making it possible for farmers to react appropriately to local problems. In summary, therefore, this thesis has attempted to add to the debate by suggesting ways in which such community support and encouragement can be given through existing extension systems. Initially a discussion of past development efforts highlighted the areas where change is necessary, and a description of Nigeria's agriculture gave a background. Following this, an ethnobotanical survey in the two main study villages and the consequent choice of and germination and growth trials for four indigenous woody species, helped to illustrate the combination of formal research with local knowledge for effective community-led agricultural change. Finally the bringing together of the gathered information in community meetings and subsequent discussion of current extension practices in the study area, led to the development of a framework to aid future rural development programmes in the region.

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APPENDICES

Appendix A

List of species which appear in the text and tables of the thesis, and, where appropriate, their authorities.

Acacia leucophica (Roxb.) Willd.
Acacia niolotica (L.) Willd.
Acioa barteri Engl.
Adansonia digitata L.
Afzelia africana Sm.
Albizia adiantifolia (Schum.) W.F.Wight
Albizia glaberrima (Schum.& Thonn.) Benth.
Albizia schimperiana Oliv.
Albizia zygia (DC.) J.F.Macbr.
Alchornea cordifolia Schum.& Thonn.
Alstonia boonei De Wild.
Amaranthus caudatus L.
Anacardium occidentale L.
Ananas comosus (L.) Merrr.
Annona muricata L.
Anthocleista djalonesis A.Chev.
Arachis hypogaea L.
Artocarpus atilis (Parkinson) Fosberg
Artocarpus heterophyllus Lam.
Azadirachta indica A.Juss.
Baillonella toxisperma Pierre
Bambusa vulgaris Schrad. ex Mendel
Baphia nitida Lodd.
Barteria nigritana Hook.f.
Bombax ceiba L.
Brachystegia eurycoma Harms
Bridelia spp.
Cajanus cajan (L.) Millsp.
Calamus spp.
Calliandra calothyrsus Meissn.
Calpocalyx dinklagei Harms
Canarium schweinfurthii Engl.
Capsicum annum L.
Carica papaya L.
Carpolobia lutea G.Don
Cassia siamea Lam.
Ceiba pentandra (L.) Gaertn.
Chromolaena odorata L.
Citrus spp.
Cocos nucifera L.
Cola acuminata (P.Beauv.) Schott & Endl.
Cola lepidota K.Schum.
Cola nitida (Vent.) Schott & Endl.
Cola pachycarpa K.Schum.
Cola rostrata K.Schum.
Coula edulis Baill.
Crescentia cujete L.
Croton zambesicus Meull. Arg.
Cucumeropsis edulis Cogn.
Cucumis sativus L.
Curcurbita pepo L.
Cylicodiscus gabunensis Harms
Dacryodes edulis (G.Don) H.J.Lam.
Daniellia oliveri (Rolfe) Hutch.& Dalz.

Delonix regia (Hook.) Raf.
Dennettia tripetala Bak.f.
Dialium guineense Willd.
Dioscorea spp.
Diospyros mespiliformis Hochst ex A.DC.
Dracaena arborea (Willd.) Link
Elaeis guineensis Jacq.
Enanthia chlorantha Oliv.
Ficus exasperata Vahl
Funtumia africana (Benth.) Stapf
Funtumia elastica (Preuss) Stapf
Garcinia cola Heckel
Gliricidia sepium (Jacq.) Walp.
Glyphaea brevis (Spring.) Monachino
Gmelina arborea Roxb.
Gnetum africanum L.
Grevillia robusta Cunn.
Hallea spp.
Harungana madagascaiensis Lam. ex Poir.
Hevea brasiliensis (A.Juss) Meull.Arg.
Hibiscus esculentus L.
Hura crepitans L.
Hylodendron gabunensis Taub.
Imperata cylindrica (L.) Rausch.
Ipomoea batatas (L.) Lam.
Irvingia gabonensis (O'Rorke) Baill.
Khaya ivorensis A.Chev.
Klainedoxa gabonensis Engl.
Laccosperma spp.
Leucaena leucocephala (Lam.) De Wit.
Lophira alata Banks ex Gaertn.f.
Lovoa trichiliodes Harms
Lycopersicon esculentum Mill.
Manihot esculenta Crantz
Mangifera indica L.
Marantaceae
Margaritaria discordea (Baill.) Webster
Melia volkensii Gürke
Milicia excelsa (Welw.) Benth.
Momordica angustisepala Hutch & J.M.Dalz.
Morinda lucida Benth.
Musa paradisiaca L.
Musa sapientum L.
Musanga cecropoides R.Br.
Nauclia diderrichii (De Wild. & Th.Dur.) Merrill
Nauclia latifolia Sm.
Newboldia laevis (P.Beauv.) Seeman ex Bureau
Nypa fruticans Wurmb.
Oryza sativa L.
Parkia bicolor A.Chev.
Parkia biglobosa (Jacq.) Benth.
Pentaclethra macrophylla Benth.
Persea americana Mill.
Petersianthus macrocarpus (P.Beauv.) Liben
Pinus caribaea Morelet
Piper guineense Schum. & Thonn.
Piptadenestrum africanum (Hook.f.) Brenan
Plumeria rubra L.
Poga oleosa Pierre

Prosopis juliflora (Swartz) DC.
Psidium guajava L.
Pterocarpus mildbraedii Harms
Pterocarpus osun Craib
Pterocarpus sayauxii Taub.
Pycnanthus angolensis (Welw.) Warb
Randia spp.
Raphia hookeri Mann & Wendlend
Raphia sadamica A.Chev.
Ruavolfia vomitoria Afzel.
Ricinodendron heudelotii (Baill.) Heckel
Rhizophora spp.
Saccharum officinarum L.
Sclerocarya birrea (A.Rich.) Hochst.
Sesbania grandifolia (L.) Pers.
Sesbania macrantha Welw. ex Phill.& Hutch.
Shorea robusta Gaertn.f. Roxb.
Spondias mombin L.
Synsepalum dulcificum (Schum. & Thonn.) Daniell.
Syzygium malaccense L.Merr.& Perry
Talinum triangulare Willd.
Tectona grandis L.f.
Telfairia occidentalis Hook.f.
Terminalia catappa L.
Terminalia ivorensis A.Chev.
Terminalia superba Engl.& Diels.
Tetrapleura tetraptera (Schum. & Thonn.) Taub.
Theobroma cacao L.
Treculia africana Decne.
Trema orientalis (L.) Blume
Triplochiton scleroxylon K.Schum.
Uapaca heudelotii Baill.
Uvaria chamae P.Beauv.
Vernonia amygdalina Del.
Vitex doniana Sweet
Xanthosoma mafaffa Schott.
Ximeia caffra Sond.
Xylopia aethiopica (Dunal) A.Rich.
Xylopia quintasii Engl. & Diels
Zanthoxylum gilleti (De Wild.) Waterman
Zea mays L.

Appendix B

Schedule of fieldwork: April 1992 to December 1993

1992

APRIL		Fieldwork for CRNP in study area
JUNE		General field survey and village selection
JULY		Begin village survey work
	09 - 11	Igonigoni
	17 - 19	Abo Mkpang
AUGUST	03 - 05	Igonigoni
	10	Akwa Ibom Forest Department
	13 - 17	Abo Mkpang
	24 - 28	Igonigoni
SEPT	03 - 10	Preparation and running extension/agroforestry workshop for CRNP
	21 - 24	Abo Mkpang
	30	Igonigoni
OCT		Start of monthly tree measurements/observations
	01 - 02	Igonigoni
	07 - 08	Abo Mkpang
	19 - 22	Abo Mkpang
	27 - 28	Igonigoni
NOV	04	Obiokpok
	16 - 18	Abo Mkpang
	23	Igonigoni
	27	Obiokpok
DEC	09	Obiokpok
	14 - 15	Abo Mkpang
	18	Igonigoni

1993

JAN	05	Obiokpok
	14	Obiokpok
	19 - 21	Abo Mkpang
	26	Igonigoni
FEB	15 - 16	Abo Mkpang
	23 - 24	Igonigoni
MARCH	01 - 04	Obiokpok
	15 - 16	Abo Mkpang
	23 - 24	Igonigoni
APRIL	13 - 15	Abo Mkpang
	21	Igonigoni
	29	Obiokpok
MAY	11 - 13	Abo Mkpang
	21	Obiokpok
	26	Igonigoni

JUNE	02	Igonigoni
	15 - 16	Abo Mkpang
	17	Igonigoni
JULY	01	Obiokpok
	16	Obiokpok workshop
	20 - 21	Abo Mkpang
	22	Igonigoni
AUGUST	12 - 13	Abo Mkpang
	14	Igonigoni
SEPT	10	Obiokpok
	13	Igonigoni
	14 - 15	Abo Mkpang
OCT	01 - 04	Forest Department PRA Exercise
	18	Igonigoni
	19 - 20	Abo Mkpang
NOV	12 - 14	Abo Mkpang
	19 - 21	Igonigoni
DEC	01	Obiokpok
	10 - 13	Abo Mkpang
	17 - 19	Igonigoni

Appendix C

Checklist for village surveys: Abo Mkpang, Igonigoni and Obiokpok.

Name of family group..

No. of people in household..

Do you have a food crop farm?.....................................

What crops do you grow?...
....

What is the yield like?...

Is it the same, worse or better than before?......................

Do you have other farms: plantation, river?.......................

What do you grow there?...

What is the yield like?...

Is it the same, worse or better than before?......................

Who owns your farm land? Food farm.................................
Other.....................................

How do you get new farm land?.....................................
....

How often do you get new land?....................................

How long does the fallow last?....................................

Is this the same, shorter or longer than before?..................

How is the land: plenty or not much?..............................

Do you grow any crops next to the house?..........................

What do you grow?...
....

Do you do anything to keep the soil good?.........................

Do you have any livestock?..
....

What are the main problems you have?..............................
....
....
....

Are there any trees on your food crop farm?.......................

What are they?..
....
....

Which ones did you find there and which are planted?..............
FOUND:..
....
PLANTED:..
....

What is each kind used for?.......................................
....
....
....
....

Apart from the main crop (ie. oil palm, cocoa, etc.) are there any other trees on the plantation farm?..

What are they?..
....
....

Which ones did you find there and which are planted?...................
FOUND:..
....
PLANTED:..
....

What is each kind used for?...
....
....
....

Are there any trees near the house?.....................................

What are they?..
....
....

Which ones did you find there and which are planted?...................
FOUND:..
....
PLANTED:..
....

Are there any laws about planting trees?..............................
....
....
....

Are there any laws about collecting tree products?.....................
....
....
....

Do you use any other trees?...

What are they?..
....
....
....

What is each kind used for?...
....
....
....

Are they easy to find or scarce?..
....
....

Are any tree products becoming more difficult to find?.................
....
....

Do you sell any trees products?...

What do you sell?...
....
....

Where do you sell them/who to?..
....
....

For how much do you sell them?..
....
....

Appendix D

Data collection sheet for germination trials of *Dialium guineense*, *Ricinodendron heudelotii* and *Uvaria chamae*, carried out in Calabar, Cross River State, 1993.

Species:______________________ Treated/untreated

Seedling No.	Week 1	2	3	4	5	6	7	8	9	10	11
	(Height of seedling in cm)										

Appendix E

Form used for collecting monthly growth/observation data for the twenty-three trees of each of the four study species.

TREE RECORD FORM

Date____________________Village______________________________

Species______________________________Tree number______________

Location__________________________

Surrounding vegetation____

Topography____

Size [young/mature/seedling]____________________________________

Girth/height____

Crown status____________________Climbers______________________

Condition____

Habit____

Phenology____

Appendix F

Uses/descriptions, local names and botanical names of all trees cited in village surveys in Abo Mkpang and Igonigoni.

Abo Mkpang

Local name	Botanical name	Description/use
Kankpun	*Albizia zygia*	Leaves for soup
Boku	*Alstonia boonei*	Soil fertility, timber
Cashew	*Anacardium occidentale*	Cashew
Dogoyoro	*Azadirachta indica*	Malaria medicine
Bojie	*Baillonella toxisperma*	Mimosop-timber, seeds for oil and soup
Otang	*Bambusa vulgaris*	Stakes/poles
Nkom wan	*Barteria nigritana*	Home of stinging ants
Kekpuruk	*Brachystegia eurycoma*	Seeds for soup,soil fertility
Kachi bewong	*Bridelia* spp.	Soil fertility
Otion	*Calpocalyx dinklagei*	Medicine
Bushu basung	*Canarium schweinfurthii*	Scares witches
Kenkwalag	*Carica papaya*	Pawpaw fruit
Bukim	*Ceiba pentandra*	Cotton tree
Ntsokod	*Citrus* spp.	Orange, lime, etc.
Oku	*Cocos nucifera*	Coconut
Dibe	*Cola acuminata*	Kola nut
Abiase	*Cola lepidora*	Monkey kola
Kengpongkerong	*Cola pachycarpa*	Edible fruit
Kendim	*Cylicodiscus gabunensis*	Bark treat fever/cough
Bushu	*Dacryodes edulis*	Pear
Oshibin	*Diospyros mespiliformis*	Ebony timber
Bayep	*Elaeis guineensis*	Palm oil
Kakeleng	*Enantia chlorantha*	Quinine tree, fever
Kenkparak	*Eremospatha cecropoides*	Cane rope
	Ficus exasperata	Ringworm medicine
Nkwame	*Funtumia africana*	Used for pillow
Nkwame	*Funtumia elastica*	Latex
	Funtumia spp.	Carving wood
Ojie	*Garcinia kola*	Bitter kola
Gmelina	*Gmelina arborea*	Timber
Ntioreh	*Harungana madagascariensis*	Live stake
Kichi debed	*Hallea ciliata*	Timber
Kachi etare	*Hura crepitans*	Thunder tree
Boka	*Hylodenron gabunense*	Live stake
Bojep [Ogbono]	*Irvingia gabonensis*	Bush mango
Kekam	*Laccosperma secundiflorum*	Cane stick
Kabanikong	*Lophira alata*	Iron wood
Cedar	*Lovoa trichiliodes*	Timber
Buzip okagara	*Mangifera indica*	Mango fruit
Nsan	*Milicia excelsa*	Iroko
Eling	*Mormordica angustisepala*	Sponge
Kakobuk	*Morinda lucida*	Red wood, fever
Bukobe	*Musanga cecropioides*	Soil fertility

Nkare kichi	*Nauclea diderrichii*	Opepe timber
Nbendikum	*Newboldia laevis*	Live stake
Kakpaja	*Parkia bicolor*	Soil fertility, soup, timber
Kachi kabiam	*Parkia biglobosa*	Cough, timber, seasoning
Kennabe	*Pentaclethra macropylla*	African oil bean, soup
Bushu okagara	*Persea americana*	Avocado pear
Nnunung	*Petersianthus macrocarpus*	Timber
Onyio	*Poga oleosa*	Seeds eaten
Guava	*Psidium guajava*	Guava fruit
Buku	*Pterocarpus osun*	Camwood, latex used to slow labour
	Pterocarpus spp.	Timber, soup
Bucham	*Pycnanthus angolensis*	Soil fertility
Kizibhe	*Randia acuminata*	Chewing stick
Nstu	*Raphia hookeri*	Mats, palm wine
Katong	*Rauvolfia vomitoria*	Cold, cough
Bokpasi	*Ricinodendron heudelotii*	Seeds eaten & for oil, live stake, medicine
	Syzygium malacensis	Apple tree
Kenkange okagara	*Terminalia catappa*	Fruit, shade
Kenkange	*Terminalia ivorensis*	Mahogany [black]
Kenkange	*Terminalia superba*	Mahogany [white]
Four sides	*Tetrapleura tetraptera*	Soup, porridge
Cocoa	*Theobroma cacao*	Cocoa
Obeche	*Triplochiton scleroxylon*	Seeds, timber
Odang	*Uapaca heudelotii*	Wood & chewing stick
Bulonge	*Xylopia quintasii*	Medicine
Kachicham	*Zanthoxylum gilletii*	Tooth ache cure

Igonigoni

Local name	Botanical name	Description/use
Kuka	*Adansonia digitata*	Leaves for soup
Efem	*Alchornea cordifolia*	Live fence, snake bite medicine, coagulant
Biku	*Alstonia boonei*	Wood for facing board
Cashew	*Annacardium occidentale*	Cashew fruit and nut
Chop chop	*Annona muricata*	Soursop fruit
	Annona squamosa	Sweetsop fruit
Npununpun	*Anthocleista djalonensis*	Roots for fever
Dogoyoro	*Azadirachta indica*	Malaria medicine
Bamboo	*Bambusa vulgaris*	Yam stakes, markers, fire wood
Ebei	*Baphia nitida*	Medicine for rashes
Ohurie	*Baphia* spp.	Chewing stick, pound palm fruits for oil
Ekun	*Brachystegia eurycoma*	Leguminous tree
Rewar	*Canarium schweinfurthii*	Scares witches
Ngbiridi	*Carica papaya*	Pawpaw fruit
Owum	*Ceiba pentandra*	Cotton tree
Isokoro	*Citrus* spp.	Orange
Ehuarara	*Cocos nucifera*	Coconut

Rebo	*Cola acuminata*	Kola
Acharicha	*Cola rostrata*	Monkey kola
Upaharar	*Crescentia cujete*	Calabash
	Croton zambesicus	Thunder tree
Rayar	*Dacryodes edulis*	African pear
Ogba	*Daniellia oliveri*	Leaves eaten with yam
	Delonix regia	Flamboyant, decoration
Ehane	*Dialium guineense*	Seeds edible
Etong	*Dracaena arborea*	Boundary marker, yam barn
Bhode	*Elaeis guineensis*	Palm oil
Ogbo	*Ficus* spp.	Leaves for soup
Ekamu	*Garcinia cola*	Bitter kola
Bhunobhen	*Glyphaea brevis*	Chewing stick, leaves for soup
Gmelina	*Gmelina arborea*	Timber
	Hura crepitans	Thunder tree, shade
Bomeh	*Irvingia gabonensis*	Bush mango
Bumeraroy	*Klainedoxa gabonensis*	Timber
	Lophira alata	Iron wood
Mango	*Mangifera indica*	Mango fruit
Orki	*Milicia excelsa*	Iroko
Ebhori	*Musanga cecropioides*	Soil fertility
Enojune	*Nauclea latifolia*	Lvs & roots for fever
Ngugu	*Parkia bicolor*	Soil fetility, soup
Emmam	*Pentaclethra macrophylla*	African oil bean
	Plumeria rubra	Frangipani, decoration
Guava	*Psidium guajava*	Guava
Oko	*Pterocarpus mildbraedii*	Leaves for soup
Bhose	*Pterocarpus osun*	Camwood, leaves soup
Etorakpa	*Pterocarpus santalinoides*	Leaves for soup
Roffah	*Raphia hookeri*	Thatch, palm wine
Itong	*Raphia sundanica*	Thatch
Ehirihar	*Spondias mombin*	Live stake, fruit, leaves treat cough
Apple	*Syzygium malacensis*	Fruit
Almond	*Terminalia catappa*	Shade, fruit
Odom	*Terminalia ivorensis*	Mahogany timber
Epine ise	*Terminalia superba*	Mahogany timber
Cocoa	*Theobroma cacao*	Cocoa
	Triplochiton scleroxylon	Soup
Roverizoi	*Uvaria chamae*	Fruit, chewing stick, Roots & lvs for fever
Opia	*Vitex doniana*	Edible leaves

Appendix G

Ranking of woody species according to the number of times each was mentioned in Abo Mkpang and Igonigoni.

TREE SPECIES	NUMBER OF TIMES MENTIONED Abo Mkpang Number	Abo Mkpang Rank	Igonigoni Number	Igonigoni Rank	Total Number	Total Rank
Adansonia digitata			5	18=	5	33=
Albizia zygia	8	24=			8	30=
Alchornea cordifolia			5	18=	5	33=
Alstonia boonei	10	22=	6	17=	16	23=
Anacardium occidentale	25	14	14	10=	39	15
Annona muricata			4	19=	4	34=
Annona squamosa			1	22=	1	37=
Anthocleista djalonensis			6	17=	6	32=
Azadirachta indica	4	28=	5	18=	9	29=
Baillonella toxisperma	42	8			42	13
Bambusa vulgaris	2	30=	26	7=	28	19=
Baphia nitida			9	15=	9	29=
Baphia spp.			10	14=	10	28=
Barteria nigritana	1	31=			1	37=
Brachystegia eurycoma	27	13=	1	22=	28	19=
Bridelia spp.	1	31=			1	37=
Calpocalyx dinklagei	2	30=			2	36=
Canarium schweinfurthii	3	29=	2	21=	5	33=
Carica papaya	7	25=	13	11=	20	21=
Ceiba pentandra	29	11=	3	20=	32	16
Citrus spp.	89	2	71	1	160	1
Cocos nucifera	19	17=	31	6	50	11
Cola acuminata	70	5	11	13	81	6
Cola lepidora	11	21			11	27
Cola pachycarpa	6	26=			6	32=
Cola rostrata			2	21=	2	36=
Crescentia cujete			2	21=	2	36=
Croton zambesicus			1	22=	1	37=
Cylicodiscus gabunensis	10	22=			10	28=
Dacryodes edulis	96	1	26	7=	122	2
Daniellia oliveri			5	18=	5	33=
Delonix regia			3	20=	3	35=
Dialium guineense			43	4	43	12
Diospyros mespiliformis	4	28=			4	34=
Dracaena arborea			2	21=	2	36=
Elaeis guineensis	29	11=	60	2	89	5
Enantia chlorantha	8	24=			8	30=
Eremospatha cecropoides	3	29=			3	35=
Ficus spp.	1	31=	1	22=	2	36=
Funtumia spp.	3	29=			3	35=
Garcinia cola	14	19	2	21=	16	23=

TREE SPECIES	Abo Mkpang Number	Rank	Igonigoni Number	Rank	Total Number	Rank
Glyphea brevis			1	22=	1	37=
Gmelina arborea	1	31=	3	20=	4	34=
Hallea ciliata	4	28=			4	34=
Harungana madagascariensis	2	30=			2	36=
Hura crepitans	1	31=	6	17=	7	31
Hylodendron gabunense	10	22=			10	28=
Irvingia gabonensis	85	3	33	5	118	4
Klainedoxa gabonensis			3	20=	3	35=
Laccosperma secundiflorum	1	31=			1	37=
Lophira alata	13	20	3	20=	16	23=
Lovoa trichiliodes	2	30=			2	36=
Mangifera indica	72	4	47	3=	119	3
Milicia excelsa	52	6=	23	9	75	7
Momordica angustisepala	4	28=			4	34=
Morinda lucida	2	30=			2	36=
Musanga cecropoides	8	24=	1	22=	9	29=
Nauclea diderrichii	19	17=			19	22=
Nauclea latifolia			5	18=	5	33=
Newboldia laevis	1	31=			1	37=
Parkia bicolor	27	13=	2	21=	29	18
Parkia biglobosa	20	16			20	21=
Pentaclethra macropylla	5	27=	10	14=	15	24=
Persea americana	30	10			30	17
Petersianthus macrocarpus	4	28=			4	34=
Plumeria rubra			1	22=	1	37=
Poga oleosa	9	23=			9	29=
Psidium guajava	24	15	47	3=	71	8
Pterocarpus mildbraedii			26	7=	26	20
Pterocarpus osun	28	12	24	8	52	10=
Pterocarpus santalinoides			4	19=	4	34=
Pterocarpus soyauxii	3	29=			3	35=
Pterocarpus spp.	3	29=			3	35=
Pycnanthus angolensis	15	18			15	24=
Randia acuminata	6	26=			6	32=
Raphia hookeri	3	29=	12	12	15	24=
Raphia sudanica			13	11=	13	26
Rauvolfia vomitoria	1	31=			1	37=
Ricinodendron heudelotii	9	23=			9	29=
Spondias mombin			8	16	8	30=
Syzygium malacensis	7	25=	3	20=	10	28=
Terminalia catappa	3	29=	2	21=	5	33=
Terminalia ivorensis	52	6=	13	11=	65	9
Terminalia superba	49	7	3	20=	52	10=
Tetrapleura teraptera	2	30=			2	36=
Theobroma cacao	38	9	3	20=	41	14
Triplochiton scleroxylon	1	31=	1	22=	2	36=
Uapaca heudelotii	1	31=			1	37=
Uvaria chamae			9	15=	9	29=
Vitex doniana			14	10=	14	25
Xylopia quintasii	5	27=			5	33=
Zanthoxylum gilletii	1	31=			1	37=

Appendix H

Locations of trees mentioned during village surveys, and the number of times each species was mentioned for each location.

ABO MKPANG

Species	House	Farm	Plantation	Forest	Total
Albizia zygia	-	5	1	2	8
Alstonia boonei	-	4	6	-	10
Anacardium occidentale	14	8	3	-	25
Azadirachta indica	2	1	1	-	4
Baillonella toxisperma	-	13	12	17	42
Bambusa vulgaris	-	-	-	2	2
Barteria nigritana	-	-	1	-	1
Brachystegia eurycoma	-	6	15	6	27
Bridelia spp.	-	1	-	-	1
Calpocalyx dinklagei	-	-	1	1	2
Canarium schweinfurthii	-	2	1	-	3
Carica papaya	7	-	-	-	7
Ceiba pentandra	-	16	13	-	29
Citrus spp.	37	30	22	-	89
Cocos nucifera	14	1	4	-	19
Cola acuminata	25	25	20	-	70
Cola lepidora	-	-	2	9	11
Cola pachycarpa	-	-	2	4	6
Cylicodiscus gabunensis	-	2	3	5	10
Dacryodes edulis	27	40	29	-	96
Diospyros mespiliformis	-	1	2	1	4
Elaeis guineensis	6	14	6	3	29
Enantia chlorantha	-	1	3	4	8
Eremospatha hookerii	-	-	-	3	3
Ficus exasperata	-	1	-	-	1
Funtumia spp.	-	1	2	-	3
Garcinia kola	-	6	2	6	14
Gmelina arborea	-	1	-	-	1
Harungana madagascariensis	-	2	-	-	2
Hellea ciliata	-	2	2	-	4
Hura crepitans	1	-	-	-	1
Hylodendron gabunense	-	2	8	-	10
Irvingia gabonensis	5	28	25	27	85
Laccosperma secundiflorum	-	-	-	1	1
Lophira alata	-	1	11	1	13
Lovoa trichilioides	-	1	-	1	2
Magnifera indica	34	21	17	-	72
Milicia excelsa	-	26	20	6	52
Momordica angustisepala	-	-	-	4	4
Morinda lucida	-	-	-	2	2
Musanga cecropioides	-	5	3	-	8
Nauclea diderrichii	-	7	9	3	19
Newboldia laevis	-	1	-	-	1
Parkia bicolor	-	11	16	-	27
Parkia biglobosa	-	9	11	-	20
Pentaclathra macrophylla	-	1	2	2	5

	House	Farm	Plantation	Forest	Total
Persea americana	13	10	7	-	30
Petersianthus macrocarpus	-	1	3	-	4
Poga oleosa	-	-	3	6	9
Psidium guajava	13	9	2	-	24
Pterocarpus osun	-	14	9	5	28
Pterocarpus spp.	-	2	-	1	3
Pycnanthus angolensis		5	10	-	15
Randia accuminata		-	1	5	6
Raphia hookeri		2	-	1	3
Rauvolfia vomitoria	-	1	-	-	1
Ricinodendron heudelotii	-	2	3	4	9
Syzygium malacensis	2	3	2	-	7
Terminalia catappa	3	-	-	-	3
Terminalia ivorensis	-	21	27	4	52
Terminalia superba	-	19	25	5	49
Tetrapleura tetraptera	-	1	-	1	2
Theobroma cacao	1	-	37	-	38
Triplochiton scleroxylon	-	-	1	-	1
Uapaca heudelotii	-	-	1	-	1
Xylopia quintasii	-	1	4	-	5
Zanthoxylum gilletii	-	-	1	-	1

IGONIGONI

Species	House	Farm	Plantation	Bush	Total
Adansonia digitata	4	-	-	1	5
Alchornea cordifolia	-	2	-	3	5
Alstonia boonei	-	1	4	1	6
Anacardium occidentale	2	7	5	-	14
Annona muricata	3	-	1	-	4
Annona squamosa	1	-	-	-	1
Anthocleista djalonensis	-	2	2	2	6
Azadirachta indica	3	2	-	-	5
Bambusa vulgaris	-	20	-	6	26
Baphia nitida	3	5	1	-	9
Baphia spp.	-	7	-	3	10
Brachystegia eurycoma	-	-	1	-	1
Canarium schweinfurthii	-	-	2	-	2
Carica papaya	13	-	-	-	13
Ceiba pentandra	1	-	1	1	3
Citrus spp.	52	14	5	-	71
Cocos nucifera	26	-	5	-	31
Cola acuminata	2	1	4	4	11
Cola rostrata	-	1	1	-	2
Crescetia cujete	1	-	1	-	2
Croton zambesicus	1	-	-	-	1
Dacryodes edulis	11	3	8	4	26
Daniellia oliveri	-	3	-	2	5
Delonix regia		3	-	-	3
Dialium guineense	-	26	1	16	43
Dracaena arborea	-	1	1	-	2
Elaeis guineensis	1	32	16	11	60
Ficus spp.	1	-	-	-	1

	House	Farm	Plantation	Bush	Total
Garcinia kola	1	1	-	-	2
Glyphaea brevis	-	-	1	-	1
Gmelina arborea	-	3	-	-	3
Hura crepitans	6	-	-	-	6
Irvingia gabonensis	1	7	9	16	33
Klainedoxa gabonensis	-	-	2	1	3
Lophira alata	-	1	1	1	3
Magnifera indica	35	7	5	-	47
Milicia excelsa	-	8	9	6	23
Musanga cecropioides	-	-	1	-	1
Nauclea latifolia	-	2	1	2	5
Parkia bicolor	-	2	-	-	2
Pentaclathra macrophylla	-	6	1	3	10
Plumeria rubra	1	-	-	-	1
Psidium guajava	38	6	3	-	47
Pterocarpus mildbraedii	22	3	1	-	26
Pterocarpus osun	3	6	5	10	24
Pterocarpus santalinoides	1	-	1	2	4
Raphia hookeri	-	1	7	4	12
Raphia sudanica	-	-	9	4	13
Spondias mombin	3	3	2	-	8
Syzygium malacensis	3	-	-	-	3
Terminalia catappa	2	-	-	-	2
Terminalia ivorensis	-	3	4	6	13
Terminalia superba	-	-	1	2	3
Theobroma cacao	-	-	3	-	3
Triplochiton scleroxylon	-	1	-	-	1
Uvaria chamae	-	4	-	5	9
Vitex doniana	-	4	1	9	14

Appendix I

Species in Timber Tariff Classes 1 & 2

Timber group 1

Baillonella toxisperma
Brachystegia spp.
Diospyros spp.
Entandrophragma spp.
Khaya spp.
Lovoa trichilioides
Milicia excelsa
Nauclea diderrichii
Piptadeniastrum africanum
Poga oleosa
Pterocarpus osun
Terminalia ivorensis

Timber group 2

Afzelia spp.
Albizia spp.
Antiaris toxicaria
Daniellia ogea
Garcinia spp.
Gossweilerodendron spp.
Guarea cedrata
Guarea thompsonii
Holoptelea grandis
Lophira alata
Parkia spp.
Pentaclethra macrophylla
Pterygota spp.
Tetrapleura tetraptera
Triplochiton scleroxylon

(Cross River State Forestry Department, 1993)

Appendix J

Tree species mentioned during village surveys as being present in homegardens in Obiokpok (source: own data 1992-1993).

Species	Common Name	Use
Annona muricata	Soursop	Fruit
Artocarpus altilis	Breadfruit	Fruit
Artocarpus heterophyllus	Jack fruit	Fruit
Azadirachta indica	Neem	Medicine(fever)
Baillonella toxisperma	Mimosop	Oil,soup,timber
Bambusa vulgaris	Bamboo	Poles
Carica papaya	Pawpaw	Fruit
Chrysophyllum albidum	Udara	Fruit
Citrus spp.	Orange,tangerine,lime	Fruit,medicine
Cocos nucifera	Coconut	Fruit
Cola nitida	Kola	Chewing
Cola rostrata	Monkey kola	Fruit
Coula edulis	African walnut	Fruit
Croton zambesicus	Thunder tree	Lightening conducter
Dacryodes edulis	African pear	Fruit
Dennettia tripetala	Nkarika	Fruit
Elaeis guineensis	Oil palm	Oil,palm wine,thatch
Garcinia cola	Bitter kola	Chewing
Hura crepitans	Thunder tree	Lightening,shade
Irvingia gabonensis	Bush mango	Fruit,soup
Mangifera indica	Mango	Fruit
Milicia excelsa	Iroko	Timber
Musanga cecropoides	Umberella tree	Soil fertility
Pentaclethra macrophylla	African oil bean	Oil,soup
Persea americana	Avocado	Fruit
Plumeria rubra	Frangipani	Amenity
Psidium guajava	Guava	Fruit
Raphia hookeri	Raphia palm	Palm wine,thatch
Spondias mombin	Hog plum	Fruit,yam stake
Synsepalum dulcificum	Miracle berry	Fruit
Syzygium spp.	African apple	Fruit
Tetrapleura tetraptera	4 sides	Soup
Theobroma cacao	Cocoa	Fruit,beverage
Treculia africana	African breadfruit	Fruit

Appendix K

Sheet used in the field to record monthly botanical data for each study tree.

TREE RECORD SHEET

Species:________________ Tree No.:________________

	VEG	TOPO	AGE	GIRTH/ HEIGHT	CROWN STATUS	CLIMB	CONDIT	HABIT	PHENO
SEPT									
OCT									
NOV									
DEC									
JAN									
FEB									
MARCH									
APRIL									
MAY									
JUNE									
JULY									
AUG									
SEPT									

COMMENTS________________________________

Appendix L

List of slides shown during participatory village meetings
(All slides are taken in Nigeria unless otherwise stated.)

Showing that many people already have trees on their farms:

1) *Dialium guineense* on cassava farm.
2) *Ricinodendron heudelotii* on a farm.

Most people also have trees on their fallow land:

3) *Albizia zygia* as part of secondary regrowth on a fallow plot (Ghana).

People know that some trees are good for the soil:

4) *Musanga cecropioides* (Umberella tree).

And some trees are useful for other things:

5) Shade - *Terminalia catappa.*
6) Oil - *Elaeis guineensis* (oil palm).
7) Fruit - *Dacryodes edulis* (African pear).

Trees are used in farming - when the farm is first cleared, the trees are burnt to put ash in the soil to make it fertile:

8) Burnt farm plot (Ghana).

But there are many other ways to use trees to help the farm be bettter. Trees can be used to make the soil good by cutting the leaves off and keeping them on the soil as mulch or green manure:

9) Trees can be planted in hedgerows like this picture (Ghana), but you can plant them anywhere in the field, or just leave the trees where they come up naturally, and use the leaves from them:

10) Trees you do this with should be ones that grow back again fast when they are cut (*Gliricidia sepium* - Ghana).

11) Or even grow back after being burnt (*Dialium guineense*).

Trees can be used as yam stakes on the farm, and if they are left alive you don't have to cut new poles each year:

12) *Ricinodendron heudelotii* as a live yam stake.
13) *Mangifera indica* (mango) as a live yam stake.

14) Trees can be planted to make a fence to keep animals out of the farm or to slow down soil erosion (*Jatropha curcus* - Ghana).

15) Trees can also be used to fence animals in (*Pithecellobium dulce* - Sri Lanka).

16) And the leaves of some trees can be used to feed animals in a "cut and carry" system (*Leucaena leucocephala*).

Appendix M

Extracts from the Strategic Management Plan for the forestry sub-sector and related resources of Cross River State (Cobham, 1994).

1.22 The main objectives include, the need to:

* improve resource stocks and annual outputs;
* achieve a distribution of forest benefits and responsibilities, which help to unify rather than divide the interests of stake-holders in sustainably managing the Forest Estate;
* devise appropriate policies, supporting measures, programmes and projects for implmenetation of the Strategy;
* strengthen all public and private sector organizations, NGOs and community organizations involved in the management of the Forest Estate;
* encourage the protection and management of forests in all identified scenic and fragile (erosion and environmental disaster prone) areas of the Forest Estate.

1.23 It is intended that these main objectives shall be achieved through observing the following operating principles:

* close participation of local committees, representing local communities in the management of the Forest Estate;
* allocation and payment of rewards to the Forestry Department, local communities, Chain-saw operators and concessionaires in accordance with agreed management plans;
* use of the most effective techniques for management and restoration of the Forest Estate;
* co-operation and regular liaison to enable all main stake-holders to contribute towards achieving sustainable management of the total Forest Estate, both within and outside Cross River National Park.

3.32 The fourth and final programme relates to the measures proposed for Community or Local Forests. These involve:

* the development of agroforestry systems to relieve pressures on the THF Reserves, the CRNP and the Community Forests;

* the encouragement and improvement of "traditional" agroforestry practices through research and development;

* the participation of Local Communities and individuals in establishing and owning small plantations of Irvingia, Mahogany etc;

* the establishment of pilot agroforestry plots on strategically located farms within the State for demonstration purposes in all Local Government Areas;

* the investigation and propagation of appropriate, exiisting multi-purpose trees for interested

Community Participation

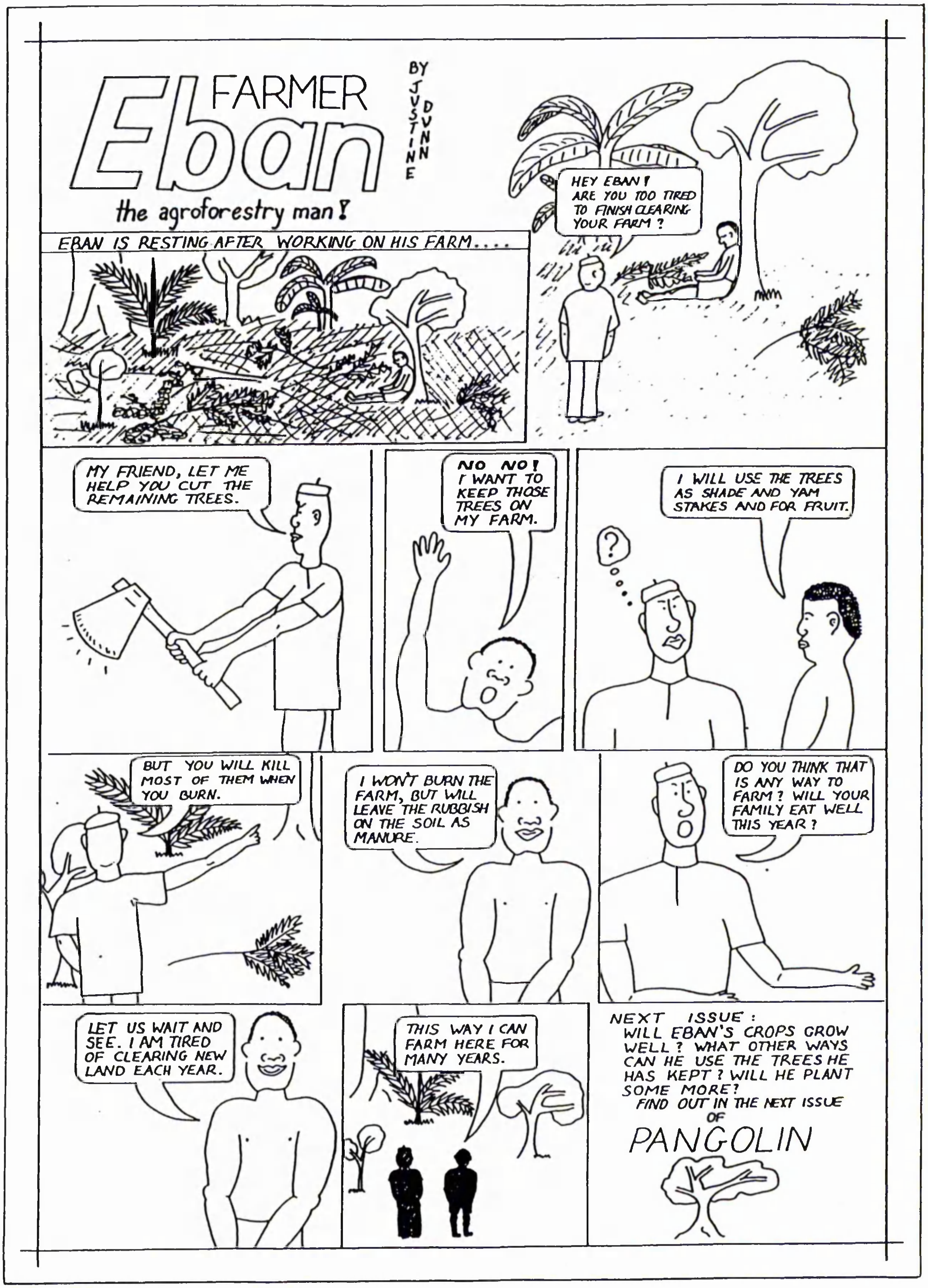
3.14 The involvement of communities in forest management will be sought through the provision of grants, prizes, tax concessions and annual rewards/incentives to encourage them. The Forestry Development Department will substantially assist local communities that desire to manage their Community Forest sustainably, to do so. This will be done through dialogue, training material and the provision of technical expertise to the community. Appropriate penalties shall be imposed on communities that do not adopt a sustainable management method.

Institutional Strengthening

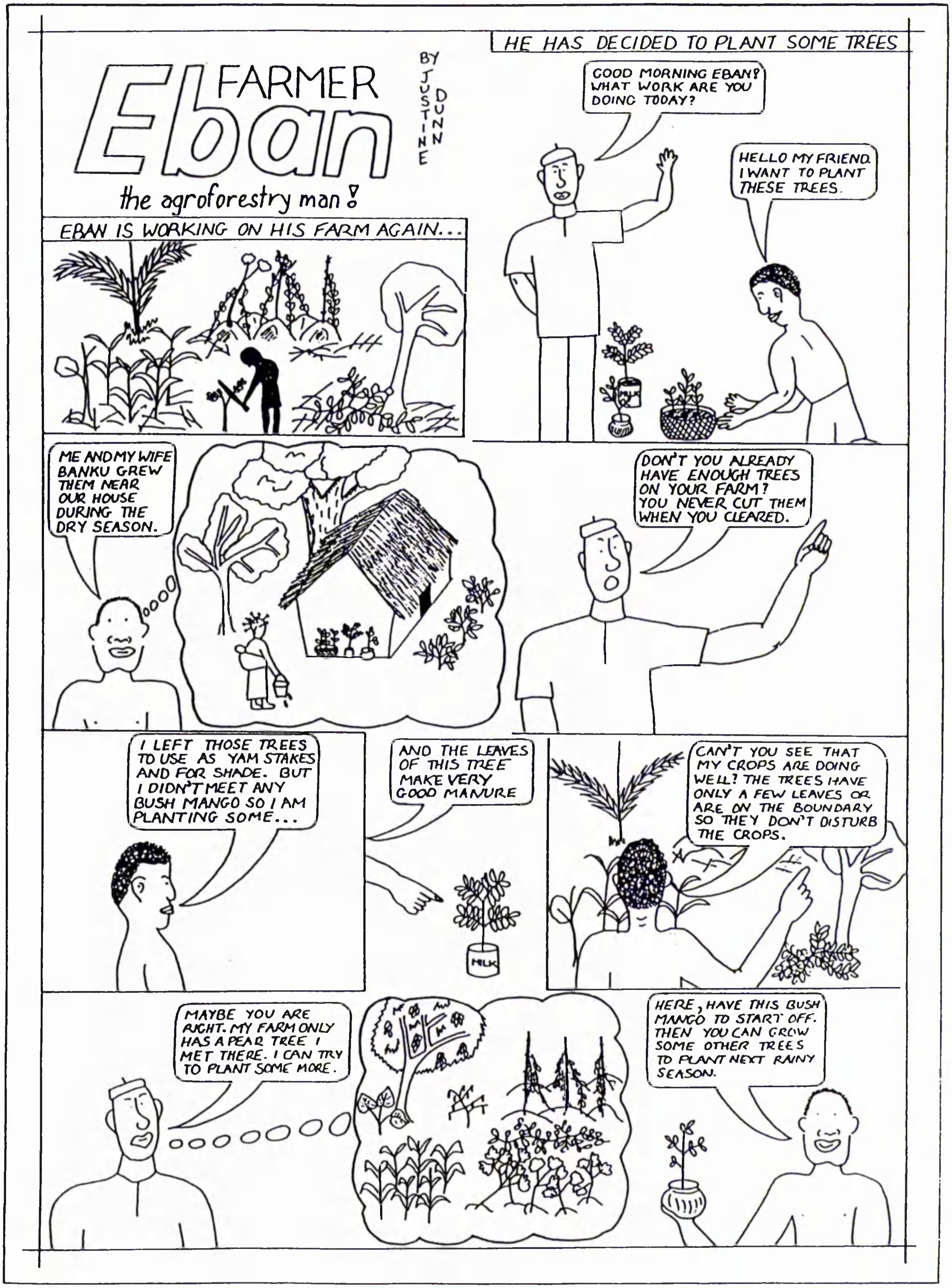
3.15 A strong two-way flow of information will be adopted whilst liaising with the public sector, NGOs, local communities, private sector management companies, concessionaires, processing and marketing businesses. In addition the linkages will be maintained both with and between stake-holders responsible for logging, processing, extension and co-operative trading activities. Each of these stakeholder groups, with which the FDD needs to work towards achieving sustainable use and management of the Forest Estate, will be strengthened, adequately advised and supervised. Particularly important amongst these groups are the Community Co-operatives and all of the Departments within the Ministry of Agriculture.

Appendix N

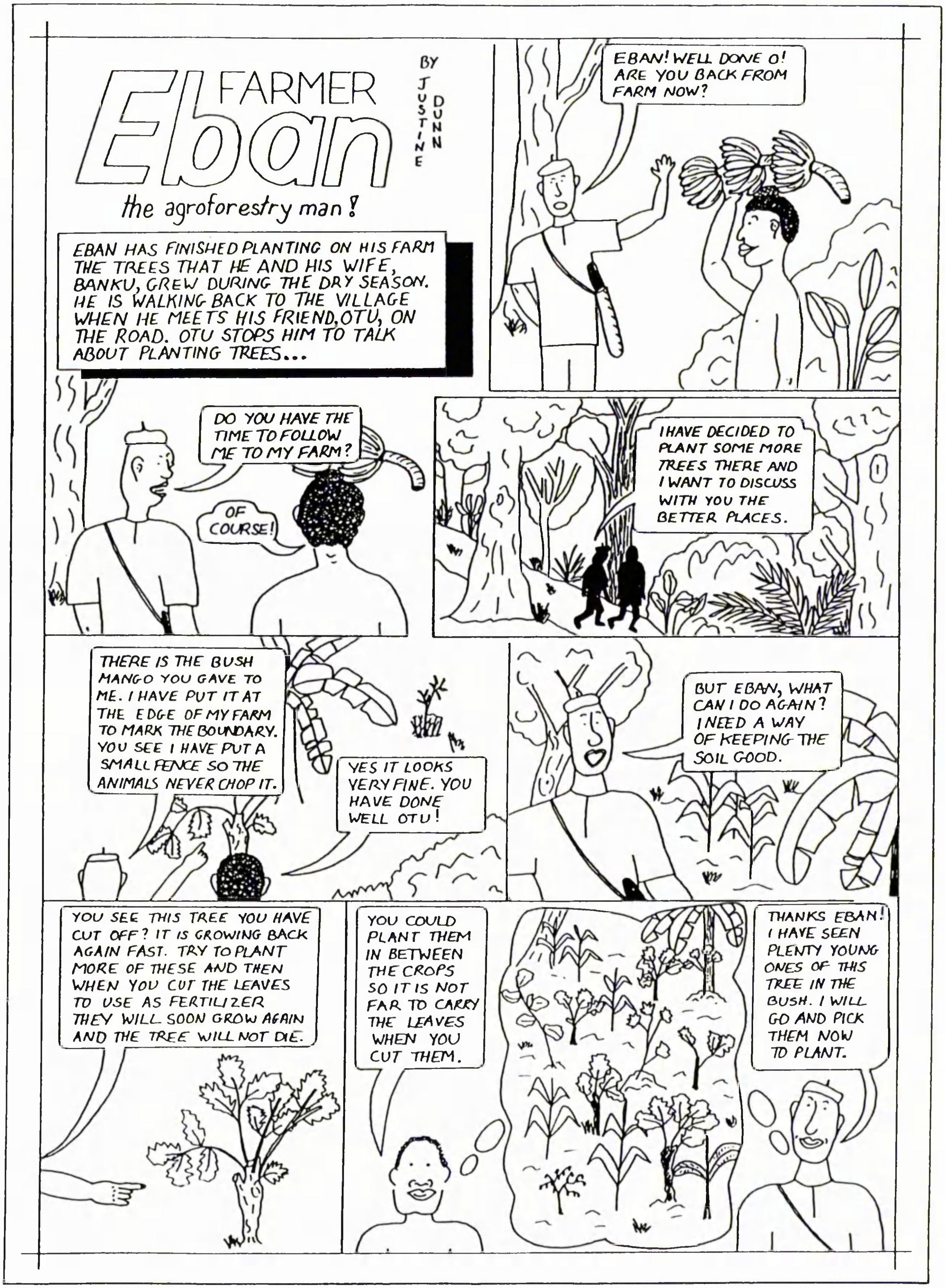
Examples of regular contributions by the author to *Pangolin*, the CRNP magazine, distributed free of charge to Support Zone villages.



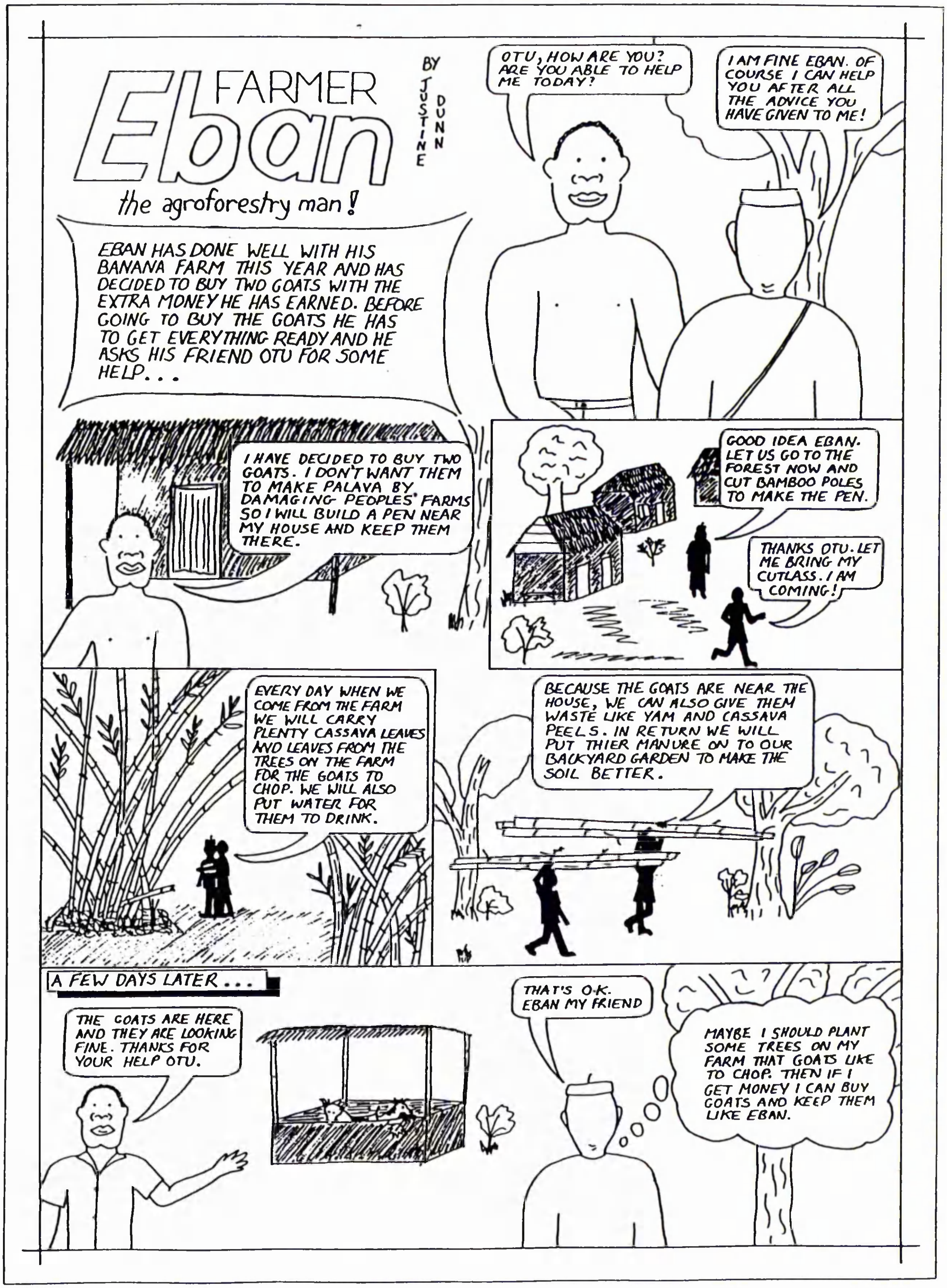
Appendix N


FARMER
Eban
the agroforestry man!
BY JUSTINE DUNN
EBAN IS WORKING ON HIS FARM AGAIN...
HE HAS DECIDED TO PLANT SOME TREES
GOOD MORNING EBAN? WHAT WORK ARE YOU DOING TODAY?
HELLO MY FRIEND. I WANT TO PLANT THESE TREES.
MILK
ME AND MY WIFE BANKU GREW THEM NEAR OUR HOUSE DURING THE DRY SEASON.
DON'T YOU ALREADY HAVE ENOUGH TREES ON YOUR FARM? YOU NEVER CUT THEM WHEN YOU CLEARED.
I LEFT THOSE TREES TO USE AS YAM STAKES AND FOR SHADE. BUT I DIDN'T MEET ANY BUSH MANGO SO I AM PLANTING SOME...
AND THE LEAVES OF THIS TREE MAKE VERY GOOD MANURE
MILK
CAN'T YOU SEE THAT MY CROPS ARE DOING WELL? THE TREES HAVE ONLY A FEW LEAVES OR ARE ON THE BOUNDARY SO THEY DON'T DISTURB THE CROPS.
MAYBE YOU ARE RIGHT. MY FARM ONLY HAS A PEAR TREE I MET THERE. I CAN TRY TO PLANT SOME MORE.
HERE, HAVE THIS BUSH MANGO TO START OFF. THEN YOU CAN GROW SOME OTHER TREES TO PLANT NEXT RAINY SEASON.

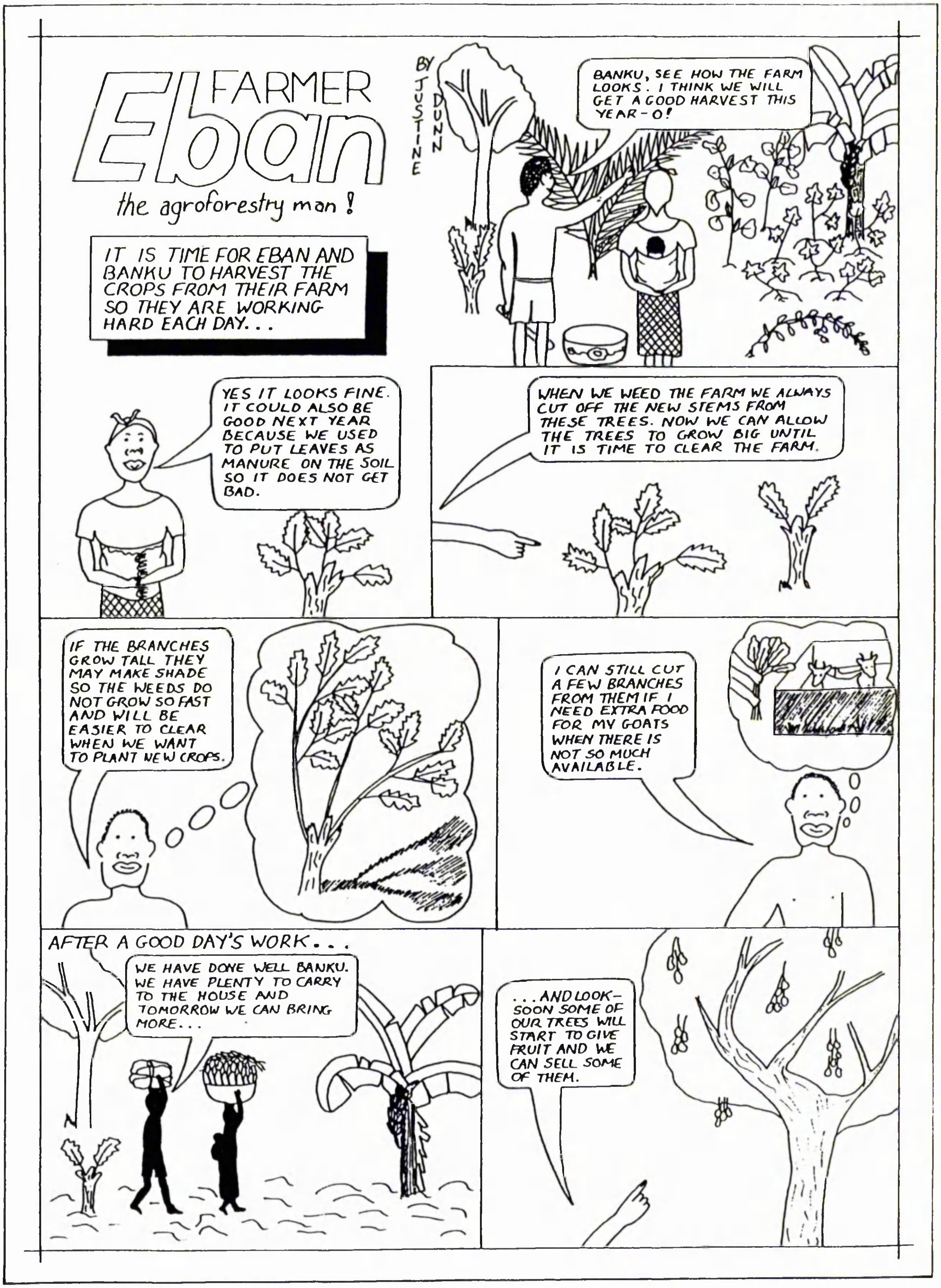
Appendix N


FARMER
Eban
BY JUSTINE DUNN
the agroforestry man!
EBAN HAS FINISHED PLANTING ON HIS FARM THE TREES THAT HE AND HIS WIFE, BANKU, GREW DURING THE DRY SEASON. HE IS WALKING BACK TO THE VILLAGE WHEN HE MEETS HIS FRIEND, OTU, ON THE ROAD. OTU STOPS HIM TO TALK ABOUT PLANTING TREES...
EBAN! WELL DONE O! ARE YOU BACK FROM FARM NOW?
DO YOU HAVE THE TIME TO FOLLOW ME TO MY FARM?
OF COURSE!
I HAVE DECIDED TO PLANT SOME MORE TREES THERE AND I WANT TO DISCUSS WITH YOU THE BETTER PLACES.
THERE IS THE BUSH MANGO YOU GAVE TO ME. I HAVE PUT IT AT THE EDGE OF MY FARM TO MARK THE BOUNDARY. YOU SEE I HAVE PUT A SMALL FENCE SO THE ANIMALS NEVER CHOP IT.
YES IT LOOKS VERY FINE. YOU HAVE DONE WELL OTU!
BUT EBAN, WHAT CAN I DO AGAIN? I NEED A WAY OF KEEPING THE SOIL GOOD.
YOU SEE THIS TREE YOU HAVE CUT OFF? IT IS GROWING BACK AGAIN FAST. TRY TO PLANT MORE OF THESE AND THEN WHEN YOU CUT THE LEAVES TO USE AS FERTILIZER THEY WILL SOON GROW AGAIN AND THE TREE WILL NOT DIE.
YOU COULD PLANT THEM IN BETWEEN THE CROPS SO IT IS NOT FAR TO CARRY THE LEAVES WHEN YOU CUT THEM.
THANKS EBAN! I HAVE SEEN PLENTY YOUNG ONES OF THIS TREE IN THE BUSH. I WILL GO AND PICK THEM NOW TO PLANT.

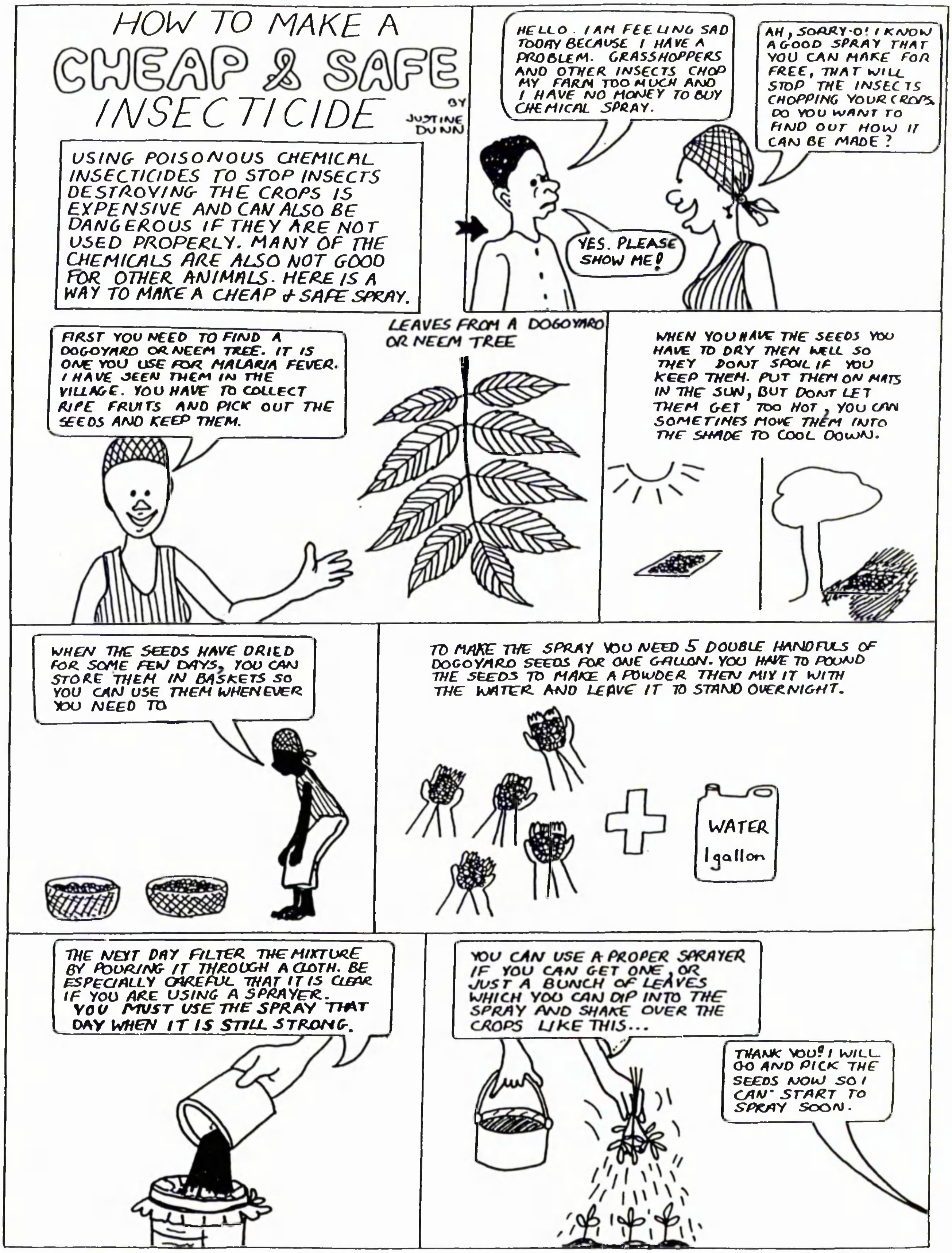
Appendix N


FARMER
Eban
BY JUSTINE DUNN
the agroforestry man!
EBAN HAS DONE WELL WITH HIS BANANA FARM THIS YEAR AND HAS DECIDED TO BUY TWO GOATS WITH THE EXTRA MONEY HE HAS EARNED. BEFORE GOING TO BUY THE GOATS HE HAS TO GET EVERYTHING READY AND HE ASKS HIS FRIEND OTU FOR SOME HELP...
OTU, HOW ARE YOU? ARE YOU ABLE TO HELP ME TODAY?
I AM FINE EBAN. OF COURSE I CAN HELP YOU AFTER ALL THE ADVICE YOU HAVE GIVEN TO ME!
I HAVE DECIDED TO BUY TWO GOATS. I DON'T WANT THEM TO MAKE PALAVA BY DAMAGING PEOPLES' FARMS SO I WILL BUILD A PEN NEAR MY HOUSE AND KEEP THEM THERE.
GOOD IDEA EBAN. LET US GO TO THE FOREST NOW AND CUT BAMBOO POLES TO MAKE THE PEN.
THANKS OTU. LET ME BRING MY CUTLASS. I AM COMING!
EVERY DAY WHEN WE COME FROM THE FARM WE WILL CARRY PLENTY CASSAVA LEAVES AND LEAVES FROM THE TREES ON THE FARM FOR THE GOATS TO CHOP. WE WILL ALSO PUT WATER FOR THEM TO DRINK.
BECAUSE THE GOATS ARE NEAR THE HOUSE, WE CAN ALSO GIVE THEM WASTE LIKE YAM AND CASSAVA PEELS. IN RETURN WE WILL PUT THIER MANURE ON TO OUR BACKYARD GARDEN TO MAKE THE SOIL BETTER.
A FEW DAYS LATER...
THE GOATS ARE HERE AND THEY ARE LOOKING FINE. THANKS FOR YOUR HELP OTU.
THAT'S O.K. EBAN MY FRIEND
MAYBE I SHOULD PLANT SOME TREES ON MY FARM THAT GOATS LIKE TO CHOP. THEN IF I GET MONEY I CAN BUY GOATS AND KEEP THEM LIKE EBAN.

Appendix N



FARMER Eban
the agroforestry man!
BY JUSTINE DUNN
IT IS TIME FOR EBAN AND BANKU TO HARVEST THE CROPS FROM THEIR FARM SO THEY ARE WORKING HARD EACH DAY...
BANKU, SEE HOW THE FARM LOOKS. I THINK WE WILL GET A GOOD HARVEST THIS YEAR-O!
YES IT LOOKS FINE. IT COULD ALSO BE GOOD NEXT YEAR BECAUSE WE USED TO PUT LEAVES AS MANURE ON THE SOIL SO IT DOES NOT GET BAD.
WHEN WE WEED THE FARM WE ALWAYS CUT OFF THE NEW STEMS FROM THESE TREES. NOW WE CAN ALLOW THE TREES TO GROW BIG UNTIL IT IS TIME TO CLEAR THE FARM.
IF THE BRANCHES GROW TALL THEY MAY MAKE SHADE SO THE WEEDS DO NOT GROW SO FAST AND WILL BE EASIER TO CLEAR WHEN WE WANT TO PLANT NEW CROPS.
I CAN STILL CUT A FEW BRANCHES FROM THEM IF I NEED EXTRA FOOD FOR MY GOATS WHEN THERE IS NOT SO MUCH AVAILABLE.
AFTER A GOOD DAY'S WORK...
WE HAVE DONE WELL BANKU. WE HAVE PLENTY TO CARRY TO THE HOUSE AND TOMORROW WE CAN BRING MORE...
...AND LOOK- SOON SOME OF OUR TREES WILL START TO GIVE FRUIT AND WE CAN SELL SOME OF THEM.


HOW TO MAKE A
CHEAP & SAFE
INSECTICIDE
BY JUSTINE DUNN
USING POISONOUS CHEMICAL INSECTICIDES TO STOP INSECTS DESTROYING THE CROPS IS EXPENSIVE AND CAN ALSO BE DANGEROUS IF THEY ARE NOT USED PROPERLY. MANY OF THE CHEMICALS ARE ALSO NOT GOOD FOR OTHER ANIMALS. HERE IS A WAY TO MAKE A CHEAP & SAFE SPRAY.
HELLO. I AM FEELING SAD TODAY BECAUSE I HAVE A PROBLEM. GRASSHOPPERS AND OTHER INSECTS CHOP MY FARM TOO MUCH AND I HAVE NO MONEY TO BUY CHEMICAL SPRAY.
AH, SORRY-O! I KNOW A GOOD SPRAY THAT YOU CAN MAKE FOR FREE, THAT WILL STOP THE INSECTS CHOPPING YOUR CROPS. DO YOU WANT TO FIND OUT HOW IT CAN BE MADE?
YES. PLEASE SHOW ME!
FIRST YOU NEED TO FIND A DOGOYARO OR NEEM TREE. IT IS ONE YOU USE FOR MALARIA FEVER. I HAVE SEEN THEM IN THE VILLAGE. YOU HAVE TO COLLECT RIPE FRUITS AND PICK OUT THE SEEDS AND KEEP THEM.
LEAVES FROM A DOGOYARO OR NEEM TREE
WHEN YOU HAVE THE SEEDS YOU HAVE TO DRY THEM WELL SO THEY DONT SPOIL IF YOU KEEP THEM. PUT THEM ON MATS IN THE SUN, BUT DONT LET THEM GET TOO HOT, YOU CAN SOMETIMES MOVE THEM INTO THE SHADE TO COOL DOWN.
WHEN THE SEEDS HAVE DRIED FOR SOME FEW DAYS, YOU CAN STORE THEM IN BASKETS SO YOU CAN USE THEM WHENEVER YOU NEED TO
TO MAKE THE SPRAY YOU NEED 5 DOUBLE HANDFULS OF DOGOYARO SEEDS FOR ONE GALLON. YOU HAVE TO POUND THE SEEDS TO MAKE A POWDER THEN MIX IT WITH THE WATER AND LEAVE IT TO STAND OVERNIGHT.
WATER
1 gallon
THE NEXT DAY FILTER THE MIXTURE BY POURING IT THROUGH A CLOTH. BE ESPECIALLY CAREFUL THAT IT IS CLEAR IF YOU ARE USING A SPRAYER. YOU MUST USE THE SPRAY THAT DAY WHEN IT IS STILL STRONG.
YOU CAN USE A PROPER SPRAYER IF YOU CAN GET ONE, OR JUST A BUNCH OF LEAVES WHICH YOU CAN DIP INTO THE SPRAY AND SHAKE OVER THE CROPS LIKE THIS...
THANK YOU! I WILL GO AND PICK THE SEEDS NOW SO I CAN START TO SPRAY SOON.

Appendix P

Village tree tenure in south east Nigeria.

The tenure and perceived value of trees are issues that have many regional, cultural and intra-community variations and an understanding of these is useful when examining patterns of wild resource use (Scoones *et al.*, 1992) and management (Shepherd, 1992).

Some tenure relations are common over wide areas. For example, throughout West Africa farmers may be allowed to cultivate borrowed land for free, or for a token payment, but when they want to plant tree crops they are opposed by the traditional landowner for fear that the presence of trees will give farmers a greater security of tenure over the land, and may eventually wrest it out of the landowner's control (Schreckenberg, 1996).

Other tree tenure issues are much more localised or confined to one sector of the community. In Ghana the existence of taboos is widespread when some tree species or products may not be dealt with by certain members of the community (eg. pregnant women) or by the whole community at particular times. There are also areas of forest in parts of Ghana, known as sacred groves, which are set aside for religious purposes and may only be entered by certain members of the community at particular occasions. In some areas in Africa there may be problems of tenurial insecurity experienced specifically by women, where divorcees and sometimes widows, lose all rights to the land and trees they have planted (Fortmann & Nihra, 1992). In most areas of West Africa Berry (1988) blames the under-investment by women in tree crops on the land ownership patterns, where in most cases, except in some areas of Ghana, men own and inherit farmland.

In the study area no evidence of taboos or sacred areas emerged during the field research period, and tree tenure rules appear to be based on practical and use criteria. However a few species, for example *Canarium schweinfurthii*, are seen to have spiritual value.

Trees on farm or fallow land are owned by the landlord who has the right to harvest the products even if the land is being cultivated by another person. The only exception to this is that fruits which fall from the tree can be gathered from the ground by the farmer. In the forest or bush which is controlled or owned by communities, tree and other products can be harvested by community members, occasionally following a rotational system of harvest and regrowth areas developed by some villages for some products, such as that found for *Afang* in Old and New Ekuri (Dunn *et al.*, 1996). No-one from outside the community is allowed to harvest products from community forest, and must instead purchase the products from villagers.

Trees in villages which were present when the village was established, rather than being planted in a homegarden, belong to the community, and products harvested from these are sold and the income put into community funds. Children appear to be fairly free to pick fruit for their own consumption from any tree within their own community's land. As with most other cases in the study area, restrictions are imposed on non-indigenes.

Special Appendix References

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Scoones, I, Melnyk, M & Pretty, J.N. 1992 *The hidden harvest: wild foods and agricultural systems, a literature review and annotated bibliography*. IIED, London. 256pp.

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Appendix O

PARTICIPATORY RURAL DEVELOPMENT PROJECTS FOR FOREST CONSERVATION AND AGRICULTURAL IMPROVEMENT

A GUIDE FOR EXTENSION WORKERS

This appendix forms part of the Thesis: 'The role of indigenous woody species in 'farmer-led' agricultural change in south east Nigeria, West Africa.' Department of Geography, School of Oriental and African Studies (SOAS), University of London.

Justine Dunn
1996

'TOP-DOWN' DEVELOPMENT

Until recently, most rural development projects have worked in what is known as a 'top-down' way. This means that decisions about the project have been taken by the people in charge of the organisations carrying out the development work. Examples of some these are:

1) who it is trying to help (eg. women, landless people, children);

2) what problems the people have (eg. low crop yields, poor health, no school);

3) what the project is trying to do (eg. set up a clinic, improve farming systems, reduce forest clearance); and

4) how it will be done (eg. training of health workers, introduce new farming methods, set up forest reserves)

In many cases the people deciding what should be done and how to do it, never even go to the place that they are trying to improve. If they do manage to visit the area, they usually don't have time to ask people what their problems are or get to know them a little. If this is so, how can the people at the top of the organisations setting up the development projects possibly know what is best for the area in question?

UP TILL NOW THE PEOPLE AT THE TOP, FURTHEST AWAY FROM THE PROJECT AREA, HAVE USUALLY DECIDED HOW A PROJECT SHOULD BE CARRIED OUT.

INDIGENOUS TECHNICAL KNOWLEDGE

We have all been educated to believe that if you have been to school or college then you are better than people who have grown up with out any formal education. It is true that you will be able to read a book, something that a farmer who has not been to school may not be able to do, but that does not mean that you know more or better things than the farmer.

The farmers have grown up in the area and so know many things that it would take you a very long time to learn. The kind of information they have, usually called indigenous technical knowledge or ITK, can be important when trying to develop projects of any kind. Some kinds of the things local people can tell you about are:

- Plant and animal species - often people will apologise for only knowing the local name of something. The name they use is not important, what is important is the fact that they can identify so many different plants and animals.
- Properties of plants - there will be many different local uses for the plants that grow in the area including medicinal, food, building materials and agricultural. The knowledge of these will help in deciding which plants should be included in new farming systems.
- Local ecology - farmers will be able to tell you about many important ecological factors which will be helpful in developing new farming systems. These include soil types, rainfall patterns, seasonal changes, and insect, bird and mammal pests.

LOCAL KNOWLEDGE (ITK) IS PLENTY AND VALUABLE

INDIGENOUS TECHNICAL KNOWLEDGE (ITK) AND SCIENCE

ITK can provide answers to many questions or problems that arise during development projects, but this does not mean that local people always have all the information they need. Sometimes for example, so that a new farming method can be created, local people may ask extension workers to find out some information they do not have, but that would be useful in their development process.

Using ITK should not mean that we never make use of science and information that comes from more formal sources such as text-books, but that the information is only given to local people as they ask for it.

For example, it may be decided by the community that it would be useful to produce some seedlings so they can use a particular tree species as part of a new farming system. They may ask the extension worker if he/she knows the best way to do this. In such a case, the extension worker can act as an information collector, going to government departments and libraries, and talking to other professionals, and can bring any information to be found, back to the community. If it is possible to get some of the information needed for developing/adapting farming systems from outside sources, this may help the village to move towards solutions more quickly. The same may be said about opinions and experience of the extension worker. If the villagers ask your opinion, please give it, but if not, try to keep quiet until you are asked.

ITK AND SCIENCE CAN BE USEFULLY COMBINED IF REQUESTS ARE MADE BY THE COMMUNITY FOR INFORMATION FROM OUTSIDE SOURCES.

WHAT IS PARTICIPATORY RURAL DEVELOPMENT?

Participation means being involved, so participatory rural development means that local people are part of the whole development process. This does not mean they carry out improvements to their farming systems that have been developed by scientists somewhere else, and presented by extension agents. It means from the very beginning local people are deciding what problems need to be solved, and how this should be done.

To do this we have to think about how the extension agent should be part of the development process. Before, the role of the extension worker has usually been to tell farmers about new technologies, or show them how they are done, and then to encourage them to try the technologies out in their own farms. Now the role of the extension worker should be first to listen carefully to what the local people want, what they think their most important problems are, and then to encourage the community to address these problems using their own skills and resources. The extension worker should be someone who helps to get things moving, and keep them going, rather than someone who tells people what their problems are and how to solve them.

For a really participatory development process to take place, the community have to be in charge from the very beginning, and the extension worker should be a tool for them to use when they need to. Sometimes farmers will be encouraged to create solutions to their problems faster than they would naturally as land changes tend to occur more rapidly so local innovation and adaptation needs to be accelerated in response.

PARTICIPATORY RURAL DEVELOPMENT MEANS THAT LOCAL PEOPLE LEAD DEVELOPMENT PROJECTS FROM THE START.

TWO TRUE STORIES OF HELPING LOCAL COMMUNITIES

1) A man did well in school and left the village to go to university where he became a very successful student. On graduation, he and some other men from the village who had also done well, decided to help the village as thanks for the support they had received during their schooling. So they bought many bags of fertilizer and carried them to the village in a lorry.

When the gift was given to the village, the chief asked the men to come and see him. The men asked if the chief and elders were happy with the gift, and were surprised to be told to take the fertilizer away again because the village did not need it. When the men asked why, the chief replied "We have good and plenty farm land for this village, and we can easily grow many crops to eat and sell. Our problem is not growing food, but taking it to market to sell because the road from the village is so bad. Why waste your money on something we do not need, rather than ask us what we really want? Do you think you know better than us even though you have been away for so long?" The men, feeling very humble, took the fertilizer away to sell, and gave to money to the community to help with road building.

2) An extension worker was sent to a village which had a large are of forest, to try and help the community to manage their forest wisely so that it would not be spoiled and lost. The village was very far inside the bush, and people had to walk many miles to reach a highway where they could get transport. When the extension worker began to talk with people in the village they said they were happy he had come because he could help them build their much wanted road.

The extension worker realised that until this problem of transport and access had been solved, the people would not want to pay attention to forest management. He therefore spent many months helping the village to raise money and get materials so they could build their road. Most of the work was done by the villagers themselves, with the extension agent being used as a contact to government departments and donors of money, materials and equipment.

When much of the work on the new road was on-going, the people of the village came to the extension worker and asked him to help them decide a way to use their forest wisely to make money for the community without spoiling the forest. The extension worker was very happy as this is what he had been sent to do, and the community were dedicated to learning and carrying out good management and harvesting techniques because they themselves had asked for this help. The community are still working towards selling timber from their forest through a village-based co-operative, and are determined to make it work as it has been their own idea from the start.

Which of these stories shows the better way to help a community? If the problem being solved is one that the community have decided is important, and the solutions are developed by village members, the project is more likely to be successful and long-lived and to really help the community do something they want.

HELPING COMMUNITIES WITH THEIR OWN PROJECTS, RATHER THAN GETTING THEM TO TAKE PART IN ONES DEVELOPED BY OUTSIDERS, IS MORE LIKELY TO PRODUCE SUCCESSFUL AND LONG-LASTING RESULTS.

HOW SHOULD WE BE AS EXTENSION AGENTS?

To try and create projects with full interaction or participation with local communities means that the task of the extension worker is now even harder. As well as being able to help with technical questions when required, and to find out information for the community when requested, the extension agent also has to be a diplomat who can get on well with people, become a friend to the village and someone who no longer has the status of a teacher or someone who brings knowledge.

So that extension workers are successful in this, they should try and develop some qualities which should be remembered at all times when working with communities.

1) The extension worker should be humble, not proud, s/he is present as someone who can work with the community to solve problems, not as a teacher or leader who tells the community what they need to do.

2) The extension worker should be prepared to learn, there is much information held by many members of the community which is useful to many development projects and the extension worker should be a 'pupil' to many different 'teachers' from in the community.

3) The extension worker should respect the community, its elders and its laws, and should not do anything which shows that s/he thinks that s/he is above the members of the community in status.

EXTENSION WORKERS SHOULD BE HUMBLE, RESPECTFUL, DIPLOMATIC AND STUDENTS OF LOCAL KNOWLEDGE.

FRAMEWORK FOR RURAL DEVELOPMENT PROJECTS

Many of the things in this book are fairly new ideas, so to help us put them into practice and learn as we work, a framework for rural development projects has been developed. In it the role of the extension agent is made clear at each stage. In general the extension worker is present as a catalyst, someone who gets processes going and perhaps makes them move along faster, but who does not influence or affect the results of the process.

For the extension agent to work in this way there must be support from the senior people in the department or agency that they work for so that the way in which such projects run, usually with no set plan at the outset and developing as they go along, will be acceptable.

The framework is divided into five stages and a summary of these is shown as a fold-out page at the end of this book. Although it is divided like this, the framework does not have to be carried out strictly in the order that is written here. Rather, it is a guide as to how things might progress and can be adapted to fit individual community situations.

The framework has been developed with agricultural improvement and forest conservation in mind, and therefore details such as the collection of information about local tree and shrub species are included. However, it may be possible to adapt this to other situations and the extension agent can decide, with the community, what information is needed for each project.

THE FRAMEWORK IS A GUIDE FOR EXTENSION WORKERS ACTING AS CATALYSTS IN COMMUNITIES, AND LEARNING HOW THEY SHOULD WORK IN SUCH PROJECTS AS THEY PROGRESS.

STAGE 1

The first part of this first stage of the framework is extremely important as it is the time during which the extension worker begins to get to know the community as a whole, and individuals within it. Extension agents should make sure that all local protocols and traditions are observed and respected when first introducing themselves to the community, for example in many places it is important to bring a gift, such as drink, to be presented to the chief for the community. Any welcoming ceremonies or official introductions to the chief and elders should be carried out according to village tradition, and not hurried because the extension worker wants to get on with the project.

In time the extension agent will be given the opportunity to explain the reason for wanting to work with the community. It should be made clear at this stage what agency or department the extension agent is from, what resources are available to help the work, and that the aim of the project is to address problems that the villagers themselves are experiencing and feel to be important. It should also be explained that the extension agent is not there to be the leader of such a process, but rather to work in partnership with members of the community and asked for particular help when it is required.

THE FIRST PART OF THIS STAGE IS IMPORTANT AS THIS IS WHEN THE COMMUNITY AND THE EXTENSION AGENT BEGIN TO GET TO KNOW EACH OTHER, SO CARE MUST BE TAKEN TO ACT IN A WAY THAT IS ACCEPTABLE TO LOCAL TRADITIONS AND RULES.

The second part of this stage of the framework is to begin to work with the community to gather information that will help to start a project.

Initially it will be important to find out what problems the community are facing and what they feel are their most important needs. This can be done through informal discussions, and it is often useful to try and talk with different groups within the community. For example, different age groups, the women, the land owners, the land renters, and so on. This will mean that it is possible to get a picture of local needs from different points of view.

The next thing to be achieved at this point is to begin to gather information about tree and shrub use by the community. This can be done using two methods:

a) Small group discussions during which the role of the extension agent should be to stimulate discussion by introducing a number of questions and to take careful note of what is said.

b) Meetings with individuals during which the discussion is two-way, notes of which should be made by the extension agent.

It is important that this process is started at individual or small group level so that all sectors of the community have a chance to say what they think. There are some ideas of ways to encourage group discussion and information collection at the back of this book called 'Methods for the field'.

THE AIM OF THIS STAGE IS TO COLLECT INFORMATION ABOUT LOCAL PROBLEMS AND TREE AND SHRUB USE.

STAGE 2

The first part of this stage is to discuss, with the community as a whole, the information about major problems, and tree and shrub use that has been collected during Stage 1. The extension agent should be responsible for organising a meeting at a time and place that can be attended by as many members of the community as possible. However, it should be the villagers who present the information as they see fit.

After the presentation of findings, the major problems should be selected and, through discussion, put into order of importance. This can be done by listing all the problems which are mentioned, discussing each in turn, and finally producing a list which most people agree with. The extension agent should pay attention to which people are speaking in the meeting, and try and enable those people who do not have a chance but who wish to speak, to be heard.

Once the major problems have been put into order of importance, those that can be addressed by changing farming methods should be highlighted, again by means of group discussion. This can be done by going through one problem at a time and encouraging some ideas about potential solutions to be suggested, and marking them accordingly. For example, problems such as a lack of capital with which to buy new farm tools, bad roads, and lack of access to veterinary services cannot be addressed with improved farming methods, whereas reduced fallow periods, lowering crop yields, lack of labour for first farm clearing and lack of access to chemical inputs can.

THE PROBLEMS OF THE COMMUNITY SHOULD BE LISTED IN ORDER OF IMPORTANCE, AND SORTED INTO THOSE WHICH CAN BE ADDRESSED WITH LOCAL RESOURCES, AND THOSE WHICH CANNOT.

Next, the community should be encouraged to select some tree and shrub species that they think may be useful in modifying farming systems, for further study. Local information and knowledge about the selected woody species should be pooled and a picture built up of each of the species. It is important for people to feel that anything they know about a species is useful and that they will not be 'shouted down' by others. The role of the extension agent during all these meetings and discussions is therefore often as note-taker, observer and chairperson.

Once all that the community knows about the selected species is collected together, it may be decided that some extra information is needed. This may include such things as:

1) Finding out how to grow one or some of the species from seed;

2) If they can be easily grown from cuttings or transplanted seedlings from fallow or bush; and

3) If it is possible to bud or graft some of the species to reduce the time before fruiting first takes place.

Some of this extra information can be provided by the villagers themselves by trying out some of the things they would like to know. However, they may decide to ask the extension worker first, to find out if there is any information about these questions available elsewhere.

SELECTION OF TREES/SHRUBS FOR FURTHER STUDY TAKES PLACE, AND COLLECTION OF INFORMATION ABOUT THEM IS FOLLOWED BY DECIDING WHAT OTHER INFORMATION IS NEEDED.

STAGE 3

This is the stage during which the extension agent is the most active and 'on-show'. While the collection of extra information about the selected species goes on, the community should be encouraged to think about ways in which the species can be used to address some of the problems highlighted during Stage 2.

If discussions are not progressing, it may be appropriate for the extension worker to hint at some of the different ways that trees are used in farming systems in other areas. The extension worker should make clear that these are not suggestions as to how the community can modify their own farming systems, but some ideas to stimulate discussion about modifying local farming methods. If pictures or slides are used as a tool at this stage it is best to use examples of systems that have been developed by farmers, not by scientists so they do not appear to be ideas which are 'out of reach' to the community.

After initial discussions as a community, the villagers should break up into smaller groups to discuss ways in which they feel they could use some of the selected species to address some farming problems. The groups should be encouraged to develop some ideas as to how such modifications can be carried out. The extension worker should be available to be present at these meetings if asked by the various groups, but again should try only to offer opinions or suggestions if they are sought by the group.

DURING THIS STAGE THE EXTENSION WORKER MAY SHOW EXAMPLES OF TREES IN FARMING, BUT THIS SHOULD ONLY BE TO STIMULATE DISCUSSION, NOT AS SUGGESTIONS AS TO HOW THE COMMUNITY CAN USE TREES TO ADDRESS ITS PROBLEMS.

Once small groups have had time to come up with some ideas, a meeting should be arranged for the whole community. During this, each small group should present its ideas in turn so that there is a chance for everyone to discuss the good and bad things about each method. The extension agent should take the role of the secretary recording the major ideas so all participants can see them, and taking notes of the discussion that comes from each presentation.

The community should then select some of the ideas for making use of trees or shrubs in farming to address some of their major problems. Participants should be encouraged to consider such factors as labour requirements, seedling availability, etc. for each methodology, and should produce rough outlines of each. It is hoped that from this some farmers will decide which technology, part of technology or combination of technologies they will try out on their farms. Probably not all farmers will decide to try out a new farming method, but those who do should be especially encouraged and supported by the extension worker.

THE COMMUNITY SHOULD DEVELOP, BY GROUP DISCUSSION, AND THEN SELECT TECHNOLOGIES FOR INCLUDING TREES IN FARMING SYSTEMS IN AN ATTEMPT TO ADDRESS SOME OF THEIR PROBLEMS, AND INDIVIDUAL FARMERS SHOULD BEGIN TO DECIDE IF AND HOW THEY WILL USE ONE OR SOME OF THE TECHNOLOGIES ON THEIR FARMS.

STAGE 4

This is the stage during which farmers begin to try out the technologies, in-full, in-part or in combination, which have been developed by the community during the previous stages. The major role of the extension agent during this stage should be one of support. If farmers feel they need advice, additional information or someone with whom to discuss their experiences, then the extension worker should be available for this. Sometimes farmers may feel the need for more information which can possibly be obtained from the department or agency supporting the project, either in the form of access to literature, or in the development of trials to address a specific question.

The extension agent should make careful observations of all the farm trials, and should be responsible for coordinating regular meetings during which farmers can exchange ideas and express concerns.

The government department or donor agency supporting the project may feel that at this stage the extension worker is not busy enough to justify his full-time work with one village. However, it is important for the long-term success of the project, that the community does not feel it has been abandoned before any real results have emerged. If the supporters feel they cannot allow the extension worker to remain in the community full-time, s/he should only be moved to another community close to the first one, and should visit on a regular basis so that s/he is still accessible to the villagers.

FARMERS SHOULD BEGIN TO TRY OUT THEIR FARMING MODIFICATIONS AT THIS STAGE WITH THE ROLE OF THE EXTENSION WORKER BEING ONE OF SUPPORTER.

One further task for the villagers and extension worker to begin during this stage, is to look at the way in which the community will keep records of the meetings and farm trials. The record keeping system should be developed by the community, maybe relying on reports of individual farm activities being made by farmers at meetings which are recorded by an appointed secretary. Many communities already have a system of note-taking used for village council meetings, which could be a pattern on which to base the farm experiment records.

A SYSTEM OF RECORD KEEPING BY THE COMMUNITY SHOULD BE ESTABLISHED SO THAT THE PROGRESS OF THE NEW FARMING METHODS CAN BE NOTED FOR FUTURE USE.

STAGE 5

This is the final stage of the framework, but, together with Stage 4, should continue beyond the formal time frame of the project. During this stage farmers have made modifications to technologies developed by the community, and other farmers may begin to adopt these ideas in their own farming systems. Hopefully by this stage the extension worker should not be needed to encourage the spread of farming changes as certain community members will be able to do this themselves.

However the extension agent should still be accessible, especially to groups who feel that their major problems were not addressed during the project, and attempt to work with them more specifically. Again the support of the department or agency is necessary to allow the extension worker to have continued contact with this village even if s/he is no longer able to remain there on a full-time basis.

FARMERS SHOULD BEGIN TO ADOPT MODIFIED FARMING TECHNIQUES THEMSELVES, USING THOSE WHO HAVE ALREADY TRIED THEM AS SOURCES OF SUPPORT AND INFORMATION. THE EXTENSION WORKER SHOULD BE AVAILABLE TO WORK WITH ANY GROUP WHO FEEL THEY HAVE NOT BEEN HELPED SO FAR.

IMPORTANT POINTS TO REMEMBER

1) AS AN EXTENSION AGENT YOUR TASK IS ONE OF SUPPORTER AND PARTNER IN DEVELOPMENT LED BY THE COMMUNITY TO ADDRESS THE PROBLEMS HIGHLIGHTED BY THEM. YOUR ROLE SHOULD *NOT* BE ONE OF TEACHER AND LEADER, MOVING THE PROJECT IN A DIRECTION CHOSEN BY YOU OR THE DEPARTMENT OR AGENCY FOR WHICH YOU ARE WORKING.

2) IT IS IMPORTANT TO REMAIN RESPECTFUL TO THE ELDERS AND TRADITIONS OF THE COMMUNITY AND NOT TO FEEL YOU HAVE A HIGHER STATUS THAN ANYONE IN THE VILLAGE.

3) HOPEFULLY THE DEPARTMENT OR AGENCY YOU WORK FOR WILL SUPPORT YOU IN REMAINING IN THE COMMUNITIES FOR AS LONG AS POSSIBLE. A PROJECT WHICH IS ALLOWED TO DEVELOP A SOLID, STRONG BASE IS FAR MORE LIKELY TO CONTINUE ONCE FORMAL SUPPORT HAS GONE, THAN ONE WHICH IS ABANDONED IN THE EARLY STAGES.

WHERE CAN YOU GET USEFUL INFORMATION IF ASKED?

1) YOUR OWN DEPARTMENT OR AGENCY MAY HAVE A SMALL LIBRARY OR GET SCIENTIFIC JOURNALS WHICH WILL BE A USEFUL PLACE TO LOOK FOR INFORMATION. STAFF IN THE OFFICES MAY ALSO BE ABLE TO HELP FROM EXPERIENCE.

2) OTHER LIBRARIES SUCH AS THOSE FOUND IN UNIVERSITIES OR COLLEGES MAY BE USEFUL, AS WILL BE TALKING TO SOME OF THE ACADEMIC STAFF OF THESE INSTITUTIONS.

3) IF INFORMATION IS NOT AVAILABLE LOCALLY IT WOULD BE POSSIBLE TO WRITE TO LIBRARIES OR INSTITUTIONS IN THE COUNTRY OR ABROAD WHO MAY BE ABLE TO PROVIDE ANSWERS TO SPECIFIC QUESTIONS.

4) GOING TO OTHER VILLAGES NEAR BY TO SEE HOW FARMERS THERE HAVE TACKLED THE PROBLEMS THEY FACE MAY GIVE SOME IDEAS WHICH ARE USEFUL TO THE LOCAL AREA.

METHODS FOR THE FIELD

Here are a few ideas as to how to encourage communities to share information and develop solutions to some of their problems. These are not the only things that can be done, villagers often adapt information collection methods to suit their own situation, but are her to give an idea of the type of methods that will encourage community-led development.

1) Often it is difficult to get agreement as to how important a problem is and whether it should be addressed. One way to reach some sort of agreement is to suggest that the villagers develop a ranking systems which they can use to note the relative importance of different aspects of one problem, and hence arrive at an overall picture of the situation. A simple example of this is given below, but it should be remembered that, like the framework as a whole, this is just a starting point on which to build locally appropriate methods.

	WHO/WHAT IS MOST AFFECTED?					
PROBLEM	Women	Men	Food	Health	Farms	Total
Short fallows			X	X	X	3
No forest	X	X	X	X		4
No farm tools	X	X			X	3
Bad road	X	X		X		3
No chain saw		X			X	2

ETC.

2) A similar method can be used to select tree species that may be useful in farming by listing tree species in the first column, and marking the number of different uses they have (eg. fruit, seeds, poles, firewood, shade, soil improvement) in the following

columns. This can be done either on paper, or on the ground using leaves to show each species, and fruits, seeds, soil, wood, etc. to represent the different uses. Such a chart will help to see which species are most appropriate to address certain problems and which of those have the most uses and may therefore be worth studying further.

3) Sometimes it may be useful for villagers to look at why certain problems are occurring, and where this is the case putting together a history of the village is often a good starting point. One way of doing this is to draw maps of the village and the surrounding area. This does not have to be done with pencil and paper, but can be created using locally available materials (eg. sticks, stones, beans, leaves, fruits, etc.) on the ground. The maps illustrate changes that have taken place, as well as stimulating discussion about particular events and their timing. Although most members of the community may be aware of the village history, it is often useful to look at it all together and the cause of a problem may become clear.

4) During discussion of the development of new farming methods, it may be useful for the community to focus on particular environmental changes or patterns in order to create some time scale in which to work. For example, an estimation of the average number of rainy days that occur in each month is a good way of seeing when the rainy and dry seasons start and end, and this again can be done using locally available materials such as beans or stones to represent the number in each month.

These ideas can be adapted to suit local situations, or new ones can be developed by the communities.

STAGE 1

Getting to know the community.
Information collection - interactive exercise led by the community to outline major problems and gather information on tree and shrub use.

STAGE 2

Presentation of findings from research by community members.
Discussion of problems to be addressed.
Selection by the community of tree/shrub species for further study.
Opinions should be obtained from different sectors of the community.
Information gathering for selected species - pool all knowledge about the species such as uses, growth patterns, germination potential and methods and frequency, to form a picture of each of the species.
Obtain missing data through establishment of trials or refer to data sources - eg. germination trials, coppicing and regrowth measurements.

STAGE 3

Most pro-active stage for field worker.
Introduction of agroforestry concepts to the community to include discussions of local agroforestry systems and some examples of other systems which could be adapted for the local environment.
Small groups to attempt to develop agroforestry systems/methods to combat some of the agricultural problems.
Set up community record keeping system - monitor through Stages 4 & 5.
Community meeting for discussion of suggested agroforestry technologies, and selection of those technologies to be tried.

STAGE 4

Implementation of new farming technologies - in-full or in-part as appropriate, field staff to be available for any technical advice requested and to make careful reports of farm trials.
Setting up and co-ordination of meetings between farmers and the rest of the community to share information from trials.

STAGE 5

Adoption of technologies by other farmers, and further adaption to suit individual needs.
Return to Stage 4 for development of technologies for groups whose needs have not yet been addressed.