Rural people's response to soil fertility decline. The Adja case (Benin)

1993
J.H.A.M. Brouwers
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PROPOSITIONS

1. It is a good thing, from a social, economic and environmental perspective, that farmers often do not accept external knowledge offered to them by agricultural research and extension (this dissertation).

2. Local knowledge systems are not local, not knowledge and not a system in the sense that they are not restricted geographically to one locality, not knowledge in the sense that extractable knowledge can represent its essence, and not a system to the extent that diversity and heterogeneity are dominant features (this dissertation).

3. The technical component of rural people's knowledge is inseparable from its social component (this dissertation).

4. With regard to the conditions found on the Adja plateau, management of soil fertility is served more by paying attention to soil life, than to chemical fertilizer (this dissertation).

5. Rapid Rural Appraisals are not capable of in dept appreciation of rural people's knowledge because their time frame does not allow for sufficient mutual confidence building (this dissertation).

6. Gathering of rural people's knowledge products without analysing the knowledge processes at stake and without the involvement of rural people in the utilisation of results is a form of post-colonialism (this dissertation). An example is given by the gene banks, which only accumulate stores of varieties, without taking into consideration the socio-economic context for, and the local uses of, the varieties, and which do not give rural people access to the gene banks.

7. Whereas more erudite scientists affirm that the more they learn, the more they realize how little they know, a researcher of rural people's knowledge experiences in addition that the little he or she knows is fundamentally questioned (this dissertation).

8. Propositions accompanying a Dutch dissertation are closer to indigenous proverbs than most scientists think (this dissertation).

9. A consistent application of the arguments put forward in this dissertation requires that a representative of the group that provided the knowledge analysed is present at its defense (this dissertation).

10. Studying rural people's knowledge enhances interdisciplinarity because each discipline has to study reality as experienced by farmers, as well as

explain to members of other disciplines how the own discipline is handled by farmers (this dissertion).

11. Constructing scientific knowledge for a dissertation is a special form of rural people's knowledge (Röling, pers. communication).

12. 'Many anthropological statements possibly evoke more about the anthropologist and his culture than about the culture of the participants.' (Bakker, 1988: 100)

Jan H. A. M. Brouwers
October 12, 1993
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Rural people's response to soil fertility decline. The Adja case (Benin)

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Summary

This study examines rural people's knowledge in changing conditions such as decreasing soil fertility and increasing population. It explores how farmers, who depend on rainfed agriculture and are confronted with an ever increasing population, react. The study presents the case of an ethnic group, the Adja, who live in South-West Benin (West Africa).

Chapter 1 looks at agriculture in tropical rainfed areas experiencing a decline in soil fertility. Research and extension have so far generated few feasible technical solutions to the problem. This chapter explores how rural people themselves cope with the situation. Rural people's knowledge processes still seem to be poorly understood. This study investigates how the Adja farmers perceive demographic pressure and how they react to it, what knowledge influences them and what learning processes have resulted in their knowledge.

The second chapter provides a theoretical perspective relevant to this study. An analysis of the relationship between researcher and rural people is given, as well as a systems perspective on rural people's knowledge, a conceptualisation of rural people's knowledge and related concepts. Rural people's knowledge will be viewed as the reconstruction of knowledge by both rural people and the researcher through a dialogical process. In addition, the reconstruction can only indicate this knowledge at a given moment in time. Three levels of studies on rural people's knowledge are distinguished: (1) knowledge 'products', (2) the social construction of rural people's knowledge, and (3) the activities which resulted in their knowledge.

Chapter 3 presents the methodology used in this work. Special attention is given to methodological issues related to research on rural people's knowledge and the role of the researcher.

In Chapter 4, a general introduction to the Adja plateau and its inhabitants is presented. Besides an agronomic point of view, also the Adja classification point of view is given for basic elements of the environment. The agro-ecological conditions on the plateau, the socio-cultural organisation of the Adja, as well as the history of the plateau and the interventions to change it, are described. The complexity of Adja farming is one response to the risks involved in farming. The Adja use several elements from their environment to plan agricultural activities. The history of Adja farming shows constant changes in agricultural practices, giving a dynamic picture. Agronomic interventions designed to tackle the declining soil fertility problem have been limited in their results.

The Adja oil palm-based agro-forestry system broadly relieves problems imposed by increasing population pressure and is outlined and analysed in Chapter 5. The system produces significant quantities of biomass and at the same time the oil palm is firmly entrenched in Adja agricultural activities. Also a view on soil fertility as seen by the Adja themselves is described, together with

an analysis of the effect of the oil palm system on soil fertility. The Adja recognise and appreciate the importance of soil life and organic matter, a viewpoint which is corroborated by the soil analysis.

In Chapter 6, a presentation is given of phenomena related to rural people's knowledge on the Adja plateau, connected with variable demographic pressure and soil fertility. Oil palm densities are higher in the more populated areas. When the oil palm system comes under pressure, farmers try to prolong the cultivation of annuals, increasing the pruning of oil palms and felling them sooner. Intensification and increasing diversification of agricultural production takes place in the more populated areas. In addition, such areas have developed more dynamic and diverse aspects of social life (e.g. religion, off-farm work, migration, trade, legislation) compared to areas with more land per caput. Leadership conventions have a broader base, than in earlier days. In addition to older people, enterprising or educated young people, women and men are included in decision-making. The emergence of women as agricultural entrepreneurs, with considerable trading freedom, and who buy small pieces of land hiring more labourers than male farmers, is partly explained by male out-migration and ongoing individualisation of the Adja society.

In order to understand why farmers act the way they do, one must try to proceed from their knowledge, values and ideas. Elaborating on earlier chapters dealing with Adja knowledge, Chapter 7 seeks to understand the Adja perspective by examining Adja 'sense making' activities, like learning, transformation of technology, classifying and theory making. Various examples show that Adja learning has its roots in action. In the daily practice of this learning, constant attention to possible improvement is evident. Results of experiments are shared, interpreted and discussed only in a restricted group. Encounters between different experimenting groups take place in specific social and physical contexts. Externally generated technologies are transformed and combined with social, economic, political and other factors to become an integral part of agriculture. The variability amongst Adja farmers argues in favour of the capacity to assess at an individual or experimenting-group level the potential value of a new method or technique. In the more highly populated areas, this feature of new relationships and networks result in a dynamic cultural identity.

In the final chapter, it is concluded that Adja farmers have a rich body of knowledge related to agriculture. However, their agricultural knowledge is strongly related to other phenomena (e.g. religion, social struggles and diversity, access to resources, migration). In addition, it is not static, but in a continuous process of change. It is also concluded that researchers may be able to sustain ongoing Adja experiments by elaborating on a broader set of methodologies for interactive and shared learning. The adaptive research performances of farmers might be enhanced by researchers who visit farmers in their fields and try to join in their discussion. The ability of researchers to enlarge their discursive analysis by incorporating a view of practical activities as applied by farmers seems an important prerequisite for fruitful collaboration. In addition, adaptive performances of farmers might be understood and discussed by researchers if they are willing to acknowledge dimensions other than agriculture.

Preface and acknowledgments

Traditional transfer of technology models do not seem to be effective for improving rainfed agriculture in difficult and fragile environments. The search for more effective and efficient ways of generating and exchanging knowledge is likely to be enhanced by acknowledging farmers' capacities. The present book seeks to make a contribution to that search. I thank the farmers from the research villages who enabled me to make this attempt for sharing with me their feelings, and teaching me how they cope with life. I am also indebted to the members of the university cooperation programme between the Faculty of Agricultural Sciences of the National University of Benin and the Wageningen Agricultural University (WAU). This programme, funded by the Netherlands Organisation for International Cooperation in Higher Education (NUFFIC), enabled me to undertake the fieldwork for the present study. I am also grateful to the members of the Department of Rural Sociology and Extension in Benin and the members of the Department of Communication and Innovation Studies (WAU) who provided a stimulant environment for research. I am especially indebted to Niels Röling for creating the Wageningen Research Programme on Knowledge Systems for Sustainable Agriculture, of which this study forms a part.

Many persons contributed to this book in one way or another, and I would like to take this opportunity to mention several of them. I thank the Beninese and Dutch students who shared their experiences and opinions with me: Mark Breusers, Constant Dangbégnon, Bert Hiddink, Ronny Dobbelsteijn, Els Verhagen, Christine Wipfler and Césaire Gnanglé. I am grateful to Constant Dangbégnon for assisting me during the fieldwork, for maintaining the contact with farmers during my other duties and for his critical comments. I am also indebted to Jon Daane, Anne Floquet, Doortje Wartena, Arnoud Budelman, Valentin Koudokpon, Mark Breusers, Renske Schamhart and Davo Vodouhê for their critical contributions. Without the help of the translators Marcellin Dansou, Vincent Bodji, Michel Ehou and Julien Senou, the research would not have been possible. I thank Egbert Westphal for his comments on Annex 6, Theo Guiking for his comments on the use of the QUEFTS model, Dick Kuiper for his help with the layout, Tonny Brouwers for the Figures, Nanda Doku and Carrie Bone for the correction of the English and Piet Holleman for drawing the Maps. I am also grateful that the editorial committee of *Wageningen Agricultural University Papers* accepted this book for publication as well as the help of Rolf Moeliker and printer Veenman for the final printing.

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Wageningen, June 20th, 1993

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Acronyms

ARCIK	African Resource Centre for Indigenous Knowledge
CARDER	Centre d'Action Régional pour le Développement Rural
CEC	Cation Exchange Capacity
CENAP	Centre National d'Agropédologie
CIKARD	Centre for Indigenous Knowledge for Agriculture and Rural Development
DRA	Direction de la Recherche Agronomique
F.CFA	Currency in most Francophone African countries (50 F.CFA = 1 FF = ±0,20 $)
FSA	Faculté des Sciences Agronomiques (Cotonou)
FSR/E	Farming System Research and Extension
HCN	Hydrocyanic
HEIA	High External Input Agriculture
IITA	International Institute for Tropical Agriculture
NGO	Non-Governmental Organisation
PTD	Participatory Technology Development
QUEFTS	Quantitative Evaluation of the Fertility of Tropical Soils
RAMR	Recherche Appliquée en Milieu Réel
SSM	Soft Systems Methodology
SVR	Section Sociologie et Vulgarisation Rurales (FSA)
TOT	Transfer of Technology
UNB	Université Nationale du Bénin
WAU	Wageningen Agricultural University

'To see ourselves as others see us can be eye-opening.
To see others as sharing a nature with ourselves is the merest decency.
But it is from the far more difficult achievement of seeing ourselves
amongst others, as a local example of the forms human life has locally taken,
a case amongst cases, a world amongst worlds, that the largeness of mind,
without which objectivity is self-congratulation
and tolerance a sham, comes'.
(Geertz, 1983: 16)

1 Exploring the problem: rural people and changing conditions

After providing a general introduction to the present book, Chapter 1 looks at agriculture in tropical rainfed areas where declining soil fertility is being experienced. Research and extension have so far generated few feasible technical solutions for the problem. This chapter explores the ways in which rural people themselves cope with this situation. The knowledge processes of rural people still seem poorly understood. The chapter ends with a justification for further research and the formulation of research questions and objectives for a case study.

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Agricultural University Wageningen, Department of Communication and Innovation Studies.

1.1 Introduction

The first chapter of this book includes a formulation of the research problem, as well as the research objectives which guided the study reported in the following chapters. The second chapter gives a theoretical perspective to the present research. In Chapter 3, the methodology used in the research is explained. Chapter 4 introduces the research area. In Chapter 5, an indigenous agroforestry system, a significant response to the declining soil fertility, is presented and discussed. Chapter 6 comprises an introduction and discussion of variability in demographic pressure and corresponding differences in dealing with soil fertility decline. Chapter 7 elaborates rural people's knowledge in the present case study. And finally, Chapter 8 provides the conclusions.

1.2 Declining soil fertility in rainfed tropical areas

The present book deals mainly with tropical areas characterised by dependency on rains which are unpredictable, both in volume and distribution. It seeks to understand how farmers living in these areas and experiencing an increase in population, cope with their situation. Allen (1965) was one of the first to identify effects of population pressure on African agriculture. Declining soil fertility in tropical rainfed areas seems to be an increasing problem for a growing number of people.

Instead of the Malthusian approach, in which population growth is seen as the dependent variable (depending on agricultural development and disposable arable land), Boserup (1965) proposed that population growth should be regarded as an independent variable, as a major factor determining agricultural development. She argues that the adoption of new land use systems is a consequence of increasing man/land ratios. Consequently, communities with a sustained population growth have a better chance of embarking upon a process of genuine economic development than communities with stagnant or declining populations. Soil fertility, in this view, may be the result of the use of intensive methods of land utilisation and not *vice versa* (*ibid.*, p.19).

Lagemann (1977: 6), however, argues that both the pessimistic Malthusian hypothesis (resulting in starvation or migration) and Boserup's hypothesis are oversimplifications of reality. In his view, it seems evident that people are able to change cultural practices and also adopt systems which enable them to feed their increasing populations. Depending on the natural and social conditions, this process will over time reach a stage at which it might be difficult to go beyond what he calls 'the traditional setting'. When such a situation occurs, starvation and/or migration are inevitable. Via increasing subsistence demands and the extension of cash cropping, increasing population density ultimately leads to impoverished soils and a low-level equilibrium, unless investment in productive resources can be realised.

Ruthenberg uses the term 'low-level steady state' to describe the situation towards which some fallow systems, often transient systems, slowly move (Ruthenberg, 1983: 101). Farmers often apply strategies (e.g. moving into expansion areas, off-farm work, intensification in valley bottoms and on compounds, whilst maintaining an outfield in a fallow system) to prolong the lifetime of a fallow system, but the change to permanent cultivation occurs as a necessary consequence of increased population and cash cropping, resulting in a 'low-level steady state' (*ibid.*, p.102, my quotation marks, JB). This process is described for various areas, e.g. Bantje (1987) in Tanzania and Fresco (1986) in Zaire.

The 'low-level steady state' also involves a change in the type of crops used. Often, the cultivation of such crops as cassava and sweet potato increases since they give high yields and certain caloric returns per hectare and per hour of work (Ruthenberg, 1983: 164). Also, cropping systems change; for example Lagemann found that for Eastern Nigeria the number of arable crops grown in one field at the same time, as well as the density of all crops, trees included, increased with a village's population (Lagemann, 1977: 43).

Various authors (e.g. Ruthenberg, 1983: 165; Hayami & Ruttan, 1985) consider the only way out of this 'low-level equilibrium trap' to be the attainment of higher returns per hectare and per animal as a result of yield-increasing innovations. In addition, improvement of productive resources (e.g. land consolidation, irrigation, drainage and terracing), as well as improvement of social organisation, can contribute considerably. Unfortunately, few research-based technical and organisational answers seem available for rainfed agriculture under demographic pressure.

The 'Green Revolution' introduced new technologies for irrigated and fairly homogeneous regions with a reasonably developed infrastructure. As a consequence more and more countries manage to be self-sufficient in food production, especially in Asia (Röling, 1988: 103). Food prices have been decreasing as a result of increased production, also for upland, rain-dependent farmers, who could not use the new technologies. The negative environmental and social impacts of High-External-Input Agriculture (HEIA) have become increasingly obvious in recent years (Reijntjes *et al.*, 1992). Rural people's knowledge might play a role in solving such 'second generation problems' of the Green Revolution, because it can contribute to finding knowledge-intensive alternatives to intensive use of external inputs (Röling & Van de Fliert, 1993).

Formal agricultural research has not, as yet, been able to deliver a similar set of technologies for rainfed agriculture. One reason is that the more complex, risk-prone and heterogenous situation found in this kind of agriculture, is characterised by:

1) pronounced diversity in topography, soil hydrology and soil fertility within small areas;
2) complex interactions between the different components of the farming system like crops, animal husbandry and perennials (mixed cropping and agro-forestry are typical examples);

3) complexity in time (various activities and processes during one or several years);
4) the importance of off-farm work for many farmers;
5) emphasis on risk spreading due to a high dependency on the climate (e.g. erratic rainfall both in volume and distribution).

These complex systems change continuously in response to environmental changes (e.g. climatological and political). Said Boserup (1965: 7): '"primitive" (my quotation marks, JB) agricultural communities are dynamic and subject to continuing change in agricultural technology; induced by population pressure'. In this view, soil fertility for example is not seen as an exogenous or an even unchangeable 'initial condition', but as a variable, closely associated with changes in population pressure and related changes in agricultural methods (*ibid.*, p.13). Terms like 'steady state' and 'equilibrium', as used by Lagemann (1977) and Ruthenberg (1983), or 'involution' (Geertz, 1963) do not, therefore, seem to characterise these agricultural systems well.

The issue as to whether formal research can deliver valuable technologies for the above mentioned situation will be discussed later (Chapters 7 and 8). The next paragraph takes a closer look at the farmers' perspective. How do they cope with their situation?

1.3 Rural people's knowledge and changing conditions

1.3.1 Rural People's Knowledge

Before any consideration can be given to possible developments on smallholdings and the means by which these can be brought about, farmers' daily practises should be studied, what factors govern their actions, and what pressures cause the actual pattern of agriculture. Farmers have insights and adaptive skills which are based on years of experience and this collection of learning experiences may be called rural people's knowledge. Selection processes are at work to test possible improvements. A practical intelligence responds directly to emerging problems. This body of knowledge and learning capability has often been accumulated and communicated through family members over generations. Rural people possess a collective memory through culturally encoded structures. Such knowledge may relate to various cultural norms, social roles, or physical conditions such as climate or lunar cycles (elaborated from Thrupp, 1989: 15). Constant responsiveness and adaptation demonstrate farmers' ability to make sense of an uncertain situation.

Experience shows that tropical smallholders are usually very skillful at choosing optimum crops, crop sites, and crop mixtures. Also new crops are integrated: agrarian history reveals that New World crops such as maize, beans and cassava

established themselves as major staple crops in tropical Africa after their initial introduction.

Dommen (1988: 2) characterises features of African rural communities as follows:

1) an ability to work with the environment rather than attempting to override it (cf. Richards, 1985);
2) a deliberate utilisation of diversity of micro-environments;
3) the purposeful selection throughout the production period of crops planted and cultivation practices used and the integration of livestock into the system as a means of maintaining soil fertility; and
4) the deliberate staggering of outputs in space and time.

Another feature also seems important:

5) the use of crop combinations which give a higher return per person per hour during the major labour bottleneck period and which give a more dependable result in variable rainfall (Norman *et al.*, 1987: 13).

Thus, a major strength of rural people's agricultural knowledge lies in its functional integration of different resources and farming techniques (Reijntjes *et al.*, 1992: 18). By integrating various land-use functions (production, protection, conservation and maintenance) and the use of different biological components, the stability and productivity of the farming system as a whole might be increased and the natural resource base conserved (*ibid.*, adapted).

While managing fairly complex (farming-) systems, farmers try to:

1) manipulate diversity and variation, and change instability into stability in order to earn their livelihood;
2) establish a balance between needs, labour availability, knowledge and technologies, and (natural) resources in such a way that survival, both short term and long term, is possible.

This complex farming management system demands much knowledge and insight, be it from a female farmer hiring land to grow capsicum pepper mixed cropped with maize and cassava somewhere in West Africa or a floricultivator with greenhouses in the Netherlands. Both create complex 'livelihood systems' and no one else can do it for them. A farmer's strategy is based on a shrewd evaluation of all the factors which determine his or her survival (adapted from Jungerius, 1986: 17). Farmers' survival strategies show all the characteristics of a multidisciplinairy approach (*ibid.*, p. 15).

It is presumed that farmers give more attention to environmental phenomena than agronomic scientists. Day-to-day, in-the-field observation by farmers provides them with a monitoring capacity (Leesberg, 1983; Haverkort *et al.*, 1991; Stolzenbach, 1992). For example, processes occurring during a season as a result of rotation or mixed cropping, or of climatological variation are presumably taken into account by rural people. However, most literature dealing with rural people's knowledge focuses on local classifications, in a rather utilitarian way.

A local soil classification system presents the nature of soil differentiation and emphasizes its importance. But the underlying knowledge of soil management processes (e.g. placing and timing of organic matter decomposition and management of soil fertility, fallows and mixed cropping) can be overlooked by an emphasis on classification.

Thus, most research related to rural people's knowledge can be qualified as evaluative, with a focus on results of knowledge processes, using mainly Western standards. Natural resource management by farmers is often described as adaptive, both ecologically and socio-economically (Fairhead, 1992: 14). This leaves an open question as to how farmers adapt and vary their practices according to diverse social and ecological circumstances. It seems more useful to study natural resource management in ways rural people themselves understand it. In this way general principles can be applied in a flexible way under diverse and changing ecological circumstances.

Farming practices should not be seen as the isolated 'packages' offered by extension services. The afore-mentioned heterogeneous nature of rural people's knowledge and its variety of answers to changing ecological circumstances, such as the problem of soil fertility decline, seem to constitute the rule rather than the exception. Various sub-(farming-) systems (for elaboration of terms: see Chapter 2, Theoretical perspective) within the knowledge system can be identified as socio-economic, agro-ecological, or other sub-systems. Amongst community members, there is often differential access to valued knowledge, whereby certain people control more information than others. In addition, there are variations in attitudes towards experience-based knowledge versus external knowledge and ideas.

Experiences of agro-ecological (mis)fortune are not always shared within the community. On the contrary, it seems that the existence of opposing forces within a community is the norm. So, differential knowledge can reveal differential positions within a socio-political and economic struggle, both within the community and with external (formal) actors and institutions. Social differentiation, e.g. gender differentiation, as expressed in social discourse can reveal viewpoints and interests associated with different categories in a community. Therefore, one should avoid elaborating a model shared by all the members of a community from the perspective of only one group or category within that community.

Differences in the disclosure of ideas may also depend on whether or not the ideas are used for competitive personal interests. Individual knowledge that is used for aims of accumulation or market competition tends to be kept more confidential than knowledge that is needed for mutual interests of survival within a community (Thrupp, 1989: 16).

Heterogeneity appears to prevail. A more detailed elaboration on rural people's knowledge will be given in Chapter 2 (Theoretical perspective).

1.3.2 Rural people and changing conditions

Morgan (1969: 267) argues that 'For the whole period of which we have knowledge of African peasant agriculture, we have evidence of adaptation and

change. In part, changes have arisen not through conscious interference with agriculture or attempts at improvement, but indirectly through the introduction of new means of exchange, methods of transport, the slave trade, the encouragement of migration and the introduction of new crop plants'.

Jacks (1956, quoted in Gleave & White, 1969: 294) envisaged three stages in the evolution of the soil under man's stewardship. The first stage is one of ecological balance, where shifting cultivation does not permanently deplete soil fertility. The second is one of soil exhaustion, during which man mines the fertility of the soil without replacing plant nutrients removed by cultivation or by erosion. The third is the conserving stage, when man replaces what is removed by cultivation, so that the soil remains productive. These stages seem to concur more or less with the three phases in the evolution of agricultural practices; from shifting cultivation through rotational bush fallowing to semi-permanent and permanent cultivation.

Smallholders in many parts of the tropics experienced, within a few decades, the change from shifting cultivation with temporary homes, to sedentary farming with perennial crops. With the decline of fallow periods and fallow acreage, other means had to be developed by the cultivators in order to gain a living from the soil.

Shifting cultivators know how to adjust to changing natural conditions, and so in this respect many smallholders are very knowledgeable (Ruthenberg, 1983: 315). But Ruthenberg questions whether they are prepared for the tasks of transforming natural conditions by conscious human effort and of improving yields by the proper maintenance of the plants. He further argues that handling these tasks have been learned by farmers with centuries of land shortage or decades of cash cropping (*ibid.*). Richards (1985), however, argues that even if farmers are using extensive shifting cultivation techniques, and consequently have comparatively little experience of intensive cultivation practices, they nevertheless frequently manage part of their farming activity more intensively and reveal a comprehensive grasp of fertility management practices.

The amassed experience of people living for generations in a hostile environment, provides a fundamental source of knowledge for the future. Even if unconsciously applied, it shows a capacity to deal with that environment. Ukara Island in Lake Victoria demonstrates this maxim, when Wakara farmers with only 2.25 acres to maintain an average family of 4.5 people (figures of 1956) managed to survive over a long period of time (Lunan & Brewin, 1956: 263). The methods of cultivation are admirable, yet full benefits cannot be obtained owing to the overcrowding unaccompanied by better farming methods. Lunan and Brewin conclude (*ibid.*, p.267) that it is evident that the soil conservation and other farming practices of the Wakara, remarkably effective as they are, merely slow down the gradual deterioration of the fertility of the soil and of the yields of crops.

Lal & Stewart (1990: xiv, quoted in Fresco, 1992) estimate the current rate of soil erosion and loss in the world at five to seven million hectares per year, an annual rate that might climb to ten million hectares by the turn of the century.

If rural people are able to slow down the deterioration process, at least it will be useful to identify the related body of knowledge. Potentially, synergetic effects might be expected if this body of knowledge is integrated with formal research and extension.

Processes of change in indigenous ways of farming are still little understood. Suggestions have been made (e.g. Ruthenberg, 1983) that farmers are able to adapt to long-term environmental changes, whereas adaptation to 'faster' changes like commoditisation, penetration of capital, state intervention and rapid environmental change as a result of climate appears to have received varied responses. In general, attention is focused on the short-term effects, whilst the longer term effects receive much less consideration. It will be useful to learn more about the farmers' capacity to change. To what degree and with what speed do they react to changes occurring in their socio-economic and physical environment? What are the differences between farmers with respect to changes? Can local research and development activities be identified in this respect? What characterizes these activities?

Research indicates that management and development planning concepts, long regarded as the domain of the Western world, also exist in other regions. Indigenous organisations have played important, self-reliant development functions for many generations (e.g. Richards, 1985, for West Africa; Rhoades & Bebbington, 1988, for Peru; Ravnborg, 1990, for Tanzania; Warren, 1992, for Nigeria). Notwithstanding these efforts, more research seems necessary to identify the body of knowledge and the ability to change at the local level, taking into account geographical, ecological and cultural variations.

In tropical rainfed areas farmers live in a fairly uncertain situation. In relation to decreasing soil fertility, farmers and other actors will have to collect or generate information from their physical and social environment. New objectives, technologies and social behaviour will have to be created (not always consciously) in response to changes in the environment. These changes can result predominantly from internal dynamics or originate from outside, in the latter case sometimes after adaptation or regulation by inside forces. As experience is accumulated, populations increase or decrease. New opportunities and aspirations arise, and the natural resource base deteriorates or improves. The farming system changes correspondingly with these varying features. The development of technology through experimentation and integration of new knowledge is a current phenomenon amongst rural people.

Selection and adaptation by farmers of outside information and knowledge are guided by processes like preference, relation with actual experience, perception of the external information and knowledge, and their own research and development capabilities (adapted from Rogers, 1983). Rogers uses the term 're-invention' to describe processes of adaptation (*ibid.*, p.175). Concepts to describe these phenomena will be elaborated in Chapter 2 (Theoretical perspective).

Fresco (1986: 37) argues that, to a large extent, the African (agricultural) crisis today is also a crisis of local knowledge that is not adapted anymore to the

rapidly changing circumstances, in particular changing man/land ratios. This assumption needs further research: What impact have these new circumstances had on rural people? How can dynamic change in rainfed agricultural systems be identified?

1.4 The articulation of rural people's knowledge with research and extension

During the colonial era and after independence, rural people's knowledge was often regarded as backward, static and 'traditional'. Indigenous systems were regarded as having low productivity and in need of replacement by 'modern' techniques. As mentioned in § 1.1, in the 1970's the Green Revolution worked reasonably well for the richer farmers living in advantageous conditions (homogeneous, irrigation, developed infrastructure, etc.) in some Asian regions. Often, it did not work for small-scale farmers in Africa who depend on rainfed agriculture (Lipton & Longhurst, 1989). A basic assumption underpinning the Green Revolution as well as other dominant models like the Training and Visit System (Benor & Harrison, 1977), is that the technology needed is externally generated and has to be brought to farmers.

Gradually attention has shifted more towards specific target groups. In extension science it is seen as essential to analyse and build on the knowledge of the target group. Predispositions of this group vis-à-vis the intervention theme is seen as a vital point of attention for the success of any intervention (Van Woerkum, 1987). Extension, research and other 'solution building' institutions must have information from and about their target clients otherwise they remain totally ineffective (Röling, 1988: 54). Röling argues that research, extension and other 'solution building' institutions must have 'needs orientation' and be 'client oriented' (*ibid.*). Extension programs aiming to change voluntary behaviour are more effective if they incorporate and build upon knowledge already existing in the envisaged people. When studying farmers it is obvious that they were already farming long before agricultural researchers started. Farmers developed useful crops, crop varieties, cropping systems, knowledge about soils, etc.

'Target' group suggests that knowledge and technologies are constructed externally for a given group of people, which will then be 'extended' to the 'target' group. During this process attention is often given to participation by the 'target' group. However, the assumption still holds that development practitioners are the experts who collect the intelligence. Experimenting together with farmers and the deliberate facilitation of their capacity to experiment is an altogether different approach (cf. Röling, 1992b).

Researchers began to advocate the acceptance and incorporation of rural people's knowledge in the late 1950's (cf. De Schlippé, 1956), though, incidentally, earlier studies had stressed the value of rural people's knowledge (cf. De Vries 1931a; Thornton & Rounce, 1933; Faulkner & Mackie, 1933). In recent years, interest surrounding this issue is increasing (cf. the Centre for Indigenous

Knowledge for Agriculture and Rural Development (CIKARD) at Iowa, USA; Geschiere, 1984; Rhoades, 1984; Richards, 1985; Baerg, 1985; Chambers and Jiggins, 1986; Chambers *et al.*, 1989; Warren, 1990; Dupré, 1991; Warren *et al.*, 1991; Jiggins & De Zeeuw, 1992, (Participatory Technology Development)). The creation of regional centres for indigenous knowledge such as the African Resource Centre for Indigenous Knowledge (ARCIK) at Ibadan, Nigeria, demonstrates growing interest in this subject.

Warren (1992: 7-8) argues that in the past decade, considerable attention has been given to the role that rural people's knowledge and decision-making as well as indigenous organisations play in the development process (e.g. Warren *et al.*, 1991). In the context of local-level development, indigenous decision-making is carried out through knowledge processes whereby rural people identify their problems, discuss priorities, and seek solutions to them. Most rural people's knowledge systems have not been recorded and hence are inaccessible to outsiders. Likewise, the myriad of indigenous organisations which can exist in a community are often invisible to the outsider unless that person spends considerable time in the locality. Development activities can, however, be greatly enhanced by working with and through indigenous organisations rather than setting up new associations (*ibid.*).

Until recently, research on rural people's knowledge was mainly conducted by anthropologists, but nowadays the subject has gained the interest of other disciplines. Fairhead distinguishes two distinct approaches emerging in the study of rural people's knowledge (Fairhead, 1992: 2). The first approach considers the study of rural people's knowledge to involve interpreting and empirically analysing the validity of local agro-ecological beliefs and practices, in terms of the conceptual apparatus of Western agricultural science and economics. This approach aims to:

1) evaluate the accuracy of rural people's knowledge;
2) bring it together with formal science in the research and development process, so that the comparative advantages of each can be realised; and
3) empower local people vis-à-vis those scientists and planners who will only be convinced of indigenous wisdom through scientific assessment of it.

This is the dominant perspective (*ibid.*).

The second approach assumes that the cross-cultural study of agricultural knowledge necessarily challenges the conceptual apparatus of Western agricultural science (e.g. Darré, 1985; Bourdieu, 1990; Long, 1989; Long & Long, 1992; Fairhead, 1992). Whereas the first approach aims at better 'targeting' towards the corresponding 'target' group, the second approach recognizes the farmer as an expert and elaborates on the consequences of this fact for development activities. The first approach assumes the existence of one 'truth' and one 'existing reality'. The second approach acknowledges that different perspectives can be equally valid and that several socially constructed realities exist. 'Reality is in people'. These two different approaches as well as their consequences for development activities will be elaborated in Chapter 2 (Theoretical perspective).

Current agricultural disciplines seem unable to handle the heterogeneity characteristic of rainfed farming under demographic pressure (see § 1.1 and § 1.2). Heterogeneity often impedes universal solutions. Scientists tend to overestimate the value of generalisable universal knowledge and information compared to location-specific knowledge and information.

Whereas the Western academic disciplinary approach tends to be compartmentalised and reductionist, rural people's knowledge can be characterised as integrated across disciplines. As argued in § 1.2, farmers have an integrating role, seeing the farming system as a whole, with perceptions of 'natural' divisions in the biological worlds and land-plants-animals-human relationships within each division (adapted from Posey, 1983: 879). Integrated systems of beliefs (perceptions, cognition, and practices) are present amongst various rural peoples across the world. Muchena and Williams (1992: 16) see rural people's knowledge as holistic and inclusive in its epistemological framework and approach to reality. Agriculture in many rural people's knowledge systems is both technical and social in that it has strong cognitive and affective dimensions. A technical aspect as well as a social or cultural aspect seems inherent in rural people's knowledge. To understand why things are as they are researchers need to accept the epistemological challenge that their way of considering agro-ecology is not the only way (Fairhead, 1992: 15). Abstraction of technical knowledge from farmers' conditions neglects the cultural and historical knowledge basis of local practices (see also Chapter 2: Theoretical perspective).

Indeed, a connected problem mentioned in relation to the articulation of the two bodies of knowledge (e.g. Thrupp, 1989; Warren *et al.*, 1991; Fairhead, 1992) is the danger of rural people's knowledge being marginalised or losing its value when researchers 'scientise' it by examining it with formal empirical methodologies and using laboratory-controlled trials. In the process of abstraction, the cultural and historical knowledge base of farmers' practices might be neglected. Attempts at scientific systemization may misinterpret the cultural value and subtle, complex nuances of such knowledge systems that are incomprehensible in terms of Western scientific theories. Ethical considerations should be established regarding how scientists or researchers should (or should not) extract, study, and 'use' knowledge of rural peoples (Thrupp, 1989: 22). Farmers should not come to regard their own knowledge as 'non-scientific' and begin to undervalue it.

A new role emerges for indigenous organisations and the body of knowledge existing at the local level. Whereas former models of extension emphasized utilisation of formal research results, increasingly attention is given towards rural people's knowledge. Many agricultural technologies in use today were developed by farmers, not by formally educated scientists (Reijntjes *et al.*, 1992). During the last two decades (1970-1990) development approaches have shown a gradual shift from top-down approaches to more bottom-up approaches which integrate the participation of the target groups. From Transfer of Technology (TOT) (Chambers & Jiggins, 1986) attention has shifted to facilitation of rural

people's own 'sense making' activities (Röling, 1992b; see also Chapter 2).

Nevertheless, participatory meetings are often dominated by bearers of formal knowledge, preventing alternative ecological perspectives from being aired (Fairhead, 1992: 24). Moreover, mutual articulation of the two bodies of knowledge, the formal ('scientific') and the informal ('local') is as yet inadequately developed.

The former scientific body of knowledge tends to rely on the existance of 'one single reality' outside people which is increasingly 'discovered' by scientists. However, mutual articulation of scientific knowledge with rural people's knowledge seems better served by adopting the view that reality is socially constructed by means of 'sense making activities' (Berger & Luckmann, 1967; Holzner, 1968). This issue will be examined in Chapter 2 (Theoretical perspective).

A recent example of collaboration is Participative Technology Development (PTD), a methodology by which various partners in technology development cooperate in order to ameliorate technology used by farmers (Chambers & Jiggins, 1986; Haverkort *et al.*, 1991; Jiggins & De Zeeuw, 1992). PTD is the process by which knowledge and research capacities of farmers are joined with those of commercial and scientific institutions. In joining these capacities, PTD tries to strengthen the already existing experimental capacity of farmers, as well as the local management of innovation processes.

However, where rural people's knowledge and related issues such as local experimental capacity are still insufficiently understood, additional research seems necessary. Studies of the products of rural people's knowledge, though valuable, do not reveal those underlying properties and knowledge processes in a satisfactory way. The processes of learning of rural people, such as experimentation, observation, reaching consensus, and adaptation need a new approach in the assessment of their value and support in the conception and implementation of relevant development activities.

1.5 Formulation of the research problem, objectives and justification

1.5.1 Formulation of the research problem

A research problem definition seeks to formulate the central question which the research aims to answer (Swanborn, 1981: 17). Previous paragraphs in this chapter have described the situation of farmers in rainfed agriculture in terms of their body of knowledge, a need for change induced by increasing demographic pressure, and limited support by research and extension.

The present book seeks to present the case of just such an ethnic group: the Adja, living in South-West Benin, West Africa (see Annex 7: Map 1). A deeper insight into Adja knowledge and its creation related to their situation, characterised by increasing demographic pressure, will be sought. In addition, an elaboration of inherent properties of Adja knowledge and change capabilities will be

given. The Adja have an urgent need for a change due to declining soil fertility. Meanwhile, at the time of the fieldwork, no clear alternatives were available in terms of off-farm work or migration, or were offered by formal agronomic research (for the last element: cf. Von der Luhe, 1991b). This provided a unique research setting for a case of rural people's knowledge in action. For an elaboration of this argument and my choice of the Adja people for this research: see Chapters 3 and 4.

The overall question which the present study addresses is formulated as follows:

How do Adja farmers experience and react to increasing demographic pressure (resulting in declining soil fertility), what is the related body of (agricultural) knowledge they use, and which learning processes result in this knowledge?

More specific questions this study tries to answer are:
1) What is the body of knowledge which Adja farmers have developed?
2) How is Adja agricultural knowledge constructed and used (knowledge processes)?
3) How is external knowledge looked for, selected, tested, evaluated and eventually integrated, in an adapted form in Adja farming methods (knowledge processes)?
4) What are the characteristics of the various categories of Adja farmers in respect to their reaction to declining soil fertility?
5) What are the implications for research, extension and policy, and what is the potential for development?

1.5.2 Research objectives

The main objective of the present research is the identification and description of Adja farmers' agro-ecological knowledge products and related knowledge processes with an emphasis on farming under demographic pressure and declining soil fertility. This general objective will be divided in the following six derived objectives.

The first is the identification and description of Adja ways of classifying and conceptualising agro-ecological knowledge (e.g. soil types, climatological indicators, mixed cropping systems, weeds, etc.).

The second is the identification and characterisation of individuals and groups within the Adja community who are especially active in their involvement with knowledge processes, e.g. changing norms and values of how to farm.

The third is the identification of new norms and values of Adja farming and concomitant technologies as a result of increasing land scarcity.

The fourth is a description of diversity in Adja ways of farming, including demographic conditions, individual variation, as well as social differentiation.

The fifth is the identification of Adja experiments, inventions and innovations, and the tracing of innovations.

And the last derived objective is the identification and description of processes implemented due to externally generated technical change. The term 'externally' will be further subdivided to distinguish the research and extension carried out on (or related to) the Adja plateau on the one hand, and other external sources of change, for instance migrated Adja, other ethnic groups, traders, or taxi drivers, on the other hand.

1.5.3 Justification of the research

The identification of Adja knowledge and related knowledge processes provides a fund of useful material that can be utilised by the Adja farmers themselves, other farmers facing similar difficulties, researchers, extension agents and others interested in human adaptation to changed circumstances. Principles of agro-ecology can be identified by studying the agro-ecosystem as practised by the Adja, which opens possibilities for such principles to be applied in other situations, e.g. for environmental problems in Western types of agriculture. Conventional farming in industrial countries is generally seen as unsustainable.

In addition, understanding Adja knowledge and related knowledge processes hopefully allows a better theoretical understanding of coordination between farmers, research, extension and other actors operating in a development perspective. The present study seeks to enhance mutual articulation amongst Research, Extension and rural people's knowledge and to provide a baseline for policies and interventions to support Adja farmers adopting a PTD approach. Facilitation of rural people's knowledge production will be enhanced by understanding rural people's knowledge processes and products. It is intended that this will motivate outsiders to gain respect for rural people's knowledge, as well as providing an insight into how improvements might be brought about. Instead of trying to discover the complexities in models of farming, the study seeks to develop models of joining ongoing farmer activities. The information gathered during this work, and its application in the future by different concerned parties, form the justification for the research.

'I do admit that at any moment we are prisoners caught in the framework of our theories; our expectations; our past language. But we are prisoners in a Pickwickian sense: if we try, we can break out of our framework at any time. Admittedly, we shall find ourselves again in a framework, but it will be a better and a roomier one; and we can at any moment break out of it again'.
(Popper, 1970: 56)

2 Theoretical perspective

This chapter gives the theoretical perspective relevant for the present research. An analysis of the relationship between researcher and rural people will be given, a systems perspective on rural people's knowledge as well as an elaboration of rural people's knowledge and related items.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

2.1 An introduction to the mutual articulation of rural people's knowledge and scientific knowledge

In Chapter 1, the need to analyse rural people's knowledge was assessed, viewed as part of the increasing problems in rainfed agriculture owing to declining soil fertility and stagnating development efforts. Understanding of environmental degradation processes indicates that greater attention should be given to stability and sustainability. The latter two issues can be better understood by studying rural people's knowledge. The complexity of the processes involved cannot be defined only by research on variables relating to productivity. Chapter 1 argues that farmers establish a balance between needs, labour availability, knowledge and technologies, and resources while manipulating diversity. This process is location and time-specific, and results in unique ways of farming which are an inseparable part of the ethnic culture. However, rural people's knowledge tends to be marginalised and eroded as a result of 'modern' influence (e.g. Bolhuis & Van der Ploeg 1985; Warren *et al.*, 1991). This chapter discusses some theoretical views and concepts regarding rural people's knowledge and the role of the scientist.

Chapter 1 (end of § 1.3) argues that the mutual articulation between the formal ('scientific') body of knowledge and its informal ('local') counterpart is poorly understood. Currently a crisis in development thinking is apparent as a result of lack of effect or even negative results. One possible approach towards responding to the crisis is a better mutual articulation of the two above-mentioned bodies of knowledge. Rural people's knowledge, as well as underlying knowledge processes like experimentation and information exchange amongst rural people, has become a subject of increasing importance. In addition, the exploration of rural people's knowledge reveals socio-economic factors important to development practitioners.

There has been a noticable change in the ways that researchers and extension agents deal with rural people, or the 'target' group. New knowledge, supposedly beneficial, was formerly constructed after studies into socio-economic factors. In older approaches like the commodity approach, which concentrated on export crops often mainly for colonial interests, this type of study was absent. In more recent approaches the inclusion of socio-economic factors is extended to the knowledge construction phase: *on-farm technology development*. As indicated in Chapter 1, a new approach has evolved (e.g. Chambers & Jiggins, 1986; Röling, 1988; Haverkort *et al.*, 1991; Van der Ploeg, 1991), which gives yet another role to the researcher or change agent. It is his or her work to acknowledge the part that rural people play and to stimulate the ongoing research and diffusion within the rural community. Chapter 1, § 1.3 ended with the example of Participatory Technology Development (PTD). PTD aims to mobilise and ameliorate farmers' capacities to produce and integrate new knowledge and transform this into practical methods and skills, through experimentation and evaluation. Haverkort *et al.* (1991) described the PTD approach as the practical

process of combining the knowledge and research capacities of the farming communities with that of the commercial and scientific institutions, in an interactive way. It involves activities where farmers and traders work together with external actors in the identification, generation, testing and application of new technologies. Rural people should not be viewed as passive recipients. Within the new approach they are viewed as intentional beings who generate new knowledge and insights, while reacting actively upon environmental limitations and possibilities. They actively construct their world.

Until recently, one reason for the analytical neglect of cultural values in ecological matters is that these values are often encoded in religious beliefs, rituals, ceremonies, and myths (Brokensha *et al.*, 1980; Posey, 1983). Another reason might be that current agronomic science is not accustomed to dealing with the highly complex, diverse and inter-related knowledge of rural people (see § 1.2). Formal science has a tendency to become fragmented along disciplines.

As argued at the end of § 1.4, formal science is often seen as the agency which will reveal 'reality' progressively. According to this view, only one reality exists outside the observer. Incidentally, rural people might have contributed to that reality, but formal science is seen as the dominant agency constructing 'reality'.

In the present study, another view has been adopted; social construction of several realities takes place via 'sense making' activities (Berger & Luckmann, 1967). Berger and Luckmann (*ibid.*, p.20) argue that knowledge is generated in everyday life via objectification of subjective processes. Thus, reality is inter-subjectively constructed. Rather than seeing human conduct as governed by laws or as caused like events in nature, we have to understand the intentions and reasons which people have for their activities (Giddins, 1990: 125). Likewise, Maturana and Varela (1984), studying cognition as a biological phenomenon, argue that the world is brought forth in the process of knowing. In their view (*ibid.*, p.244) '... cognition does not concern objects, for cognition is effective action; and as we know how we know, we bring forth ourselves'. Understanding this argument gives human beings insight into the reasons for their behaviour, and its social setting.

Van der Ploeg (1991: 211-2, discussing Koningsveld & Meertens, 1986) elaborates on the difference between rural people's knowledge and scientific knowledge. The latter is mainly constructed in a nomological way, with an *if – then* structure. The Western cognitive system is based on propositions which are universal in place and time and mainly based on cause effect relationships. Its cognitive basis has principles identified by induction or based on propositions which are logically deduced from axioms. Ultimately it might result, under precise determination of preconditions, in prescriptions on how to operate in practice. This way of making theories is, however, reductionistic; in this manner the study of rural people's knowledge leads to its impoverishment.

Van der Ploeg (*ibid.*, p.212, discussing Van Kessel, 1988) argues that cause – effect relationships are also present in the 'environmental' knowledge of rural

people. However, the basic structure of the argument seems often to be different from scientific knowledge: a subjunctive way which points at a universe of possibilities. 'The subjunctive mood is rooted in the creative fantasy of man and orientated towards the exploration of possibilities and (...) selection of preferences considered realisable' (*ibid.*, quoting Van Kessel, 1988: 38, my translation, JB). Van Kessel argues (1988: 35; quoted by Van der Ploeg, *ibid.*, my translation, JB) that 'within rural people's knowledge, sources of knowledge are present like intuitive preferences, admiration, predilection, faithfulness to tradition, and responsibility'. This accords with the assumption made in § 1.3.1 that rural people's knowledge is inclusive in its epistemological framework and approach to reality.

Correspondingly, Habermas (in Brand, 1990) criticizes 'scientism', that is, science's view of itself, not as one form of cognition but as cognition as such. To accept this self-image of science would, for Habermas, amount to banning important questions related to the problem of what constitutes right action. According to Habermas, widening the concept of rationality infers the acknowledgement that theoretical discourse, centering on questions of truth about the objective world, is not the only form of rational discourse. This point recognises that practical discourse which focuses on questions of rightness concerning the social world can also make a valid contribution (*ibid.*).

The present study adopts the view that one true reality outside us cannot exist. Rather, knowledge is socially constructed and therefore changing and evolving constantly within society (cf. Röling, 1988; Nencel & Pels, 1991). We actively construct knowledge and try to make sense out of a chaotic environment (Röling, 1988: 183-6).

2.2 Rural people and the scientist, an analysis of the interaction

As argued before, the dominant perspective on development leads to an evaluation of rural people's knowledge in terms of the conceptual apparatus of Western agricultural science and economics. However, the PTD approach acknowledges rural people as experts and elaborates on their knowledge in development. Technologies are inseparable from their socio-economic situation. This fact was recognised through the problematic introduction of externally generated technologies into rural people's societies and has become a generally accepted assumption, nowadays (e.g. Bolhuis & Van der Ploeg, 1985; Warren *et al.*, 1991; Cernea, 1991; Fairhead, 1992).

Rural people's norms and values, as well as the practical organisation of their work and objectives can be analysed in a dialectical process, whilst studying their technologies. This means more than just respecting rural people's knowledge: it involves the sharing of respective ways of knowledge. There is an important difference between researching with the farmer on issues that have been identified as important to him or her through a participative process, and doing

research on issues which only the researcher considers important (Sriskandarajah *et al.*, 1989).

Studies of rural people's knowledge often use *participant observation*, a commitment by a researcher to adopt the perspective of the respondents by sharing their day-to-day experiences. In order to 'get into the "subjects" skin', an anthropologist will often endeavour to live amongst them, seeking to empathize with their everyday roles (Rogers, 1983: 46). Through 'total' immersion in the respondents' world, the anthropologist gains a holistic perspective of the lifestyles, world views, and social relationships of the respondents. However, the anthropologist, whilst trying to understand the variety of human experience, cannot hope to isolate that experience and comprehend it permanently. Even in attempting this, he or she contributes to human experience, distorts its meaning, and thus makes it all the more difficult to comprehend (adapted from Dwyer, 1979: 205). Dwyer argues (*ibid.*, p.217) that in the confrontation between researcher and subject, both parties change and develop as they interact with one another. Thus, whilst trying to determine and present various viewpoints of members of farming communities, it should not be assumed that these are the only ones. The researcher's theoretical suppositions and values intrude, even with the best of intentions.

Cicourel (1964; quoted by Zijderveld, 1973: 164-5) argues that social scientists tend to forget that their research itself also should be viewed as an interaction process. Zijderveld (*ibid.*) analyses this interaction as a *symbolic interaction*, which happens in a shared culture with rules and values taken for granted; as expressed by both the scientists' language and the respondents' language. Cicourel (1964: 35, quoted by Zijderveld, *ibid.*) discusses language: 'We view the language of measurement as a derivation from our conception of the physical world and the nature of logical and mathematical systems. Thus, science and scientific methods as a means of viewing and obtaining knowledge about the world around us, provide those who accept their tenets with a grammar that is not merely a reproducing instrument for describing what the world is all about, but also shapes our ideas of what the world is like, often to the exclusion of other ways of looking at the world. Language, and the cultural meanings it signifies, distorts, obliterates, and acts as a filter or grid for what will pass as knowledge in a given era'.

Thus, anthropologists construct meaning rather than just observe it. Many anthropological statements possibly evoke more about the anthropologist and his culture than about the culture of the participants (Bakker, 1988: 100). Accordingly, Bourdieu (1990: 34) calls participant observation, in a sense, a contradiction in terms. He argues (*ibid.*): 'The participationist option is simply another way of avoiding the question of the real relationship of the observer to the observed and its critical consequences for scientific practice'. The researchers' model of reality is not the same model that participants apply. It is not a very useful exercise to determine which model is more appropriate. Jarvie (1984) argues that the ancient view of science to gain the truth is challenged in anthro-

pology by the doctrine of cultural relativism, that is, that truth varies with the cultural framework.

Jarvie (*ibid.*, p.30) argues that science is an institution that functions to facilitate learning from experience; and that societies also have other institutions which fulfil this function, for example folk wisdom, religion and magic. In his view, these latter institutions are less effective than science. I would argue, however, that merely comparing those two kinds of rationality does not promote an integral point of view, in which scientific rationality is combined with the rationality of a given society.

Furthermore, in my view effectiveness or rationality cannot only be regarded in abstract, non-social terms like universality, transcendence and neutrality. For instance, the search for sustainable ways of dealing with nature and for guaranteeing agricultural productivity demands locality-specific forms of agriculture. This search will be helped by the historically amassed body of knowledge created by the corresponding society and local ways of learning and related social institutions, which are intrinsic parts of rural people's knowledge systems (see also elaboration on soft systems in § 2.3).

While discussing the conditions in which the production of rural people's and scientific knowledge takes place, it should be noted that applied science rarely comes up to the rigorous, universal scientific standards. Like farmers, agronomists act with a body of concepts and theories with which they explain the world and which is not constantly questioned. This body of concepts and theories is often constructed away from the scene of operation and the choice of research subject and methods is largely determined by the institute in which the scientist works. The institute is often entrenched in its own particular structure with its own norms, networks, negotation possibilities, etc. In his or her daily working conditions, the agronomist is in a position which is not fundamentally different from that of a farmer (adapted from Floquet, 1992: 11 and Drinkwater 1992: 7).

In anthropology there is a debate on rationality (e.g. Jarvie, 1984) in which the central question is whether 'rationality' is culture-bound or whether, on the contrary, it has a universal structure. In this debate Habermas, like Jarvie, takes the latter position (in Brand, 1990: 33). But he adds the qualification that this holds only if rationality is not identified just with goal rationality but regarded as also having to do with validity claims concerning the social world and the world of the inner states and feelings. Habermas insists that validity claims (of respondents, JB) cannot be understood without being taken seriously, and that taking them seriously requires that people take a position towards them (*ibid.*, adapted). We cannot understand reasons without at least implicitly evaluating them (Habermas, 1985: 204, quoted by Brand, 1990: 33). Likewise, Latour (1987) stresses the fact that the context in which research takes place should be included in the analysis. He argues that in discussions on rationality, scientists tend to understand results of science as rational, *known facts*, whereas other views are seen as irrational, *believed* by non-scientists.

In trying to understand the others' point of view, a continuous dialectical

connection can be noticed between the most local of local details and the most global of global structures in such a way as to bring them into simultaneous view (adapted from Geertz, 1963: 69). Geertz argues that this *hermeneutic circle* is central to ethnographic interpretation or to the informal annotation of everyday experience we call common sense (*ibid.*). The concept of *hermeneutic circle* seeks to express the idea that a social scientist is bounded by the own culture (Zijderveld, 1973: 191).

Dwyer (*ibid.*, p.217) argues that in the confrontation between what he calls *Self* and *Other* (researcher and respondent, JB), both parties change and develop as they interact with one another: 'In the succession of events and dialogues, we are able to see what we should in the presentation of any anthropologist's fieldwork experience: a complex process of adjustment and readjustment, of false beginnings, hesitation, and redirection, of streaks of continuity and moments of rupture. This experience is not a series of steps towards absolute knowledge of a pristine, discreet Other, or of a prior reality, but involves the *creation* of an interdependent Self and Other which constitutes a *new* reality' (*ibid.*). 'Dialogical anthropology' (*ibid.*) views and presents its 'knowledge' as a moment in an ongoing process, which is constantly open to reconsideration and reinterpretation. It is fundamentally reciprocal and symmetrical. 'Dialogical anthropology' rejects the privileged role of the anthropologist in constructing and interpreting anthropological 'data'. In the encounter with people from other cultures 'dialogical anthropology' further questions the cultural framework of the anthropologist as critically as that of the participants.

Nowadays, rural people's knowledge interacts with scientific knowledge in almost all rural areas (Van der Ploeg, 1991: 213). Therefore, rural people's knowledge is increasingly involved in this interaction by refusing, selecting and adapting parts of scientific knowledge. Van der Ploeg (*ibid.*, p.214, adapted) argues that within agrarian development both bodies of knowledge represent different interests and perspectives, and that ultimately the main issue relates to who controls the labour and production processes in agriculture.

I would add to this assumption, following Dwyer's argument (*ibid.*), that the researcher, interested in rural people's knowledge, operates at this interaction level. By identifying and recognising the control of different actors representing both bodies of knowledge, the researcher contributes to a clarification of knowledge and control processes. Pointing out that control mechanisms exist and should be dealt with accordingly, clarifies the positions of both bodies of knowledge.

Thus, whilst examining rural people's knowledge, a critical analysis of the researcher's intention is necessary. For example, knowledge on medicinal utilities of various plants can be utilised by external commercial agents, who seek to develop new drugs. Rural people might stop using plants for medicinal treatments due to the adoption of Western standards, the same standards that invoke them to buy pharmaceutical drugs chemically developed by using extractions from their own plants.

Correspondingly, a representation of rural people's knowledge should be viewed as a reconstruction of (momentary) knowledge by both rural people and the researcher through a process of dialogue. It cannot be a pure objective representation of rural people's knowledge as the researcher, intentionally or otherwise, imposes an explicit structure upon his or her experience. Inevitably it tends to concentrate upon the observer's framework rather than that of the participant. Seen from this point of view, attention should be paid to research which mainly seeks to identify a classificatory 'stock' of knowledge *products*. Apart from the fact that it could evoke a static view, and by doing so, overlook key knowledge processes which resulted in the 'stock', it also camouflages the researcher's point of view.

Lévi-Strauss (1962) was one of the first to alert writers to the complexity of the classifications and the taxonomies that appear in the languages of 'simple' societies. He argued that 'the universe is an object of thought as it is a means of satisfying needs' (*ibid.*, p.3). Classifying, as opposed to not classifying, has a value of its own, whatever form the classification may take. In addition, *in vivo codes*, as Strauss and Corbin (1990: 69) label classification terms of informants, give more understanding of people's interpretations of reality.

An example is given by Darré (1985), who has shown that within a small French community of livestock breeders, informal communication networks exist whereby reality is constructed. In order to transform their knowledge and skills to meet new demands, farmers seek to have access to new information by relating to informal networks. 'Professional groups' as he calls them, experiment and elaborate on norms and methods of operation as stock breeders. These norms are constructed and transformed into daily dialogue and Darré and his collaborators used the corresponding breeders' words as 'our means to access their cognitive system' (*ibid.*, p.11, my translation, JB).

However, the interpretation and reconstruction of classificatory principles is not without problems. A static view could be evoked, whereby problems of change (of which creative activity is a significant part) are relegated to the background. Furthermore, rural people tend to classify in a functionalistic way, whereas scientists tend to classify according to 'universal' criteria; thereby overstressing general knowledge compared to location-specific knowledge. Soil scientists, for example, use soil classifications which are universally applicable; whereas farmers are more interested in field specific conditions.

Thus, studies on rural people's (classificatory) knowledge *products* should not obscure attention to related knowledge *processes*, which often indicate changes and differences in knowledge at a heterogeneous and dynamic level. A momentary analysis of practice and current knowledge to be found should not detemporalize its rhythm and directionality (Bourdieu, 1990: 81). Bourdieu argues that 'practice is inseparable from temporality not only because it is played out in time, but also because it plays strategically with time and especially with tempo' (*ibid.*).

Ethnographic studies show constant experimentation on the part of 'traditio-

nal' farmers with both cash and subsistence crops. Traditionalism evokes the assumption of agricultural communities constantly using particular production technologies with the same crops and livestock. A proper model, however, as indicated in § 1.3.1, shows reliance on highly complex, social, agronomic and economic interactions to ensure survival. Diversity is dominant, and includes crops, livestock, forest products, value added, labour trading, and selling activities. Whilst each enterprise may have a risk associated with it, in combination the activities balance each other, reducing risks (adapted from Flora, 1990: 30).

Attention should be paid to customs which are hardened in a way that advances vested interests at the time of its codification. Ranger (1983: 254) mentions some particular cases: the elderly sometimes tend to appeal to 'tradition' in order to defend their dominance of the rural means of production against challenges by the youth. Men might tend to appeal to 'tradition' in order to ensure that the increasing role which women play in production in rural areas does not result in any diminution of male control over women as economic assets. Another example given by Ranger (*ibid.*) are indigenous populations who sometimes appealed to 'tradition' in order to ensure that migrants who settled amongst them did not achieve political or economic rights.

The present research does not regard rural people's knowledge as the optimum knowledge basis warranting no further discussion. Rural people's knowledge often does not suffice for present problems, a point acknowledged by rural people themselves (Van der Ploeg, 1991: 292). This observation is strengthened by the fact that rural people intensively experiment (*ibid.*).

Accordingly, Swift (1979) and Biggs (1980) (in Chambers *et al.*, 1989: 37; adapted and extended) present some more problematic aspects of rural people's knowledge:

* rural people's knowledge and innovative capacity is unevenly distributed within and across communities;
* the ability of individuals to generate, implement, and transfer rural people's knowledge varies greatly;
* social groups and economic stratification affect the type and extent of rural people's knowledge in rural societies (e.g. richer individuals are likely to innovate more in aggregate, but poorer people may be forced to innovate by their poverty (Swift, 1979));
* the transfer and use of information is sometimes constrained and error prone where it has to be passed on orally and held in the heads of practitioners;
* the scope for improvements from 'pure' rural people's knowledge is limited to what can be done with the local pool of techniques, materials and genetic resources, plus whatever is introduced casually;
* genetic possibilities are not always explored within the informal system, such as the crossing of self-pollinating crops where specific plant breeding techniques are required. Rural people's knowledge seems particularly limited concerning phenomena that cannot be directly observed;
* the confidence in rural people's knowledge may decline when people are faced with an environmental crisis or external interventions (adapted from Farrington & Martin, 1988);

* because it is not deliberately organised, rural people's knowledge might not change fast enough.

Insight into social differentiation and social struggle can be obtained by the actor approach which concentrates on actors and their existing or changing social networks (Long, 1989; Leeuwis *et al.*, 1991; Long & Long, 1992). Groups of actors may share the same sources of knowledge, networks, search for knowledge and its control, together with ways to acquire it, and by doing so enlarge their margin of manoeuvre. Whilst it seems clear that local networks exist within every community, it also seems evident that knowledge is not produced and exchanged in harmony. In addition, different kinds of knowledge represent different kinds of social positions and knowledge confrontation can be the result. This has often been observed in studies where rural people adhered to their knowledge and refused 'modern' knowledge. Whereas it was argued before that every farmer is an experimenter, the degree and range obviously varies. The degree of coordination and shared learning (or lack of it) are socially determined in every community.

The actor approach suggests that research adopts a view which allows room for the active role of persons in shaping the worlds they live in. Also it is argued that it is necessary to emphasise change and process, and the variability and complexity of life. These views are present in the Grounded Theory approach of Glazer and Strauss (e.g. Glaser & Strauss, 1967; Strauss & Corbin, 1990) and will be used in the present research. Strauss and Corbin (1990: 111) argue that 'In developing a grounded theory we are able to capture as much of the complexity and movement in the real world that is possible, while knowing we are never able to grasp all of it'. Grounded Theory seeks to systematise and solidify connections by using a combination of inductive and deductive thinking, in which we constantly move between asking questions, generating hypothesis and making comparisons (*ibid.*, p.131; Wagemans, 1987: 256). Chapter 3 (Methodology) gives an elaboration of this perspective. The role of the researcher, in this perspective seen as crucial, is elaborated upon in § 3.4.

Studies of rural people's knowledge reveals distinguishing features relating to a given collection of people sharing a culture, language, and common concepts (e.g. classification concepts). Before elaborating on concepts in § 2.4, a systems perspective will be discussed in § 2.3 which deals with interaction.

2.3 A systems perspective on rural people's knowledge

A systems approach to a problem takes a broad view, tries to take all parts of a problem into account, and concentrates on interactions between the different parts of a problem (adapted from Checkland, 1981: 5). A system can be identified as a collection of elements or entities and their relations (many definitions exist; for elaborations on the concept of system: e.g. Checkland, 1981;

Fresco, 1986: 40; Silverman, 1987; Röling, 1988: 186). According to Checkland (1981: 121), an observer's description of a system would contain as basic elements: his or her purpose, the system(s) selected, and various system properties such as boundaries, inputs and outputs, components, structure, the means by which the system retains its integrity, and the coherency principle which makes it defensible to describe the system as a system. By regarding a certain number of elements as a system, other elements are disclosed and an environment is created. If elements are functioning according to a systems perspective, synergy might be generated.

Farmers' decisions are not single and isolated but many and often constructed through social interaction. Social interaction has a historical dimension. Because of their prior existence and their consequent impact on choice, systems cannot be reduced to the sum of individual actions (adapted from Wells, 1991: 741). Farmers build up useful social networks and institutions whereby these social structures themselves help determine the acquisition, evaluation, use and even generation of farmers' knowledge. As argued by Kuhn (1962), a sharp distinction between issues related to the creation of knowledge (context of discovery) and issues related to evaluation and usefulness of knowledge (context of justification) cannot be made.

If change occurs within a rural society, e.g. as a reaction to soil fertility decline, an analysis of corresponding changes in rural people's knowledge might be clarified by using a systems perspective. Wells argues (*ibid.*) that rather than studying variables in isolation, a systems perspective seeks to explore the interrelationship amongst variables, thereby providing a more inclusive understanding of farmers' decision making constraints. By doing so, the intertwining of technical and social variables can be analysed. In addition, rather than focusing on individual choice, patterns of behaviour pursued over time by groups of farmers are examined, thus highlighting important differences in farmers' values and in their control over resources.

Funtowicz and Ravetz (1990a & 1990b) argue that the recognition of skills and judgements ('knowing-how') of people, in contrast to traditional scientific knowledge (mostly regarded as 'knowing-that'), gives way to a new type of science which they call *second order science*. Second order has a connotation of reflectiveness, which reminds us that science cannot be undertaken in neglect of human values and interests; nor can it ignore its own methodological presuppositions and problems (*ibid.*, 1990a: 14). Accordingly, they argue (*ibid.*, 1990a: 20) that it is becoming apparent that people's beliefs and feelings, whatever their source and validity, must be recognised and respected lest they become totally alienated and distrustful.

Funtowicz and Ravetz argue that urgency, complexity and uncertainty of current environmental problems indicate that the traditional view on science as having stable paradigms and purely involved in the 'knowing-that' has to be enlarged with the 'knowing-how' of other scientists and experts (*ibid.*, 1990b: 7). The latter refers to broad and complex issues of environment, society and

ethics, representing interests outside the social paradigm of the official expertise (*ibid.*, 1990a: 21). The present research specifically includes these issues when using the concept of knowledge system (see also § 2.4, conceptualisation of *knowledge system*).

Knowledge processes are viewed in this research as a key aspect of a knowledge system. Knowledge production will be viewed not as monopolised by formal research but as taking place within every individual. Everybody is engaged in interpreting reality and, by doing so, in constructing knowledge. Transfer of knowledge within rural communities takes place via socialisation, learning, exposure to other kinds of knowledge, etc. Stored knowledge is often encoded according to cultural preferences, e.g. oral media, elderly people, and religious regulations.

Engel *et al.* (1991) point to another knowledge process: the effective use of knowledge. For example, due to restrictive habits, some members of rural communities do not have access to or the right to use certain knowledge.

The way knowledge processes function is open to change, e.g. as a result of interaction with formal knowledge representatives or as a result of critical reflection by rural people. In addition, they also might vary as a result of the heterogeneity within rural communities. When conceptualising *learning* and *culture*, this will be further elaborated (see § 2.4).

Other issues given by Engel *et al.*, *(ibid.)* which can be studied within knowledge systems are functional differentiation between actors, integration between actors who each orientate towards a specific part of the knowledge system, coordination of actors, the effectiveness of a knowledge system, its adaptability to emerging new criteria, its interaction with possible new relevant actors and, finally, its internal dynamic.

Taking a broader perspective of farmers, not limiting rural people's knowledge research to its technical outcome and classificatory assets, can be done by applying the so-called 'soft' systems view (Checkland, 1981; Checkland & Scholes, 1990). 'Hard' systems are conceptualised as natural systems (e.g. the human body) or constructed systems (e.g. a car). Hard systems are seen as having unproblematic transparent functions, causes and purposes, and mostly the status quo is implicitly accepted and alternative social arrangements are not considered (Tsoukas, 1992: 640-1). A 'soft' system, in contrast to a 'hard' system, is regarded as being more open to the assumption that a 'human activity system' (Checkland, 1981: 114) is a social construct, with normative boundaries, and that its goals are people's goals since systems themselves do not have goals.

A distinction should be made between cognitive systems and systems related to networks of actors. In a cognitive system, actors do not necessarily know each other but share the same cognitive properties. In the second type of system, a network may perhaps become a system, i.e. when members of a network regard themselves as belonging to a system, emergent properties may be realised. It should be stressed that when regarding rural people's knowledge as soft systems

related to networks, actors involved mostly do not consider themselves as belonging to a system. A rural people's knowledge system will be regarded in the present research as a mental construction made for analysis.

A 'hard' system can be useful when the goal of participating actors is set clear; the *Weltanschauung* of actors mostly being taken for granted. However, in uncertain situations, where organisational development or other 'human activity systems' are observed, goals are not clear and 'hard' system methodology is not effective. In 'soft' systems methodology (SSM), we are forced to work at the level at which *Weltanschauungen* are questioned and debated; 'soft' problems being concerned with different perceptions deriving from different *Weltanschauungen* (Checkland, 1981: 219). Here, the task is to set common goals, to agree on boundaries and to make visible agreed-upon feedback indicators (Röling, discussing Checkland, 1992a: 14). Actors involved, with their multiple perspectives and intentionalities, may arrive via various processes at shared objectives and a shared view on reality (Checkland, 1981: 279; Röling, 1992a). SSM, being concerned with the creation of agency at a higher level of aggregation, may increase the potential for complex actor networks to make social learning more effective (Pretty, 1993: 5-6). SSM-like processes are taking place in many complex actor networks without a facilitator being present at all (Woodhill *et al.*, 1993).

A 'soft' system perspective on rural people's daily activities, intentions, preferences, etc., including other relevant actors (e.g. state representatives, business people, other cultural groups, transport agents) does not isolate certain parts of rural people's knowledge and regard them as optimal. In line with the analysis of the relation between researcher and rural people held in § 2.2, it identifies knowledge as situational and temporarily determined. It is the outcome of interaction between the afore-mentioned actors. The 'soft' system methodology offers the chance of making the transition from finding out about the real world to taking action in the real world by means of some system thinking *about* the real world (Checkland, 1981: 279). Its emphasis is thus not on any external 'reality' but on people's perceptions of reality, on their mental processes rather than on the objects of those processes (*ibid.*). Accordingly, Checkland argues (*ibid.*, p.219) that in a certain sense 'human activity systems' do not exist; only *perceptions* of them exist, perceptions which are associated with specific *Weltanschauungen* (see also discussion on 'sense making' activities in § 2.2 and 2.4). 'Soft' systems methodology scholars emphasise the embodiment of the paradigm of learning; the notion of 'a solution' whether it optimises or satisfies, is inappropriate in a methodology which involves a never-ending learning process (adapted from Checkland, 1981: 279).

Society should be conceived at as both System *and* Lifeworld, says Habermas (Brand, 1990: 38). Habermas connects action theory with systems theory, and argues that society should be 'understood' from the participant attitude of the actor as far as the Lifeworld is concerned; and from the objectifying attitude of the observer as far as the System is concerned. The former activity is an exer-

cise in communicative rationality, the latter a grasping of functional reason (in Brand, 1990: xiv). Likewise, Jackson (1991: 142-3) refers to Ulrich's insistence that the systems rationality of planners should always be tested against the social rationality of the affected (Ulrich, 1983). Jackson adds (1991: 145) that critical systems analysis must focus as much on revealing lost or suppressed knowledge as on the examination of knowledge which have survived and become dominant.

In the next paragraph, the concept of *rural people's knowledge system* and related concepts will be elaborated, taking into account the above discussion.

2.4 Conceptualising rural people's knowledge and related items

The present research regards a farmer as a person constantly engaged in learning about the characteristics of his or her environment (including social phenomena) in which he or she operates as part of the process of building and maintaining enduring relationships with other people and with the 'things' around him or her (adapted from Sriskandarajah *et al.*, 1989). A farmer deliberately acts upon farming practices by planning, observing, interpreting, manipulating and evaluating, ultimately generating a dynamic element (adapted from Van der Ploeg, 1991: 27). Accordingly, the 'average' farmer does not exist; diversity is a common phenomenon to be encountered amongst rural people.

Geertz (1983: 90) argued that common sense wisdom is shamelessly and unapologetically *ad hoc*: "It comes in epigrams, proverbs, *obiter dicta*, jokes, anecdotes, axiomised theories, or architectonic dogmas'. Geertz continues to argue that it is in the saying in a short manner, the paradigmatic form of vernacular wisdom, that the absence of methodology of common sense comes out most vividly (*ibid.*, adapted). I would argue, however, that related to rural people's knowledge another kind of knowledge is evident, with its concomitant methodology, which cannot simply be compared to scientific methodology. Rural people account for actions in 'common sense situations of choice', as Garfinkel calls it (1967: 11), and they have their own apparatus to classify, experiment and evaluate daily phenomena.

Departing from this standpoint, the following concepts related to rural people's knowledge will be further developed:

Rural people	Knowledge
Rural people's technology	Knowledge system
Innovation and invention	Rural people's knowledge system
Learning	Rural people's theory
Sense making activity	Learning system
Rural people's experiment	Culture
Organisation	Network
Gender	

Rural people

Regarding rural people's knowledge, various synonyms can be found: folk science, local knowledge, 'art de la localité', traditional knowledge, traditional agriculture, local inventiveness, ethno science, community environmental knowledge, indigenous technical knowledge, indigenous agro-ecological knowledge, and informal sector Research and Development.

In the present research, terminologies like 'indigenous', 'ethno', 'folk', and 'local' are not preferred, as they do not account for the fact that rural people actively look for and adapt external knowledge. The concept *rural people* will be used here to have a more or less neutral term which does not evoke obvious limiting connotations. The terminology 'traditional' will be avoided, as this often evokes a static connotation amongst readers, which does not acknowledge the dynamic aspect of rural people's way of living. The term 'traditional' in reference to agricultural communities is a relative one. Communities that are totally self-sufficient and currently engaged only in non-market subsistence production, are seldom found. Partial commoditisation (reducing factors of production to only monetary value and market exchange) is common amongst the majority of ethnic groups, and relations with market, state representatives and other ethnic groups nowadays is usual.

Knowledge

The concept of knowledge is a complex one and extensively discussed (e.g. Maturana & Varela, 1984; Beal *et al.*, 1986; Kuiper & Röling, 1991; see also § 2.1). Berlo, quoted from Engel (1991), defines knowledge as the set of concepts, meanings, skills and routines acquired actively over time by individuals or groups.

Knowledge will be viewed in this study as an interaction between a subject and the way reality is perceived or reconstructed. 'Knowing does not consist in copying the real, but in acting upon it and transforming it' (Florès, 1972: 33, my translation, JB). Knowledge is closely linked with action; farmers' experience is both expressed by its action as well as its knowledge. Thus, there is only a 'perspective' knowledge (Bourdieu, 1990: 28) and knowledge will be understood here as the result of experience, adaptation, shared learning and similar processes.

This view concords with the discussion in the former paragraphs of this chapter: knowledge will be regarded as a social construction that is only made meaningful when the agency of actors is accorded a central place in the analysis (Leeuwis *et al.*, 1991: 24). Knowledge is subjective, differentiated, constructed in its social context and not always accessible by everybody. It has a social dimension (knowledge is constructed in interaction between people) as well as an individual component.

The knowledge of a given group or community of rural people is the product of a long succession of experimenting to resolve agricultural, environmental, and social problems in a particular agro-ecological and socio-cultural context. As such it contrasts with scientific knowledge, which deals with presumed uni-

versal knowledge and is not primarily location or socio-culturally related. Rural people's knowledge does not feign universality, but is an explicatory concept related to a given place, period and group or category of people. It derives from their direct interaction with environment. Individual interpretation and reconstruction of exposed knowledge takes place in conjunction with conflicting factions. Within a given community, factions may exist that acquire external knowledge and integrate it with their prior knowledge; whereas other factions may coexist which rely predominantly on internally evolved knowledge. The confrontation of these different types of knowledge may result in new rural people's knowledge.

So, *rural people's knowledge* is defined in this research as the set of concepts, meanings, skills, and routines which emerge actively over time. These derive from the interaction amongst individuals from a particular rural society and their environment, which has been formed and transformed by the society itself (Chambers & Jiggins, 1986; Chambers *et al.*, 1989; Engel, 1991).

Rural people's knowledge is in a dynamic relationship with its environment (including the socio-economic and political environment) and is in constant evolution over time. Consequently, rural people's knowledge should not be viewed as static, with easily identifiable 'units' of knowledge, much like the packages offered by extension agents.

A distinction can be made between (1) knowledge *products*, (2) the social construction of rural people's knowledge which reveals social struggle and differences in theories, classifications, etc. (e.g. gender differences in farming); and (3) related knowledge *processes* (e.g. learning and knowledge creation processes, which result in knowledge products).

In short, it could be said that the present research regards rural people's knowledge not as a homogeneous, internally undisputed body of knowledge, nor does it attribute a romantic view to rural people's knowledge. Rather, obstructions exist which impede free entrance to knowledge and its exchange, whereby differentiation and diversity are to be expected within rural people's communities.

Rural people's technology

Rural people's technology will be viewed as the embodiment in terms of: (1) tools, equipment, machines and capital goods (hardware); and (2) forms of organisation, methodologies, procedures, practices and methods (software), with which to intervene upon the environment (adapted from Röling, 1992a: 8). We usually think of technology especially when dealing with instrumental relationships, i.e. interventions in the bio-physical environment (*ibid.*).

Knowledge system

A *knowledge system* consists of the articulated set of actors or networks, expected or managed to work synergically to support knowledge processes

which improve the correspondence between knowledge and environment, and/or the control provided through technology use in a given domain of knowledge activity (Röling, 1992c).

The actors comprising a knowledge system might be individuals, as well as aggregates of persons sharing one or more qualities, or organisations. They maintain contact with each other to a varied degree and quality. As argued in § 2.3, a network may become a knowledge system when individuals and/or organisations regard themselves as belonging to a system, pursuing emergent properties.

Rural people's knowledge system

A *rural people's knowledge system* will be regarded in this research (elaborating on Röling & Engel, 1988; Engel *et al.*, 1991) as consisting of a group of actors, members of a given rural community with their mutual relations and interactions, involved in making a livelihood out of natural and social resources at their disposal in a rural environment and engaged in various knowledge processes (e.g. knowledge generation, selection, manipulation, adaptation, encoding in retrievable messages, transferring, and utilisation). Actors may be individuals as well as social institutions, e.g. experimenting groups. Knowledge systems, as complex organisations, only acquire a mission as the outcome of the stakeholders' (often conflicting) objectives (Röling & Engel, 1991: 11). Rural people's knowledge systems, regarded here as soft systems (cf. § 2.3), do not have given objectives. The elaboration of objectives often takes place via negotiations, struggles, compromises, reformulations and similar actions.

Innovation and invention

Rogers (1983: 11) defines an *innovation* as 'An idea, practice, or object that is perceived as new by an individual or unit of adoption'. He defines *invention* as 'the process by which a new idea is discovered or created' (*ibid.*, p.138). An invention might be made by a farmer within the rural people's knowledge system or made externally (e.g. by formal research), both possibly leading to innovation and diffusion within the rural people's knowledge system. The former will be described in this research as *internally generated technical change*, and the latter as *externally generated technical change*. Note that externally generated technical change might be the result of rural people extracting externally made technology, without any involvement of external agents after the invention.

Learning

Learning will be regarded as the process by which an actor acquires and appropriates ways and repertoires to act, interact and reflect in the social and material world, that can help him or her realise objectives (adapted from Rap, 1992: 7). Rather than passively adapting to their external circumstances as they are originally encountered, human beings act positively (and sometimes at great costs) to transform recalcitrant environments in accordance with the dictates of subjectively held normative ideals (Heritage, 1984: 11). In this process learn-

ing is involved and rural people's knowledge systems are viewed here as learning systems. The learning capacity of rural people's knowledge systems is the result of learning by individuals and social learning, the latter being a derivative feature of interaction between the individual and his/her social peers. Successful methods of production are shared and communicated intra-generationally and inter-generationally through oral and experimental means (Richards, 1985; Elwert & Bierschenk, 1988: 99; quoted by Mazur & Titilola, 1992).

Learning will be regarded here as a dynamic process; a flux between sensory experiences of the world and their mental abstractions, and between experiencing and making meaning of these experiences (Bawden, 1989: 2). Likewise, Kolb (1984: 38) argues that learning is the process whereby knowledge is created through the transformation of experience. Kolb (1984: 40) discerns four adaptive learning modes in the process of experiential learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Most psychological approaches to human learning look within the individual in order to understand how learning occurs (Rogers, 1983: 304). The social learning approach looks outside of the individual as he or she exchanges information with others in order to explain how behaviour changes. The central idea of social learning theory is that an individual learns from others by means of observational modelling (*ibid.*).

Collective action is not unimportant in learning, but the continuity of a specific culture is largely maintained through the cumulative effects of the individual applications by its members. These can be members who are living at present and ones who are already dead but whose former actions somehow left their mark on the present. Likewise, changes result from the cumulative modifications of the existing cultural framework individual members have introduced in their everyday lives and which might be regarded as the result of learning. However, Western based models of learning might be more individually orientated, compared to other models of learning; thus implying that an open view for collective models of learning should be taken by researchers on rural people's knowledge systems. Shared learning models might have interesting lessons for other people.

Learning system

A *learning system* does not limit learning to the nature of the object under study but includes attention to the nature of the inquiry itself. Learning about learning and the ways we observe and understand reality implies that the observer cannot remain objectively remote from the system being studied (Bawden, 1989; Bawden & Macadam, 1991). Rather, it involves researchers in helping others to inquire into their own worlds as a basis for better informed actions (Bawden, 1989: 13).

Rural people's theory

In accordance with the definition of learning, a *theory* as used by rural people will be viewed as a set of congruent judgements, models or constructions made

by rural people whereby they explain observed phenomena and make predictions.

Sense making activity

To quote Berger and Luckmann (1967: 183): 'Man is biologically predestined to construct and inhabit a world with others. This world becomes for him the dominant and definitive reality. Its limits are set by nature, but once constructed, this world acts back upon nature. In the dialectic between nature and the socially constructed world the human organism itself is transformed. In this same dialectic man produces reality and thereby produces himself'. The basic assumption of Berger and Luckmann (*ibid.*), which will be adopted, is that of reality being actively constructed through processes of 'sense making'. *Sense making activities* are activities whereby people identify shared objectives, make theories, and learn.

Rural people's experiment

Experimenting is a 'sense making' activity. In accordance with the discussion held in § 2.2, an *experiment* of rural people is conceptualised as the linking together by rural people of cyclic observation, interpretation, and manipulation of his/her environment and the resources at his/her disposal. Likewise, Bolhuis and Van der Ploeg (1985: 46-7) see farmers' labour as inherently linked with experimenting. They argue that farmers' labour is characterised by the fact that it combines intellectual and manual work: thinking is constantly interacting with doing (*ibid.*).

Culture

Culture refers to specific systems of more or less interdependent, historically created and transmitted symbols, which are open for inspection, and through which groups of people order and direct their individual and collective lives (adapted from Bakker, 1988: 10). Knowledge is structured, transferred and diffused by cultural processes; culture giving knowledge and the related processes a coherent perspective.

Keesing (in Bakker, 1988: 121) criticises the tendency of interpretative anthropology to take culture as collective creations; to reify them into texts and to objectify their meanings. This approach obscures the fact that cultures also act as ideologies: 'Cultures are webs of mystification as well as of signification' (adapted from Bakker, 1988: 161). The analysis of cultural meaning has therefore to be complemented with an analysis of the wider social, economic and political structures in which this meaning is rooted. In practical terms, one has to examine who creates and defines cultural meaning, and to what ends (*ibid.*). According to Geertz (in Bakker, 1988: 144) all the aspects of culture, including religion and ideology, are ultimately not produced, maintained or changed by culture as a self-sufficient system in itself, but in and by the concrete daily practices of actual living people. This view agrees with the above mentioned definition of a rural people's knowledge system and the importance of 'sense making' activities.

Organisation

An *organisation* is a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labour (Rogers & Agarwala-Rogers, 1976: 26; quoted in Rogers, 1983: 348-9). Organisations are created to handle routine tasks and to lend stability to human relationships. Their efficiency as a means of organising human endeavours is in part due to this stability, which stems from the relatively high degree of structure that is imposed on communication patterns (*ibid.*).

Network

A *network* refers to a set of direct and indirect social relations, centred around given persons, which are instrumental to the achievement of the goals of these persons, and to the communication of their expectations, demands, needs, and aspirations (Anderson & Carlos, 1976). Social networks give insight into processes of interaction between people. Rogers and Kincaid (1981: 346-7) describe networks as *communication systems* and distinguish a *dyad* (two individuals connected by a communication link), a *clique* (subsystem whose elements interact with each other relatively more frequently than with other members of the communication system (network)), and a *personal communication network* (those interconnected individuals who are linked by patterned communication flows to a focal individual).

Gender

The term *gender* refers to a social rather than a biological construct, whereas *sex* refers to the physical and biological differences between men and women (adapted from Poats *et al.*, 1988). Poats *et al.* (*ibid.*) argue that *gender* describes the socially constructed attributes of men and women, including male and female roles. As a social construct, gender roles are based on learned behaviour and are flexible and variable across and within cultures.

2.5 Summary

Lastly, some key points will be given for the theoretical perspective of the present study. In the following chapters, the representation of rural people's knowledge will be viewed as the reconstruction of knowledge by both rural people and the researcher through a dialogical process. This reconstruction can only indicate knowledge at a given moment in time. Thus, when regarding knowledge, it will be viewed as the result of active construction of reality through 'sense making' activities. Three levels of study on rural people's knowledge will be distinguished:

1) study of rural people's knowledge products (e.g. a farming system);
2) the social construction of rural people's knowledge which reveals social struggle and differences in theories, classifications, etc. (e.g. gender differences in farming);
3) the 'sense making' activities which resulted in certain types of knowledge (e.g. experiments undertaken which result in a new farming system).

'In the country of the blind, who are not as unobservant as they look, the one-eyed is not King, he is spectator.'
(Geertz, 1983: 58)

3 Methodology

This chapter presents the methodology with which research objectives are intended to be met. Special attention is given to methodological issues related to research on rural people's knowledge.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

3.1 Introduction

The problem remains as to how the social researcher can retain a certain degree of 'objectivity' if he or she has to calculate in the interpretative attitude, that is, by being a participant with participants. More than one researcher has dealt with this subject (see for example Schutz, 1962; Garfinkel, 1967). As mentioned in Chapter 2, research concentrating on rural people's knowledge should recognize the value of frameworks which emphasize the analytical primacy of the actor's point of view and the social construction of reality. However, the methodological way as to how to work with rural people's knowledge needs attention.

Interaction between researcher and respondent takes place against the background of non-explicit, taken-for-granted notions, which have great influence on the interpretation of explicit utterances. Habermas uses the word 'Lifeworld' to indicate this background (Brand, 1990: 34).

Geertz (discussed in Bakker, 1988) argues that, unlike the participant, the researcher lacks the immediate experience of the culture he or she studies which results from a life-long socialisation. His or her knowledge about another culture is further influenced by the own cultural background, including, more specifically, the symbolic framework of the researcher's discipline. It consists of the researcher's culturally distorted personal constructions of the participant's symbolic constructions of reality. Yet, in Geertz's opinion, anthropological-like knowledge should reflect the participant's symbolic constructions as closely as possible. Geertz names his epistemological perspective 'actor-orientated'. This means that anthropological-like knowledge is reflected on the participant's cultural perspective of reality and is directed at the same (*ibid.*).

According to Geertz (1973), the anthropologist is able to display an approximate knowledge of other cultures, despite his or her status as an outsider. However, he explicitly and emphatically rejects the idea that this is due to the anthropologist's ability to internalise the participant's perspective regarding reality by identifying with them, by means of 'trying to get into people's heads' (*ibid.*). In his opinion, a gap will always remain between the participant's and the researcher's perspective regarding reality. Cultural reality, whether directly observed or indirectly studied, presents itself to the researcher in fragmented bits and pieces, rather than systematically. Usually, the researcher gains access to only a limited part of the participants' lives. There are always meanings and dimensions when endeavouring to understand their culture that the researcher fails to grasp (Bakker, 1988: 23).

As mentioned in Chapter 2, cultural meaning is constructed through the researcher's imaginative attempts to put a culture's scattered bits and pieces together, as well as to evoke its concealed shades of meaning. Lastly, the researcher also relies on a cultural framework in coping with the world, which mediates his or her knowledge of other cultures. Therefore, anthropological-like knowledge production, in a sense, consists of the construction of a culture (of the participant) by another culture (of the researcher, assuming he or she is

an outsider to the culture studied; adapted from Bakker, 1988: 100-1).

A suggestion is to regard the direct observation of the manifestations of meaning as an ideal which in actual practice will probably never be ascertained. The researcher only gets a limited, and often indirect, access to symbolic forms and instances of social conduct. Thus, he or she is forced to resort to a second best overall strategy: to reconstruct symbolic forms and social conduct through interviews with the participants, and to make imaginative guesses about a culture as a whole on the basis of the limited symbolic forms and instances of social conduct he or she, directly or indirectly, has gained access to (adapted from Bakker, 1988). An essential requirement for dealing with errors and bias is self-conscious awareness that it exists and that it has to be encountered (Bulmer & Warwick, 1983: 213).

Research which seeks to adopt a symbolic-interactionistic perspective, giving room to respondents' view, has a preference for qualitative methods of research (e.g. Glaser & Strauss, 1967, Zijderveld, 1973; Wagemans, 1987). Participative observation often is a principal method, though the researcher has a relatively huge range in the choice of techniques, e.g. observation, interviewing, listening to conversations, organising groups discussions, documentation related to the researched actors (Wester, 1984: 50; quoted by Wagemans, 1987). Regarding the use of interviews, they will be semi-structured or open, preferring intensive conversations above structured questionnaires.

Taking into account the above mentioned limitations, the present research sought to include especially participative methods. They will be discussed into more detail in the following paragraphs.

3.2 Area and village selection

The Benin Republic (Annex 7: Map 1), as most West African coastal countries, has a major part of its population located near the coast in the South. The Adja ethnic group is located in the South-West of Benin and part of South-East neighboring Togo. The majority of the Adja live in the Mono province (South-West Benin), where the Adja plateau is to be found (see Annex 7: Map 2; plateau = table land). The Adja are known to be 'good farmers' by neighboring ethnic groups like the Fon (Wartena, 1992), Ajizo and Mina.

The Adja plateau is one of the most populated regions in the South of Benin; within the 944 square km of this plateau (24,8% of the Mono province surface) live 41 % of the population of the Mono (1985), which produces about half of the agricultural production of the Mono province (Daane & Perthel, 1988; Anon., 1990). Demographic pressure has become a common feature of the Adja plateau: 240 persons per square km (1985) with an annual growth of 2,8%, in which migration is already discounted (BDPA, 1985).

An additional argument to choose the Adja plateau was the presence of several other researchers (e.g. economists, anthropologists, sociologists, pedologist, etc.

from the 'Faculté des Sciences Agromiques' (FSA), FSR&E/'Recherche Développement' researchers from the 'Direction de la Recherche Agronomique' (DRA)) as well as some NGOs operating in the area. This gave important additional information for the research and the possibility to compare data (see also § 3.6).

Finally, pragmatic cost-beneficial aspects were in favour of the choice of the Adja plateau; firstly the presence of a research guest house (in Dogbo, see Annex 7: Map 3) and secondly relatively low travel costs. Initial visits to the area whilst elaborating on the research proposal were made in 1988 to get acquainted with the main features of Adja farming. During this period, the Dean of the 'Faculté des Sciences Agronomiques' as well as the head of the regional agricultural service (CARDER) of the Mono province were approached and their cooperation obtained. Actual fieldwork started early 1989 and ended late 1991, with temporary absences due to other obligations. In this period, the researcher regularly visited three research villages and lived for half a year in one of them. A total of fifteen months field work was done, during which three long rainy seasons and three short rainy seasons were followed. A research assistant lived for two years in the area maintaining contact with farmers during the absence of the researcher (cf. § 3.3).

As the overall objective of the study was to examine changes as pressure on land use increases, three villages were chosen to provide information on farming and related activities under differing demographic pressure. Taking into consideration the objectives of the study, a marked difference in population density was the dominant criterion for selecting the three villages.

Similarity between the villages was sought in relation to:
- location on the Adja plateau (and thus having the same climatological conditions, vegetation, and predominance of the same soil);
- having more or less the same access to markets and major roads;
- predominance of agricultural activities.

An attempt was made to select villages with Adja-Ehoué, known as the 'real' cultivators amongst the three Adja ethnic sub-groups present on the plateau; as well as Dogbo-Ehoué, known as being commercially orientated (cf. § 4.3).

The same method of choosing three villages according to varying demographic pressure was chosen by other researchers in this region (e.g. Lagemann, 1977, for South-East Nigeria; and Calon, 1990, for South Togo, the latter also on the same type of soil), giving the opportunity to compare results (see Chapter 6).

Various villages on the Adja plateau were visited during a reconnaissance survey, involving discussions with key informants, amongst who were farmers, local leaders, researchers, extension staff and market dealers, in order to select three villages. Most of the villages on the Adja plateau are accessible by 4-wheel drive vehicles throughout the year. In the dry season also 2-wheel drive vehicles

can reach all villages. Qualitative information was gathered on land-use, cropping systems, infrastructure and resources on the plateau and on the structure and functioning of research and development institutions. This part of the research could be done relatively easy, due to the fact that the researcher was a member of the Beninese Agricultural Faculty.

Variation in demographic pressure was assessed via literature (Anon. 1988), aerial photographs (made in 1957 and 1981, see § 6.2.1) and key informants such as farmers, transport agents, other researchers, and agricultural extension agents.

For the village under high demographic pressure, first an area was sought with a high demographic pressure. Such an area was identified in the region of Northern Dogbo District and Southern Toviklin District (see Annex 7: Map 2). Here 12 villages were visited in order to select one. Natural fallow longer than two years hardly exists in this area. After an introduction, farmers were asked what their main problems were. A first selection criterion was the reference to soil fertility decline as a major problem. The willingness of formal representatives and farmers to accept a study in the village was solicited. Villages in which no previous research activity had been undertaken were preferred. In addition, French speaking youngsters should be available and interested in working as translators, lodging should be possible, the distance to main roads and markets should be average, and finally, access during the rainy period should not be to difficult. As a result it was decided to choose Allada, in the Dogbo district. This village represented the area with the highest demographic pressure (see Annex 7: Map 3).

The village with the lowest relative demographic pressure was easier to find (with the help of the aerial photographs, maps and informants) in an area with few villages in the Western part of Dogbo District. In these villages, people indeed did not mention soil fertility as their main problem and natural fallow of several years was still to be found. After consultation with farmers and other informants, the village Adidevo (Dogbo District) was chosen (see Annex 7: Map 3).

Finally, an intermediate village was chosen: Kokohoue in the District of Djakotomey (see Annex 7: Map 3). This selection took some time because it was desirable to have at least one Ehoué village as one of the three research villages. The Adja-Ehoué are seen as the 'good farmers' amongst the three Adja ethnic sub-groups present on the Adja plateau (cf. § 4.3). The main population in Allada and Adidevo consist of Adja-Dogbo, whilst also some Ehoué were present (often women who came from an Ehoué village via marriage). In the area geographically between Allada and Adidevo, an Ehoué village was sought, but not found. Finally, in the District of Djakotomey, several Ehoué villages were visited, amongst which Kokohoue was chosen. It should be noted, however, that after working in the village for some time, the impression was that Kokohoue also is densely populated. On the (relative) land scarcity scale, Kokohoue should be regarded as closer to Allada(high) than to Adidevo(low).

Table 3.1. Population density figures in the 'communes' (level between district and village) of the chosen villages (1988). [Sources: figures for Adidevo and Allada based on census March 1978 (Anon., 1988) extrapolated with 2,8% yearly increase, for Kokohoue based on census 1988 (Municipality 'commune' Kokohoue)].

village:	Adidevo(L)	Kokohoue(M)	Allada(H)
commune:	Deve	Kokohoue	Totchangni
persons/km^2:	82	184	249

All the three villages are mainly occupied with agriculture and within one hour walk from a market, though the market for Adidevo(low) (in Deve, see Annex 7: Map 3) is not as developed as those for Allada(high) and Kokohoue-(medium) (resp. Dogbo and Azove, see Annex 7: Map 3). Adidevo lies about 10 min. walk from the road that runs from Aplahoue to Lokossa, while Kokohoue is 5 min. walk from the road that runs from Azove to Lokossa and Allada 15 min. walk from the same road; both roads being major roads in the province (see Annex 7: Map 3). Due to the high population found on the plateau, its road network is rather dense. Population densities in the 'communes' (each district is subdivided in a few 'communes') are given in Table 3.1.

The three villages can be seen in aerial photographs (§ 6.2.1), showing relative availability of fallow fields around Adidevo(low), while fallow is almost absent and fields smaller in Kokohoue(medium) and especially Allada(high).

In order to make the assumptions on social phenomena at village level in the present research refutable, village names are non-fictitious. In addition, villagers were in favour of their villages becoming more known. Names of collaborating farmers, however, have been made fictitious in order to protect them.

3.3 Selection of research assistant, translators and survey farmers

As discussed in Chapter 2, conversation analysis as well as analysis of the use of language (e.g. use of 'professional' terms) was practised (Darré, 1985; Van Dongen, 1991). This is a key element in describing rural people's knowledge and related changing processes. Since the researcher was an expatriate, it was indispensable to include the help of a Beninese research assistant together with carefully selected translators. However, more detailed studies on this issue are better left to the representatives of the ethnic group itself, as they are able to follow discourses in detail. The present study seeks only to give a first exploratory account of Adja discourse analysis.

Conversation analysis generates additional information in addition to factual information. For instance; the organisation of the subject, the taking of turns between researcher and informant (Van Dongen, 1991: 35), time allocated per subject, choice of words, and the presence or absence of readily available words also supplies additional information. This analysis can only give additional information if linked with contextual ethnografic information.

The researcher's assistant had finished a report on Adja maize knowledge (Dangbégnon, 1990) and was acquainted with research on rural people's knowledge. He helped in analyzing recorded interviews with key-informants, maintained the contact with survey farmers during absence of the researcher, and carried out research on the classificatory system of the Adja related to soil types, use of wild plants, climatological phenomena, plagues and diseases of crops, and crop varieties.

The translators were chosen in consultation with the villagers, the assistant researcher and sometimes students who had already undertaken a study in the village. He or she should speak French well, be acceptable to the villagers, be available regularly, and be able to translate as accurately as possible. After a trial period with various candidates, one or two translators were chosen for each village. Translators were given a short training on main issues of the research and special attention points for translation. The translators saw each other regular in order to exchange experience. In Adidevo(low), no French speaking girl could be found. Female candidates in Kokohoue(medium) and Allada(high) proved to be unsuitable for the job or could not get permission from their parents. Therefore only male translators were selected. During their trial period, they were specifically screened on their ability to communicate with women.

Selection of the survey farmers required much attention. After an initial period in the village, lists of villagers were made together with translators and villagers. Applying sociometric interviews, networks related to agriculture were identified. It should be stressed that every farmer is an expert; so asking for fellow farmers respected in the community for their (agricultural) knowledge was preceded by emphasizing this point. Special attention was required for the following:

- to keep the number of farmers manageable, a maximum of twelve per village were chosen;
- willingness of the farmer to cooperate with the researchers;
- demographic distribution was accounted for by selecting at least four female farmers out of twelve, (relative) rich, medium and poor farmers, all varying in age;
- farmers who were also active in off-farm work;
- farmers who form small groups to discuss agriculture or related special topics;
- farmers who show evidence of experimenting (e.g. having fields cultivated in a non-orthodox way or having a stock of varieties).

(Relative-) wealth was ascertained, as emphasized by the number of wives (for male farmers), indication by translators, amount of land owned, number and quality of house(s), presence of corrugated iron roof covering of houses, maize mills, palm wine distillation work place, (access to-) wells, etc. A particularly good indication of the wealth of a person, even better than the land owned,

is the number of palm groves ('palmeraies') he (seldom she) owns (criterion also used by other researchers in the same area, e.g. Daane & Perthel, 1988; Biaou, 1991; see also Chapter 5).

When villagers, not included in the survey, understood that the researcher was looking for 'good' farmers, they sometimes tried to capture the researcher's attention. The present research was open to this kind of additional information, though often redundant data were provided. Nevertheless, this eagerness to be acknowledged as 'good farmers' was remarkable and sometimes gave interesting data. An instance is where somebody had obtained a new crop variety and reported this to the researcher.

Likewise, when a woman had agreed to cooperate, in some cases her husband had to be consulted. In one village, a *feticheur* turned out to be often operating together with another old man. Therefore, when he was present he had to be consulted too (cf. Box 7.3). In fact, it was later seen as valuable with regard to specific kinds of knowledge (and related processes) to approach the two men as a group, rather than just the *feticheur* as an individual. These phenomena are to be seen as an inseparable aspect of research on rural people's knowledge.

Annex 1 presents the farmers in the three research villages who collaborated in the research. 'Co-researchers' is a better fitting description than respondents.

3.4 The role of the researcher

The researcher aimed to learn about Adja agriculture in ways which would respect its inherent complexity and dynamism. He tried to join the Adja in their daily 'sense making' in a complex and difficult environment as a participant-observer. The complexity of the situation had to be 'embraced', as expressed by Bawden (1989: 10). In addition, a researcher adopting such a stand has to be critically conscious of the assumptions about science and truth and the ways of the world, that pervade throughout each stage of the research (adapted from Bawden, *ibid.*).

In § 2.2 it was argued that the role of the researcher is central in a study which seeks to represent rural people's knowledge and related knowledge processes. It is the researcher who will impose on the research his or her 'making sense' out of reality. Insights from former scientific debates and results are elaborated on, but the selection of relevant insights is a 'sense making' activity of the researcher. The problem formulated in Chapter 1 and the theoretical perspective chosen in Chapter 2 present a logical framework for looking at reality, but from the point of view of the researcher. Likewise, Checkland argues that a description of a human activity system should always include an account of the observer and the point of view from which his observations are made (Checkland, 1981: 118).

The fact that room is left for 'local' concepts, classification concepts and anal-

ysis of actors themselves, does not mean that the researcher disappears or is reduced to someone who is merely transmitting information from the field to the reader. It is the researcher who decides which statements and analyses will be included in the report. In addition, it is the researcher who decides on research techniques, formulation of research methodologies and composition of the bibliography. Although discussing his material with actors can help the researcher to obtain more insight and confirmation, he or she cannot escape his or her own cultural background and conceptual frameworks (Seur, 1992: 45-6).

If one wants to study reality, seen as the result of 'sense making' by actors, one has to give actors a central place in the study. Therefore, the relationship between researcher and actors has to be close; mutual trust is a pre-requisite. The researcher not only tries to register behaviour, but also to understand arguments leading to that behaviour, in addition to means and limitations as actors experience or judge them (Wagemans, 1987: 260). The researcher is required to be part of the field of research and be involved in activities of actors.

In order to share ways of knowing and ways of acting, the researcher lived for half a year in an Adja village (Kokohoue) and assisted with, or participated in, ceremonies, field activities, discussion groups, and the like. Living for fairly long periods amongst farmers allows for registration of unexpected events, not specifically looked for in the research plan. It allows for closer attention to the dynamics of local beliefs and power relations in agricultural knowledge. Arguments amongst people or people showing a clearly negative attitude towards the researcher potentially contain valuable information. An example is tension between wives and co-wives expressed in specially designated field units with maize lines as borders and clusters of crops each belonging to one women (Leach, 1991). On this occasion, individual ownership, not only local notions of ideal crop combinations, is determining knowledge.

The next chapters, which present various aspects of the way the Adja 'make sense' out of their complex and difficult environment (Chapter 4: Introduction to the Adja plateau, Chapter 5: The Adja oil palm agro-forestry system, Chapter 6 and 7: Adja diversity in knowledge and knowledge processes) are clearly coloured by the researcher.

At the start of the fieldwork, the research proposal outlined interviews, field visits and soil analysis as activities to be carried out. However, after a first period in the field, during which the researcher learned much of Adja ways of dealing with agriculture, he realised that changes in methodology were necessary. Growing awareness of how Adja knowledge is organised, composed and constructed, gave way to new methods of information collection. In this way, identification of farmer discussion groups, the subsequent observation of their activities, and participating in farmer visits to other villages (e.g. during ceremonies or market visits) yielded important information. Also a growing understanding of Adja heterogeneous ways of dealing with the world implied a change of the hypothesis of a more or less coherent Adja way of agriculture.

Farmers are to be seen as capable participants in the social dialogue by which

the structuring of the (agricultural) social order takes place (Benvenuti, quoted in Bolhuis & Van Der Ploeg, 1985: 15). It was intended not to limit information gathering by means of interviewing to reflection by informants on social and agricultural practices whereby a theory is constructed *ex-post facto* (Bourdieu, 1990). As mentioned in Chapter 2, explicit construction of knowledge in a dialectical way via discussions amongst farmers themselves and between researcher and farmers, was sought.

Traditional anthropological research has a tendency to view fieldwork as one-sided with the researcher's goal, established prior to an encounter with the informant, remaining paramount (Dwyer, 1979). Truth varies with the cultural setting to which it relates; thus attempts at cross-cultural identification of knowledge, as well as de-constructing underlaying processes should be kept open to redefining the main objective of the research in an interacting process between researcher and key-informants/co-researchers.

Farmers were sometimes actively involved in research activities. For example, two farmers together with a translator reconstructed the way a new cassava variety arrived in the village (see Box 7.7). Another example were visits of foreigners. When a group of farmers from another village or researchers came, the villagers often decided, after agreement with the visitors, what were relevant objects to visit or subjects to discuss.

3.5 Data collection

In order to be able to choose survey farmers it is indispensable to have a good relationship with villagers in general. Thus, an introduction time has been used to let people become acquainted with the researchers and their intentions. During this period it was stressed that the research aimed to learn from already 'ongoing research' in the village. After this initial period, confidence also had to be built progressively with those farmers willing to operate as informants. Initial confidence building and becoming acquainted with the villagers is a crucial pre-requisite for collecting data later.

Non-directive and semi-directive interviews were used for collecting data. Where possible, the interviews were held while participating in activities, e.g. working activities in the field, collecting useful herbs, discussion meetings at public places, following women walking to the market, and experimenting activities. Every farmer was accompanied several times in his or her fields, to demonstrate what was discussed. However, participative activities were mostly done in a relatively short time: working in 33 °C and 80% atmospheric humidity is not easy, even without a child on your back.

A second source for data included assisting, though not intervening, at social events, e.g. discussion groups, visits made by farmers to other regions, and religious ceremonies. These events were registered with the translator, and later analysed, where possible also with the farmers, in the course of which verbal information of the translator and farmers was checked with non-verbal informa-

tion registered by the researcher. Undoubtedly, the mere presence of researcher and translator influenced the events, but nonetheless useful insights were obtained regarding the above-mentioned events.

In general an attempt was made to be flexible in the methodological approach used in the research. If a pre-determination of data and information which should be collected was too strong, it could divert attention from other important information. Influence of farmers on methodological changes was incorporated by discussing and selecting possible adaptations together with them. For instance other farmers were included to the survey group when experience revealed that they could provide valuable information. Also some non-interview moments proved to give valuable information. Assistance at farmers discussion groups and accompanying farmers on their visits to other regions were included in the methodology, after initial confidence building. Listening to dialogues in the corresponding social situations proved to be valuable. For example, whilst walking with farmers through fields, an evaluation of practices and performances observed was rather common. In this way, collection of technical as well as social information was done in an integrative manner.

A researcher who seeks to identify rural people's knowledge should be open to unexpected and unplanned events. In the village of Adidevo(low), for example, a major problem troubled the villagers during the arrival of the researchers. A group of hippopotami were devastating the fields and endangering maize production. Discussing other subjects was not possible until this problem was thoroughly discussed. Identifying possible solutions together and trying out some of them (contacting the game keeper, planting of defensive thorn-hedges, chasing away of the creatures) eventually contributed to confidence in the researchers on the part of villagers.

The same village yielded another example. After agreement of the village elders, a student tried to collect some soil samples in order to analyse them in a laboratory. Nevertheless, he was quickly stopped by the villagers. After discussion it turned out that state representatives in the 1970's had claimed a major part of the land of a neighbouring village and had installed a state-owned rice plantation (see aerial photographs 6.1 and 6.2). Oil palm groves present on this land were simply expropriated. This event had thoroughly alarmed neighbouring villages. At first hand one might be inclined to explain the intervention of the villagers in terms of superstition. After discussions, it turned out to be sensible that outsiders are well observed when it comes to land evaluation! The state representatives had started with soil sampling to find suitable fields for rice cultivation...

For data collection, a more qualitative emphasis was used during the first period of the research, selecting general information on the main elements of Adja farming. In this respect, Adja classificatory principles were identified related to soil taxonomy, pests and diseases of crops, climatological phenomena, crop varieties and use of wild plants. In this way, the researchers became

acquainted with basic features of Adja agriculture and related terminology. Meanwhile, farmers realised that their knowledge was valued and sought after. Increasing confidence in the researchers as well as understanding of their objectives contributed to the following stages of the research. In addition, social organisation of activities related to agriculture were identified and studied, examples being: discussion 'scenes', theories on agricultural phenomena, religion and cosmovision, search for and incorporation of external knowledge, experimentation, presence and functioning of networks, innovation, and learning.

Secondly, after an initial understanding of Adja classificatory principles and social organisation of agriculture, the related semantic organisation was studied, giving special attention to ordering principles and distinctive features.

Finally, there was an attempt to create a correspondence between the semantic organisation of Adja classificatory principles and Adja practice. This gave way to a comparison between cognitive standards and actual behaviour in practice. Rules of culturally appropriate behaviour related to Adja agriculture were identified. Differences and similarities gave valuable insights in cognitive standards, normative behaviour, and different strategies. Land-users may be unaware of the bases of their decisions, being subconsciously influenced by factors they have never realised (Jungerius, 1986: 13). Accordingly, it was tried not only to ask questions whether a farmer did or did not follow certain norms but also to raise the allegedly related question as to whether the norms concerned were right or not (cf. Brand, 1990: 33). This complementary question can only be asked after initial confidence building. Even then it is not always possible to be explicit about the norms and question them.

Assertions could sometimes be assessed using the local board game *oyo* (or *adyotou*), found in many places in Africa. In virtually every village in the area people are seen playing this game in the village square (cf. Barker, 1979). In this manner, ordering soil types qualified for certain crop systems can be easily indicated by farmers, using the holes of the board in front of them. In addition, mixed cropping in rotation was demonstrated by them with seeds of maize, groundnut, cow pea, oil palm, etc., which were arranged by the farmer, each hole representing a year of the rotation. Holes of the board game can also represent fields cultivated by the farmer, who then subsequently shows which crop combination he or she cultivates on which fields; showing *inter*-field management. Variation in densities can also be demonstrated by the farmer, if he or she uses more or fewer seeds representing the different crops in each hole. For farmers with different cropping practices it proved altogether a good method of encouraging discussion on cultivation practices and differences in those practices. This method placed the initiative with the respondents.

Other methods that were used to encourage farmers' initiatives wherever possible were:

- open and semi-structured interviews, with few structuring initiatives from the researcher;

- participative observations in the field and during social activities in the village;
- questionnaires especially with open questions;
- after receiving operational guidance, farmers themselves used a camera and recorder; results were discussed with them later;
- referring as much as possible to factual practices observed in the fields.

Continuing field visits were held during the whole research period for various reasons. Firstly, naturally, farming practices and more interestingly, variations in those practices could be observed. In addition, some discussion topics were easily identified by demonstrating related cropping practices in the field. Finally, differences between what people say and what they do were assessed. Frequently, 'good' farming is related to farming practices as they used to be in the 'olden days', whilst actually in the field new farming practices are to be found. Roughly, a quarter of the interviews were held in the fields or while walking through them.

Agronomic methods applied were density assessment of crops in mixed cropping systems, yield assessment, analysis of major crop pests and diseases, and soil nutrient analyses. In collaboration with the project 'Recherche Appliquée en Milieu Réel' (RAMR), soil data were collected from the topsoil (0-20 cm) of the *Terre de barre*, common on the Adja plateau, each sample representing a mixture of 10 sub-samples (for details: see Annex 3). Soil samples were analysed at the CENAP (Centre National d'Agropédologie) at Calavi-Abomey near Cotonou, Benin.

3.6 Additional supportive research and study of literature

Students carried out parts of the research, in order to deliver additional information on Adja agricultural knowledge. This additional supportive research, with an exploratory character, resulted in reports on:
- the Adja maize knowledge system (Dangbégnon, 1990);
- Adja knowledge of cassava (Breusers, 1990a);
- Adja knowledge of soil fertility management (Hiddink, 1990);
- knowledge and strategies of Adja female farmers (Verhagen & Wipfler, 1992)
- the Adja oil palm based fallow system (Gnanglé, 1992); and
- Adja knowledge on mixed cropping of annuals with oil palm (Dobbelsteijn, 1992).

Apart from qualitative data, an interpretive anthropologist needs to put his or her analysis within a framework of at least some 'hard' data, which can be obtained through small-scale surveys, the study of statistical materials from government agencies, or researchers from other disciplines, supplemented with information from key informants (Bakker, 1988: 46). This was provided for by other research carried out on the Adja plateau, which was relevant to get a better insight in Adja agriculture and in how the Adja deal with their situation (e.g.

RAMR project documentation; Wartena, 1988a and 1988b; Biaou, 1991; Agbo, 1991; Fanou, 1992). In addition, the 'Faculté des Sciences Agronomiques' provided quantitative material, collected during a 4 year extensive base line study on the Adja plateau (Daane & Breusers, in press).

In addition, literature on rural people's knowledge, extension science related to development issues, applied anthropology, and other relevant subjects were sought throughout the whole research period.

First internal reports on Adja ways' of classification, use of wild plants, networking, and the oil palm-based Adja Agro-forestry system were made in French and discussed with farmers and various researchers in Benin (cf. Brouwers, 1991; Dangbégnon & Brouwers 1991a; 1991b; 1991c). It was felt that discussion on methodology and preliminary research results were quite valuable during fieldwork.

'You people get knowledge from books.
We get knowledge from animals and things.
The honey-cuckoo shows us where to find honey...'.
Mukahamubwatu

4 The Adja plateau

This chapter presents a general introduction to the Adja plateau and its inhabitants, also seen from the Adja classification point of view. The agro-ecological conditions on the plateau and the socio-cultural organisation of the Adja are examined. In addition, the history of the plateau and its interventions are described.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

4.1 Agro-ecological conditions on the Adja plateau

The Adja plateau covers 944 square km (Daane & Perthel, 1988) of sometimes slightly inclined land with an average altitude of about 150 m in the North of the Mono province, South-West Benin in West Africa (see Annex 7, Map 2 and 3). In this paragraph the climate on the plateau and its soils will be discussed. Simultaneously, some Adja classification concepts, practices, and environmental indicators will be presented. Their actual use, change, interaction with outside knowledge and related processes will be elaborated on from Chapter 5 till 8. For Adja words: see Annex 2.

4.1.1 Climate

The climate on the Adja-plateau is sub-equatorial with two dry seasons and two rainy seasons. The average yearly temperature is about 27°C (Mondjannagni, 1977: 53). The average yearly rainfall (69 years of observation) is about 1,100 mm; see Table 4.1. During the period of rainfall observations the absolute minimum yearly rainfall was 564.4 mm, and the absolute maximum was 1847.2 mm. The variation of rainfall between years amounts to about a quarter of the yearly average. Rainfall is spatially and temporary highly varied. Net rainfall has been decreasing gradually during the last decades while maintaining a high variability. Dry periods of several weeks may occur in the rainy seasons.

There is a long rainy season from March to July, followed by a relatively dry period in August, and a short rainy season of about two and a half months starting in September. Coefficients of variation in Table 4.1 show that variation between years is limited in the period April-June, relative to the period September-October. One could conclude that the long rain season is the most dependable season.

Farmers claim that rainfall patterns change from a bi-modal to a more unimodal distribution, with increased rainfall during August and lower rainfall during autumn. This trend has also been observed in adjacent South Togo (Calon, 1990). Although August rainfall data show a slight increase, when calculating averages over 10 year periods, the short rains averages stay more or less constant. It is true, however, that during the past decade August rains have been better than the overall average.

One of the most recent signs of the dynamic nature of the Adja farming system is the development towards an intermediary season, that runs from the end of

Table 4.1. Average total rainfall on a monthly basis (top row rainfall in mm; bottom row coefficients of variation in per cent; source: figures station Applahoué 1922-1990).

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
12,2	36,5	94,3	132,6	142,4	168,2	117,1	73,1	136,6	130,2	35,8	12,0	1091
>100	97	62	42	47	40	77	90	60	51	84	>100	24%

July to September. Failure of the maize crop in the first season, may lead farmers to sow the *tokpoué* short variety in the intermediate season. While relay-cropping (e.g. maize-cassava, maize-cotton) is practised already as a matter of routine, today also crops such as capsicum peppers, cow pea and tomato figure prominently between the two rainy seasons. Women especially profit from this 'third season', since they grow the crops and sell the produce on the local markets. The three mentioned crops can be harvested in small amounts and in regular periods, thereby fitting in with the 4-daily market period and with the limited labour availability of women.

Adja farmers distinguish three seasons which are related to agricultural practices: *eli* (long rainy season), *ezo* (small rainy season) and *ballohoui* (Harmattan wind during the long dry season in December-January). These concepts can be recognised in other terms, e.g. *elibafo*: maize of the long season, *ezobafo*: maize of the small season. *Elibafo* is generally grown to fill the households stock, whereas *ezobafo* varieties have to be short cycle varieties and can be grown for marketing purposes when *elibafo* has been successful.

The Adja use a farm calendar based on lunar periods, each period corresponding to certain farm activities like preparing fields, sowing or planting, weeding, etc., see Table 4.2. The literacy rate amongst the Adja in the Mono is 17% (figure of 1978, Anon., 1988); especially older people and women are illiterate. Nevertheless, people have references; as a farmer described it: 'Because we do not know paper we count the farmer months'.

Table 4.2. Adja farm calendar, based on lunar 'months' (for Adja words: see Annex 2).

Adja 'month'	activity/proverb
Zokin	sowing starts for small season (approx.: September)
Bléamédézoui	'he who sows in this month will be betrayed' (too late for sowing, approx.: October)
Adjakossé	'rain which makes the flowers fall' (appr.: November)
Ballowoui	arrival of Harmattan (dry Sahel wind, appr.: December)
Zadota	'eza stars' pass the zenith. Start of clearing fields (approx.: January)
Ntonnonmadoui	'father is not allowed anymore to eat from this field' (he gives it to a son, approx.: Jan.-Feb.)
Agomakploe	'do not take a new wife with you: she will distract you and you have to clear the field' (approx.: February)
Bogan	time for sowing the big maize field (approx. March/April)
Zalékoui	month with few rains (approx.: April/May)
Afo	name for weather with many rains (approx.: June/July)
Gbonfoui	rain with 'small droplets' (approx.: July)
Vouvô	preparation of fields for the small season (appr.: August)

Box 4.1:
Nouhoumon relates how he uses trees and other plants for planning agricultural activities.

Nouhoumon: 'In order to know the moment when to sow, I observe the behaviour of some trees. These trees loose their leaves and flowers or get new ones in well determined periods. The tree which I observe often at the onset of eli (long rain season) is called tchiti (*Millettia thonningii*). For the start of ezo (small rain season), I look at tchiplanloui (not identified). After the New Years festival, tchiti will loose all its leaves and bloom. If the flowers fall, and they are washed away by a big rain, I know it is a good moment to sow maize or any other crop of the long season. When the maize cobs become visible, it is the time to sow cow pea between the maize rows. When the cow pea blooms, so will also cassava and tchiplanloui. That is the moment for preparing the fields for the small season. If the fruits of tchiplanloui become dark, a big rain will come and we can sow the maize. If the tchiplanloui fruits are mature, cow pea can be sown between the maize, or the last sowing of maize'.

Apart from the farm calendar, the Adja have additional indicators which inform them of the coming rain, when to plant or sow, and if the season will be good. One group of indicators is formed by celestial bodies (stars, moon, meteorites, planets). For an elaboration of the '*eza* stars' see § 7.2.3.

An additional group of environmental indicators used by the Adja are the presence and intensity of certain winds. An example is the *ezavouvouato*, which is a wind that indicates the arrival of the '*eza* stars'. Another example is the *ballowoui*, a dry and dusty Sahel wind. If the *ballowoui* is intense, it will be followed by a good rainy season; the opposite if it is very dusty or short.

Fauna and flora also give climatological or time indications; though indications from the fauna (e.g. arrival of certain birds) is nowadays limited due to the disappearance of forests and natural fallow. However, trees are currently used as meteorological indicators. The original natural vegetation is sub-sudanese clear forest, with tree species like *Chlorophora excelsa*, *Parkia biglobosa*, *Adansonia digitata*, and others. Physiological manifestations of trees and other plants like flowering and falling of leaves give the Adja indications as to how and when to run their activities, see Annex 4. An example of how a farmer regulates his activities by observing trees and crops is given in Box 4.1.

4.1.2 Soils

According to the FAO soil classification, the soil on the plateau, generally known as *terre de barre*, consists mainly of nitisols (sandy to sandy-loam soils) (FAO/UNESCO/ISRIC, 1988). However, where the topsoil shows a clear sandy horizon, soils should be classified as acrisols (Koudokpon *et al.*, in press). In the French classification, *terre de barre* soils are classified as 'sols ferralitiques à dominance rouge' (D'Hoore, 1964) or 'sols ferralitiques faiblement désaturés'. Erosion, though not absent at the more inclined parts, is limited on *terre de barre*, as these soils enable a good water absorption. Water retention capacity

Box 4.2:
Holou explains soil 'fertility' of the red soil.

Holou: 'If a red soil is fertile, its colour will be darkish. The "vitamins" deposited by composting herbs, leaves, etc. make the soil's colour darkish. However, when the *vitamins* leave, the soil will turn reddish like a cloth which has been washed many times. In that case, the soil is asleep, and has to be wakened by planting cassava, pigeon pea or cow pea. If it is well asleep, the soil can be awakened by organic garbage or chemical fertilizer, or *ede xo gnigban* ("the palms take over the field"); it becomes a "palmeraie" (palm groove)'.

is low. Surrounding the plateau are heavy hydromorphic clayey soils found in the depressions, which are classified as vertisols with especially montmorrillonite and illite. Farmers regularly cultivate fields on the plateau as well as on the vertisols.

Nitisols have good physical properties because of their deeply developed, excellent structure, and their resilience to surface erosion. Most of the nitisols on the plateau have a declining fertility level due to intensive agriculture. Kang *et al.* report a soil organic carbon level of only 0,33% (Kang *et al.*, 1991). Phosphate and especially potassium are present in low levels. A representative farmers' view on soil 'fertility' is given in Box 4.2 (see also § 5.3.1 for an elaboration on farmers' view of soil 'fertility').

The Adja have their own way of classifying soils (see Table 4.3). Variables such as parent material and geological history, used by soil scientists, are not taken into consideration by the Adja way of classifying soils. Their interest lies in the topsoil, as the topsoil varies due to previous management practices.

The Adja classification is based on utility, geographical indication, or historical vegetative indication. Direct utility is expressed by the fact that for every type of soil, the water retention capacity, possibility of inundation, and fertility

Table 4.3. Adja classification of soils on the Adja plateau (note: clayey soils are divided in 5 types).

gnigban djoun	soil with a red colour
gnigban douwor	loose soil
gnigban wou	ash coloured soil
afignigban	more pronounced ash coloured soil
gnigban korhor	sandy soil
gnigban foun-foun	very sandy soil
kpédji	stony soil on slope
kédji	soil with small stones, not on a slope
zohoudji	soil whose vegetation is without trees
gnigban ko/gnigban komê	all clayey soils; divided in:
– ekogbokitchi	black clay, very heavy
– ekozohaya	medium heavy clay
– ekoakpan	whitish clay
– ekognigbô/ekognou	blackish clay
– ekodjoun	reddish clay

level is well known. In addition, the present herbs on a field serve as indicators for actual soil fertility, e.g. presence of *glazoui* (*Talinum triangulare*) indicates good fertility, whereas *Cyperus spp.* indicate low fertility. Presence and quantity of soil macro fauna, especially earthworms, are also indicators for soil fertility. Thus, the consequences for farming of each type of soil, its suitability for certain crops and mixed cropping options and consequently its agricultural potential, are clear for a farmer.

A first classification criterion for farmers is the colour of the soil: red, black, or grey soils, including gradations in colour. A second criterion is soil texture (sandy, clayey, ashy). However, the most frequently used criterion for classification is related to the fields, not the corresponding soils. Nomenclature of fields may relate to type of soil, geographical indication, a special characteristic important for agriculture, or former natural vegetation. Geographical indication mostly refers to another village, if the fields are outside the village borders (e.g. *sossoukpouhoué*: 'fields on the territory of the hamlet Sossoukpouhoue'); whereas fields near the village have specific names (e.g. *goutovnou*: 'fields near the well'). Fields which have a special characteristic important for agriculture are for example *tandji* ('on rippling water'): inclined fields which often have waterlogged parts below, requiring special management; or *ahouégodou* ('at the back of the house'): fields near the house which receive household garbage and consequently have a relatively high fertility (see Chapter 6). Nomenclature related to former natural vegetation are *hévé* ('forest of ehe trees'), *kouovou* ('forest of kouko trees'), *segbahomé* ('under the segba trees'), or *zohoudji* ('burned grasses', sandy fields where grass is regularly burned).

4.2 Livestock, crops and cropping systems

As is the case elsewhere in the sub-humid and humid tropics, the presence of domestic animals is limited mainly by diseases. Practically no cattle are found in the Adja farming system because of Trypanosomiasis. Small ruminants also suffer from a high incidence of various diseases (Gbego, 1991).

As a result, animal production has a marginal significance economically. This is reflected in the number of sheep and goats kept per farm, on the average 4.3 heads in one survey (Adegbola & Koudandé, 1992). Pigs and fowls can be found in all villages, but on a limited scale. Raising domestic animals for the local market is seriously hampered by the fact that imported meat is about half the price of the meat locally produced. Nevertheless, more than 95% of the households raise livestock, mostly fowls and goats (De Wit, 1988). Animals are rarely consumed within the household and most of the animals are owned by men, the exception being fowls.

The main food crops are maize (*Zea mays*), cassava (*Manihot esculenta*), and cow pea (*Vigna unguiculata*). The primary cash crops are cotton (*Gossypium*

spp.), tomato (*Lycopersicon esculentum*), okra (*Abelmoschus esculentus*), capsicum pepper (*Capsicum spp.*) and groundnuts (*Arachis hypogaea*). However, it is to be noted that the difference between cash crops and food crops is not always clear. Cassava, for example, is also processed into gari and sold at the market. Okra and groundnuts might also be consumed. Oil palm (*Elaeis guineensis*), intercropped with virtually all other crops, is mainly a cash crop via the marketing of processed palm fruits and palm wine, but oil or soap made from the oil is also consumed in the household. The agricultural output of the Adja plateau is roughly half of that of the Mono Province as a whole, while the plateau area is about one-quarter of that of the province (Daane & Perthel, 1988; Anon., 1990). Average crop yields of the four major annuals in the period 1984-1987 were 750 kg/ha maize, 6.350 kg/ha cassava, 850 kg/ha cotton and 560 kg/ha cow pea (Anon., 1990). However, due to rainfall variability yield variation is high. In addition, most crops are mixed.

Farmers use several varieties; e.g. the present research identified 20 cow pea and 26 cassava varieties (see Annex 5 for identified varieties of 9 crops). Farmers sow different varieties at different times in different fields, e.g in the case of maize, to reduce the risk of food shortage at the end of the long rainy season due to rainfall variability.

Use of chemical fertilizer (14-23-14-5-1 NPKBS) and insecticides is mainly limited to cotton, the main crop stimulated by state intervention on the plateau. High fertilizer prices, relative to market prices for crops, and the unpredictable crop responses to fertilizers, make the expansion of fertilizer use unrealistic at the present time. Fertilizer use on the *terre de barre* of the Adja plateau may expect a great response provided that organic matter has been maintained at a high level and rains fall favourably.

Maize, the staple food, is produced in normal years in sufficient quantities to feed the population of the plateau, import quantities equalizing export quantities (Fanou *et al.*, 1991). Despite increasing demographic pressure, the Adja have managed to maintain a self-sustained degree of production in maize, with a low level of external input use. Adja households will arrange their cropping system in such a way as to assure maize production. Due to humid conditions, storing of cereals is difficult and expensive over long periods. Supply of maize is therefore not balanced between seasons; likewise, maize prices fluctuate regularly (Lutz, 1992).

The following crops can be found on a less important scale: Pineapple, egg plant, sweet potato, leafy vegetables (e.g. *Amaranthus spp.*), yam, taro, sugar cane, tobacco, papaya, mango, guava, banana, teak, neem, *Citrus spp.* and pigeon pea. Coffee and cacao have been tried unsuccessfully; some sporadic plants might be found.

Several other plants, naturally to be found in the area, are used for various objectives, e.g. medical (for human beings as well as for livestock), as a fodder, for building material, or as a vegetable. Unlike the prevailing Western view on weeds as only noxious plants, the Adja consider various plants, not deliberately sowed or planted ('weeds') as useful (see Annex 6).

The Adja practice an almost minimal tillage. Only before sowing of groundnuts weeds will be burned, otherwise weeds are left on the soil surface. Together with crop refuse, this form of mulching helps to preserve the water in the soil and contributes to the organic matter content. Herbs and shrubs are cut just above or below the surface of the soil, using principally the hoe; a chopping knife only being used for larger shrubs. The Adja have constructed a hoe suitable for flat cultivation (Wartena, 1992).

Crops are mainly cultivated in a mixed cropping system. Leguminosae alternate as much as possible with other crops on the same field. Oil palms will be found in virtually all fields (for an elaboration of the oil palm system: see Chapter 5). Alley cropping (e.g. with oil palm, cassava or pigeon pea in the alleys) and relay cropping (e.g. maize-cotton, maize-capsicum pepper, or maize-cow pea) are current practices (cf. Gibbon & Breusers, in press). However, oil palm and pigeon pea are mostly planted at random and not in alleys. Cropping patterns and density figures vary according to the objectives of the farmer, his or her labour availability, the type of soil and field specific characteristics (e.g. locality specific fertility variation), the fertility level of the soil, and rotation history and planning (cf. Box 7.8).

4.3 Socio-cultural description of the Adja

The Adja are an ethnic group living in the South-West region of the Republic of Benin and the South-East region of the Republic of Togo. Like many other African ethnic groups, the Adja were divided by the colonial powers and now belong to two countries, Togo and Benin. The ancient capital of the Adja, Tado, is located in Togo, near the Benin border.

The Adja King in Tado is still seen as a religious leader for the Adja on the Adja plateau. However, near Ayomi (between Adidevo and Dogbo, see Annex 7, Map 3) since about 1700 (Wartena, 1988a: 55) another 'King' or *chef de terre* and 'Queen' have lived. This couple is consulted regularly by animist farmers of the Adja plateau for religious activities and to help with problems, e.g. to evoke the rains when they are late. The Queen is consulted when plagues or plant diseases are severe; she will take care of affected fields.

Among the Adja on the Adja plateau, three groups are to be distinguished: Adja-Ehoué, Adja-Dogbo and Adja-Chikpi (Den Ouden, 1989a: 2-3). The Adja-Ehoué are mainly orientated towards agriculture, whereas the Adja-Dogbo historically are more interested in trade. The Adja-Chikpi form a small minority. Each group speaks a different dialect within the Adja language.

Animist religion is dominant, though other religions like islam, catholicism and protestantism are increasing. For the animist, daily activities are inseparably interwoven with religion. *Mawu* (female) and *Lisa* (male) are the couple which form the head of all divinities and men. *Mawu* is associated with reproduction,

Table 4.4. Important *voodoos* on the Adja plateau (cf. Mondjannagni, 1977: 121).

voodoo:	role attributed:
Sakpata	Master of land and smallpox
Hèbiosso	Master of the lightning
Agbè	Master of the waters
Aguè	Master of the forests
Gou	Master of the iron
Lègba	Master of communication
Dan-Ayidohouèdo	Master of prosperity
Fa	System of divination

fertility, moon, wisdom, friendliness, joy and ordering nature. Her role is conceptualisation and reflection. *Lisa* is associated with fire, heat, sun, work, youth. His role is seen as ordering the world.

Mawu and *Lisa* govern a pantheon of *voodoos*, offspring of *Mawu* and *Lisa*, each with a specific role. Table 4.4 presents the most important *voodoos* on the Adja plateau.

Hèbiosso is able to ask *Mawu* for rains. *Aguè*, spirit of the forest, possesses the secrets of art and technology. *Gou* is considered to be in charge of transforming the natural world, via various technologies, especially iron-based. The market day, every fourth day, is reserved for him, during which everybody using iron tools (farmers, blacksmiths, hunters, etc.) are prohibited from working. *Legba* is able to travel freely and can therefore serve as an intermediate between *voodoos* and people. His statue will be found in virtually every village as well as at crossroads, markets, etc. The *fa* is a personal divinatory instrument, which can be consulted via *féticheur* and *lègba*.

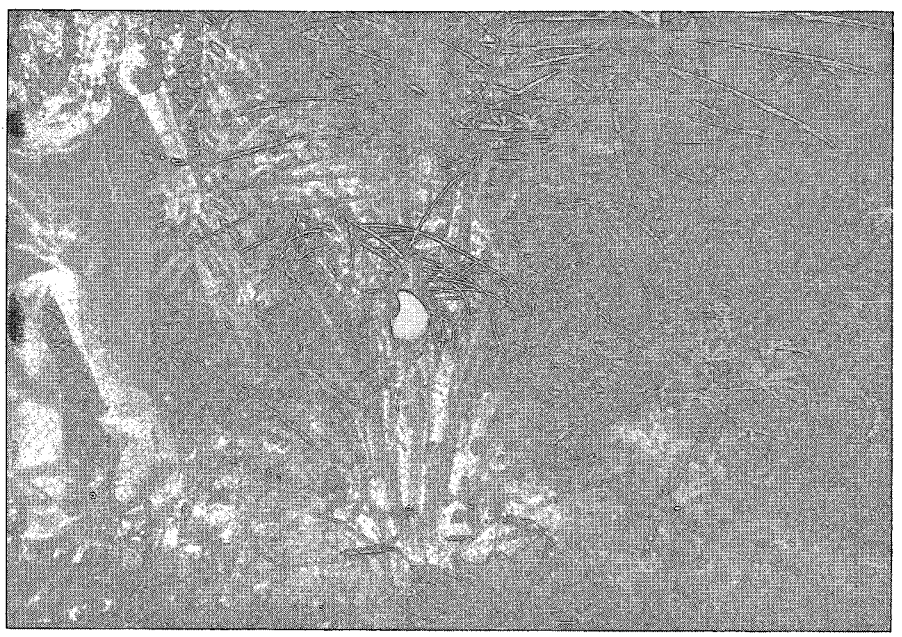
Certain objects can serve as intermediates for *voodoos*, e.g. in an old tree, present at the arrival of the founder of the village, may provide residence for a *voodoo*. Some people, called a *féticheur* or a *bokonon*, can make contact with the *voodoos*. They have considerable power in Adja society, as nature and events can be influenced via the *voodoos*. In each of the three research villages a group of apprentice *féticheuses* is present; young girls who live separately in the household of a *féticheur*.

Religion is not viewed in a fixed way. On the Adja plateau many people do not recognise the existence of the couple *Mawu* and *Lisa*, but only of *Mawu* (now being masculine!). In addition, Adja christians and muslims call their god *Mawu*. In general, new gods or *voodoos* were introduced and accepted in Adja society quite easily (cf. Mondjannagni, 1977; Wartena, 1988a). Muslims, christians and animist intermix smoothly; an ill animist may ask his christian neighbour to pray for his well-being or vice versa. Elwert (1983) describes the *bokonons* as 'entrepreneurs of the *voodoo*' and indicates that monetisation in South Benin seems to have started in religious ceremonies.

Magic plays an important role in Adja society. Marwick (1982; quoted in Breusers, 1990a: 143) describes magic as 'referring to the activities or craft of a magician, a person who, suitably prepared, performs rituals aimed at controlling impersonal supernatural forces held responsible for the succession of events. In these rituals, the magician manipulates objects and substances, often having characteristics or origins symbolically related to the objects desired, while reciting an appropriate verbal formula'. Especially individual religious ceremonies will often be related to magic and the use of *gri-gri*. A *gri-gri* serves for one's well-being or to put a spell on somebody else. Almost all the houses have *gri-gris* to protect its inhabitants. Likewise, most farmers place *gri-gris* in their fields to protect them against thieves or plant diseases and pests (see Photograph 4.1).

Whereas the collective worshipping of *voodoos* and deceased ancestors diminished during this century, magic and the use of *gri-gris* increased. Magic is an important means for individuals by which they try to control their environment (cf. § 6.2.2 and § 7.2.3).

Adja society is patrilinearly organised. Until the rapid incorporation into the 'modern' market and state in the 1920's, the *hennou* or patri-linage was the dominant organisation unit. Traces of this organisation unit may still be found among Adja-Ehoué groups, but the most dominant organisation unit nowadays is the household or *houé*. Frequently, villages are named to the founder of the *hennou*, e.g. Koko founded Kokohoue. Many religious activities in a village, showing



Photograph 4.1. Use of a *gri-gri* to protect a field against thieves.

manifestations of solidarity within the *hennou*, will be orientated towards the *voodoos* and the founder of the *hennou*. Unlike Western views, deceased people are still considered to be present in some form. Religious ceremonies after the death of people, are frequently observed. Economically, they constitute a heavy burden.

There are organisations, present at village level, which ensure the payments of funeral expenses, if a member's kin died. Likewise, credit groups on rotational basis called *tontines* are commonly found. Credit and saving is mostly informally organised, the bank and credit system being still in the embryonic stage. Adja farmers mainly invest capital in the form of palm groves, making them an indicator of wealth. Individual oil palms can be sold or hired, providing financial room for manoeuvre in case of sudden necessity.

Agriculture is the main activity for 90% of the active population living on the plateau, making it the principal economic activity on the plateau (Daane & Perthel, 1988). Agriculture-related activities such as trade and processing (e.g. *gari* from cassava, *sodabi* distillation from palm wine, palm oil from palm fruits) are also important. Men, women and children are more or less equally active in preparing fields, sowing and weeding. However, as more men than women migrate, for a temporary or longer duration, women and children outnumber men. Women and children assure most of the transport between fields, village and markets. Average distance of fields from the village is 2,1 km (Biaou, 1991); however, fields at a walking distance of more than three hours are no exception. Of the active population, 61% was females in 1979 (BDPA, 1985). All crops are cultivated by women. However, they seldom own land.

Nowadays, land is rarely used collectively, as was the case in ancient days with a *chef de terre*. Adidevo(low) is one of the few examples where still a small part of the land is used collectively. A large majority of the land is individually owned, mostly by men. Individual rights are confirmed by planting trees, especially oil palm. For the Adja plateau, the average area per caput is 0,2 ha (Biaou, 1991). Due to demographic pressure, landless labour is increasing. In the most populated areas more than 70% of the adult males do not possess land (Biaou, 1991). However, this category has other access to land. Apart from inheriting or buying land, Adja farmers might hire or borrow land or work as a tenant. Tenants mostly cultivate maize and cassava during short periods; whereas owners, hirers and borrowers intercrop annuals with oil palm for longer periods. In the latter systems the rights to oil palm products are agreed upon in various ways between owner and farmer. The most current tenant system is called *déma*: 'sharing the oil palm'. One hiring system is called *contrat palmier*: palms at the age of 7 to 12 years are 'leased'. At the palm age of about 20 they are felled, with the palm wine being for the hirer, and the re-fertilised land returns to the owner.

A rich male farmer, as head of the household, tends to rely on the labour of his household. Family labour accounts for more than 50% of the labour

requirements in agricultural activities and may amount up to 88% (Houndekon, 1986; Quenum, 1986). Smaller working units, consisting of some brothers with their sons, or co-wives with their daughters, are a general practice. Much of the agricultural education of the young takes place in these groups. Working on the household fields is seen as both apprenticeship and duty. The emphasis, however, is on apprenticeship and 'learning' (cf. § 7.2.1). The Adja see farming as an art that has to be taught. They hold people who 'know how to cultivate', or more exactly 'know how to hoe' (*se agblen*) in high esteem (Wartena, 1992).

Wage workers, mostly landless young men, are engaged especially by female farmers, and paid by unit of surface (cf. Biaou, 1991: 180). Land measure units used by the Adja are *katchi* ($\pm$ 570 m^2) and *aboho* ($\pm$ 400 m^2). The *katchi* and *aboho* are also used to measure labour activities. The smaller *aboho* unit is apparently used in the more densely populated zones of the Adja plateau and is currently replacing the *katchi*. A *katchito* is an agricultural labourer. Fields can regularly be seen with square patches of which the boundaries are marked with maize hedges; indicating *katchi* or *aboho* units. While harvesting these units, the fresh maize from the hedges is served to the *katchitos*.

Whereas farming knowledge is seen as a first asset, physical strength and the ability to clear or weed a large area of land within a short period of time is also highly valued. In Allada, people still recall that in 1979 a farmer weeded 16 *aboho* in one day; a record (however, the next day he felt sick and had to stay in bed for two weeks).

Communal working, though declining in importance, exists in the form of *efidodo*, a working party on the basis of reciprocity. In addition, labourers may help somebody as and when the occasion arises, e.g. with the building of a house receiving nourishment in recompense. On the whole, the Adja community is seen as an increasingly individualistic society (Wartena, 1988b; Den Ouden, 1989b). Labour shortages have been aggravated by the individualisation process. Processes of knowledge diffusion are furthermore decelerated due to internal struggles. Jealousy and faction struggle are common phenomena.

Variation in preferences for crops is frequently found. For instance around the town of Klouékanmé (NE of the plateau, see Annex 7: Map 3) farmers have specialised in tomato growing. They regularly apply fertilizer to tomatoes, whereas the fertilizer is obtained with credit on condition that it only be used for cotton. In the populated area around Allada(high), groundnut is cultivated more than is usual; a result of declining fertility. Villages sometimes have a certain specialisation, e.g in *gari* production (processed cassava) or *sodabi* production (processed palm wine).

Farmers regarded as 'good' farmers will often be seen as such due to their wealth and oil palm groves. However, also other categories, such as young farmers, female farmers, and poor farmers vary in their abilities to farm successfully. In addition, farmers indicate that there is not just only one fixed way to farm. Access to resources varies and is for the greater part socio-economically determined, but room for manoeuvre is not absent. For instance an old man

said: 'Nowadays young people are astute, as they have less land than we had'. Women who have the right to use a plot of their husband's land might feel tempted to neglect weeding around the oil palms or prune palms excessively in order to retard palm growth and lessen shading by palms on the crops cultivated by the women. Examples of changes in the Adja farmers' knowledge, or practices due to expression of conflicting interests (e.g. not weeding palms by women) are frequent (cf. Chapters 6 and 7).

Migration is especially common for young men. Whereas migration, e.g. to Ghana, Nigeria, or Togo, tended to be prolonged in earlier days, nowadays seasonal migration is taking over. Landless young men often migrate seasonally to adjacent Togo (cf. Faure, 1990), the savanna in the North of the Mono Province, or to the Northern Provinces like the Zou or the Borgou. Mobility is considerable; survey farmers including women were sometimes absent due to travelling. This was observed most in the villages with higher population pressure (Kokohoue and Allada).

Interesting is the fact that when Adja arrive in a new area, they would attempt to start with the oil palm mixed cropping system where this proved to be ecologically possible, in contrast to other ethnic groups present on the site (Faure, 1990). Contact with other ethnic groups is rather intensive via migrants but also through other agents, like traders. This is not a recent phenomenon. For example the *fa* (system of divination; Wartena, 1988a: 223) and the *voodoos Sakpata* and *Lègba* originate from the Yoruba region (Mondjannagni, 1977).

When women marry they move to the village of their husband. However, they will assist at religious ceremonies in their original villages. Therefore, some knowledge processes between villages occur especially via women. Women in Kokohoue for example, have often learned in detail how to grow, process and market cassava only after their arrival in Kokohoue, a village whose women specialise in cassava production. Processing of cassava, groundnut, oil palm fruits and maize is done by women. Accordingly, they tend to specialise in related knowledge. An example is the knowledge of the suitability of cassava varieties for different ways of processing which is mainly a domain of women (Breusers, 1990a). Women also undertake the marketing of the products. During market days most of the women will go to the market and be able to meet many people.

4.4 History of the Adja plateau

The Adja migrated from Tado in Togo (Pazzi, 1979). Tado is considered to be the place from where several ethnic groups like the Ewe (South Togo), Fon (Abomey), Goun (Porto Novo), Ayizo (Allada), and others originated. The language used by these ethnic groups is related to the Adja language. The Adja plateau became populated with the Adja from Tado long before 1800, but increasingly during the 19th century. They apparently mixed with minor groups

(unknown to date) who were already present on the plateau, and with some Yorouba groups from the East. Migratory tendency and uncertainty was especially due to slave raids by neighbouring groups. Politically the King in Tado was head of the patrilinear lineages present on the plateau. He received taxes in kind and had judicial power. The Adja, like neighbouring ethnical groups, based their political structures on the religious system.

The *chef de terre* in a new area was primarily a priest negotiating with *Sakpata*, representing the land. After due respect is given to *Sakpata*, the *chef de terre* was entitled to give land in stewardship to others. He distributed the land with the topography of the area (e.g. slopes, streams, types of soil) and the necessities of the newly arrived people in mind. The pact with *Sakpata* has to be affirmed regularly.

Though initially respectful towards its Adja origin, the Fon influence on the Adja progressively grew and was dominant in the 18th and especially 19th century (Pfeiffer, 1988; Wartena, 1988a: 48-9). The introduction into the farming system, and the more or less imposed planting of the oil palm started about 1840, an initiative of Ghezo and Glele, Kings of Abomey (Mondjannagni, 1969: 116; Pfeiffer, 1988: 25). Trade, at first mainly in slaves, from the mid 19th century in oil palm products, was already important before the arrival of the colonialists. The influence of the Adja King declined further as animistic religion was challenged by the coming of islam and especially christianity. As a result, individualism grew resulting for instance in sub-division of land, whereas before landrights used to be vested in the head of the lineage. The return of ex-slaves from America, increasing trade with neighbouring ethnic groups, and especially the arrival of the French colonialists in the 1880's contributed to major socio-economic changes. Forced labour resulted in new roads and rail roads which linked local markets into a wider and more intensive network. After colonisation, the number of trading women grew quickly. Monetary exchange increased after 1920 to such an extent that cowries as the unit of currency disappeared from circulation.

Bush fallow, already less common before World War II, gradually disappeared around 1950. Whereas in the 19th century new fields could still be cleared and taken into production by newcomers after permission of village elders; at the beginning of this century the majority of the fields were already occupied. Farmers developed new types of 'fallow' with cassava, pigeon peas and especially oil palm (cf. § 5.3.1).

Figure 4.1 shows the relative importance of some of the key crops in the Adja farming system over the past 160 years, including demographic increase. Until the 1930's population grew at 1.1% per year, but has accelerated since; between 1960 and 1979 growth was 2.8% a year (Wartena, 1988a). The figure points to a highly dynamic farming system, constantly in search to adapt to changes in the context in which it has to operate. Driving forces in this respect include demographic developments, new economic opportunities, results of what could be classified as Adja policy-making in agriculture, and changes in the quality of the agricultural resource base.

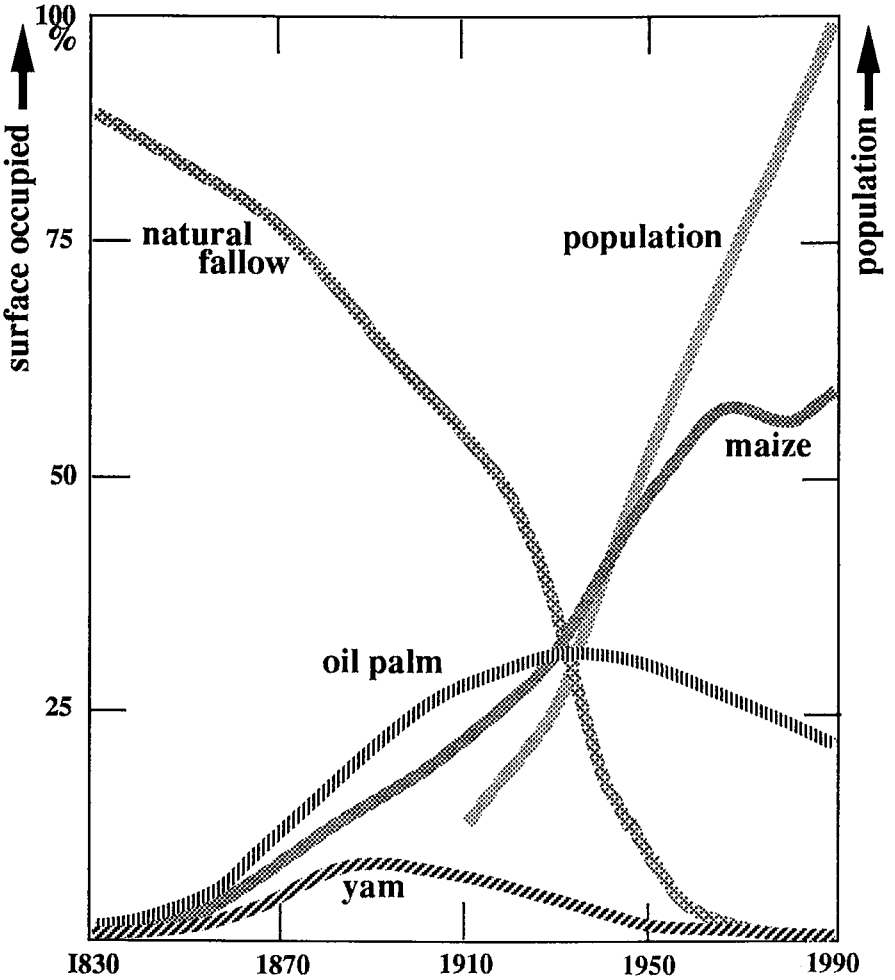


Figure 4.1. Relative importance of some key crops on the Adja plateau in the period 1830-1990. (Source: Koudokpon *et al.*, in press, reconstructed with data from BDPA, 1985; Anon., 1988; Daane & Perthel, 1988; Wartena, 1988a).

The cultivation of yams, historically a very important crop in West Africa, ended because forest reserves were depleted. This crop particularly requires a relatively high level of chemical fertility, a requirement that can be satisfied starting afresh after a long forest fallow, but is difficult to maintain over the years on the same field. Yam as staple crop has gradually been replaced by cassava, and more importantly by maize in the 18th and 19th century. Since the 1950's, yam cultivation has been confined to home gardens (Wartena, 1990: 16).

Cotton, a relatively recent introduction, has become a primary cash earner for farmers, although declining prices have had their effect on the crop's progress in the area.

Cassava has become gradually more important this century. It proved to help overcome droughts and famine. In addition to being a consumption crop, cassava also became a cash crop with the growth of market influence. Its processed products can be stored well and are marketed by women. As the role of oil palm changed from oil fruit production to palm wine production (see § 5.2), women became involved in other marketable crops, like cassava, groundnut, cow pea and vegetables.

Weeding became more and more difficult in recent decades. Whilst at the turn of this century one weeding round was sufficient per annual crop, nowadays 2 to 5 times is common. Weeding takes about half of the Adja's labour time in agriculture, 42% in peak periods (Houndekon, 1986; Kersten, 1988), and is done by scratching superficially the soil and uprooting herbs which are left to decompose. Only on fields where groundnut will be grown, are weeds burned after drying.

One of the things to be noticed here is that the Adja have one word, *agblen*, with two meanings, namely cultivating and weeding. The Adja know the neighbouring Fon way of weeding and tillage, which entails the making of ridges resulting in time saving labour (one weeding round suffices) and short term fertility concentration in the ridges (Wartena, 1990). However, they prefer their minimum tillage practice, as the ridge practice 'asks too much from the soil'. The Adja view on weed is expressed by the following proverb: 'The son of the house is the herb (*ahwevi*). The crop (*amejro*) visits the house. However, the son does not like to be dominated by the stranger. Therefore, when we sow a crop, we have to weed; if not, the crop will not produce'.

In earlier centuries, men were responsible for clearing the fields and most of the weeding, while women were responsible for planting, harvesting and transport. Before 1920, only a few Adja women cultivated their own plots (Wartena, 1988a), but from then on female farming came up and extended to almost all women. Women increasingly participated in agricultural activities; a development that has become more noticeable during the past two decades (Van der Schenk, 1988). Meanwhile, their subsistence contribution to the household has increased, nowadays comprising roughly half of the staple responsibilities (Wartena, 1990).

Off-farm work of women consists principally in trading and processing (*gari* from cassava, palm oil, groundnut oil, and *akassa* from maize). Labour productivity of these activities is low compared with productivity of agricultural activities (Houndekon, 1986). Still women prefer these activities, as it gives them the only opportunity to use their labour in certain periodes and because other off-farm work demands high investment.

French intervention in agriculture through commercial enterprises was orientated towards commodity crops like oil palm, ricinus, cotton, maize, tobacco and castor beans. Coffee and cocoa were tried without success. Between the two World Wars, the surplus extracted by the state varied from 10 to 30 %

of the global agricultural production in the South of Benin (Pfeiffer, 1988: 65). After World War I, France exploited the peasantry at least equally, if not more than the Kings of Abomey in the 19th century (*ibid.*, p.66).

After independence in 1960, the commercial enterprises still functioned till 1977, when they were formed into a central state service responsible for agricultural extension and development; 'Centre d'Action Régional pour le Développement Rural' (CARDER), as well as the 'Direction de la Recherche Agronomique' (DRA) which is responsible for agronomic research.

Farmers in South-Benin have experienced interventions into their farming since precolonial times. On the basis of experiences since the beginning of this century it can be shown that state interventions have in very rare cases been able to meet their formal commitments towards farmers (Von der Lühe, 1991a: 288). This can be traced from the 'Sociétés de Prévoyance' in the thirties, the 'Sociétés Mutuelles de Développement Rurales' and the marketing cooperatives in the forties and fifties, the collective village – or cummunal fields shortly after independence, the forced membership in the so-called cooperative oil palm plantations ('Sociétés d'Aménagement Rural') in the sixties up to the integrated rural development programs of the CARDER (*ibid.*).

The national currency, Franc CFA, being related to the French Franc (50 F.CFA = 1 FF = $\pm$0,20 $), relatively favours imports against exports. National maize and meat prices cannot compete with world market prices. Likewise, technology packages of improved seeds, fertilizers, and pesticides proved to be economically unfeasible for the majority of Adja farmers, with the exception of cotton.

4.5 Recent interventions on the Adja plateau

The CARDER is mainly orientated towards cotton production, though officially also responsible for other crops. Inputs for cotton production are provided by CARDER on a credit basis; CARDER also gives extension on cotton cropping techniques and collects the harvest. Extension by the CARDER is organised according to the Training & Visit system of the World Bank (cf. Benor & Harrison, 1977). A rather top-down technical approach is dominant, which seldom accounts for farmers' knowledge and past experience (cf. Von der Lühe, 1991b). Due to ineffective results and a recent introduction of the Structural Adjustment Programme in Benin, major changes are expected. A privatisation of input deliveries as well as a more pronounced role of farmers' organisations are foreseen.

CARDER receives its research input mainly via the DRA. However, a central problem was noted in 1981: '...we have to observe the continuing of a fundamental problem: the non-transfert of the research station results to farmers' (Gbégo, 1991: 3; my translation, JB).

A solution to this problem was sought via the *Farming System Research and Extension* approach (FSR/E), carried out since 1986 via the DRA in the project

'Recherche Appliquée en Milieu Réel' (RAMR). RAMR, which is backed by the International Institute for Tropical Agriculture in Ibadan, Nigeria, seeks to carry out *on-farm research*. In the first years, research was orientated towards chemical fertilizers and new varieties. Recent RAMR research is involved in alley cropping, the role of goats and sheep in the farming system, the oil palm system as practised by the Adja and ground cover crops. Results taken over by farmers are limited to a restricted adoption of new maize and cow pea varieties and use of *Mucuna pruriens* for clearing fields invaded with spear grass (*Imperata cylindrica*). In addition, RAMR made considerable institutional results, introducing FSR/E methodologies into the DRA (Koudokpon, 1992). Although the *Farming Systems* approach to agricultural research and extension has always placed a high priority on farmer participation and generation of technologies through *on-farm* experiments, there are several constraints a rural people's knowledge component could help to eliminate (Warren, 1991: 166). The reality of FSR/E is that it is still dominated by a transfer-of-technology approach that spends less time with resource-poor farmers (Chambers & Jiggins, 1986).

Several Non-Governmental Organisations (NGO) or international agencies operate on the Adja plateau, with regional, national, or international funding (e.g. World Bank, European Community, Canadian, American, Dutch, German, Italian and French aid).

Despite the efforts of the above mentioned agencies, it has to be mentioned that the problem of declining soil fertility has as yet not been answered sufficiently.

4.6 Conclusion

In summary it can be said that the rainfed agricultural activities on the plateau are faced with a rather high climatic variability. This chapter demonstrated the complexity of the Adja farming system as one answer to the risks involved in farming. The Adja use several elements from their environment to plan agricultural activities.

Individuals and households are more important decision units nowadays than they used to be. Also in religion, the collective worshipping of *voodoos* and deceased ancestors diminished, whereas magic and the use of *gri-gris* has increased.

The history of the Adja farming system shows constant changes in agricultural practices, giving a dynamic picture. Agronomic interventions to tackle the declining soil fertility problem were rather limited in their results until now.

One can conclude that the Adja farming system has all the appearances of a system on the move, of farmers who are adapting their production strategies to perceived environmental changes.

'Le palmier c'est notre richesse'.
(Adja saying)

5 The Adja oil palm system: an answer to declining soil fertility

This chapter presents and analyses the Adja oil palm-based farming system. How the oil palm is firmly entrenched in Adja agricultural activities will be described. A view on soil fertility as seen by the Adja themselves is given, in addition to a soil analysis of the soil fertility consequences of the oil palm system. This last analysis, presented in § 5.3.2 and § 5.4.1 relies heavily upon: Koudokpon V[1], Brouwers JHAM, Versteeg MN[2], Budelman A[3] 1993 *Priority setting in research for sustainable land use: The case of the Adja Plateau, Benin.* submitted to: *Agroforestry Systems.* With permission of Agroforestry Systems, of this article § 4 and part of § 5.1 are used for the present chapter, with minor adaptations.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

[1] Projet Recherche Appliquée en Milieu Réel, Lokossa, Republic of Benin
[2] International Institute for Tropical Agriculture
[3] Department of Agricultural Development, Royal Tropical Institute, Amsterdam

5.1 Introduction

When talking with the Adja about the way they organise agriculture, the oil palm is frequently mentioned as playing a key role. The Adja have sayings like 'Our oil palm is made of gold', or 'The oil palm is our wealth'. The way the oil palm is being used in the Adja farming system in my view gives a good insight as to how the Adja manipulate their resources and deal with constraints and by doing so, construct knowledge. Through understanding the way how the Adja use the oil palm, this chapter seeks to disclose parts of Adja reasoning.

The next paragraph (§ 5.2) will present the oil palm-based farming system as practised by the Adja. Paragraph 5.3.1 presents the Adja view on soil fertility. An evaluation of the soil fertility consequences of the oil palm farming system is given in § 5.3.2 by analysing changes in availability of soil nutrients as a result of the Adja farming system. Finally, § 5.4 gives an interpretation of the former paragraphs and draws conclusions.

5.2 The Adja oil palm-based farming system

It is generally accepted that the oil palm originates from West and Central Africa (Portères, 1962). According to Zeven (1967), the occurrence of oil palm in situations where rainforest is the climax vegetation is unusual. In his view, oil palm establishment depends on man disturbing the natural environment, thereby providing a suitable habitat for the species. The oil palm groves (*Elaeis guineensis* var. Dura) which were first established around 1840 (see § 4.4) are clearly man-made, and not spontaneous elements of a fallow vegetation (see also Mondjannagni, 1969: 116-7).

The oil palm is mostly regarded as a crop producing oil. Oil palm fruit production of farmers in Benin is about 1.4 ton/ha, Dura type (De Lange, 1987); the limited production mainly due to low mean annual rainfall. However, the main economic value for the Adja comes from the palm wine, the sap extracted from the palm trunk. A distillate, *sodabi*, can be made out of the palm wine which can be stored easily and has a stable price. A Beninese soldier, Mr. Sodabi, who served in the French army during World War I, started the distillation technique of palm wine (Feil, 1991: 306). He observed the technique in France and after his return to Benin tried it out on oil palm wine. Palm wine distillation started in the 1920's and spreaded rapidly, but was often prohibited. In 1992 a farmer still had to pay 50 Franc CFA ($\pm$ $ 0.20) for each palm he felled (only men fell oil palms). (for an elaboration of the sodabi case: see Box 7.6.)

A mixed cropping system based on oil palm, which evolved in its current form in the 1960's (cf. § 4.4), is the dominant cropping system to be found on the Adja plateau. The system combines soil fertility recovery via oil palm fallow with economic production of the palms.

Oil palms will be found on the majority of the fields. On the plateau 17,2%

Photograph 5.1: A typical Adja field with oil palms associated with annuals.

is under 'palmeraie' (groves with only oil palms; BDPA, 1985), the other fields often having younger oil palms in an associated cropping system with annuals (see Photograph 5.1).

Palms are planted about 2,5 to 5 m apart (variations are due to field specific characteristics and preference of the owner), giving between 400 to 1,600 palms/ha. 'Palmeraies' with up to 2,000 palms/ha might be found. Palm wine is collected after felling trees. According to farmers, palm wine production is higher with high densities (compared to 150 palms/ha advised for oil palm fruit production, cf. Purseglove, 1977).

New palms are planted 2 to 5 years after felling the palm groove. Planting palms establishes the property rights of the owner; boundaries of fields are more densely planted. During the first 5 to 10 years farmers grow two or more annuals between the young palms. Annual crop components change in species and number as the rotation progresses (Gibbon & Breusers, in press). Farmers prune the palms 2 to 3 times a year. Oil palm leaves are used as fodder for goats and sheep, as mulch, as fuel (leaf sheaths) and as construction material (leaf stalks) for mats, fences, store houses, etc. Pruning will go on until the 'palmeraie' starts with a pure stand of oil palms, after 5 to 10 years of intercropping: *ede xo gnigban*, ('The palms take over the field'). Figure 5.1 gives an overall view on how the oil palm is being used by the Adja.

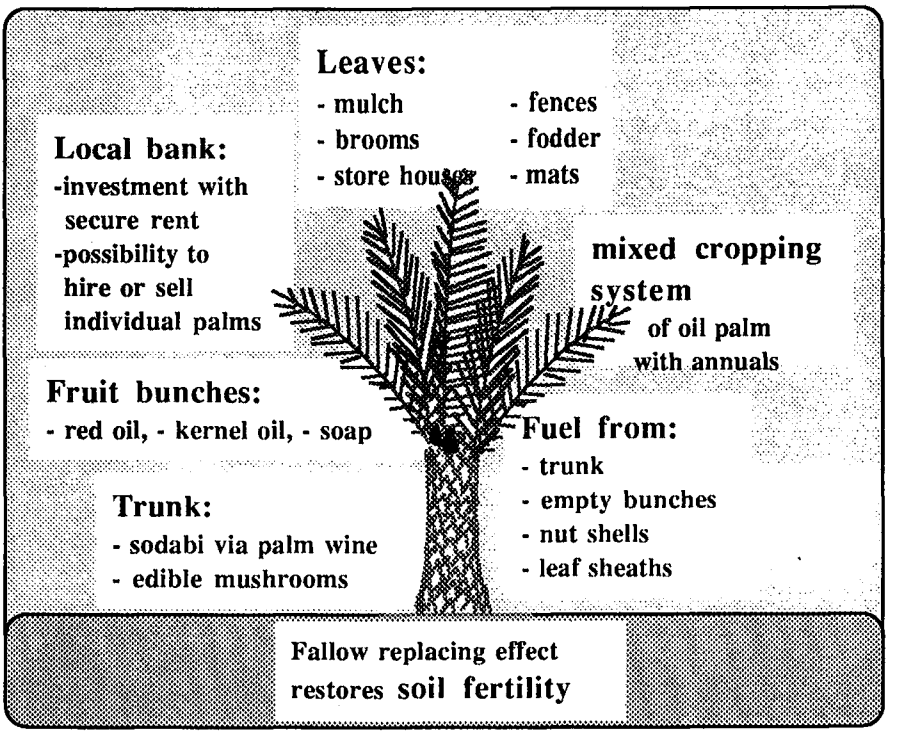


Figure 5.1. Different utilities of the 'oil' palm, as practised by the Adja.

Most women and also poor farmers who often hire, lease or borrow a field and do not own the palms, will try to intercrop for as long as possible, though after 5 or 6 years most fields will not give high maize yields. In case they own palms, they will cut down their 'palmeraie' sooner (e.g. 8 – 10 years of closed 'palmeraie' with felling age of palms at about 15 years). In § 4.3 it was mentioned that one tenant system is in use regarding certain usufruct like collection of fuel (leave sheaths, trunks of felled trees) and oil fruits of the palms: *dema* ('sharing the palms') while the hiring system *contrat palmier* purchases the right to use all the economic products of the palms.

Richer farmers are able to leave their 'palmeraies' for a longer period (e.g. 20 years or more) and they can collect more palm wine and palm fruits and eventually have a better fallow effect (cf. Quenum, 1988). Palms can be hired or sold individually and are seen as an excellent investment with a secure rent (in palm fruits, fodder, fuel, building material and augmentation of palm wine and soil fertility). Accordingly, oil palms serve as an investment, as a reserve and as an indication of wealth.

Kang (1977) found higher soil fertility and better maize production on land where palm trees had grown than on surrounding sites where natural forest had

been cleared. Adja farmers unanimously say that 'palmeraies' have a fallow-effect in that the palms increase the soil fertility, especially the organic matter level (palms provide good *vitamine*, cf. § 5.3.1). Trunks, roots and other biomass left on the field will decompose within 2 to 3 years. Quenum (1988: 120) found higher maize yields (1,5 – 2 tons/ha) after felling of 'palmeraies' with higher densities (1500 – 2000 trees/ha) compared to 500 to 700 trees per ha. After about 6 years, maize yields will drop to the level mentioned in § 4.2, of around 700 kg/ha. As demographic pressure is high, this soil fertility aspect is rather important on the plateau.

That yields during the first year after fallow are lower, compared to that of the second year, is probably because of nitrogen shortages. This nutrient is temporarily immobilised in the decomposition of large amounts of organic matter available just after cutting and (partially) burning of the fallow vegetation. In § 5.3.2 an analysis will be given of soil fertility effects as a result of the Adja oil palm farming system.

Adja farmers on the Adja plateau have access (via ownership, borrowing, hiring, and/or leasing) to several fields; Biaou gives an average of 2,72 fields with an average of 0.30 ha per field (Biaou, 1991: 170). Men have more fields than women: 3,77 (*ibid.*). Generally farmers divide their fields into three cropping stages of the oil palm-based system; see Figure 5.2. One field is under palms, a 'palmerai': *dékan* ('dé': fruit bunch and tree, 'kan': bush). A second field,

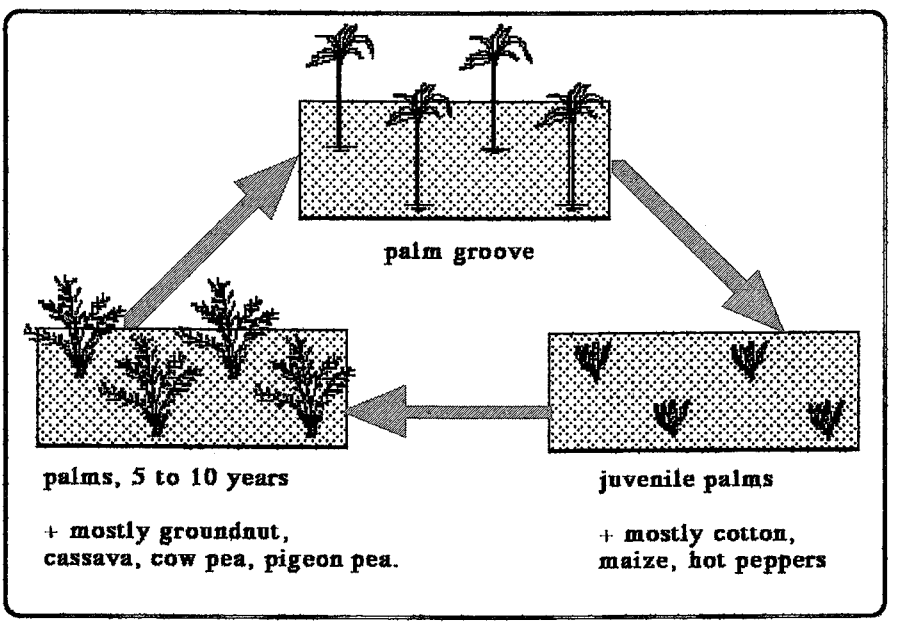


Figure 5.2. Schematic rotation between fields of mixed cropping systems with oil palm.

recently cleared, after being a palm groove for a while, is named *bo* or *bodji* ('bo' means field). On this sub-plot after a few years new palms will be planted, and mixed cropped with annuals which are more demanding in soil fertility, water and light use, such as maize, tomato, and cotton. Finally, a third field is called *bogbu*; the 5-10 years old palms on this sub-plot are named *bogbudi* ('small palms'). Generally, on this field annuals like cow pea, pigeon pea, groundnut or cassava will be grown, as these crops can still produce something on an exhausted soil (cf. Quenum, 1988).

When a *bogbu* ceases to become a young *dékan* ('The palms take over the field'), an older *dékan* will be felled to get a new field (*bodji*), generally with a higher fertility level than at the end of the *bogbu* stage. Meanwhile, in an older *bodji* the palms will grow and form eventually a *bogbu*. Thus, it can be said that rotation of cropping systems with oil palm and annuals also gives a rotation of soil fertility around the fields of Adja farmers. *Inter*-field management constitutes an important issue for Adja farmers. The described system gives farmers the opportunity to spread risks and cultivate a variety of crops, each crop fulfilling certain objectives. Figure 5.2 resumes the process.

Oil palms play another important role in this mixed cropping system. Generally, tropical soils in West Africa are known for their low level of fertility, while facing climatological influences (high solar radiation, wind, rain) which may cause erosion. After the felling of the forest, it became clear that the forest protected the soil, acting as a buffer between the soil and climatological influence (Budelman, 1991). Moreover, the forest also functioned as a storage for biomass, which 'feeds' the soil with organic matter (*ibid.*, see also § 5.3). After clearing of the forest, this protection and biomass is lost. Agriculture mainly based on annuals might be rather unsustainable without such a protection. The agroforestry system of annuals with oil palms, as developed by the Adja, seems more sustainable. In addition, the Adja tolerate wild shrubs in the oil palm groves, and practise minimum tillage in preparing fields and whilst weeding. Leaves and herbs are generally left to decompose on the surface of the soil, protecting it against run-off, sun and heavy rain.

The minimum tillage system of the Adja, combined with mixed cropping of palms with annuals often did not appeal to agronomists. On my arrival in the area in 1988, extension workers and researchers almost apologised for the 'irrational' way the oil palm was used by the Adja, who 'destroy their palm plantations for tapping palm wine'. Likewise, the mixed cropping of annuals with oil palms was seen as unproductive; 'The maize is hindered by the palms'.

5.3 Soil fertility of Adja farmers' fields

Nowadays, it is widely acknowledged that sustainable land use on rain-fed uplands in the tropics critically depends on a balanced organic matter cycle (Young, 1986), in addition to the obvious need to care for a balanced nutrient

budget (Van der Pol, 1992; Budelman & Van der Pol, 1992). Adja farmers are aware of the necessity to ensure a balanced organic matter level. Their view on soil fertility will be presented in § 5.3.1. In § 5.3.2, a topsoil analysis is given to display the nutrient balance seen from soil science point of view. For this purpose a fertility survey of the topsoil was made (cf. Koudokpon, Brouwers, Versteeg & Budelman, in press).

5.3.1 Soil fertility as seen by the Adja

Fairhead (1992: 6) states that it is often doubtful if farmers speak of soil fertility in the same terms as scientists are used to do. Likewise, the Adja do not seem to have such a concept. When Adja farmers talk about soil 'fertility' they speak of it in terms related to a bodily state. A field with good fertility is referred to as *gnigban zozou*: 'hot soil'. A field with poor soil fertility is 'tired' (*gnigban kpokpo*: an old field). If the soil fertility is very low, they speak of a 'comatose' field. In such a field, weed growth will be limited and presence of earthworms and other species of the soil macro fauna will be very limited. Soil 'fertility' can be restored by giving *vitamins*: organic material which decomposes in the soil like *noukplo* (collected refuse) or chemical fertilizer: 'engrais'. The process of making a soil more 'fertile' is explained in terms like 'feeding the soil', or 'giving the soil its force'. Plants growing on a field give an indication of the soil fertility (cf. Dangbégnon & Brouwers, 1991b). For instance *glazoui* (*Talinum triangulare*) and *shikagbè* (*Ageratum conyzoides*) indicate a good soil fertility. *Shikagbè* has the suffix *shika* (gold) and *bè* (leaf): 'leafs which give gold', referring to a fertilizing effect. Some plants like *shikagbè*, cow pea, pigeon pea, *engraisbè* ('fertilizer leaves', *Mucuna pruriens* or *Centrosema pubescens*) and groundnut are known for their fertilizer restoring capacities. In addition, the performance of plants gives indications as to the fertility of the soil. This is especially the case with *klogbou* (*Panicum maximum*) which grows vigorously on soils with good fertility and remains small on soils with low fertility.

The soil is seen as an entity which has to be maintained in order to be able to use it again. At the start of the season, especially if a field will be cultivated for the first time by a new tenant or owner, benediction is implored from *Sakpata*, the *voodoo* who reigns the land.

In former days a *gri-gri* called *adjitèbo* was sometimes used to augment the productivity of a field or to transfer productivity capacity from a neighbours field to one's own. Nowadays this is not done anymore, as explained by Missihoun, *féticheur* in Allada: '*Adjitebo* was a practice sometimes undertaken by our ancestors, but nowadays not anymore. In those days fields were bigger and not as dispersed as they are now. Then the soil was strong, but now we have asked too much of it'. This indicates that the Adja seem to regard soil fertility as a limited good.

Each vegetative material (weed, debris of crops, trees) gives its specific *vitamin*,

also conceptualised as *houinhouin*, see Box 5.1. A general management practice in response to varying soil fertility is change in species and number of annual crop components. Fields which have a very low soil fertility, *champs comateux*, can get to a high fertility level according to Adja farmers, by applying special management. If the oil palms are 5 to 10 years old, the owner might choose to 'let the palms take over the field'. In the last season of mixed cropping he or she might plant pigeon pea between the palms. If the palms are still young, the farmer might decide to cultivate cassava, which, contrary to much literature, is considered by Adja farmers as fertility restoring (cf. Breusers, 1990a: 115). Farmers explain this by pointing to the large quantity of leaves and stalks which remain on the field and the turn over of the soil while harvesting tubers. If cassava, apart from producing tubers, is also meant to augment the soil fertility, they might leave it for 3 or 4 seasons and not weed certain plants like *Mucuna pruriens* (*kpasahon*) or *Centrosema pubescens* (*eyiyou*). These ground covering crops, originally introduced as aid crops for oil palm plantations, are sometimes called *engraisbè*, ('fertilizer leaves').

After a season with cassava on a field with a low soil fertility, a second crop might be a leguminous like cow pea, pigeon pea or groundnut. Compared with other crops, the leaves of these crops are considered to give a good *houinhouin* and to decompose quickly in the soil. Groundnut is also appreciated for the fact that the soil is tilled during harvest. Tilling of the soil, as is done after harvesting cassava and groundnut, or by felling an oil palm groove, is beneficial for the soil fertility on *terre de barre*, according to the Adja farmers.

A system in which cassava is left on a field for 2 or 3 years is called *dégbézoui*: 'cassava-fallow'. Natural fallow, nowadays absent in the more populated areas, is called *avesou*: 'big forest'. The fallow system with oil palm presented in § 5.2 is called *ekpon*: 'small forest'.

The concept of *houinhouin* is often unknown to young farmers. They tend to use concepts like *engrais* (related to chemical fertilizer) or *compost* (related to organic manure). However, as is the case with their elders, they also explain the process of fertilizing a soil in terms like 'feeding the soil'.

Box 5.1:
Rosa explains the concept *houinhouin*.

Rosa: 'At the harvest of each crop you can smell its *houinhouin*. For instance, after harvesting cassava tubers, the remaining leaves and stalks will give a typical cassava *houinhouin* to the field. This will serve as nourishment for the next crop. However, it is not good if cassava will be planted as the next crop. First the *houinhouin* brought by the cassava has to be taken out of the field by another crop. Each crop gives his *houinhouin* to the next crop. Those of cassava, groundnut, cow pea and pigeon pea are especially beneficial for next crops. After a 'palmerai' has delivered its field again, the *houinhouin* of the palms make the field especially suitable for maize cultivation, not cassava'.

5.3.2 *Topsoil analysis*

Generally, the quality of upland soils in the tropics profits from a perennial cover, after having been used for the purpose of annual crop production. Normally, during fallow, soil organic matter content increases, as does the cation exchange capacity. Particularly on soils like *terre de barre*, that contain kaolinite as the main clay component, organic matter is instrumental in the maintenance of the Cation Exchange Capacity (CEC) (cf. Jaiyebo & Moore, 1964; De Boissezon, 1970; Brams 1971; Sanchez, 1976; Budelman & Zander, 1990).

The aim of the fertility survey of the topsoil (survey undertaken together with the team of FSR/E project 'Recherche Appliquée au Milieu Réel') has been to establish the soil ameliorating powers of the oil palm fallow used by the Adja. The main questions were:

1) whether there is a relationship between the CEC and the soil's organic carbon and clay content;
2) if fallowing with oil palm increases the soil's organic carbon content; and
3) how the topsoil must be rated chemically.

One hundred topsoil samples (0-20 cm) were collected on 4 cultivated fields, and from 6 adjacent palm groves (for methodology of soil analysis: cf. Annex 3). In all cases the history of soil use was discussed with the owner. Fields and groves sampled were located in an area of less than a square kilometre near the RAMR research village Zouzouvou (near Djakotomey, cf. Annex 7, Map 3). The latter village is comparable to areas with medium population pressure like Kokohoue (cf. Biaou, 1991). All samples were analysed for clay and carbon content, and for the value of the CEC. Table 5.1 gives the regression equations where the CEC is estimated as: (1) a function of the soil carbon content; (2) of the clay fraction; and (3) of their combination.

Although the fit (expressed in the correlation coefficient r^2) is relatively low, the soil's CEC can be estimated reasonably well using the values for soil carbon (eq. 1). The clay content, however, explains much better the variation found in the CEC (eq. 2).

Combining the variables carbon and clay in a multiple regression analysis (eq. 3), slightly improves the fit. The amount of variation in the CEC that can be attributed to carbon is low (about 7%), and in fact not statistically significant,

Table 5.1. Cation Exchange Capacity as function of soil clay and carbon content (Y is estimator for the CEC value).

regression equatations	r	r^2	signif.
(1) Y = 2.64 * % carbon + 4.28	+0.255	0.065	P<0.025
(2) Y = 0.36 * % clay + 2.33	+0.788	0.621	P<0.001
(3) Y = 0.35 * % clay + 0.68 * % carbon + 1.96	+0.791	0.625	P<0.001

average CEC value = 5.99 meq.; % C = 0.65; % clay = 10.2; (n=100)

Table 5.2. Soil organic carbon as buffer (between brackets the number of samples analysed).

	nutrient / factor
strongly correlated with organic carbon; $P < 0.001$	nitrogen (40), exchangeable calcium (43), magnesium (43)
moderately correlated with organic carbon; $P < 0.010$	total phosphorus (40), pH (100)
weakly correlated with organic carbon; $P < 0.050$	exchangeable potassium (43)

compared to that of the clay fraction which contributes just under 60%.

It can be concluded that the Cation Exchange Complex, the soil's carrier of exchangeable nutrients, is more determined by its clay content, than by its organic carbon content.

Nitrogen, exchangeable potassium, calcium, magnesium, total phosphorus and the soil's pH, are all positively related to organic carbon, see Table 5.2. This demonstrates the importance of organic matter acting as buffer in nutrient supply and its role in neutralising hydrogen ions.

There is a strong relationship ($r = +0.455$; $P < 0.001$) between soil acidity and the soil's exchangeable calcium content: higher values for the pH go hand in hand with higher availability of calcium (cf. Dabin, 1956). In general, base saturation is positively correlated with pH values ($r = +0.430$; $P < 0.010$), which confirms observations made by Pichot (1971).

Table 5.3 (next page) shows the results of the topsoil survey, as a function of land use. Comparison of average results from fields cultivated and fields that lie fallow reveals that the soil's organic content is raised only slightly during fallowing. The lower value of the CEC found on fields under fallow is a consequence of the lower clay content. The reason for this is not known.

A comparison with existing literature shows that the data presented in Table 5.3 are normal for uneroded *terre de barre*. While Saragoni *et al.* (1990) found slightly higher carbon and nitrogen contents in the soil under a 10 year old fallow on *terre de barre* in South Togo, other fertility indicators show values similar to our data. The soil data provided by Marquette (1986), taken from fields in South Togo that were cultivated before, situated on both uneroded and eroded soils, show analytical results that are all inferior to the data collected in the Mono Province, Benin. The same is true for soil data collected by Raunet (1971), taken from strongly eroded *terre de barre*, augered near Abomey, Benin.

According to Latham (1971), the values for nitrogen in Table 5.3 fall within the range required for medium yield levels of cotton (0.040-0.075 % N for 500 to 1,000 kg per ha of grain cotton).

Minimum total phosphorus in ferralitic soils for oil palm cultivation needed is 200 ppm P_2O_5, equivalent to 460 ppm P (Martin & Prioux, 1972), and about 600 ppm P_2O_5 (1370 ppm P) for cotton (Latham, 1971). Berger (cited in Boyer, 1982: 282) considers soils containing less than 0.4 pro mille total P_2O_5 (or 920 ppm P) as being poor with regard to cotton cultivation.

Phosphorus, therefore might be a limiting nutrient, depending on the crops grown.

Tinker and Zibo (1959) defined a relative minimum value for exchangeable potassium: K/CEC * 100 >= 1.5. All K/CEC ratios in Table 5.3 are above this minimum value, with 2.1 being the lowest (fields cultivated 12-15 years). According to Boyer (1982), most agronomists assume 0.10 meq. potassium per 100 g soil to be the absolute minimum value for soils moderately rich in clay, irrespective of the crop grown.

Tabel 5.3. Soil fertility indicators as function of land use (between brackets the number of samples analysed).

situation	fields cultivated			palm groves of varying age			
fertility indicator	12-15 years (a)	> 30 years (b)	average	1-2 years (c)	6-8 years (d)	18-20 years (e)	average
% clay	11.6 (30)	11.0 (10)	*11.5*	12.1 (20)	8.3 (30)	7.2 (10)	*9.4*
% carbon	0.64 (30)	0.56 (10)	*0.62*	0.71 (20)	0.63 (30)	0.68 (10)	*0.66*
tot. N %	0.056 (12)	0.048 (4)	*0.054*	0.059 (8)	0.052 (12)	0.059 (4)	*0.056*
pH (water)	6.1 (30)	5.6 (10)	*6.0*	6.0 (20)	5.9 (30)	6.0 (10)	*5.9*
Ca meq.	2.75 (12)	1.92 (5)	*2.50*	2.98 (9)	2.15 (12)	2.40 (5)	*2.48*
Mg meq.	1.17 (12)	0.52 (5)	*0.98*	1.14 (9)	0.81 (12)	0.80 (5)	*0.92*
K meq.	0.14 (12)	0.18 (5)	*0.15*	0.20 (9)	0.13 (12)	0.18 (5)	*0.17*
CEC meq.	6.63 (30)	5.88 (10)	*6.44*	6.86 (20)	5.14 (30)	5.04 (10)	*5.70*
% saturat. of complex	62 (12)	49 (5)	*58*	67 (9)	65 (12)	70 (5)	*67*
tot. P ppm	420 (12)	682 (4)	*485*	1216 (8)	801 (12)	242 (4)	*846*

Evaluation of soil fertility using QUEFTS

QUEFTS (Quantitative Evaluation of the Fertility of Tropical Soils) is a computer-aided model for soil fertility evaluation, specifically developed for tropical soils (Janssen *et al.*, 1990). The model helps to assess the relative importance of nitrogen, phosphorus and potassium in the soil, as potentially limiting factors in maize production. It calculates potential yields of unfertilized maize, based upon the soil fertility indicators pH, organic carbon, phosphorus and potassium. QUEFTS is applicable to well-drained, deep soils, that have a pH-H_20 in the range of 4.5 to 7.0, properties that are found in the *terre de barre* sampled.

Although proper use of the model QUEFTS requires calibration through locally established field trials, it is used here without such adaptation to obtain a first indication whether nutrients may be a factor explaining low yields, or that other factors are more likely to be considered as constraints for crop production.

Using soil analytical data from Table 5.3 (situations (a) to (e)), QUEFTS calculates potential maize yields; Table 5.4.

According to Table 5.4, potential yields vary from 1,490 kg/ha (situation (b), field cultivated > 30 years) to 2,080 kg/ha (situation (c), fields under 1-2 years old oil palm groove). This corresponds well with the figure given by Quenum in § 5.2. In reality average yields do seldom exceed 700 kg/ha, a figure based on interviews with farmers, that corresponds well with statistical data from the area (cf. § 4.2). Actual yields are lower than the ceiling set by nutrient availability.

The calculation also shows that at yield levels of about 1,5 t/ha, figures for nutrient uptake in the crop and nutrient availability in the soil come close for all three nutrients N, P and K. In other words, already modest applications of one of the elements in the form of fertilizer would cause the other elements to be limiting factors soon. In the case of maize production, nitrogen is probably the first limiting nutrient; Table 5.4.

Although there may be other factors at play, such as sub-optimal maize plant numbers per surface unit, the great difference between potential yields based on soil analytical data, and actual yields (a factor 2 to 3) makes it likely that

Table 5.4. Non-calibrated results of QUEFTS; nutrient supply, uptake estimates (kg/ha), most limiting nutrient and potential maize yields.

situation (see Table 5.3)	potential supply from soil kg/ha			estimated final uptake kg/ha			most limited nutrient	maize yield estimate kg/ha
	N	P	K	N	P	K		
(a)	31.6	6.9	45.4	31.5	6.0	39.3	N and P	1,635
(b)	26.5	9.8	70.5	26.5	7.1	48.3	N	1,486
(c)	35.7	18.0	60.2	35.7	10.8	50.3	N	2,077
(d)	29.6	12.2	45.7	29.5	8.4	38.8	N	1,646
(e)	30.6	4.4	60.8	29.9	4.2	47.9	N and P	1,511

nutrient scarcity is not the immediate reason explaining current modest maize yield levels.

5.4 Interpretation and conclusions

This paragraph discusses the relative merits of the Adja oil palm-based farming system as presented in the former paragraphs. In § 5.4.1 an interpretation is given of the soil data presented in § 5.3.2 (topsoil analysis). § 5.4.2 gives concluding remarks.

5.4.1 Interpretation

The field, which is cultivated for over 30 years (Table 5.3, situation 'b'), according to the owner, has lost its capacity to produce (*champ comateux*). Although the fertility indicators point to a somewhat lower nutrient status (for example relative to the situation under an 18-20 year old palm groove, situation 'e'), the soil cannot be considered as dramatically depleted, nor can acidity be considered as the reason for the soil's lack of productivity. In fact, the figures compare favourably with those collected on degraded *terre de barre* near Abomey (Raunet, 1971; see also Poss, 1987). That region is generally considered forward in terms of degradation of soil resources, as compared to the plateaus in the Mono.

A comparison of soil analytical data, with the minimum values required for crop production as they are given in literature for the plant nutrients nitrogen, phosphorus and potassium, supports the belief that the nutrient levels actually found are not the first cause explaining the low average yields found. The outcome of the QUEFTS model for estimating potential maize productivity confirms this conclusion.

It can be assumed that the loss of productivity of the soil is at least partly caused by physical constraints to crop production. Lal (1988) in general, and Raunet (1971) in particular, point at the importance of soil life (earthworms, termites and other species of the soil's macro fauna) to maintain the soil's structure. Raunet (*ibid.*) discusses the role of earthworms in *terre de barre* in redistributing fine soil particles, nutrients and organic matter. In strongly degraded soils, even under bush fallow, earthworms are typically not found. In § 4.1.2 it was indicated that the presence and quantity of earthworms and other soil macro fauna is an indicator used by Adja to assess the level of soil fertility. In addition, Adja farmers also point to the beneficial effects of tilling the soil, as a result of harvesting cassava or groundnut, or the felling of oil palm groves (the main roots are also dug out), see § 5.3.1.

Raunet's conclusion is that soil life depends on a favourable micro-climate; continuous humidity, absence of extreme temperatures and food in the form of fresh organic matter. Vegetative cover and derived litter layer, in his opinion, are a *conditio sine qua non* for soil life to maintain existence, which in turn seems

a basic condition to keep *terre de barre* productive.

One can therefore conclude that sustainable land use on the Adja plateau requires crop production systems that cater for sufficient fresh biomass per unit of time, both to physically protect and to feed the soil. The Adja oil palm-based farming system gives an example of such a system.

From the point of view of management for sustainability in land use, oil palm acting as planted fallow is an almost ideal choice. Palms create dense, but rather shallow root mats around the stem. According to Purseglove (1977) the majority of the roots are found in the top 15 cm of the soil, with main concentrations near the palm and a secondary concentration in a band at 1.5 to 2 m from the trunk. In that zone, intensive root activity is responsible for micro-site enrichment. Kang (1977) shows that within a radius of 2 m all soil fertility indicators are improved compared to values found further away from the stem. At 0.25 m distance from the tree, the bulk density of the soil is about half that of the soil sampled at 4 m distance. Similar patterns can be observed in organic C content, total nitrogen, CEC, exchangeable potassium, calcium and magnesium.

Such site-specific enrichment by trees in general is well-known (cf. Kater *et al.*, 1992). However, one must be aware that the soil improvement around the stem may be at the expense of the soil further from the base of the tree. It is therefore realistic to consider the tree's effect on nutrient availability in the soil first of all as nutrient redistribution in a horizontal manner, creating gradients in relation to the position of the tree. This redistribution process adds to soil variability found at field level (cf. Kang, 1977).

However, once mature and closed, oil palm groves represent enormous amounts of biomass, relative to a stand of maize or cotton. Its volume and perenniality create suitable conditions for soil life (less fluctuation in water availability and temperature, as compared to uncovered soil), while the constant flow of plant debris serves as its feedstock. In comparable alley cropping systems of maize with regularly pruned trees, Rosecrance *et al.* (1992: 159) evaluated nine tree species which produced between 5 and 12 dry t/ha/year green manure. Elaborating on the statements put forward in former paragraphs, the hypothesis is that the soil's physical fertility in particular improves, as a result of the presence of the palms. Crops can profit after a palm fallow from the soil's improved quality.

5.4.2 Conclusions

The former and present chapter not only demonstrated that the Adja farmers respond to emerging opportunities, such as new crops and new technologies introduced, but adapt also to perceived climatic change (e.g. the creation of an intermediate season), and over time have developed local solutions to the questions that had to be solved. Their farming system is in constant evolution. In the last 3 decades, an oil palm-based agro-forestry system was developed, which more or less answered problems imposed by increasing population.

However, it also seems that the oil palm system which caters for sufficient *in situ* produced biomass has its limitations. After all, more production per unit of area means greater extraction of nutrients. If losses are not compensated, one could argue that intensive use of woody perennials constitutes a threat to available soil nutrient resources, thereby accelerating soil degradation (Budelman, 1989). If population increases further, and if a net export of nutrients from the plateau is the case, one will have to look at compensation for nutrient loss.

Solutions that sustainably support intensification of the Adja agriculture therefore require both organic matter management and appropriate use of fertilizers. While few long term studies are available, the available evidence points at the inevitability of such a combination (cf. Pichot *et al.*, 1981; Dommen, 1988: 60-7; Budelman & Van der Pol, 1992). However, if maintenance of the soil life is to be guaranteed, the influence of chemical fertilizers on soil life will have to be analysed too (cf. Seifert, 1974).

Organic matter management of the Adja seems an interesting point for further analysis. The concept of *houinhouin* and its daily use shows that farmers regard organic matter as an issue of importance for soil fertility management. The differential use of *houinhouin* related to trees (oil palm and woody shrubs left in the palm groves), weed species, types of crop (leguminous versus not leguminous, tuber crops versus other crops) and rotation of crops indicate at a typical application and elaboration of the use of organic material. Given the type of soil, typical field conditions, specific objectives and access to chemical fertilizer, each farmer installs his or her own way of how to manage the production and use of organic matter.

Adja farmers use metaphorical concepts to 'make sense' of soil fertility ('feeding the soil', 'awakening a sleeping soil'). Sikana argues (1993: 15) that 'taken together, such concepts form a network of meaning, but they are not fixed in time and space. They do not describe the permanent condition of a soil type, but are used in relation to specific circumstances'.

In the context of fertilizer use, there is a need to determine nutrient balances for the cropping systems practised by the Adja, at various levels of productivity and seen from *inter*-field soil fertility management. The practice of blanket recommendations or mono-nutrient fertilizer use must be replaced by promoting fertilizer mixtures that reflect the actual export of nutrients. However, recommendations might best be developed by joining farmers' ways of assessing soil fertility. In addition, farmers seem to be best informed as to how to translate recommendations pertaining to their specific field conditions.

In the next chapter, a closer look will be taken at the effects of population pressure on land use, by comparing villages with varying degree of land availability per caput.

'If the cadence changes, the steps change too'.
(Adja proverb)

6 Comparison of different levels of demographic pressure

The objective of this chapter is to give a presentation of phenomena related to rural people's knowledge on the Adja plateau as a result of variable demographic pressure and soil fertility.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

6.1 Introduction

The present research took place in three villages, varying in demographic pressure, as explained in Chapter 3. Adidevo still has a few long-term fallow areas and has, compared to other regions of the plateau, a low population pressure (L). In contrast to Adidevo, Allada lies in an area which has a high population pressure (H) of about 300 persons per square km (in 1991, cf. Biaou, 1991). Kokohoue is in the middle (M) between Adidevo(L) and Allada(H), though probably closer to Allada.

This chapter describes changes occurring in these villages. First, changes in land use will be presented and analysed in § 6.2.1. Social changes, related to changes in land use will be discussed in § 6.2.2. The final paragraphs provide a discussion and conclusions.

6.2 Change as a result of population increase

6.2.1 Changing functions in land use

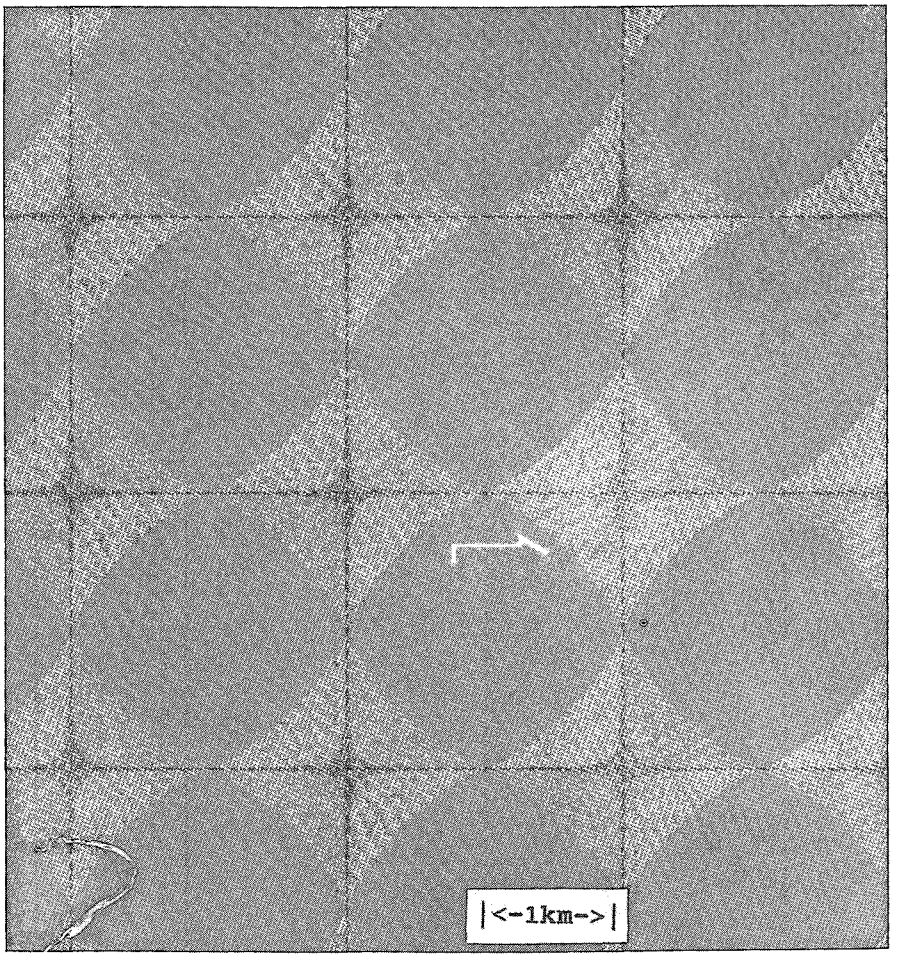
In § 4.4, a general historical view was given regarding Adja agricultural practice. The constantly changing picture of the Adja agricultural practice gave a dynamic view as to how the Adja handle agriculture. Of these changes, recent developments will be regarded. Photograph 6.1 shows the area of Adidevo(L) in 1957, whereas Photograph 6.2 shows the same area in 1981. Likewise, Photographs 6.3 and 6.4 show the differences for Kokohoue(M) and Allada(H) between 1957 (6.3) and 1981 (6.4).

The photographs of 1981 show more fragmented and smaller fields compared to 1957. In 1981, Adidevo(L) still has long-term fallow fields and a forest zone around the village; whereas Kokohoue(M) and Allada(H) do not have long-time fallow fields and only rudimentary parts of the former forest zone (see below) around the village.

Figure 6.1 (p.85) elaborates on the photographs and gives a schematic representation of the broad trends in the development of land use typical of the area.

Originally, each village (zone I) has once been surrounded by an intact circular zone of original vegetation (zone II). This zone is still to be seen in some villages in 1957 (small arrows in Photograph 6.3), whereas they are rudimentary in most villages in 1981 (Photographs 6.2 and 6.4). The zone used to serve in former days as a defensive barrier to hide from slave traders. Where still present, it helps to restrict damage to nearby fields by village-based but freely-roaming small ruminants. In addition, the zone provides herbalists and *féticheurs* with plants, used for medical treatments or magic.

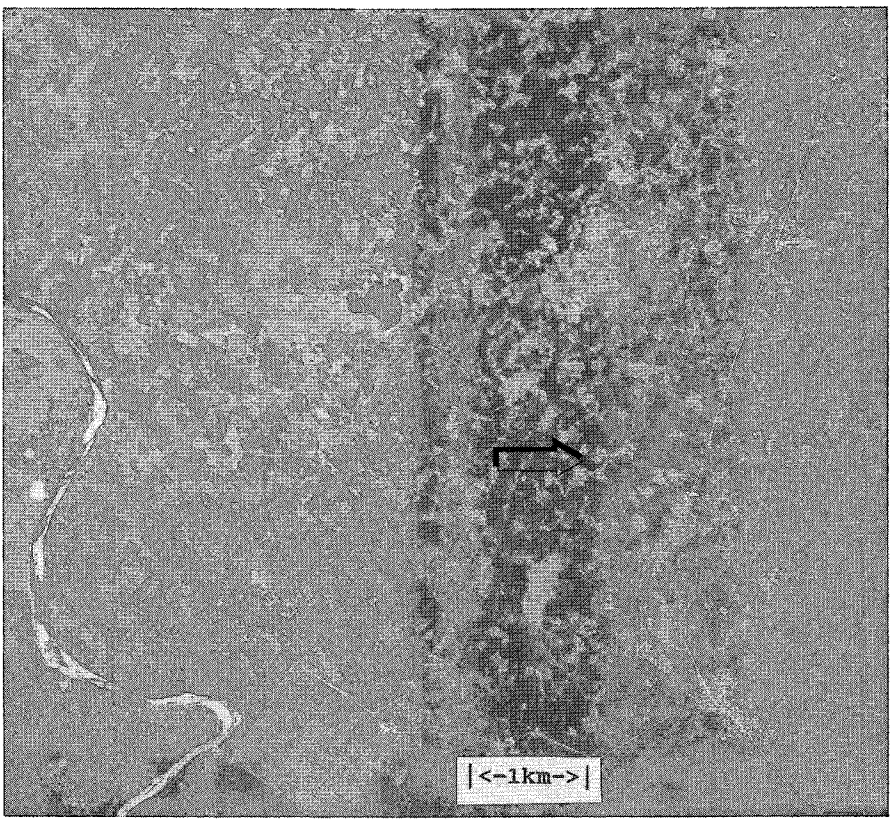
Surrounding the forested zone, fields are found to be diversely occupied by



Photograph 6.1. Area around Adidevo (arrow, Adidevo has two quarters) in 1957. At the left, below: part of the Mono river. (Source of aerial Photographs: Institute National de Cartographie, Cotonou. Photographs from 1957: mission unknown, Photographs from 1981 taken on April 20th, at an altitude of 4.400 meter.)

mixtures of food crops and young oil palms, interspersed by densely populated, sole-cropped oil palm groves in all stages of development (zone IV). Palms in this zone will typically be felled at the age of 15 to 20 years or longer. As discussed in the former chapter, the palm plays the role of a productive, planted fallow. Finally, the outer fields are used for cotton and maize cultivation (zone V). Here, crops are cultivated in a relay system, beginning with maize.

The situations described hold where land is still available, as in Adidevo(L). Increasing population led to the gradual disappearance of the surrounding forest (zone II); Figure 6.1, villages Kokohoue and Allada. The forest is cleared, save



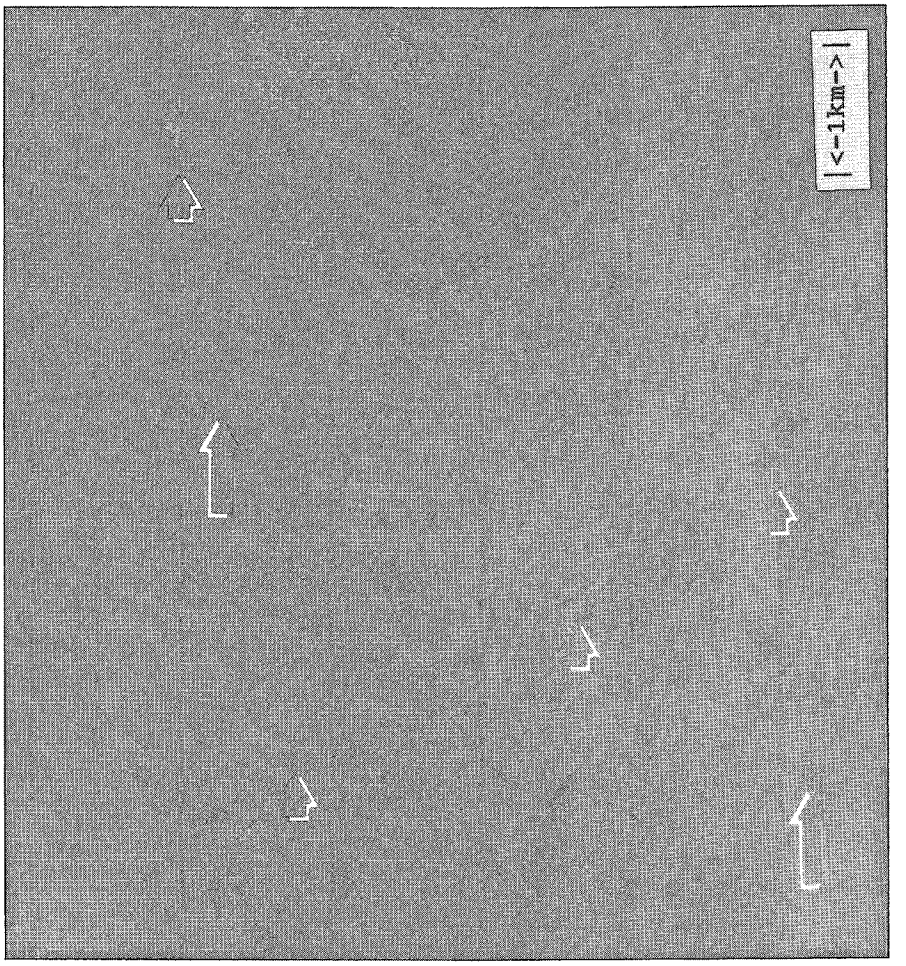
Photograph 6.2. Area around Adidevo (arrow) in 1981. At the left, below: the new rice-scheme (cf. § 3.5).

for some islets that are maintained for religious purposes (*bois sacré*), and converted into arable land under a regime comparable to that of zone IV. As a result, villages are gradually becoming directly surrounded by fields, increasing the damage from domestic animals in the process.

However, oil palm groves surrounding Kokohoue and Allada seem to have partially replaced the ancient forest zone.

At the same time, the fields formerly used in mixed cropping of annuals with oil palm, change into a zone III type of plant production. Zone III presents intensively cultivated fields, where oil palms are frequently not older than 15 years before being felled. The oldest zone IV type fields, mostly occupied by women and older people, are typically the most degraded. It is here, that one encounters the so-called *champs comateux* (literally fields in deep sleep, fields that have become marginally productive; see § 5.3).

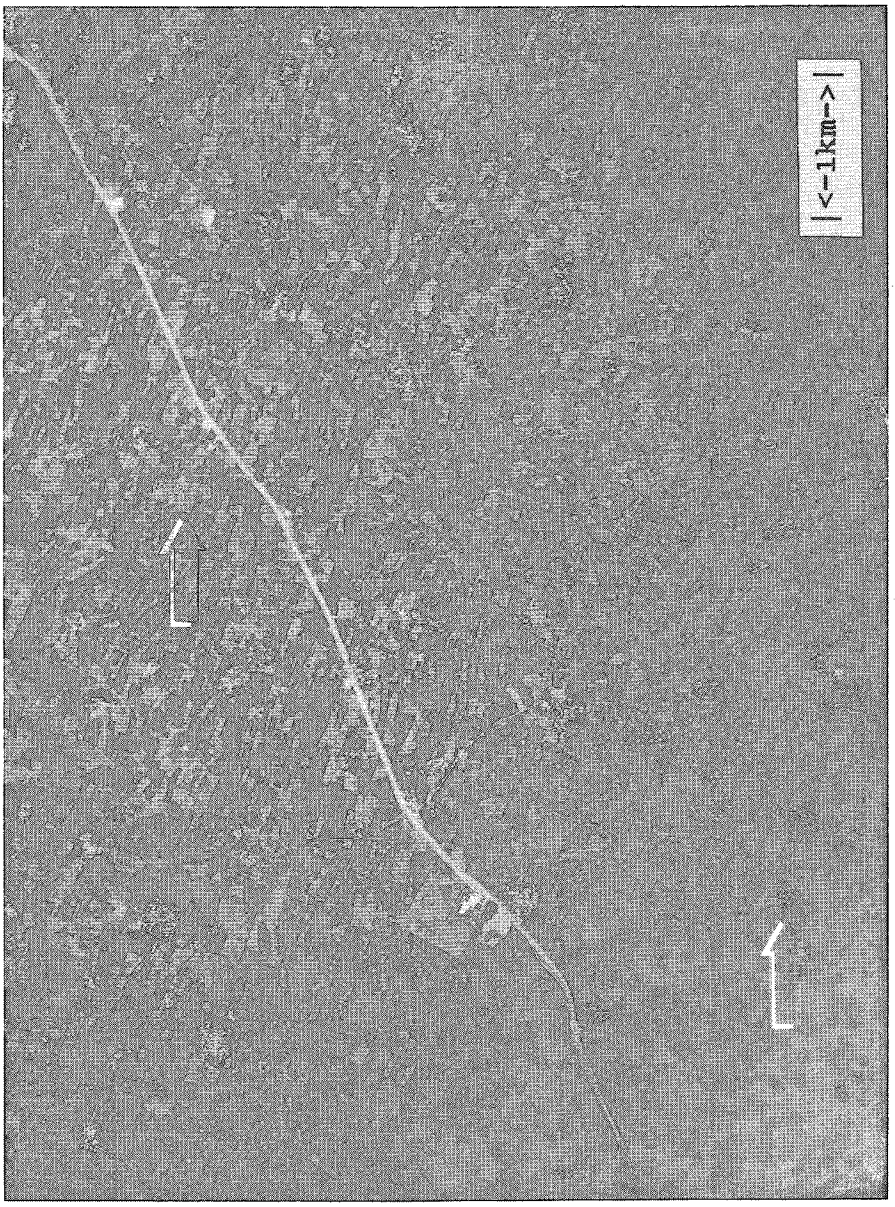
Typically, fields of Adidevo(L) are bigger compared to Kokohoue(M) and Allada(H), and mostly mono-cropped with maize or cotton in relay cropping



Photograph 6.3. Area around Kokohoue (arrow at the left, middle) and Allada (arrow below, right) in 1957. The small arrows indicate a circular forest zone around villages still present in 1957.

(zone V). Farmers from Kokohoue(M) and Allada(H) who visited Adidevo(L) commented that this village was rich in maize and cotton. Oil palms are not as frequently found as in the other two villages and remain on the farms for up to thirty years and over.

In Kokohoue(M) and Allada(H) fields are smaller, cultivated with mixed cropping of oil palms with two or more annuals, and palms usually do not grow older than 25 years (zone type III of plant production). Sometimes they are felled as early as at the age of 15. After a visit to Adidevo(L) with Nouhoumon and Victorin from Allada(H), Nouhoumon commented: 'Yovo (=white man), I should not lie to you. They seem to have more land in this village. However,



Photograph 6.4. Area around Kokohoue (arrow at the left, middle) and Allada (arrow below, right) in 1981.

they do not know the secret of how to grow oil palm, as we do in Allada. Also, they do not often practise mixed cropping in Adidevo'. Indeed, during the visit of Adidevo(L) farmers to Allada(H) they commented that '... this village is rich,

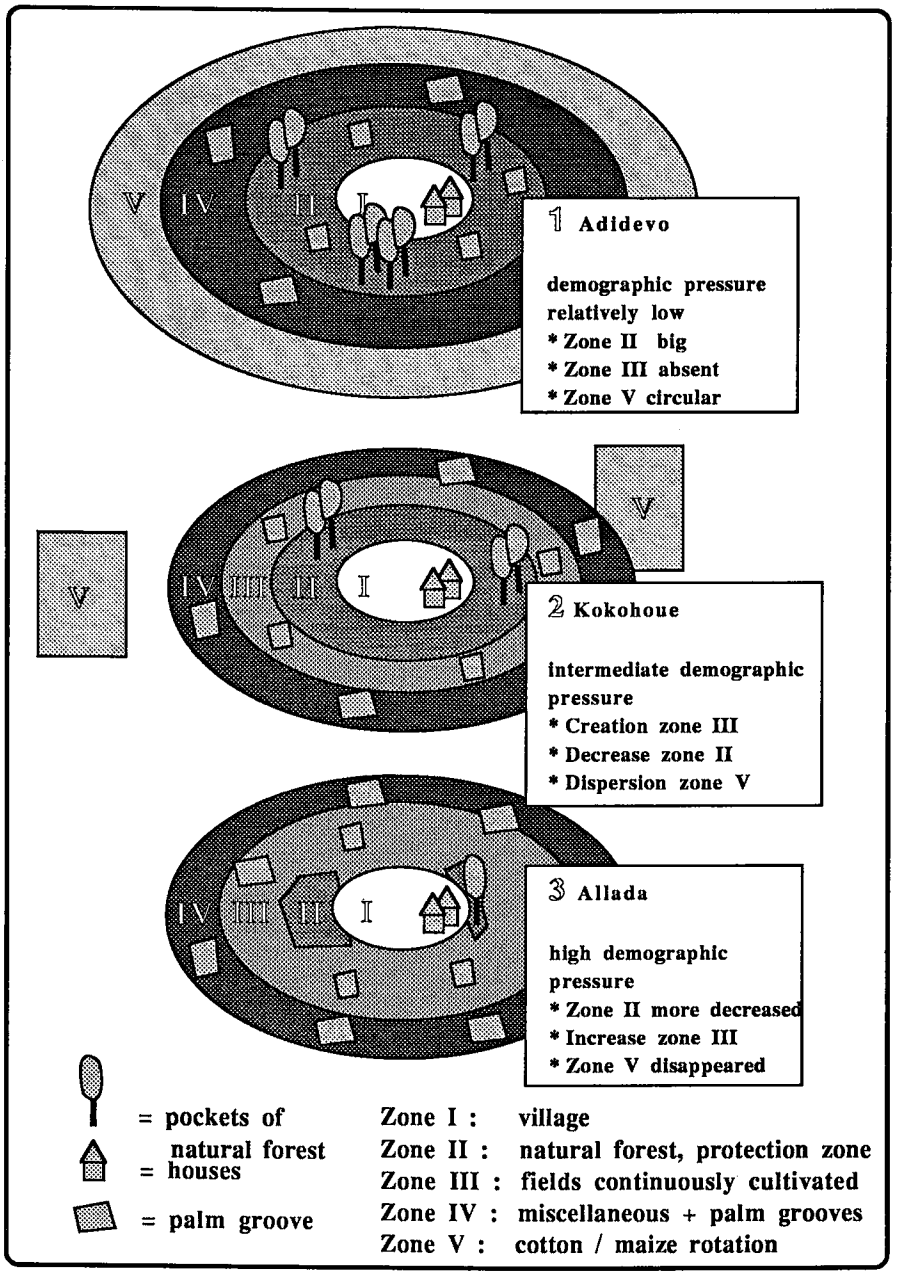


Figure 6.1. Land use in the three villages: schematic presentation. (Adapted from: Koudokpon, Brouwers, Versteeg & Budelman, submitted to *Agroforestry Systems*)

there are many oil palms. But they planted the palms too dense and will not have oil palm fruits. And we in Adidevo have more land'.

During this visit the Adidevo farmers suddenly ran to an oil palm. They discussed with the Allada(H) farmers vividly and collected oil palm fruits (Photograph 6.5). It turned out that this palm was a variety (*fandi*, *E. guineensis* var. idolatrica) not known in Adidevo(L). Further enquiries made by farmers who assisted with this excursion revealed the existence of another variety (*sedi*, *E. guineensis* var. virescens). These two oil palm varieties are mainly used for religious purposes (the fruits are used for the *fa*, cf. § 4.3) and it is prohibited to fell these palms (cf. Gnanglé, 1992). However, increasing interest in palm wine production has loosened this norm; *fandi* and *sedi* palms are increasingly being felled resulting in their disappearance on parts of the plateau.

Apart from the small patches of forest left around the more densely populated villages, a host of new forms of land use developed close to the village; small, enclosed kitchen gardens, pigsties, small plantations of closely planted neem and teak trees, fruit trees, etc. The well-manured kitchen gardens provide a wide variety of legumes, green maize, etc. Women of Kokohoue(M) and Allada(H) are active in cultivating capsicum peppers, cow pea (for beans and leaves), tomatoes and other legumes. The fruits or leaves (cow pea, *Amaranthus spp.*) of these crops can be harvested in various periods; thereby enabling the women to spread their labour and have a small, though regular income. This system of organising a staggered harvest fits in well with the fourth-day marketing system on the Adja plateau. Likewise, when some of the women visited Adidevo(L), they remarked that the village grew few capsicum pepper and cow pea; and that Adidevo women were less involved in market activities, compared to them.

When limits of the village territory are reached farmers install their cotton and maize fields outside the plateau area in the savanna (North of the Mono Province), in the depths of the valley lands of the various depressions in the neighbourhood, or even in Togo (cf. Faure, 1990) or the Northern Provinces like the Zou or the Borgou. Young and middle age farmers especially, mostly men, are engaged in this type of seasonal migration. Broadly speaking there is a trend that females and older males tend the fields relatively close to the village (Figure 6.1, zone III), while the younger males tend fields that are under the zone V type of production regime (large maize and cotton fields, Figure 6.1). Young farmers from Kokohoue(M) often migrate seasonally to Togo; whereas young men from Allada(H) are often to be found in the Northern Provinces Zou and Borgou during the main rainy season. Working as labourers, a phenomenon which started in the early 1960's (Wartena, 1988a: 214), is mostly done by young males and landless people.

A location-specific element that has an influence on technology choice is related to the movements of plant nutrients from one part of the farming system to another. Lagemann (1977), who also studied effects of varying population

Photograph 6.5. Farmers observing the oil palm variety *fandi* (*Elaeis guineensis* var. *idolatrica*). Note the closed leaves; *E. guineensis* (common oil palm) has leaflets which are not joined.

pressure, gives extensive details regarding the situation in Eastern Nigeria which seems similar to that of the Adja case.

There is an overall fertility flux from fields in the periphery to the center of the farming system, the village and its surroundings (see also Figure 6.1), and onwards to regional markets. The latter part of the flux actually represents losses from the farming system.

This movement of fertility is a result of man's activities, and much less of domestic animals. Where the forest belt is still intact, household refuse, human excrements (the forest is used as latrine) and droppings from small ruminants and poultry enriches its soil. Nutrient extraction from outer fields is not really threatening the system's sustainability as long as fallow periods are long enough.

Where population pressure increases, and the forest belt makes way for cultivation, the fertility piled up during the lifetime of the village is subsequently exploited. Increasingly, household refuse, ash and dung are composted and used on small patches of fenced land, that serve as highly productive kitchen gardens. The last type of fields are called *ahouegoudou* ('at the back of the house') and known for their good soil fertility (cf. § 4.1.2). In Kokohoue(M) and Allada(H) opportunistic catch cropping of intermittently productive niches and boundary production (cf. Jiggins, in Altieri & Hecht, 1990: 46) are to be found. Examples are small depressions, profiting from a surplus of water compared to surrounding parts, the *ahouegoudou* fields and the use of small patches in a cultivated field, where the seeds have not grown.

The introduction of cotton, in combination with compound fertilizer use, cultivated on the outer fields to some extent compensates for the nutrient losses incurred since maize, that is grown in rotation with cotton profits from fertilizer residues.

6.2.2 Social change

Total amount of land per caput clearly diminishes: 0.17 ha/caput in the more densely populated parts of the plateau compared with 0.36 ha/caput in areas comparable with Adidevo (Biaou, 1991: iv). Whereas the amount of land per caput in Kokohoue(M) and Allada(H) is considerably lower than in Adidevo(L), various social changes seem more intense in the former villages. To illustrate this, this paragraph will present some examples from religion (and magic), formal education, mobility and (seasonal-) migration, off-farm work, women's activities, legislation and experimentation in search for solutions to the decline in soil fertility and land availability.

Religion shows individualising tendencies. Firstly, the increase in number of religions gives the individual more choice. In Adidevo(L) all the villagers are animists, whereas in Kokohoue(M) and Allada(H) some are catholics or protestants (e.g. *chrétiens célèstes*, jehovah witnesses, pentecostal church). In Allada the members of one household converted to the muslim religion, after several years of working in the Borgou Northern (muslim) Province.

Where previously collective (patri-lineage) worshipping was dominant, these days magic and the use of *gri-gris* are current practices. In former days a *voodoo* was seen as an essentially collective element, but nowadays the *féticheurs* take a commercial interest in their intermediary role between *voodoo* and people. Missihoun, an influential *féticheur* in Allada, regularly receives visitors from other villages and even from Lokossa (provincial capital) or Cotonou. Personal problems are more and more explained as the result of magic and not as the result of violating the prescribed rules of the *voodoo* (cf. Elwert, 1983: 330). In Kokohoue the last *voodoo* which arrived in the village is *Kounougbeto*, a *voodoo* which gives protection against magic.

Kokohoue(M) and Allada(H) both have primary schools; Adidevo(L) does not have a school. In the former villages most of the youngsters speak French, whereas it was hard to find a translator in Adidevo(L). In all the villages, young people work sometimes as an apprentice (e.g. taxi driver, seamstress, mechanic); but this is more common in Kokohoue(M) and Allada(H).

Mobility in Allada(H) and Kokohoue(L) is greater than in Adidevo(L). The former paragraph pointed at seasonal migration of especially younger men, when the availability of land decreases (relocation of type V agriculture to other regions, see Figure 6.1). Claude, Daniel and Victorin of Allada(H) and Kossi of Kokohoue(M) were absent during the greater part of the main rainy season due to cultivation obligations in Togo or North Benin. Here they mainly cultivate big maize and cotton fields in mono cropping, often as labourers. Faure (1990) reported that Adja migrants, who stayed for a longer period in Southern Togo, established the oil palm mixed cropping system; whereas other ethnic groups, who also were given the opportunity to bring into use part of forest areas, did not do so.

In all the three villages, though particularly in Kokohoue(M) and Allada(H) some people migrate on a permanent or temporary basis. The migrant usually maintains close ties with his home area. He (mostly males are involved in (seasonal-) migration) frequently returns for brief periods to attend ceremonies and festivals. Sometimes a migrant builds a house in his home village to which he retires. Though certainly negative effects are to be noted from migration, e.g. shortage of labour, there are clearly some positive effects presents also. Migrants who have managed to find stable positions in towns, serve as a basis for their original village and transfer funds back to their home village. Tebou from Allada gives a representative account (see Box 6.1).

In Adidevo, commodities are mostly traded via external agents. Kokohoue and Allada have village based traders, who give a more diverse picture together with off-farm workers and regularly returning migrants, compared with Adidevo. Commoditisation seems one reason for the increasing individualistic social organisation on the plateau (cf. § 4.3; Wartena, 1988b).

Income from off-farm activities, which can constitute more than 50% of the household income in densely populated villages (source: FSA survey), is more

Box 6.1:
Tebou explains migration

Tebou: 'When we were young we only practised agriculture here in Allada. But now land has become scarce and people have started activities other than agriculture or have even gone to other areas. Two of my sons work as taxi drivers in Porto Novo (official capital of Benin, see Annex 7, JB) and I visit them each year. When I was young I never made such long journeys. If possible, my sons will come to Allada at the end of the year to celebrate with us the festivals. Indeed, our eyes see more and our ears hear more than in my younger days'.

current in Kokohoue(M) and particularly in Allada(H). The latter village has specialised in carpentry over the last decades; various men from Allada are engaged in carpentry on a full-time basis. This has consequences for farming practices. For instance, Yabavi works on the land of her husband, whereas he himself limits his farm activities to teak and especially neem. So, Yabavi has to cultivate on two of her three fields in mixed cropping with the latter tree crops. Neem and teak are regularly found around Kokohoue(M) and Allada(H), whereas they are sporadically found around Adidevo(L).

Between the three villages, agriculture-related activities like processing, storing and trade differ. Processing is mostly done by women, who process maize in *akassa* (maize flour), cassava in *gari* or *tapioca*, groundnut in groundnut oil or groundnut biscuits, and oil palm fruits in 'red' oil and kernel oil, sometimes processed further in soap. The men are only involved in the processing of palm wine into *sodabi*, a strong distillate. However, as groundnut and cassava are less common in Adidevo(L), women seldom produce groundnut oil, *gari* or *tapioca*. In addition, a *sodabi* workplace is not existent in Adidevo(L), whereas both Kokohoue(M) and Allada(H) have several.

Some mechanical processing machines have become prominent on the plateau. In the 1950's diesel-driven maize mills were introduced (without any assistance) and are now found in each village (Wartena, 1987: 207). Less frequently, oil kernel crackers, groundnut decorticators and cassava shredding mills might be found. However, the majority of the women still crack oil kernels separately with stones, decorticate groundnut pulses by hand and shred cassava manually. One young man from Allada frequents surrounding villages with a mobile diesel-driven oil kernel cracker.

In Adidevo(L) maize is stored in the old-fashioned way, the *adja*-type granaries (small circular structures, built with materials derived from oil palm leaves), whereas in Kokohoue(M) and Allada(H) maize store installations are different. People in the latter villages prefer to store their smaller maize quantities under the roof of their houses, minimising theft. It is only in Adidevo(L) that maize is sold in large quantities, provided the harvest has been successful.

As Kokohoue(M) and Allada(H) have more kitchen gardens, pigsties, closely planted small neem and teak plantations, and fruit trees, agricultural productivi-

ty is more diverse and the intensity of trade is greater in comparison to Adidevo(L). This seems to be enhanced by the greater mobility in the former villages.

In § 4.1.1, the introduction of an intermediary season from the end of July to September was discussed, a recent phenomenon on the plateau. In Adidevo(L), however, only rudimentary elements of this new season are to be found, whereas in this period women from Allada(H) and Kokohoue(M) are active in cow pea, tomato and capsicum peppers cultivation, processing (peppers) and marketing.

Access to land nowadays is mostly decided on an individual or household level. From the three villages, only Adidevo(L) still has rudimentary elements of the collective use of land. The Dansou linage manages collectively some 12 hectares, although the land consist of regularly flooded vertisols, a type of land which is considered difficult to cultivate.

The price of land varies between 100.000 and 280.000 F.CFA/ha (1991, ±390 –1.092,$; Biaou, 1991: 102), depending on village and soil quality, and increases with 6,4% a year (*ibid.*, p.114). Short term renting (3-4 years) costs about 21.000 F.CFA/ha a year (1991, ± 82,– $), while long term renting (± 20 years) costs about 8.500 F.CFA/ha a year (1991, ± 33,– $; *ibid.*, p.98). In the latter system the usufruct of the oil palms is given to the tenant. The hiring system has a tendency towards short term renting. Leasing land is especially found in the more populated parts of the plateau. The leaseholder gives a third or half of the harvest to the owner. In addition, the owner has the usufruct of the oil palms.

Land can only be inherited by men, although occasionally some women inherit land also. Though women make the majority of agricultural labourers on the more densely populated part of the plateau, they have access to only some 24% of the land (Biaou, 1991: 64). Women can buy land, but until recently this was not frequently found. In Adidevo(L) Kodouha is the only woman who owns land and has done so for more than 20 years. In Kokohoue and Allada however, women have started in the past years to buy small portions of land on their own account, see Table 6.1.

Table 6.1. Access to land by women in the research villages (in aboho[1]; n = 20, at random).

	borrowed[2]	rented	leased[3]	owned	total
Adidevo	13,4	4.2	5.1	–[4]	22.7
Kokohoue	3.6	6.4	2.8	0.6	13.4
Allada	3.0	4.2	1.7	2.2	11.1

Note 1: All farmers from Allada and most of Kokohoue measure land in aboho. All farmers from Adidevo and some of Kokohoue measure land in katchi. The latter figures are converted to aboho in the Table; 1 ha = 17,5 katchi = 25 aboho

Note 2: The land borrowed by women is mostly owned by their husbands or one of their (matrilinear-) uncles or brothers (cf. Den Ouden, 1989a) who remain owners of the oil palms.

Note 3: Leasing is mostly done in the *dema* system; the owner gets one third, or half of the harvest.

Note 4: In Adidevo only one woman owns about 1½ ha for more than 20 years; she was deliberately excluded from the Adidevo sample.

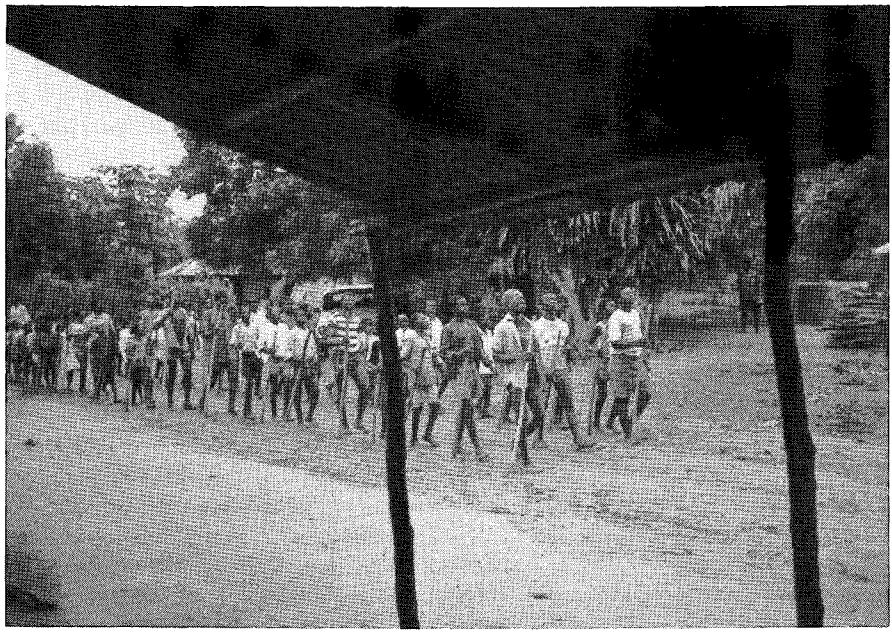
Figures of Table 6.1 are to be interpreted as tentative. Quality of land for instance clearly plays a part; if farmers are asked how much land they cultivate, they mostly enumerate soils according to agriculture quality, e.g. black soils and gravelly soils are less appreciated compared to red soils. The land borrowed by women from their (male) relatives is often of lower quality. Nevertheless, it is interesting to note that female farmers have started to buy land, be it at a modest level. The fields they buy are mostly small: only some aboho (cf. Laarakker, 1990: 21; Wartena, 1992). More women from Allada possess land (about 22 %) compared to Kokohoue (about 12 %). This might be partly explained by the fact that the latter are mostly Adja-Houe, whereas most women from Allada are Adja-Dogbo, a more commercially orientated group within the Adja on the plateau (cf. § 4.3).

Female farming has become increasingly important and is a trend which has become more noticeable in the 1970's and 1980's (cf. § 4.4). Women nowadays often farm before their husbands gives them land; unmarried girls often farm for their own livelihood. Women are the ones who mostly hire labourers and they dominate in processing activities and commercial activities. Female farming shows an increasing diversity (e.g. vegetables, fruit trees, exploration of new season end July – September, cf. § 4.1). When comparing women from Adidevo with Allada and Kokohoue, the latter show increasing entrepreneurial activities. Women have increased individual liberty to cultivate, trade and even to divorce. But, at the same time, they can no longer expect to be taken care of by their husband the same way as before. Women already with land sometimes do not get land from their husbands (cf. Laarakker, 1990: 15).

Trials in case of theft, adultery, disputes, etc. used to be held at village level by a committee of elders. Typically, they will be in session for hours, after which the losing side has to offer some gifts to the elders and if necessary to the victims. Only in severe cases, justice will be asked at the district level.

A new form of legislation has started recently at the central part of the Adja plateau in the form of a scout association. Though scouts were already present in the Mono in the 1970's, a sudden rapid increase took place at the end of the 1980's and is presently extending rapidly on the plateau. In 1991, youngsters (boys and girls) in Allada(H) and Kokohoue(M) started to have daily training sessions, mainly disciplinary sport sessions (see Photograph 6.6). In Adidevo(L) this new dispensation of justice arrived at the end of 1991. 'Scouts' are supposed to be vigilant and catch thieves, people committing adultery, owners of animals devastating crops, and the like. They also control houses when property is stolen and maintain roads.

During my time in Allada(H) and Kokohoue(M), I was present at several occasions when a sudden turmoil started and about a hundred people shouted and sang around the caught offender(s). 'Trial' and punishment (mostly strokes with a stick) are carried out immediately. Though the 'scouts' clearly have a regulatory function, the system shows totalitarian tendencies like emphasizing group discipline and obedience.



Photograph 6.6. Training session of 'scouts' in Allada

Some changes in farming organisation seem to go along with the increase in population. The urgency to find solutions for the decline in soil fertility stimulates farmers to experiment and seek solutions. One example is given by the number of varieties of cassava and cow pea. Both crops have more than 20 varieties used by farmers on the plateau (see Annex 5 for Adja varieties of major crops). However, the number of varieties for both crops found in Kokohoue(M) and Allada(H) is higher (some 20) than in Adidevo(L) (only 4 cassava and 7 cow pea varieties identified). The former paragraph showed the example of the oil palm varieties *sedi* and *fandi* which are not found in Adidevo(L).

Soil manuring and some husbandry practices show other examples of differences in farming. Danhounsi claims that he was the first to start in Kokohoue(M) with the use of dung, see Box 6.2. However, some women in Kokohoue already noticed in the 1970's that pits, (created while making walls for houses), in which household refuse was thrown, gave an abundant weed growth afterwards with high soil fertility indicating species like glazoui (*Talinum triangulare*) and Sikagbè (*Ageratum conyzoides*). In addition, when they were asked to remove old straw of old collapsed houses, they noted the same phenomenon on the place where the straw was deposited.

Consequently the women started to grow green maize or vegetables on these small patches of land, which receive ash and house refuse, swept each day by women in the morning. Only the women bring ash and house refuse, the latter

Box 6.2:
Danhounsi explains how he started applying dung in Kokohoue(M).

Danhounsi: 'Some years after the famine year (1977, both seasons without sufficient rains, JB) while working in my field, I saw each morning somebody from Sehoue (a neighboring village, JB) who passed me cycling with some bags filled with sheep dung. I asked him what he was doing and he explained to me that he brought the dung to his field because it feeds the soil. So, one day I went to his field to have a look, and indeed the crops looked better than on my fields. I made *adokpo* ("doing what you never did before", see Chapter 7) by giving dung to one part of a field with low fertility and I saw that it is a good practice. Indeed it gives force to the soil'.

translated by them as 'natural manure', to the fields since men seldom carry out transport activities. In addition, women from Kokohoue, who are especially involved in cassava cultivation and processing, often peel cassava tubers already on the field, leaving the residues for composting. Manuring nearby fields, however, seems to remain small-scale mainly because of limitations in transport and low volumes of manure available.

CARDER, the state extension service, provides chemical fertilizer. Though chemical fertilizer is delivered under the condition that it can only be used for cotton, farmers frequently apply chemical fertilizer to high fertility demanding vegetables like tomato and capsicum peppers, or to their maize. As Adidevo(L) farmers mainly cultivate big fields with cotton and maize in relay cropping (zone V in Figure 6.1), they are not interested in the afore-mentioned differentiated ways of chemical fertilizer application and limit its application to cotton.

Differences in husbandry practices give other examples. Farmers, especially female farmers, in Kokohoue(M) and Allada(H), pay attention that 'fertilizing crops' are being included in the rotation plan (cf. § 5.3.1). Thus, cow pea, ground nut, cassava and pigeon pea are found much more in Kokohoue(M) and Allada(H), compared to Adidevo(L). In addition, while selecting varieties, the quality of vegetative production is more appreciated in the former villages, since litter is seen as 'giving *vitamins* to the soil' (cf. Chapter 5).

6.3 Discussion

Though Allada(H) and Kokohoue(M) definitely have fields with a low soil fertility (zone III, Figure 6.1), compared to Adidevo(L), their general situation does not seem to have deteriorated dramatically. Pfeiffer (1988: 118) was also astonished by the apparent stability of agriculture in the South of Benin during the last hundred years, despite capital extraction and population increase. Famines on a large scale were absent during that period.

A similar result was found by Tiffen and Mortimore (1992), who examined

population growth, agricultural production and environmental conditions over a 60 year period in Machakos district, Kenya. They concluded that population increase is compatible with environmental recovery, provided that market developments make farming profitable (*ibid.*, see also Rey, 1992).

On the same soil type *terre de barre*, a study was executed in South Togo, comprising of three levels of demographic pressure (Calon, 1990). Here, land leasing systems are considered to be one of the major factors in the process of soil degradation. Farmers who rent or lease land are forced to exploit this to the maximum, during contractual term, in order to cover their costs and produce a surplus for consumption. When rental agreements are short term, farmers are obviously not inclined to invest in long term soil improvement measures which involve leaving land idle (fallow) or cultivating crops (e.g. alley crops, green manure) which do not provide immediate food or income. As on the Adja plateau, the situation is further complicated by the stipulation that leaseholders and tenants are not allowed to plant or make use of perennials on the land (cf. Mondjannagni, 1977: 170; Calon, 1990: 11). The Adja case also shows a clear increase in land leasing systems. However, in the majority of the leasing, borrowing or hiring agreements, the land owner sees to it that oil palms are planted and maintained.

In Kokohoue(M) and Allada(H) various social activities seem more intensive and rapidly changing compared with Adidevo(L). In the former villages, an increasing importance is attributed towards what Bourdieu calls *symbolic capital*: '...effective possession of a network of kinship (or other) relations capable of being mobilised or at least manifested (Bourdieu, 1990: 35)'. He further argues that 'In an economy, characterised by insecurity, a capital of services rendered and gifts bestowed is the best and indeed only safeguard against the "thousand contingencies", on which (...) depends the maintenance or loss of working conditions, from the accident that causes the loss of an animal to the bad weather that destroys the crops (*ibid.*, p.119)'.

For an important part the acquisition of means of production is increasingly done via social activities (borrowing, hiring or leasing land from relatives and friends, reciprocal labour activities, loans for acquiring harvest products to be processed, etc.). The subsequently obtained harvests and income is given or 'invested' in the personal network. Next season another cycle starts again, with the acquisition of production means from the personal network (cf. Pohlman, 1989; quoted from Van Der Ploeg, 1991: 291). Therefore, management of farming activities is not defined as a restricted or specialised economic decision making process, but includes dealings with relatives, friends, neighbours, the community, and national institutions (Bennett, 1982: 4).

The increasing importance of magic might be an indicator of social strain (cf. Marwick, 1970). Magic could be called a 'primitive science' in that it shares with researchers an attempt to explain and control an ever-changing and uncer-

tain world (cf. Jahoda, 1970). As Malinowski already stated: 'man resorts to magic only where chance and circumstances are not fully controlled by knowledge' (Jahoda, discussing Malinowski, 1970: 127).

Hobsbawm and Ranger (adapted, 1983: 6) argue that ancient materials can be used to construct knowledge of a novel type for quite novel purposes. A large store of such materials is accumulated in the past of any society, and an elaborate language of symbolic practice and communication is always available. To mention are for example the expressive and symbolic intent of magic and religion. Geschiere (1991) argues accordingly that a combination of cultural identity with a dynamic perspective should be preferred, as compared to the search for 'authentic' cultures, the latter evoking a static view. He gives examples like the flexibility of kinship relations creating new urban – rural networks amongst migrants and villagers, and the new use of magic (not in the negative connotation as viewed by Western norms) by economically successful persons (Geschiere, 1991).

Whereas in former days the main information flow was between generations, nowadays there are far more channels for information. Formal flows such as education and extension, as well as informal means like travel and meeting places (e.g. taxi ranks, markets, 'scouts' exercises) have increased. One information flow was created via out-migration, which is not only with negative effects for the home community.

Increasing off-farm work and thus diversifying income sources into the non-farm sector are important assets for the villages with a high population (cf. Tiffen & Mortimore, 1992). Lagemann (1977: 109) also noted that the income derived from off-farm sources is higher whenever the population density is great, and in his case (East Nigeria) more than compensates for the drop in income from farming. Attention to the development of off-farm employment seems as important as the development of sustainable agriculture. Employment diversification is usually omitted in studies of carrying capacity, which tend to assume a subsistence agriculture without exchange, processing, services, etc. (cf. Tiffen & Mortimer, 1992).

Strategies used in the more densely populated part of the plateau might not be available as a scenario for villages like Adidevo which now still benefit from some land. If they also experience an increase in population within the next years they will find some economic niches already occupied. Alternative opportunities will have to be looked for.

6.4 Conclusions

Chapter 5 demonstrated the Adja 'oil' palm cropping system, an example of a continuous cropping system of palms with other crops. In the present

chapter, it was shown that oil palm densities are higher on the more populated areas of the plateau. When the system comes under pressure, farmers initially try to prolong the cultivation of food crops on the same field. Palms, planted between the second and fifth year after the field has been opened for crop production are regularly pruned in order to avoid too much competition with main crops. Obviously, such a policy has its limitations, since time after time the palm experiences a setback in its development, leading to rather poor performing plants. Also, the life cycle of oil palms is increasingly shortened. Research on oil palm densities and life cycles related to soil fertility would be welcome to assess soil fertility recovering capacities, biomass production during mixed cropping and possibilities to intensify the oil palm system.

Intensification and increasing diversification of agricultural production takes place in the more populated areas. The total output of an aggregate of fields, and not only the output per field or per crop, is the important parameter for comparison of different land use intensities, whilst interactions between fields should be taken into consideration. This is demonstrated by the oil palm mixed cropping system and by the outer fields which supply fertilizing material for the kitchen gardens and other intensively cultivated fields at the border of the village.

The different phenomena in the three Adja villages illustrate the hypothesis of Boserup (Boserup, 1965) that population growth encourages development. Compared to Adidevo, with its low demographic pressure, Kokohoue and Allada show an increasing diversity in agricultural activities. In addition, other aspects of social life (e.g. religion, off-farm work, migration, trade, legislation) of the latter villages are more dynamic and diverse compared to Adidevo. In contradiction with Boserup, the Adja case shows, apart from only endogenous forces, also other factors, like more emphasis on market development, influence of town-based migrants and other external factors. Supporting technologies have been derived from many different sources, inside and outside the Adja society (see also § 7.2.2). The Adja have changed in ways which have increased their access to information and enabled new ways of leadership.

Leadership institutions get a wider base compared to before. They now include, in addition to the old, enterprising or educated young people, women and men. The emergence of the women is partly explained by male out-migration. Women hire more labourers than men (Biaou, 1991: 156) and have considerable entrepreneurial freedom. However, behind this apparent freedom for women, a clear economic dependence on male relatives continues to exist (cf. Pfeiffer, 1988: 104; Wartena, 1992).

Another difference with Boserup lies in the analysis that in Adidevo, where land is still available, invention, change, adaptation and other elements of development also take place, thus indicating that population pressure is not the only stimulant for change, as explained by Richards (1985: 86).

The on-going individualisation seems to accompany population increase. Undoubtedly a degree of specialisation and concentration on high value crops (e.g. fruits, vegetables) or processed crop products (e.g. timber, *gari*, *sodabi*) has generated in Kokohoue(M) and Allada(H) a far greater number of local non-farm jobs, compared with Adidevo(L), where the economy is more subsistence orientated. Differentiation in the more populated villages goes along with increasing off-farm work, trade and seasonal migration as well as long term migration.

In the more densely populated areas of the plateau, manuring practices gain importance. Crops are supplied with ashes, chemical fertilizer and various types of organic material: household refuse, crop residues, remains after processing, mixed cropping with crops producing continuously vegetative material (oil palm, cassava) and dung, if present. The examples of farmers responding to soil fertility declination contradicts the belief amongst researchers and development workers that farmers do not change technologies to improve the soil because they do not own any land.

Women apply household refuse and ash to their fields, as men seldom carry out transport activities. They also have a preference for cow pea, groundnut and cassava in their rotation plan. Young men tend to migrate on a seasonal or permanent basis, or start as a labourer (often on fields of women) and rent or lease a piece of land. Landowners will see to it that oil palms are grown on their fields, if borrowed by a relative, sharecropped, or rented. The oil palms will ensure soil fertility after the return of the land, in addition to other benefits.

'You can ask as much as you want
but you will never know what it is really like to be a farmer.
Your clumsy way of using the hoe looks like
you trying to put our farming in your notebook'.
Nouhoumon from Allada

7 Knowledge of Adja farmers and related knowledge processes

In order to understand why farmers act the way they do, one must, as mentioned in Chapters 2 and 3, make a switch in perspective, and try to proceed from their knowledge, values and ideas. Elaborating on Adja knowledge presented in Chapters 4, 5 and 6, this chapter seeks to understand the Adja perspective by examining Adja 'sense making' processes like learning, transformation of technology, classification and theory making.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
Agricultural University Wageningen, Department of Communication and Innovation Studies.

7.1 Introduction

An Adja boy or girl will learn the basics of agriculture as an apprentice, during the years the boy assists his father and the girl assists her mother. The learning of basic agricultural techniques is rooted in socialisation. Daily routine is partly based on knowledge taken for granted, e.g. practices, procedures, tools, places, timing, relationships, etc. Much of this has to be picked up during work activities and takes considerable time to learn. As stated by Bolhuis and Van der Ploeg (1985: 46-7), the head and body are combined in labour activities of farmers.

7.2 Knowledge processes

In the following paragraphs some knowledge processes will be presented and discussed. Various examples will be used to illustrate knowledge processes in order to have a better understanding of how Adja knowledge is constructed, used and changed. As explained in Chapter 2, it is useful to look at farmers' knowledge as being created through certain practices. In § 2.4 it was argued that reality is socially constructed through processes of 'sense making' (cf. Berger & Luckmann, 1967). 'Sense making' processes are processes by which people identify shared objectives, make theories and use them, and learn in a complex and multi-dimensional reality. During these processes 'people selectively create ideas, concepts, theories and models, and make inferences and so impose human purpose' (Röling, 1988: 185).

The next paragraph (§ 7.2.1) will try to illustrate this by looking at learning processes, which resulted in Adja knowledge. In § 7.2.2, an elaboration will be given on how Adja farmers adapt externally generated technologies. Learning and adaptation processes will be further analysed by examining Adja classifications and theories in § 7.2.3.

7.2.1 Learning

As defined in § 2.4, learning will be regarded as a dynamic process; a flux between sensory experiences of the world and their mental abstractions, between experiencing and making meaning of these experiences (Bawden, 1989: 2). Whilst learning, an actor acquires and appropriates ways and repertoires to act, interact and reflect in the social and material world. These learnt behaviours enable him/her to more easily realise particular goals. Learning can be an individual process, or shared to a certain degree with other persons. Individual interest in learning or interest in exchange with others varies, but many Adja farmers have a protective attitude about their own practices and resources. All farmers are open to changes and possible adaptations in their daily farming practices; although some seem more passive and others actively search for innovations and potential associates in learning. Some reciprocal learning takes place in certain settings, both social and physical, in which participants meet and share knowledge, information, and resources.

Farmers gain most of their knowledge through practice. As argued in the introduction, experimentation is inherently connected with the work farmers do. Adja farmers learn their metier as youngsters, whilst working with their parents. Likewise, experimenting is connected to action, and an important part of learning takes place via *doing* (cf. Van den Ban & Hawkins, 1992: 69). In addition, learning also takes place via *watching* and *copying*. Learning might also occur in a discursive manner as a result of *discussion*. These four ways of learning will be further explained. However, it should be noted that farmers' learning mostly does not take place in separate processes but in an interactive manner.

A type of experiment, related to learning by *doing*, regularly conducted by Adja farmers is called *adokpo* which might be translated by 'trying that, which you have never tried before'. In the three research villages, as well as in other villages on the plateau (cf. Dangbégnon, 1990; Breusers, 1990a), experimenting farmers are a normal phenomenon. Practising *adokpo* is quite normal amongst Adja farmers, though at a variable individual intensity. In principle, an *adokpo* always coincides with a change in the way agriculture is maintained. This change might be (1) a personal idea, (2) an idea that has already been tried by another person from the Adja society, or (3) an idea coming from outside the Adja society. Only when a new practice has become routine amongst peers, might it be adopted by a farmer without first making *adokpo*.

Adokpo is not a concept used by all the Adja on the plateau; in the South-West of the plateau the concept *ekwikplankplan* is used: 'trying to learn' (*ekwi* = try, *kplankplan* = learn; Breusers, 1990a: 122). Both concepts seem to have the same meaning, as confirmed by farmers.

Adokpo is mostly applied when testing a new variety or a new technique, like another way of planting cassava stalks or testing the use of dung (cf. Box 6.1). On several occasions during the research fieldwork, a new variety of maize, cow pea or cassava was introduced to the research villages, and was tested in *adokpo*. This is mostly done by sowing or planting one part of a field with the new variety which is then compared at harvest time, with older varieties in the rest of the field (Dangbégnon & Brouwers, 1990). Another method consists in sowing or planting drills of different varieties next to each other. Comparison include variables like production, ability to suppress weeds, duration of growth cycle, and production of vegetative material ('to feed the soil', cf. Chapter 5).

Most *adokpos* are undertaken at the individual level. The results of the *adokpo* remain at the individual level, or sometimes will be shared within a restricted personal network, an *adokpo*-group, with more or less stable patterns of knowledge production and knowledge exchange. The way *adokpo* is carried out gives direct information about the situation and preferences of a person. Women are mostly interested in varieties which suppress weeds, have a short growth cycle, can be harvested in a staggered way, and meet standards for processing (e.g. cassava varieties which grate easier and thus are good products for producing quality *gari*). The fact that most farmers from Kokohoue(M) and Allada(H)

search for varieties with a short growth cycle is another indicator for the scarcity of land.

Studying experiments as undertaken by rural people give understanding of their 'sense making' activities. Scientists tend to regard an experiment as an inquiry during which all the parameters are highly controlled except the variables under study. Farmers' 'practice' differs from the scientists' way of experimenting in the sense that it has to be included in daily circumstances. Farming experimentation is integrated in the whole farming activity. It has to provide direct comparison with adjacent fields and the previous method or technique, whilst it is intrinsically bound with farmers' conditions in the design, implementation and evaluation of the experiment.

A farmer is frequently forced to adapt a normal farming practice because of unpredictable factors. What might be called 'imposed experimenting' seems typical for farmers obliged to carry out their farming activities with low levels of control, because of factors such as climatological variability, social uncertainty and political unrest. If, for example, labour availability declines or if rains are late, a farmer has to react immediately and adapt to the initial farming plan. Richards argues (1989: 40) that many small-scale farming activities are characterised by an adaptive performance: 'a sequential adjustment to unpredictable conditions'. Though this kind of experimenting is not intentional but more reactive, it provides important learning material via reflecting on similarities and differences in farming activities and results, as practised through the years. This amassed learning process has resulted in experience. Box 7.1 illustrates the farmers' adaptive performance when confronted with sudden changes.

In addition to learning by *doing*, Adja farmers also learn by *watching* and

Box 7.1:
Flooded land in Adidevo: an example of farmers' adaptive performance

Adidevo is located close to the Mono river (see Annex 7: Map 3). In August 1991, about two thirds of all the fields were flooded for two weeks, following an overflowing of the river. All cotton, maize and other annuals on the flooded fields were destroyed. The oil palms, however, resisted such an event and to the researcher's astonishment, villagers resorted to fishing!

After the river went back to its normal level, farmers sowed short-cycle cow pea and maize, which could profit from a water reserve. Dansou commented: 'As a farmer you always have to be alert; when the conditions change, one has to change too. We know that our fields will be flooded once every 5 or 6 years and we have to live with that fact. The oil palms resist the flooding, but the other crops will be lost'.

Dansou revealed that he had his method of escaping the problems of flooding. The water level under his field is evaluated by studying the behaviour of palm leaves. If the leaves are abnormally low, he knows that 'water is far under' and that this field will probably not have problems of waterlogging, provided flooding is not too severe, since the soil can absorb large quantities of water.

copying. This kind of learning is especially important during childhood, when a girl usually learns from her mother and a boy from his father. The gender division in labour tasks thus reflects in agricultural apprenticeship. This kind of learning involves direct instructions and feedback on results.

The role of formal education is active and seems to play a part in communicating. Young farmers sometimes refer to issues they learned at school, like the importance of having a rotation of crops with different patterns of rooting. In general, young farmers tend to question or sometimes even ignore the concepts and theories used by older people. They count the days and months by the Gregorian calendar and not the farming calendar (cf. Table 4.2 and § 7.2.3) and largely use concepts like *engrais* or *compost* where older people refer to *houinhouin*. The concept of *eza* (cf.§ 7.2.3) is known by them, but they do not always obey the regulatory behaviour which goes with *eza*. Tamichin, a 30 year old farmer from Kokohoue, plants young capsicum peppers in May in order to have an early harvest, whereas this is not allowed according to the *eza* regulations. He acknowledges that the '*eza* rains' (cf. § 7.2.3) at the end of May are not good for his plants, but he still hopes to succeed in his early harvest.

Learning by *watching* and *copying* also takes place in a more individualistic and inclusive way, whilst walking along daily routes and paths or while working as an agricultural labourer during temporary migrations. Diffusion of techniques or practices often starts with people noting them somewhere else in practice. New varieties have a monetary value (e.g. 5 F.CFA for a cassava stalk) within their first introduction period. Theft of new varieties is a common phenomenon; farmers revealed that they knew of varieties stolen from the research station. If a potential interest is perceived, farmers will try to make an *adokpo*.

Field visits to the farmer's own fields are sometimes made (apart from other visits to weed, harvest, etc.) to follow crop development, presence and degree of pests and diseases, and the performance of varieties, etc. Naturally, at the same time neighbouring fields are also observed and compared. Field visits to other fields with a deliberate aim of exchange and evaluation are only common in restricted *adokpo*-groups (see below). Visiting fields of persons outside one's own *adokpo*-group is associated with theft or magic (cf. § 5.3.1, *gri-gri adjitebo*). One can visit member fields of one's *adokpo*-group without permission, whereas other fields can only be visited with the owners explicit permission. When the owner is present, it is normally acceptable, though not common, to enter the field and discuss yields, varieties and methods. However, different attitudes do exist; younger farmers are more open to field visits than older farmers. Furthermore, interest in fields also has a gender bias. In general, farmers confirm that watching other fields while walking through them, occasionally whilst having discussions with others, are important learning moments. During those moments, all elements are present to give rapid results: possibility to watch, practise, compare and discuss results.

In § 2.4 an experiment conducted by rural people was conceptualised as the linking together of cyclic observation, interpretation, and manipulation of the

environment and resources of a person or a group. It was argued that farmers' labour is inherently linked with experimenting (Bolhuis & Van der Ploeg, 1985: 46-7). Farmers' labour is seen here as intrinsically experimental; so a discussion on experiments as undertaken by farmers seems only useful when they recognise a concept like experiment. We have seen that Adja farmers do use such concepts (*adokpo*, *ekwikplankplan*).

Three areas of farmers' experiments can be distinguished: curiosity experiments, adaptation experiments and problem solving experiments (Rhoades & Bebbington, 1991: 251). In § 7.2.2, some examples of adaptation experiments will be presented. Box 7.2 gives an example of a problem solving experiment. Problem solving *adokpos* can be regularly found and thus give a good indication of farmers' priorities. Like every human being, Adja farmers are curious and sometimes organise curiosity experiments with a purely exploratory character. Koffi, a young farmer from Kokohoue, told me that he once planted cassava stalks the other way round to 'look what happened' (it did not give an interesting result). Several farmers related that they had tried out petroleum mixed with ashes or other mixtures as a pesticide. Other substances were tried out in several mixtures as a pesticide, using the left-over from *sodabi* distillation, some *gri-gris*, the insecticide provided by CARDER for cotton, and salt, amongst other substances. Some *adokpos* which tested varieties to 'look what it gives' might also be called curiosity experiments. However, the evaluative framework for these kinds of experiment is obviously prompted by current problems and interests and therefore overlaps with problem solving experiments.

A third type of learning is related to *discussion*. Social learning situations or learning settings relate to a specific social-organisational arrangement, physical surrounding and ways and means of exchange, that are given in a situation in which an actor learns something from another actor (adapted from Rap, 1992: 16). Where Adja farmers are concerned, the majority of this type of learning is associated with *adokpos*, in a preparative, executive, or evaluative way. Two or more persons exchange information, intentions, experiences, etc. These groups comprise close relatives or very good friends and normally consist of only 2 to 5 persons. Most *adokpo*-groups consist of dyads or triads. Members who are close relatives are mostly people from one family working together, whereas friends are mostly of the same age group and live in the same neighbourhood. Members of an *adokpo*-group discuss observations regularly, often work together, exchange seeds or planting material, and may organise a joint *adokpo* or exchange results of individual *adokpos*. In Box 7.2, Kossovi, her co-wife and a neighbour give an example. Box 7.3 gives another example of a typical *adokpo*-group. In these groups several types of learning come together: *doing* (individual or group *adokpo*), *watching* and *copying* (work party, field visits) and *discussion* (discursive exchange amongst members). Information from an *adokpo*-group is not easily accessible for non-members. Amongst neighbouring ethnic groups like the Aizo and Fon *adokpo*-groups with a secret character are named *xonton* (Elwert, 1983; see also Box 7.6). Nowadays the presence of *adokpo*-groups seems more pronounced and differentiated, compared to former days (cf. § 6.2.2).

Box 7.2:
Kossivi makes a problem solving *adokpo* as to how to conserve cow pea and maize.

Kossivi from Kokohoue had problems with conserving maize and cow pea. She knew the chemicals available via the CARDER, which preserves the seeds from attacks by insects, but looked for alternatives, as the chemicals are expensive. She compared the following methods: (1) no treatment, (2) mixing the seeds with sand and orange peel, (3) mixing the seeds with the residual left after the *sodabi* distillation and (4) mixing the seeds with leaves of the neem trees. Comparison was also made with the experiences of one co-wife and a neighbour (a woman) who stored maize and cow pea in the same period. Though the proper method was still to be refined, she concluded that maize was best stored with leaves of the neem tree or the residual of *sodabi* production, whereas cow pea was best stored with a mixture of sand and orange peel.

Part of social learning via *discussion* occurs at a special place. Obvious examples are field working parties. Other examples are places where processing, transport, marketing or other agricultural related activities take place. Women, for instance, discuss agricultural issues while waiting together around the maize processing mill, walking to the market and attending the same, or at the well. The maize processing mill, where various women gather to grind their produce, is an excellent place to learn about maize varieties, their performance and qualities, and how different farmers have used them or intend to in the future.

Rivalry and jealousy between *adopko*-groups certainly impedes rapid diffusion. New seeds or planting material are only distributed to close relatives or

Box 7.3:
An example of an *adokpo*-group in Allada.

Missihoun is an influential *féticheur* in Allada. Djahou, his neighbour is also a *feticheur*; they are often seen together. Initially, only Missihoun was selected to assist the research group of Allada, but every time a conversation was started with Missihoun, Djahou involved himself, so it seemed only natural to include him in the group also. In their role as *féticheur* they receive clients together. Both limit their agricultural activities mainly to oil palm groves and *sodabi* production. They consider themselves as oil palm experts: 'we know the secrets of how to grow oil palm'.

When we made visits to their oil palm groves, they showed us (amongst other things) some herbs which they collected in the groves for *féticheur* activities. They demonstrated how the entrance of strangers to an oil palm groove can be impeded, by making *azan*, (a *gri-gri* defence barrier made out of the yellow youngest oil palm leaves of a felled palm). We also discussed the various techniques involved in palm wine production and the distillation process afterwards. They certainly revealed only part of their knowledge in discussions related to palm wine production and the use of herbs. Nevertheless, we assisted at moments of discussion on some variables (the correct moment to fell the palms, length of time felled palms should be left before tapping the sap, the assessment of *sodabi* quality, selecting seedlings, density to planting palms, etc.). The discussions indicated that they frequently exchange information, points of views and intentions, undertake together an *adokpo*, and discuss results and possible new *adokpos*.

friends from one's *adokpo*-group; initially these are frequently being kept from them too. The spreading of varieties is rather passive and most farmers do not hand out seeds or planting material until they have been asked for it.

Social occasions also provide for learning by *discussion*. Burial ceremonies and memorial ceremonials afterwards, as well as religious ceremonies, frequently include people from different villages. On these occasions, women, who mostly enter a new village upon marriage, return for a few days to their native village. Knowledge between their actual village and their native village is exchanged. The fourth-daily market is another occasion, especially for women, for potential exchange of knowledge. However, these occasions are often the first time a farmer hears about a new seed, technique or method, and in most cases only superficial information is exchanged. Specific knowledge is not readily expressed during public social occasions and farmers do not acknowledge such occasions explicitly as learning occasions. In general, they relate learning to *watching*, *copying* and *doing*, and as far as *discussion* is concerned, the farmers only mention the *adokpo*-groups. An exception is found amongst some young farmers, who tend to recognise 'good' farmers amongst those who are able to discuss their agricultural experience well. This might be a result of formal education, which most young farmers have followed (see above).

Box 7.4:
An example of group learning during the research period.

In § 6.2.1, reference was made to a visit by two farmers and the translator from Adidevo(L) to Allada(H), after about one year of fieldwork. On these occasions, the farmers put on their best suits and knitted caps. After greeting the *délégué* (official head of the village), two Allada farmers took us on a trip of about two hours, showing the principal elements of farming by Allada farmers. We were invited for a final discussion in the unoccupied class room of the primary school of Allada. Obviously the farmers had chosen this place as suitable for the meeting. They discussed principal differences between Allada and Adidevo, whilst I mainly wrote down what the translator told me, without interfering.

After some discussion, the farmers addressed me: 'Yovo (white man), we talk a lot with you about agriculture. We understand that, though you come from the university, you want to learn how we do agriculture. But, in fact, what are you really after?'

At that time I had already met each of them at least ten times, in meetings lasting approximately one hour, and visited their fields with them. At first I was surprised at this comment, since I believed that they knew very well what it was that I wanted to do with my research. However, after more discussions, it became clear that whilst the farmers had discussed the differences between the two villages, they realised that until now they were not aware of the vast differences between villages existing on the plateau. Since it was my presence in the first place that had brought about these understandings, it was obvious that they sought to discover my position. In fact, at the end of the meeting, it occured to me that it was during meetings of this kind that more detailed research objectives and methodology became the subject of discussion. It was during such meetings that we acquired knowledge; we learned about differences between the two villages, yet also about why we should – and how we could, evaluate those differences, including the root of those differences. Both sides, researcher and collaborating farmers, learned.

Learning in discussion groups as a 'sense making' activity is strengthened by visualisation of environmental phenomena (cf. Röling, 1992b). In former decennia, when long term fallow was still common, the arrival of certain birds and insects, and the blossoming of certain trees gave meteorological or time indications to farmers (cf § 4.1.1). However, with the extinction of these species, simultaneous with the disappearance of long term fallow, farmers lost meteorological and time indicators, and were forced to rely more on other more elaborate indicators. Whilst discussing these issues in groups, long term environmental changes and the effects of increasing population became more apprehensible.

Our research approach also implied that our team became involved in *discussion* meetings. Box 7.4 (page 110) gives an example.

7.2.2 Internally and externally generated technical change

Internally generated technical change starts with an invention within the rural people's knowledge system, leading to innovation and diffusion within this system (for definition of concepts: see § 2.4). Southern Benin offers examples in the selection, in former centuries, of oil palm and yam as crops, and the use of celestial bodies to plan agricultural activities (cf. § 7.2.3). Examples of externally generated technical change are the introduction of maize, cassava, cotton and other crops during last centuries, together with introduction of several crop varieties, the use of chemical fertilizer, as well as many other changes.

However, the difference between internally and externally generated technical change tends to get diffused, when technologies are being adapted and integrated into existing ways of farming. Learning processes, presented in the former paragraph, are obviously instrumental for this achievement. As in all agricultural societies, in the course of time, new technologies tend to become an integral part of agriculture. Techniques are being combined and changed, and farmers develop different and specific means of undertaking agriculture. This process demonstrates the heterogeneous picture of Adja agriculture. Various examples will be given in this paragraphe, which illustrate adaptation processes to certain farming conditions, combination of techniques and variability amongst Adja farmers.

The control of the undesirable weed imperata by the soil cover crop mucuna gives a good example of an externally induced technology, which is used by the Adja in a totally different way than initially foreseen by scientists (see Box 7.5).

In Box 7.6 the history of palm wine distillation is described, giving an example of how an externally generated technology (distillation process) became well integrated into Adja agriculture.

Box 7.5:
Dealing with imperata.

On the Adja plateau *Imperata cylindrica* is one of the most troublesome weeds for farmers, as it is in many tropical (sub-)humid areas. It is difficult to clear the underground stolons of imperata, which invade neighbouring fields. Entire fields were abandoned after imperata invaded them.

A FSR/E team (RAMR, cf. § 4.5) was in the process of trying out several soil cover crops, when farmers noticed that one of these, *Mucuna pruriens*, invaded an imperata covered field neighbouring the research plot. The ability of mucuna to control imperata was further investigated and assessed, and now the use of mucuna to control imperata is a major result of the project (Milton, 1989; Versteeg & Koudokpon, 1990).

However, according to farmers of Kokohoue and Allada, imperata is a relative problem 'for those near Deve' (referring to an area with relatively more land; Adidevo(L) is located near Deve, see Annex 7, Map 3). When land becomes more scarce, farmers are forced to use fields invaded by imperata. It obviously takes a lot of manpower to clear an imperata field, but several techniques exist. One technique entails the dense planting of cassava as a cassava fallow: *dégbézoui* (cf. § 5.3.1). Farmers, not in urgent need of land, might also start an oil palm groove, without pruning and intercropping with annuals. Another method involves making mounds in an imperata field for tomato cultivation. After treatment, former imperata fields are appreciated for their soil fertility; tomatoes require a high fertility level which is provided for in this way.

Indeed, imperata is rarely found around Allada(H) and Kokohoue(M); whereas Adidevo(L) has several hectares with only imperata. The roofs in Adidevo(L) are often covered with bundles of imperata. Though they had not seen the mucuna yet, farmers of all the three villages knew the mucuna story. According to their information, which came via market contacts, mucuna does not completely control imperata.

The *sodabi* case shows that farmers are able to transform a technology (distillation process, cf. Photograph 7.1) into their former activities, resulting in a peculiar farming practice involving oil palm. Various variables of the palm wine production (moment of felling, period before opening a hole, location and form of a hole, collection of palm wine, etc.) and the distillation process (period of ripening for palm wine, distillation technique, quality assessment, etc.) were developed without any external involvement. Palm wine production also fitted the needs and aspirations of the population. In addition, palm wine production is profitable, with low risks, and the oil palm can be used as a fallow-replacing tree. Lastly, it offers an off-season occupation for the farmers. Actual *adokpos* with oil palm involve assessing optimal densities for palm wine production, improving the quality of the distillation technique, better *sodabi* marketing, and seedling selection.

Palm wine production may also be carried out by collecting the sap of the inflorescence, as practised in South-West Nigeria. This stops oil fruit production, but gives the possibility of a spreaded palm wine production. Nevertheless, the Adja prefer tapping palm wine by felling the trunk. Missihoun (cf. Box 7.3, the 'oil' palm *adokpo* group in Allada): 'Some twenty years ago, our people

Box 7.6:
The history of palm wine distillation.

As mentioned in § 5.2, collection of palm wine (sap extracted from the felled trunks) and distillation into *sodabi* is an important economic activity on the Adja plateau. The production of palm oil and *sodabi* represents the dominant economic activity for the majority of farmers in densely populated villages in the South of Benin (cf. Feil, 1991: 306). Palm wine extraction already occurred in the 19th century (Wartena, 1988a), but the distillation of the liquid was first started after World War I when the distillation process was introduced (cf. § 5.2). At first, this was done in the Atlantic province (see Map 2) on a restricted level, involving only *xonton* (Fon for 'a very close friend'; Elwert, 1983). The distillation material was kept at a secluded place in the bush and the know-how was treated as a mystery (Feil, 1991: 306).

In the 1930-40's the decrease in revenues from palm oil, the augmentations in taxes and new standards for giving gifts were favourable for the spread of *sodabi* production (cf. Wartena, 1988a; Feil, 1991). French prohibition of *sodabi* production (the demand for French liqueurs decreased substantially, Pfeiffer, 1988) further encouraged the secret character of the production. Felling of palms was forbidden for substantial periods (Wartena, 1988a). After independence, *sodabi* production became legal but was still discouraged. In 1991 farmers still had to pay a fee for each palm they felled.

When in the 1960's long natural fallow disappeared on the more populated areas of the Adja plateau, oil palm became more important in the Adja farming system (cf. Chapter 6). Higher densities and early felling of palms goes along with palm wine production, giving a more intensive use of the 'oil' palm compared to the use of palms for oil production. Combined with the various by-products and social functions (cf. § 5.2) and the fact that processing activities have their peak periods during the long dry season, the palms nowadays play a central role in the Adja farming system, to which the distillation innovation has contributed considerably. However, this externally generated innovation has undergone substantial adaptation.

who returned after working in Nigeria (Nigeria's economy prospered in the 1970's, JB) told us about tapping the inflorescences. I tried it but abandoned this method quickly: the oil palm should not be allowed to grow old, since other crops have to be cultivated too'. Oil palms grown for oil fruit production occupy the land for some 30 years or more. In situations of land scarcity, it makes more sense to have flexible short-period options. In the current system 'oil' palms may even be felled from the age of approximately 15 years (cf. § 5.2).

The use of chemical fertilizer gives another example of how an externally generated technology is handled. The extension service CARDER supplies chemical fertilizer on credit, provided that it is for cotton production only and that it is applied in uniform quantities. However, farmers also apply chemical fertilizer to maize, tomato and capsicum pepper. Much variability exists in how chemical fertilizer is applied and in what quantities (mostly lower than CARDER recommendations). Chemical fertilizer clearly adds to the repertoire of choices for Adja farmers, but its application is highly variable due to individual preferences.

CARDER recommends that chemical fertilizer should be applied in the soil between the rows. However, farmers in Kokohoue, after making *adokpo*, prefer

Photograph 7.1. Palm wine distillation workplace for *sodabi* production

to broadcast and leave the chemical fertilizer on top of the soil. This is a much less laborious task than applied in the way CARDER recommends fertilizer application. But in 1990 Danhounsi told me: 'There is a rumour going round that one indeed should apply the method recommended by CARDER. According to the rumours, when the chemical fertilizer is merely sprinkled, the *air* floating around will transform some constituencies of the chemical fertilizer into gas, which will subsequently be blown away'. (for an elaboration of the concept *air*, see § 7.2.3).

The introduction of varieties also demonstrates some processes involved in adapting a technology, see Box 7.7. This case shows how a specific network searches for new varieties, evaluates them for potential *adokpo*, and how the variety is further diffused.

In addition to the examples shown in Box 7.5, concerning the use of mucuna and the history of palm wine distillation as explained in Box 7.6, Box 7.1 (adaptive learning) shows that in regular farming activities and most forms of experimentation, the completed design is more a result of adaptations of plans than a rigid implementation of a plan. Adaptations of plans and experiments are closely related to changes in regular farming practices and strategies. At the start it is difficult to predict what consequences an experiment will have; not only for daily practice but also for other areas of life (cf. § 5.2: the use of *sodabi* in religious ceremonies, oil palm as the local bank). Thus, a controlled experiment is not suitable for the Adja way of organising an *adokpo*, since it deviates from the conditions of daily farming practices.

Box 7.7:
Arrival of the cassava variety *gbezekoutou* in Kokohoue
(reconstructed together with 2 farmers and a translator).

In 1991 about 75% of the cassava planted in Kokohoue was the variety *gbezekoutou* (Gbeze: village near the Togo border, koutou: cassava). At the time it was the most planted variety in the North-Western part of the Adja plateau and rapidly spreading to other parts. *Gbezekoutou* is a vigorous, high yielding variety with no visual signs of virus contamination. Most of the other cassava varieties have virus contamination. Farmers appreciate its production and quality to intercrop, due to more spreaded shading; compared with other varieties it forms a long stalk and branches less. In 1985 the variety arrived in Kokohoue when the women of the village went to neighbouring Djakotomey to harvest a cassava field they had bought in order to produce *gari*. They noted its qualities and tried some stalks in *adokpo*. After positive evaluation of the *adokpo* results, the variety rapidly spread in Kokohoue, mostly by means of theft. During the first two years the stalks had a monetary value (5 F.CFA).

A male farmer from Djakotomey, in whose field the Kokohoue women harvested, is a cassava 'specialist'. Each year he cultivates more than a hectare of cassava. He had brought the variety from Gbeze in 1983, where he had noted the good tubers that an old woman was harvesting. At first he thought it was due to the soil's fertility that the tubers were large, but after *adokpo* he discovered that it was a quality of the new variety.

Further inquiry of the Kokohoue farmers in Gbeze showed that most people in this village believed it to be a variety which originated from Gbeze. However, the Kokohoue farmers concluded that the variety arrived in Gbeze via relatives from Togo: seasonally migrating young men.

The introduction of externally generated technologies in the cases discussed above (mucuna, distillation process, chemical fertilizer, new varieties) have added to the repertoire of choices for farmers. However, they have all undergone quite an extensive process of adaptation by Adja farmers. The adaptive performances of farmers are a response to a variety of environmental, social, economical, technological and political factors. In the process these adaptations become an integral part of daily agricultural practice. This transformation process is partly based on a more or less shared 'sense making' of reality.

In the following paragraph an analysis will be made of how theories are used in 'sense making' processes.

7.2.3 Adja classification and theories

In the former paragraphs of this chapter 'sense making' related to learning and adaption to externally generated technology was discussed. In the following paragraph, Adja classification and some Adja theories will be discussed.

An issue on which a great deal of research of rural people's knowledge concentrates, is that of classifications as used by rural people. Making theories and nomenclature out of complex reality are important processes to make sense of life. The Adja made classification of climatological phenomena (cf. § 4.1.1), types

of soil (§ 4.1.2 and § 5.3.1), varieties of crops (see Annex 5), useful weeds (see Annex 6), pests and diseases of crops, and others. However, these classifications cannot be presented in a univocal way. In the following paragraphs, some arguments will be given for this statement, whilst studying the naming of varieties, pests and diseases of crops.

The naming of crop varieties reveals a multi-dimensional basis. Varieties are named to their origin (e.g. *gbezekoutou*, cf. Box 7.7), name of the innovator (e.g. *Kpake*, an okra variety, introduced by Mr. Kpake), the colour or form of the seeds and fruits (e.g. *agnouhoui*, white cow pea; *montokoun*, 'tyre', a tomato fruit which resembles a car tyre). Some names relate to the period required for that particular variety to grow (e.g. a maize variety that is claimed to take two lunar periods is called *houletchive*), indicating the importance of short cycle varieties.

Certain social aspects are revealed by the naming of varieties. *Doazannoufinto* is a short cycle cassava variety which means literally 'fix a date to satisfy the creditor'. The creditor will be paid at the harvest; people who grow this variety will be seen as having debts. Another cassava variety is called *kondodoukou*: 'go to the field, eat and die'. This is a variety with a high level of hydrocyanic (HCN), which is highly poisonous. Though not socially approved, due to the danger that children eat tubers and die, poisonous varieties are sometimes used to prevent theft (cf. Photograph 7.2). But *kondodoukou* reveals more (cf. Breusers, 1990a). A story goes along with the variety: 'A man was married with two wives. One of the women was jealous of the other and wanted to steal her *kondodoukou* cassava, but she did not had the permission of her husband and died'. Especially the men do not approve of poisonous cassava varieties. However, women appreciate their qualities for *gari* production, an activity controlled by women. In general, women have more knowledge than men where it concerns the processing qualities of varieties. The conflicting view on poisonous varieties indicates a tension between women and men relating to the sharing of profits in processing activities (Laarakker, 1990). Thus, the same variety may be chosen because of its yield performance, to ward off thieves, or as an expression of tension between a wife and her husband. One maize variety is specifically used as a *gri-gri*: maize *tala*, a variety with red maize corns, used to protect fields from pest and diseases.

These examples illustrate that social tensions and dependencies exist within practical agricultural performances. Somebody using *doazannoufinto* is regarded as having a debt. A field which a woman borrows from her husband with whom she has tensions, might be recognised by the oil palms (mostly not owned by her) which are excessively pruned and where weeding is neglected. 'Those who are delayed' are forced to choose certain crop associations; e.g. often women cannot sow as quickly as men. A typical woman's field in a densely populated area is small (a few *aboho*), intensively mixed cropped with mainly cassava, groundnut, cow pea, or maize and often with a few vegetables (e.g. capsicum

Photograph 7.2. Rosa shows leaves of *houla*, a cassava variety with low HCN content (on the left; big oval leaflets) and *kondodoukou*, a variety with high HCN content (on the right; smaller rectangular leaflets).

pepper, leafy vegetables like *Amaranthus spp.*, tomato). Oil palms on these fields are frequently poorly weeded and intensively pruned. Agricultural practices such as choice of crops, types of mixed cropping, and the date at which sowing or planting takes place, accordingly reflect social differences.

Pests and diseases of crops are related to insects and other causes of damage. However, damage caused by diseases is not frequently related to a 'disease', as would normally be done by phytopathologists. Some diseases are identified with human diseases (e.g. *ekpo*: leprosy; *gbodo*: scabies) when virus or bacterial infections cause similar visual effects. But often other connections are made as well. At the end of May, damage of crops is seen as caused by the '*eza* rains' (see below). Some names for 'diseases' have the prefix *eza*: (e.g. *ezahoulouaman*, *ezamlanfetri*, virus types in okra). Two maize viruses refer to metaphysical phenomena: *enoudjou*: 'fallen when two nights occurred successively' and *zodjayi*: 'fire is fallen'.

Causes of pests and diseases are also related to social behaviour. Animists can consult the 'queen' at Dogbo-Ahomey (cf. § 4.3), who will resolve the problem after certain sacrifices and other prescriptions are carried out. The animist respects the prohibition of agricultural activities during the fourth-day market. However, the increase in other religions within the Adja society (cf. § 6.2.2) have

led to violation of this rule, causing, they believe, the presence of pests and diseases. A similar pattern has been found in neighbouring villages, respecting a different market day, which may cause conflicts since they also violate the rule. Thus, presence of pests and diseases is often explained in terms of social conflicts.

In addition to classification, theories used by rural people provide understanding as to how they model and structure reality. In § 5.3.1, it was shown how Adja farmers make sense of issues related to soil fertility, in a different way from soil scientists. The Adja theory of 'soil fertility' (*houinhouin*, 'feeding' the soil, *vitamins*, etc.) indicates a specific look at soil fertility and its management. Furthermore, differences amongst the Adja were reflected in the way soil fertility is dealt with (cf. Chapter 6).

In addition to the Adja theory on soil 'fertility', various other theories used by the Adja will be described here, including theories related to *eza*, plant patterns and densities, and the use of magic. However, theories cannot be related solely to a single object. For instance, *eza* relates to plant diseases, names of crop varieties, a certain type of rain, and 'months' of the farmer calendar.

A description of Adja theories, related to agricultural activities and used as an evaluative framework, may lead to a comparison with scientific theories. This comparison is not expressed here, since this part is merely directed at gaining an understanding of 'sense making' by Adja farmers, using theories.

One group of environmental indicators, mentioned in § 4.1, is formed by celestial bodies (stars, moon, meteorites, planets). A group of stars, presumably the pleiades, are named the *eza* stars and form an important reference for the Adja (cf. Breusers, 1990a; Agbo, 1991). In former paragraphs, reference was sometimes made to *eza* (names of some farming 'months', Table 4.2; Tamichin violating the *eza* rules, § 7.2.1; names of crop varieties; the '*eza* rains'). The pleiades are used as a reference by people like the Andean farmers (Salas, 1992: 15-7) as well as the aboriginals (Lang, 1910: 125-7). Their brightness gives an indication as to whether the season will be good or bad. Like the Adja, the Andean farmers associate the cyclical movements of the moon and other celestial bodies with ecological rhythms. Farmers' astronomy is based on the observation of natural regularities and interpreted with particular categories of cosmologies related to the production and representation of meaning.

At the end of May, the *eza* stars 'disappear' and the '*eza* rains' fall, which are bad for plants, animals and human beings. The '*eza* rains' cause necrosis on leaves and stalks, and especially young plants are vulnerable. Therefore, one should not plant or sow in May, because *eza* will destroy them. *Ezavouvouato* is the name of a certain wind, which announces the return of the *eza* stars sometime at the beginning of June. From that moment on, it is allowed to sow and plant again.

However, *eza* rules are not always respected, as we saw with Tamichin (cf. § 7.2.1). Especially young farmers tend to rely on other concepts. Victorin and Claude, young farmers from Allada, use the Gregorian calendar and seldom

the farming calendar (cf. § 4.1.1), with its regulations accompagnying certain 'months' (e.g. *(e)zalekoui*: not planting or sowing). The existence of two methods of counting 'months' causes confusion. The farming calendar (Table 4.2) has 12 'months', whereas each year has 13 lunar months and some days. The missing 13th month should not be pronounced, as this calls for misfortune to the community (Agbo, 1991). The counting of farming 'months' is frequently mixed, since the calendars do not have the same number of 'months'.

Various writers argue that mixed cropping as is practised by small-holders displays their inventiveness (cf. Steiner, 1984; Richards, 1985). In West Africa about 80 per cent of all farm land is mixed cropped (Richards, 1985: 63). On the Adja plateau the majority of fields are mixed cropped. Management practices of farmers, such as change in species and varied numbers of crop components, give answers to varying soil fertility and reflect farmers' objectives. Box 7.8 gives the Adja theory related to plant densities.

Magic might be regarded as a 'sense making' process to express internal pressures and uncertainties. In general, health problems, misfortune and serious conflicts are often seen as caused by magic. In § 6.2.2, we saw that personal problems are more often explained as caused by magic and not as the result of violating religious rules. It is commonly accepted to protect fields and houses from thieves by using certain *gri-gris*. The maize variety *tala* and the poisonous cassava varieties are examples already quoted. Another practice entails putting a spell on the thief (the spell works by immobilising the thief in one's own field, making it impossible for the thief to find his or her way back home, or by causing an incurable wound, etc.). The spell can only be withdrawn by the owner of the field. Sometimes, people doubt the effectiveness of *gri-gris* because they suspect that the magic has been placed without proper incantations and other necessary rituals. Magicians have to be paid for.

One may explain magic (or sorcery) as a 'secret society' (Alapini, quoted by Pfeiffer, 1988, my translation, JB) regrouping 'people who are economically weak (...) or socially unhappy'. Additionally, 'one does not refuse something to a magician, because a demand he or she makes is a pretext for disturbance in case of refusal' (*ibid.*, p.127, my translation, JB). Whereas a redistributive element seems present in magical practices, it also takes away funds, used for protection against magic; or refrains people from starting economic activities. Urgent daily needs and problems seem to be at the basis of many magical activities and interpretations. As Bourdieu argues: (1990: 95) '.. magical or religious actions are fundamentally "this-worthily" (*diesseitig*), as Weber puts it; being entirely dominated by the concern to ensure the success of production and reproduction, in a word, survival, they are orientated towards the most dramatically practical, vital and urgent ends'. Thus, as we saw in Chapter 6, magic might be understood as a way of explaining and controlling an ever-changing and uncertain world (cf. Jahoda, 1970).

An example of the use of magic is given when regarding the way the Adja

make sense of their dependence on the rains. Rain variability is high, both in quantity and in spatial distribution. In addition, the last decennia indicate a decrease in total quantity and a tendency of the small rainy season to become more variable (cf. § 4.1.1). The importance of rains is revealed by the names of some farming 'months' (cf. Table 4.2: *adjakossé*: month with rain which makes the flowers fall; *(e)zalekoui*: month with few rains; announcing the *eza* rains; *gbonfoui*: month with rain with small droplets).

In case of persistent droughts, farmers can solicit the help of the 'King' at Tado or Dogbo-Ahomey (cf. § 4.3). But, as seen in § 6.2.2, *féticheurs* take an increasingly active profile concerning rain. Farmers can consult a 'rain *féticheur*-technician' in some villages. The emergence of such persons caused increasing tension with the 'King', who saw his clientele departing and his credibility chal-

Box 7.8:
The art of planting: combining the theory of *air* with other knowledge.

Adja farmers relate plant densities with the concept of *air*. If the density is low, the *air* 'will circulate properly between the plants', permitting them to have a good development and harvest. If plants are sowed too densely, the *air* 'cannot pass', and plants will be under-developed and flabby, resulting in bad harvests. The need for weeding is also explained with the concept of *air*: 'weeds should not restrain the *air* from passing'.

Mixed cropping, *bakabaka*, is a common practice for farmers (cf. § 4.2). The most common reasons they mentioned, were the saving of land and labour, and the spreading of risks. Mono cropping, *tagba*, is less frequently found (e.g. cassava and oil palm 'fallow'), and sometimes referred to when assessing plant densities of separate crops in *bakabaka*. Each variety has its own characteristics, making it suitable for certain plant patterns. For instance, some farmers argue that the cassava variety *ghana koutou* should be planted less densely as it branches more compared to a variety like *gbezekoutou*, which does not branch much and is more suitable for mixed cropping (cf. Box 7.7).

General rules are applied for the timing of planting or sowing in mixed cropping (e.g. not planting in May (*eza* rains); maize-cassava: maize sowed fifteen days before the cassava; maize-capsicum peppers: young pepper plants should be planted after stamen bloom of maize, etc.). However, variation is commonly found.

Plant patterns vary. Maize is mostly sowed in rows, in the direction of the principal winds in order that wind damage is minimised. Some farmers explained that 'maize rows will stimulate the passing of *air*, benefitting other crops between the rows'. Other advantages mentioned, are the ability to weed more easily and the assurance that all parts of the field are sowed or planted.

Other plant patterns are also common. When farmers do not sow or plant in rows, their practice is sometimes seen as chaotic by outsiders. However, the Adja do have a concept for this way of planting: *adokpeton* (reference is made to the cooking place consisting in the kettle on three big stones: *adokpeton* means literally '(like) the kettle unites the three sides', cf. Breusers, 1990a: 70). With *adokpeton*, farmers refer to planting or sowing in a triangular pattern.

Crops will be planted or sowed in such a way that the *air* can pass through them. In addition, farmers vary densities according to site specific soil fertility (as noted in previous harvests, with the presence of certain weeds, or other indicators, cf. § 5.3.1). Densities may also vary with topographical variance. For example, the top of a hill will receive lower densities, as water availability often will be lower compared to lower parts of the field.

lenged. In April 1983, when rainfall was delayed again, tension rose to such a level that the authorities installed a 'rain committee' which was in charge of coordinating rain making capacities (Agbo, 1991).

These conflicts are to be seen as part of a context where farmers are increasingly confronted with droughts and irregular rains. Whatever the effectiveness of 'rain-makers', they do provide a possibility to channel tension. Rivalry amongst above-mentioned actors is explained as one causal factor for rain problems. Another explanation is sought in the violation of animistic rules by members of other religions.

The reactions of farmers to rain variability are various. Again, the selection of short cycle varieties is especially important in order to use the short, second, rainy season. In § 4.1.1, it was described how women in particular start farming in an intermediate short season. Variation in sowing dates and mulching are other examples. Mulching, which increases the water retention capacity of the soil, is done by leaving the weeds, crop residues and the leaves from pruned oil palms on the land. A last example of how farmers cope with rain variability is the habit, also by land hirers, leasers and borrowers, to cultivate several fields with different growth stages of oil palm (cf. § 5.2). In this way, the effects of spatial rain distribution are countered.

7.3. Conclusions

From § 7.2.1, it is seen that learning for Adja farmers is highly associated with *doing*, *watching* and *copying*. Learning is firmly entrenched in action. In daily practice, a constant attentiveness to possible improvement is present at the individual level. Conceptualising types of farmers with terminology like 'progressive versus conservative', or 'innovator versus laggard' do not do justice to the fact that each farmer is constantly involved in active search for possible improvements in agricultural practices, albeit in a variable, individual way.

Results of *adokpos* are shared, interpreted and discussed only amongst a restricted group of persons which might be termed 'dialogue networks' (Darré, 1992: 123). Encounters take place in specific social and physical contexts. The creative capacity of these groups resulting in 'sense making' out of a problematic and diffuse situation, are key elements for understanding Adja agriculture. Research, as undertaken by practitioners in these circumstances might be described as 'an activity of practice, triggered by features of the practice, undertaken on the spot and immediately linked to action' (Schön, 1983: 308).

Farming experiences evolve from the examples in the former paragraphs as being related to congruent aggregates of knowledge consisting of possible responses to potential and unpredictable factors. This is also reflected in Vickers account of the concept *appreciation* (Checkland & Casar, discussing Vickers, 1986: 15): 'I postulate that experience, especially the experience of human com-

munication, develops in each of us readiness to notice particular aspects of our situation, to discriminate them in particular ways and to measure them against particular standards of comparison, which have been built up in similar ways. (...) Since there are no facts, apart from some screen of "values" which discriminates, selects and relates them, just as there are no values except in relation to some configuration of fact, I use the word appreciation to describe the joint activity which we call knowing and which we sometimes suppose, I think mistakenly, to be a separable, cognitive activity which is "value-free" '.

Likewise, farmers' knowledge seems primarily based on 'reflection upon chains of related operations during the production process' (Stolzenbach, 1992) and the result of farmers action (cf. discussion on the concept of knowledge in § 2.4; Maturana & Varela, 1984). These authors state that action and experience create their own legitimacy, a statement which seems useful to describe Adja farmers' *knowing-in-action*. Farmers' actions themselves help build the structures that channel their acquisition of knowledge, its evaluation, and the way it is used. The expression *knowing-in-action* (Schön, 1983; Maturana & Varela, 1984) seeks to explain that an action of a practitioner is not primarily bound to 'intellectual knowing' or 'knowing how', but much more related to 'knowing that'. Like the experience evolving from the examples in this chapter, Rap argues (*ibid.*, p.52) that '(..) knowing-in-action can only be learned "by doing", by getting experience, intuition and practical know-how in the practice, in which it is being implemented'.

Similarly, the description in § 7.2.2 of how techniques are transformed in a way which involves various 'sense making' processes, showed that knowledge is always in the making. Transformation processes are partly based on shared 'sense making' and partly based on individual or restricted group preferences and 'sense making'. A dynamic picture evolves which argues against literature conceptualising rural people's knowledge as 'traditional'. 'Traditions' are not static but change in time (cf. Hobsbawn & Ranger, 1983). Externally generated technologies are transformed and combined with social, economic, political and other factors and become an integral part of agriculture. To counter the tendency to regard imported technology as all-powerful, capacities of farmers to transform such technologies should be identified and valued. This would ensure that farmers' efforts and capacities to improve agriculture remain valued. One starting point in safeguarding a respectful attitude to farmers knowledge seems to be education, because younger farmers are amongst those who most actively look for opportunities whilst re-evaluating actual farming theories, concepts, etc. In this situation, education should avoid disregarding farmers' knowledge but instead regard it as a valuable asset.

Rhoades and Bebbington (1991: 251) state that the propensity to experiment and try out new ideas may be more pronounced in areas of diversified agriculture and poor extension services than in developed countries with less diversification and excellent research and extension facilities. The Adja case shows how farmers

in the former situation experiment as part of their ordinary activities. In addition, a higher intensity of experimentation might be an indication of urgency in the need for new ways of farming, and for the insufficiency of present knowledge. Examples from the Adja are the intensive search for short cycle varieties and the diversification of manuring practices in the more populated areas (cf. § 6.3).

Diffusion of new technologies and methods amongst different *adokpo*-groups is slowed down by the fact that they have to be verified each time in an *adokpo*. For instance, experiments with plant densities for new varieties and their suitability for certain processing activities afterwards are often repeated at the same time by various *adokpo*-groups in the same village. It has been argued that interactions amongst diverse innovators can validate rural people's knowledge in a rapidly changing world (cf. Mazur & Titilola, 1992).

Yet, the variability amongst Adja farmers argues in favour of the capacity to assess, at an individual or *adokpo*-group level, the potential value of a new method or technique. The search for an 'ideal type description' of farming does not seem useful and might undervalue or even weaken adaptive performances of farmers. Variability of Adja farming is another argument against the static view on rural people's knowledge as being 'traditional'. Farming populations are rarely homogeneous in the sense that their members are confronted with the same options and use the same evaluative frame work. This chapter, as well as Chapter 6, showed that variability (gender, access to resources, age, membership of an *adokpo* group, etc.) is a basic characteristic of farmer populations.

Researchers may be able to sustain ongoing Adja experiments by elaborating on a broader set of methodologies for interactive learning activities. Adaptive research performances of farmers might be enhanced by scientists who visit farmers in their fields and try to join their discussion on the different performances. In addition, the ability of researchers to enlarge their discursive analysis with a view to the practical activities applied by farmers seems an important prerequisite for fruitful collaboration. As Giddens (1987) argues: 'Actions are done knowledgeably, but without necessarily being available to the discursive awareness of the actor. Any analysis of social activity which ignores practical consciousness is massively deficient'.

The adaptive performance of farmers might be understood and discussed by researchers if they are willing to acknowledge dimensions other than agriculture which are perceived to be relevant by farmers. Yield assessment, for example, will not only relate to production as most change agents tend to expect, but also to political, social, economic or other factors. I would argue that researchers may only understand and sustain 'sense making' activities, and thus share knowledge processes with farmers, when they are not only able to reflect on validity claims, but also on social meanings and relational aspects of the 'sense making' activities which result in agricultural knowledge. In this way, interactive learning activities, shared between farmers and scientists, seem potentially pos-

sible. Thus shared learning is more inclusive and takes place before actual *adokpos* are implemented. Meanwhile, farmers' learning capacities should not be replaced by outsiders. Merely, one might look for ways to enhance learning and experimentation already present, by stimulating and giving input to discussion, evaluation, comparison, etc.

The Adja would be assisted by the removal of restrictions on certain activities such as the taxes on felling oil palms or on access to the market. It makes more sense to enable people to take advantage of new opportunities and thus adapt to a rapidly changing situation. Similarly, potential new plant material may be selected in a more efficient and effective way if farmers were to be involved (cf. mucuna case, Box 7.4; selection of varieties by farmers, Box 7.6).

'The object of social science is a reality that encompasses all the individual and collective struggles aimed at conserving or transforming reality, in particular those that seek to impose the legitimate definition of reality, whose specific symbolic efficacy can help to conserve or subvert the established order, that is to say, reality'.
(Bourdieu, 1990: 141)

8 Discussion and conclusions

The research objectives, drawn in § 1.5.2, will be discussed in the last chapter with reference to the results of the other chapters. Finally, the various arguments of this study are concluded.

JHAM Brouwers (1993). *Rural people's response to soil fertility decline. The Adja case (Benin).* PhD dissertation.
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The main objective of this study was the identification and description of Adja farmers' agro-ecological knowledge and knowledge processes related to population pressure (cf. § 1.5.2). Attempts by agronomic interventions to tackle the declining soil fertility problem were rather limited until now, obligating Adja farmers to find solutions themselves. Each of the derived research objectives will be examined, in the light of previous chapters. Together, they provide the material, which aims to fulfil the main objective, formulated above.

The first derived research objective aimed at an identification and description of Adja ways of classifying and conceptualising agro-ecological knowledge (e.g. soil types, climatological indicators, mixed cropping systems, weeds, etc.). Chapters 4, 5 and 7 encompass the body of work, relating to this first research objective.

Chapter 4 comprises an introduction to the Adja plateau, also seen from the Adja classification point of view. The farming calendar based on lunar months (cf. Table 4.2), is used to plan farming activities. In addition to celestial bodies (the moon for the calendar and the *eza* stars in Chapter 7), reference was made to other environmental indicators used by the Adja, such as winds, rains (cf. § 7.2.3), flora and fauna. Trees and other plants are currently used as meteorological indicators (cf. Annex 4). Soil classification as practised amongst Adja farmers is presented in § 4.1.2. The latter is based on direct utility, geographical indication or historical vegetative indication. The presence and intensity of herbs and soil macro fauna in a field give information relating to the soil fertility level. Chapter 7 illustrates how crop varieties (cf. Annex 5), pests and diseases of crops are classified. Conceptualisation of agro-ecological knowledge was illustrated by some theories used by the Adja. In Chapter 5 the Adja theory on 'soil fertility' is described, in addition to other Adja theories in § 7.2.3. Rural people's knowledge is not limited to areas of direct practical utility. Like scientific knowledge, it has to be conceptualised as being the result of intellectual processes which create order ('make sense') out of disorder. Naturally, a practical orientation is involved, but theories also comprise abstraction, analysis and conclusions.

Concepts used in classifications and theories are not uniform within the Adja society. They depend upon who uses the concept and in what context, as we saw, for example, with the variety *kondodoukou*, the explanations of the presence of pests and diseases, and the interpretations of rainfall patterns. Thus, classifications are not static and homogeneous. Likewise, Bourdieu (1990: 141) argues that 'each state of the social world is (...) no more than a temporary equilibrium, a moment in the dynamics through which the adjustment between distributions and incorporated or institutionalised classifications is constantly broken and restored. The struggle which is the very principle of the distributions is inextricably a struggle to appropriate rare goods and a struggle to impose the legitimate way of perceiving the power relations manifested by the distributions, a representation which, through its own efficacy, can help to perpetuate or subvert these power relations'. Thus, classifications for 'making sense' of the world reveal internal struggles and other variabilities. Research on rural people's classi-

fications should not lead to rigid rules for farming practices. If it does, it mistakenly perceives the logic of farmers' knowledge and action in a univocal way. It would be superficial to try to analyse discourse and classifications by focusing on the utterances, without reference to the broader space of social positions and processes.

The second derived research objective aimed at identifying and characterising individuals and groups taking a particularly active part in knowledge processes within the Adja community, e.g. those involved in changing the norms relating to Adja methods of farming. Chapter 6 demonstrates that farmers in the more populated areas are more actively searching for alternatives, compared to farmers from villages with more land. Moreover, women especially are engaged in new activities (for examples, the women initiated the use of household refuse as a fertilizer, and the peeling of tubers on site, in the field). In Chapter 7, the *adokpo*-groups, small groups involved in experiments, are discussed. They are the pioneers of new agricultural practices.

The third derived research objective concentrated on the identification of new norms and values in Adja farming and concomitant technologies that have been the result of increasing landscarcity. Marked differences exist between villages with different levels of land availability and Chapter 6 presents a description of this enquiry.

Boserup (1965) emphasises that her thesis may not be true for communities with a very high rate of population growth which are already densely populated, and which are unable to undertake the investment necessary for introducing even more intensive methods of agricultural cultivation. Today the Adja agriculture may go towards what Lagemann (1977: 17-8) calls a *low-level equilibrium agriculture* (cf. § 1.2) but this is certainly not caused by a lack of willingness to be open to change on the part of the Adja farmers themselves. An important conclusion seems to be that uncertainty is increasing. The future indicates a departure from the more or less stable way of Adja farming, and a more permanent state of uncertainty concerning the evolution of coping strategies adopted by the farmers.

The fourth research objective aimed at a description of diversity in Adja ways of farming, including demographic conditions, individual variation, as well as social differentiation. Rural people differ in opinions, innovative capacities, preferences, access to resources, etc. Their knowledge is not only based on technical issues, as demonstrated by the use of theories and classifications (cf. § 7.2.3). Heterogeneity reflects complexity of life. In a complex, dynamic world it makes more sense to think in terms of many problems interacting together, rather than in terms of unambiguous problems with technical solutions. Likewise it is more logical to think in terms of 'improving situations' rather than 'solving problems' (Bawden & Macadam, 1991: 3). Chapter 6 shows diversity as a result of differing population pressure.

The fifth derived research objective intended to identify Adja experiments, inventions and innovations, and to discover the 'roots' of these innovations. Adja learning is highly associated with *doing*, *watching* and *copying*, and farming experience evolves as being related to congruent aggregates of knowledge consisting in possible responses to potential and unpredictable factors. A universe of practice rather than a universe of discourse emerges (Bourdieu, 1990: 87). This is presented and discussed in Chapter 7.

The last derived objective concerned the identification and description of incorporating processes of externally generated technical change. Some changes are the result of formal extension and research carried out on (or related to) the Adja plateau, but other external sources (e.g. migrated Adja, other ethnic groups, traders, taxi drivers) seem at least equally important. The adoption and adaptation of these changes is described in § 7.2.2.

The way Adja farmers experiment, learn and use theories, as shown in § 7.2, indicates that Adja knowledge should not be seen as a finished product but more as an ongoing and open-ended process. Dommen (quoted from Steiner, 1984: 209) states that a basic element that characterises African low-resource agriculture is the flexibility of its mixed cropping systems: 'This means that the farmer does not know exactly what he will grow on his fields in the middle or at the end of the season. The final cropping pattern depends on the time between the onset of the rains and the latest possible planting dates for individual crops, on intervening drought periods and on the availability of labour'. Likewise, in the case of the Adja farmers, they have to reconsider their position at various periods during farming activities. Climate variability (early or late rains, droughts, flooded fields, etc.) and availability of labour (health risk, claims from household members, negotiation of labour with other resources, etc.) are two considerations, amongst others, which might change at any moment.

A *technology fix* still seems an important objective in many studies of rural people's knowledge. Evaluation is often formulated in terms of technology development and efficiency of research resources and the main objective remains the increase of production via technological changes. Concrete applications of rural people's knowledge are mostly orientated towards streamlining the diffusion of technology. Empowerment and control over resources are issues which remain at a low priority on the agenda. Works containing case studies of rural people's knowledge (e.g. Chambers *et al.*, 1989; Dûpré, 1991) often give examples of classification systems and their relations with behaviour.

By concentrating on classifications, the above mentioned research results *de facto* in increased control by formal science over rural people's knowledge. If research on rural people's knowledge is mainly limited to diagnosis and *on-farm trials*, the creative process of designing new knowledge is withheld from rural people (Breusers, 1990b: 28). The understanding of rural people's knowledge is seen as enhancing communication between rural people and development

practitioners. However, often the ultimate objective is a smoother implementation of technology transfer. Differences between rural people and scientists regarding access to resources, as a determining factor for knowledge, are seldom questioned.

These differences do need attention; previous chapters demonstrated that knowledge is not equally shared within Adja society. We also saw that knowledge differs according to status, gender, age and socio-economic position, and has its roots in the physical environment (two rainy seasons, variability of rains, necessity to 'feed the soil', etc.) as well as in the socio-cultural environment (*eza*, *air*, magic, etc.). Differences in agricultural practices as a result of social struggles are also evident (e.g. not weeding oil palms and excessive pruning by women, and differences in preferences of crop varieties). Knowledge as an expression of Adja practices is the result of these phenomena since it is an expression of differential access to resources. Farmers are involved in social relations which affect their farming, just as farming affects their social relations.

Likewise, Richards (1985: 162) argues that 'Factional conflict and personal rivalry are an everyday part of village life, so it would be naive to believe that self-help research and development strategies would necessarily work in a smooth and uncomplicated manner'. However, most writers limit problems of information exchange and power relations to signalling it (Breusers, 1990b: 32). Not problematising power relations and adhering to a *technology fix* allows the mere translation of practical problems into technological problems (*ibid.*).

The present research argues for a conceptualisation of farming systems which takes into account social interactions and contradictions between actors. This is not taken into account by studies on rural people's knowledge which are limited to a verification of ideas and practices. By failing to do so, they do not regard knowledge as a potential source of power which contributes to the heterogeneity found amongst rural people. If, for instance, representation of Adja classification of cassava varieties was done in a univocal way, gender differences as well as power issues between men and women might not be recognised (cf. § 7.2.3). Some writers (cf. Swift, 1979; Thrupp, 1989; Fairhead, 1992) accordingly state that a more effective way of enhancing capacities of rural people lies in understanding their knowledge as a potential source for empowerment. Here, the principal objective is not technology development and transfer, but consciousness-raising (cf. Freire, 1973). Freire argues that knowledge is always in the making and the result of interactions between actors in a certain context (*ibid.*, see also Leeuwis *et al.*, 1991; Drinkwater, 1992; Long & Long, 1992). To facilitate social movement and learning Mshana argues (1992: 310) that research should be envisaged which '... deals with the problems of elites, elitism and professionalism and its bureaucratic procedures within government and institutions (...) in order to develop a democratic system of power sharing in which elites become organic intellectuals accountable to their people'.

This contrasts with studies which conceptualise the life world of actors in terms of 'knowledge', with little recognition of systemic limitations, social structures and personal variation (Breusers, 1990b: 42). By reducing in this manner

the contribution of rural people, they do not allow for a translation of practical problems into technological answers by rural people themselves (*ibid.*, p.43). Thus, this translation is done by representatives of formal science who impose their *Weltanschauung* upon the definition of the situation.

Seen from this point of view, the oil palm farming system, as practised by Adja farmers, is better not evaluated on its technical merits only. In former chapters, the tight relations of the system with different social activities was revealed. In addition, different oil palm systems can be related to differences in social positions of farmers. Poorer farmers, with limited access to land and other assets, may be particularly vulnerable as they are forced to cut down oil palm-based fallows earlier than the minimum to sustain their system (Gibbon & Breusers, in press). Richer farmers, who own a considerable part of the cultivated land, plant the oil palms less densely and leave the palms for longer periods. For most women and young male farmers who are just starting with their own farms, land shortage prevents the application of techniques like cassava or oil palm fallow. However, landowners will see to it that oil palms are grown on their fields, if borrowed by a relative, sharecropped, or rented. Compared to male farmers, women cultivate smaller areas with a lower soil fertility, and have less household labour at their disposal. Women apply household refuse and ash to their fields, as men seldom carry out transport activities. Next to the staple crop maize, they also have a preference for cow pea, groundnut and cassava in their rotation plan. Young men tend to migrate on a seasonal or permanent basis, or start as a labourer (often on fields of women) and rent or lease a piece of land.

Development practitioners presumably are more effective if they join *adokpo* groups who are evaluating the oil palm system in their own terms. The history of Adja farming indicates that old farming practices will be replaced by new ones which Adja farmers are already discussing, testing, selecting and researching. The way they define their situation and give meaning to it seems a logical starting point for development practitioners. They may start with those *adokpo* groups who represent vulnerable groups in Adja society, like farmers forced to shorten the life-cycle of oil palm fallow and female farmers who look for intensive farming systems on small fields.

The need to leave initiatives with rural people and enhance their creative capacity argues against interventions that are too inflexible. The ideas of development practitioners are better not imposed upon rural people, but presented as problems which need further critical attention. When a new technology seems potentially interesting, it will be necessary to elaborate on the reasons for adopting it, and its relation to other aspects of rural people's society (cf. 7.2.2).

Chapter 7 concluded that researchers may be able to sustain ongoing Adja experiments by elaborating on a broader set of methodologies for interactive learning activities. Various writers argue that there are good arguments for shifting the emphasis towards greater mobilisation of indigenous skills and initiatives (cf. Richards, 1985: 159; Fairhead, 1992; Scoones & Thompson, 1992). The

results of the present research also argue in favour of replacing interventionist models of a *technology fix* with cooperative models in which development practitioners try to join rural people's knowledge processes. Whilst conceptualising rural people's knowledge as being multidimensional, fragmentated and diverse, with various networks involved inside as well as outside rural people's communities, 'interventions' might better be seen as encounters during which knowledge is negotiated and constructed (Scoones & Thompson, 1992: 7). In this process externally generated knowledge can be offered in an open way, open for re-conceptualisation. The initiative with respect to what should constitute the research agenda, and to how planning and evaluation should be done, is better taken in close collaboration with rural people. To enable them to do so, researchers could elaborate a broader set of methodologies for interactive and shared learning. Adaptive research performances of farmers might be enhanced by scientists who visit farmers in their fields and who try to join their discussion on the different performances. The ability of researchers to enlarge their discursive analysis with a view to practical activities as applied by farmers, seems an important prerequisite for fruitful collaboration. After an understanding of practical problems is received via a shared definition of the situation, development of technologies might be realised together with farmers. By operating in this manner, interdisciplinarity is enhanced as each discipline has to understand its field in reality as experienced by rural people. Interdisciplinarity is also enhanced as a representative of a discipline has to explain to members of other disciplines how the own discipline is handled by farmers. Thus, rural people's knowledge strengthens interdisciplinarity because it provides a logical framework for disciplines to collaborate.

Rural people's practices may hypothetically be regarded as a reasonably well developed way of dealing with agriculture. Whilst accepting this, mutual trust and frequent contact, which are essential for constructive collaboration, can be reached between development practitioners and farmers. Thus a forum can be created in which farmers can exchange ideas with each other and become more confident in what they know. In the process, development pratitioners might share their knowledge and views, not as technology presented to be 'adopted', but as knowledge to be discussed and possibly tried, in the event of there being a potential interest or need.

However, this approach asks for new attitudes from development practitioners. As Bourdieu (1991: 109, adapted) argues, the stylistic features which characterise the language of (...) all institutions, like routine action, stereotyping and neutralisation, all stem from the position occupied in a competitive field by these persons entrusted with delegated authority. Actors mobilise themselves through their way of representation via classifying and theorising. Unfortunately, development practitioners will often still see their knowledge and viewpoints as more valuable compared to those of rural people, and consensus is unlikely to be achieved without struggle. Likewise, Funtowicz and Ravetz argue (1990a: 21-2) 'Judgments of cognitive uncertainty will inevitably be influenced

by the particular agendas of the actors; and functional quality even more directly so. Hence the tasks of achieving any measure of consensus amongst all sides, even on what may seem narrowly technical questions, can become quite problematic. In the context of policy debates, where decisions may be urgent and powerful interests may be motivated by totally non-cognitive concerns, the inconclusiveness of scientific debates may come to endanger the whole process of broader participation in policy-making'.

Richards (1985) argues that successful rural development depends on inventive self-reliance, enabling farmers to make changes themselves. When Daane and Mongbo (1991) critically evaluated the socio-economic conditions in Benin for development based on farmers' initiatives their basic conclusion at that time was that 'catalysts for collective action' were more or less totally absent. Rural people's knowledge might be a catalyst, if recognised as a legitimate source for empowerment. The present research indicates that Adja farmers have a rich body of knowledge related to agriculture which seems a logical catalyst for development practitioners who seek to join Adja farmers in their efforts to define their situation and decide on actions. The Adja have found solutions for sustainability problems, which scientists have not come across until recently.

The results of the present study indicate that further research on Adja agricultural knowledge seems necessary. One issue is soil fertility in relation to soil life. With regard to the conditions found on the Adja plateau, the management of soil fertility would seem to be better served by paying attention to soil life, than to chemical fertilizer. A second issue is *inter*-field soil fertility management and the role of oil palm as planted fallow. More detailed study and quantification is required to understand the oil palm system. Finally, further elaboration on methods for effective collaboration of development practitioners with farmers would be welcome.

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Samenvatting

Dit proefschrift handelt over kennis van de rurale bevolking in relatie met achteruitgaande bodemvruchtbaarheid en toenemende bevolkingsdruk. Met name is bestudeerd hoe boeren in regen-afhankelijke tropische landbouw zelf reageren als de landhoeveelheid per boer afneemt. Informatie over wat er in dergelijke situaties gebeurt is afkomstig uit een case studie verricht bij een etnische groep die zich in deze situatie bevindt: de Adja, bewoners van het Adja plateau in Zuid-West Bénin (West Afrika).

Het eerste hoofdstuk kijkt naar regen-afhankelijke landbouw in tropische gebieden waar boeren met achteruitgaande bodemvruchtbaarheid worden geconfronteerd. Landbouwkundig onderzoek en voorlichting heeft tot nu toe weinig bruikbare technische alternatieven aangedragen voor deze categorie boeren. Het hoofdstuk beschouwt hoe zijzelf met hun situatie om gaan. Hun kennis, alsmede hoe die kennis tot stand kwam en weer verandert, lijken nog onvoldoende bekend. Het proefschrift tracht weer te geven hoe Adja boeren bevolkingsdruk ervaren en erop reageren, welke kennis zij hierbij gebruiken en welke leerprocessen resulteerden in die kennis.

Het tweede hoofdstuk geeft het theoretisch perspectief voor dit onderzoek. Een analyse van de verhouding tussen onderzoeker en rurale bevolking wordt gegeven, evenals een systeem perspectief op –, en conceptualisering van boerenkennis en gerelateerde onderwerpen. Boerenkennis wordt in deze studie gezien als de reconstructie van (tijdgebonden) kennis door zowel boeren als onderzoeker in een dialogisch proces. Drie niveaus van boerenkennis onderzoek worden onderscheiden: (1) boerenkennis 'produkten', (2) de verwevenheid van boerenkennis met sociale factoren, en (3) de zingevende activiteiten die resulteerden in boerenkennis.

In het derde hoofdstuk wordt de onderzoeksmethode gegeven voor de beoogde onderzoeksdoelen. Speciale aandacht krijgt de methodiek van onderzoek dat zich richt op boerenkennis en de rol van de onderzoeker.

Hoofdstuk vier geeft een algemene introductie van het Adja plateau en zijn bewoners, ook gezien vanuit het classificatie standpunt van de Adja. De landbouwkundige en ecologische condities op het plateau, de sociaal-culturele organisatie van de Adja, en de historie van het plateau worden beschreven. De complexiteit van de Adja-landbouw is één manier waarmee de vele risico's zijn beantwoord. Adja boeren gebruiken verschillende elementen van hun omgeving om landbouwactiviteiten te organiseren. De historische ontwikkeling van de Adja-landbouw schetst de voortdurende veranderingen in landbouwpraktijken, wat een dynamisch beeld geeft van de Adja-landbouw. Pogingen van landbouwkundig onderzoek om een antwoord te vinden op de achteruitgaande bodemvruchtbaarheid waren tot nu toe weinig succesvol.

Hoofdstuk vijf presenteert en analyseert het Adja agro-forestry systeem, gebaseerd op de oliepalm, dat in grote lijnen de problemen beantwoordde, die veroorzaakt waren door de bevolkingstoename. Het systeem geeft belangrijke hoeveelheden *in situ* geproduceerde biomassa, terwijl de oliepalm gelijkertijd verweven is in de Adja-landbouw. Het hoofdstuk geeft ook de Adja conceptualisering van bodemvruchtbaarheid, naast een nutrientenanalyse van de consequenties van het oliepalm systeem op de bodemvruchtbaarheid. Adja boeren benadrukken het belang van bodemleven en organisch materiaal, hetgeen ook volgt uit de bodemanalyse.

In hoofdstuk zes volgt een weergave van het effect van variabele bevolkingsdruk en bodemvruchtbaarheid op activiteiten en kennis van boeren. Oliepalm wordt intensiever geteeld in de dicht bevolkte gebieden: grotere dichtheid, kortere cyclus, meer gemengde teelt met andere gewassen en vaker gesnoeid. Daar waar het oliepalm systeem onder druk komt, trachten boeren de gemengde teelt met eenjarige gewassen te verlengen, door palmen meer te snoeien en eerder te kappen. Intensivering en diversificatie van de landbouw vindt plaats in de meer bevolkte gebieden. Daarnaast zijn in dit gebied verscheidene aspecten van het sociale leven (zoals religie, off-farm werk, migratie, handel, wetgeving) meer dynamisch en divers, vergeleken met gebieden waar meer land per caput voorhanden is. Leiderschapsmodellen worden meer gevarieerd, vergeleken met vroeger. Naast oudere mannen, omvatten zij nu ook ondernemende of opgeleide jongeren, en mannen zowel als vrouwen. De opkomst van vrouwen, die een aanzienlijke commerciële vrijheid hebben, kleine stukken land beginnen te kopen, en vaker dan mannen landarbeiders huren, is ten dele te verklaren door migratie van mannen en individualisering van de Adja-cultuur.

Om te begrijpen waarom boeren handelen zoals zij doen, dient men een perspectief te nemen uitgaande van hun kennis, waarden en ideeën. Gebruik makende van de Adja kennis gepresenteerd in eerdere hoofdstukken, tracht hoofdstuk zeven het Adja perspectief te begrijpen door Adja zingevingsactiviteiten te bestuderen zoals leren, transformatie van externe kennis, classificeren, en het maken en gebruiken van theorieën. Verschillende voorbeelden laten zien dat het leren van Adja boeren onlosmakelijk verbonden is met actie. Een individuele constante aandacht voor mogelijke verbeteringen is aanwezig in de dagelijkse praktijk. Resultaten van experimenten worden alleen gedeeld, geïnterpreteerd en bediscussieerd in kleine groepen. Contacten onderling van deze groepen vinden plaats in specifieke sociale en plaatsgebonden contexten. Externe technologieën worden getransformeerd en gecombineerd met sociale, economische, politieke en andere factoren, resulterend in een geïntegreerd deel van de Adja-landbouw. De variabiliteit tussen Adja boeren onderling is een indicatie voor de capaciteit om op individueel – of groepsniveau de potentiële waarde te bepalen van een nieuwe methode of techniek. In de dichtbevolkste gebieden resulteren nieuwe verhoudingen en netwerken in een culturele identiteit gecombineerd met een dynamisch perspectief.

Tenslotte wordt in het laatste hoofdstuk geconcludeerd dat Adja boeren een rijk geheel bezitten van landbouwkennis. Hun landbouwkennis is echter sterk

gerelateerd aan andere domeinen van het leven (bijv. religie, sociale strijd en diversiteit, toegang tot middelen, migratie). Ook is hun kennis niet statisch, maar continu in verandering. Geconcludeerd wordt dat onderzoekers in staat zouden kunnen zijn om lopende Adja experimenten te ondersteunen, indien zij een breder kader van methodieken ontwikkelen voor interactief leren tussen onderzoekers en boeren. Adaptieve onderzoeksprestaties van boeren zouden kunnen worden versterkt door onderzoekers, wanneer zij boeren bezoeken in hun velden en trachten aan te sluiten bij hun discussie. Voor vruchtbare samenwerking lijkt het een voorwaarde dat onderzoekers hun discursieve analyse verbreden met een visie op praktische activiteiten, zoals uitgevoerd door boeren. Daarnaast zouden adaptieve activiteiten van boeren beter kunnen worden begrepen en bediscussieerd door onderzoekers, als zij bereid zijn ook andere dimensies te respecteren dan alleen landbouw.

Curriculum vitae

Johannes Hendricus Antonius Maria Brouwers was born in 's-Hertogenbosch on November 20th, 1958. In 1977 he completed the Athenæum-B at the Augustinianum College in Eindhoven. In June 1987, he obtained his M.Sc. in Tropical Crop Husbandry from Wageningen Agricultural University. During his studies he stayed fifteen months in Peru for his practical work, acted as a teaching assistant for ten WAU courses and worked for two years part-time at the Institute for Applied Extension.

From December 1987 till January 1992, he worked in an inter-university project between WAU and the Beninese National University, as a representative of WAU's Department of Communication and Innovation Studies. Major tasks involved curriculum development and research. From January 1992 onwards, he worked on the present dissertation, as well as on two articles and a French extension handbook, the articles and handbook being written together with other authors. At the time of completing the dissertation, he was preparing for new employment in which he hoped to join teams of farmers, researchers, extensionists and policy makers, all engaged in shared learning based on farmers' knowledge.

Annex 1: Fictitious names of the Adja farmers in the three research villages who collaborated in the research, their relative wealth (village index: Rich (R), Medium (M), Poor (P)), sex, and age. (Note: age of older people is not always exact.)

Adidévo (low)

Yabavi Koukoui (M, ♀, 30)	second wife, has 2 young children
Mahouna Kouami (R, ♀, 36)	single wife, 3 children, often involved in trade
Abla Edouh (P, ♀, 38)	single wife, 6 children
Sokanhoué Édah (M, ♀, 50)	first wife, 1 co-wife, 7 children
Guidrohoué Koudoha (R, ♀, 65)	first wife, 1 co-wife, only woman who owns palm groves
Houéssou Dansou (R, ♂, 55)	rich, 2 wives, often experimenting in agriculture
Dhehonou Houdégla (M. ♂, 30)	Just married, 1 child
Codjo Soaké (P, ♂, 45)	1 wife, 4 children
Noumoni Djossou (M, ♂, 60)	2 wives, 8 children
Viagbo Anato (M, ♂, 34)	1 wife, 3 children
Besanh Goufondé (P, ♂, 24)	not married, does not own land
Sogandji Tohoun (P, ♂, 26)	1 wife, no children

Kokohoué (medium)

Yato Kossi (R, ♀, 47)	first wife, 1 co-wife, 4 children; grows often cotton and other cash crops
Djodéva Katounon (M, ♀, 42)	1 younger co-wife, 3 children
Jeanne Kossivi (M, ♀, 32)	married, no co-wives, 2 children
Modigui Thihoundro (P, ♀, 52)	married, no co-wives
Koffi Senou (R, ♂, 35)	2 wives, 3 children
Kossivi Dolo (M, ♂, 38)	1 wife, 4 children
Kétodji Fangbé (R, ♂, 60)	3 wives, 10 children, owns several oil palm groves
Tchihounké Djaho (M, ♂, 60)	1 wife, 4 children
N'Sougan Danhounsi (P, ♂, 56)	1 wife, 5 children. First who started with organic manuring in the village
Elavagnon Téclé (P, ♂, 52)	1 wife, 3 children
Tamichin Edouh (P, ♂, 30)	1 wife, 3 children. Cassava expert
Kossi Djaho (M, ♂, 26)	married, 2 children, migrates seasonally

Allada (high)

Tokindé Chiba (P, ♀, 32)	no co-wives, 3 children, husband active in off-farm work
Yéyévi Tolochi (P, ♀, 50)	1 younger co-wife, 8 children
Vidéva Sosoukpohou (R, ♀, 42)	1 older co-wife, 4 children
Rosa Bodji (R, ♀, 34)	no co-wives, 3 young children
Dhossou Bodji (P, ♂, 58)	unmarried
Koffi Missihoun (R, ♂, 61)	3 wives, 9 children. Influential feticheur, owns several oil palm groves
Gbossouvi Djahou (M, ♂, 64)	his 2 wives died, lives with one of his 8 children. Still very active in agriculture
Mahouna Tébou (P, ♂, 56)	2 wives, of whom 1 left him, 7 children
Nouhoumon Ehou (M, ♂, 38)	1 wife, 5 children
Daniel Dolo (M, ♂, 24)	not married, migrates seasonally
Claude Djokpo (P, ♂ 26)	not married, without land
Victorin Souhou (P, ♂, 23)	not married, without land

Annex 2: Adja words

aboho: land surface unit (400 m^2)
Adja-Chikpi: small group within the Adja on the Adja plateau
Adja-Dogbo: large group within the Adja on the Adja plateau
Adja-Ehoué: large group within the Adja on the Adja plateau
adjitèbo: gri-gri to augment soil fertility
adokpeton: triangular planting or sowing
adokpo (or ekwikplankplan): experiment ('try to learn')
adyotou (or oyo): board game
agblen: cultivate/use the hoe
ahouegoudou: fields 'at the back of the house'
ahwevi: herb
akassa: flour made of processed maize
amejro: crop
avesou: natural fallow ('big forest')
bafo: maize
bakabaka: mixed cropping
ballohoui: Harmattan wind during the long dry season in December-January
bè: leaf
bo: field

bogbudi: small oil palms
bokonon (or: feticheur): person who functions as an intermediary with a voodoo
dégbézoui: cassava fallow
dékan: oil palm grove
dema: land lease system called 'sharing the oil palm'
efidodo: communal working
ekwikplankplan (or adokpo): experiment ('try to learn')
eli: long rainy season
engraisbè: fertilizer leaves
eza: group of stars (probably the pleiades)
ezavouvouato: wind that indicates the arrival of the 'eza stars'
ezo: small rainy season
fa: system of divination
feticheur (or: bokonon): person who functions as an intermediary with a *voodoo*
gari: flour made of processed cassava
gnigban: soil
gnigban kpokpo: 'tired' soil (with low fertility)
gnigban zozou: 'hot' soil (with good fertility)
gri-gri: magical device for one's well-being or to put a spell on somebody else
hennou: patri-linage
houé: household
houinhouin (or vitamin): deposit of composting vegetative material
katchi: landsurface unit (570 m^2)
katchito: agricultural labourer
komê: clay
koutou: cassava
Mawu: animist God
noukplo: collected refuse (used to fertilize the soil)
oyo (or adyotou): board game
shika: gold
sodabi: distillate made of processed palm wine
tagba: mono cropping
tapioca: processed cassava
vitamin (or houinhouin): deposit of composting vegetative material
voodoo: spirit
yovo: white person

Annex 3: Methodology of soil sampling and analysis

Samples were collected, in collaboration with the RAMR project, from the top-soil (0-20 cm) of *terre de barre* on the Adja-Plateau. Each sample represents a mixture of 10 sub-samples. Sites sampled included 4 fields, that were under permanent cultivation for periods over 12 years, and 6 oil palm groves of varying age (see Table 5.3).

Soil samples were analysed at the CENAP (Centre National d'Agropédologie) at Calavi-Abomey, near Cotonou, Republic of Benin.

- The clay percentage has been determined after destruction of the sample using hydrogen-peroxide.
- Organic matter has been oxidised (Method Walkley-Black) using a mixture of potassium-bichromate and sulphuric-acid. Following oxidation the excess potassium-bichromate is titrated with ammonium ferro-sulphate.
- Total N is determined using Kjehldal.
- Total P is extracted with a combination of nitric- and perchloric-acid.
- Exchangeable bases are extracted through percolation by neutral ammonium-acetate. K is quantified by flame-photometer, while Ca and Mg are determined spectrometrically (atomic absorption).

Annex 4: Plants used by farmers as indicators for agricultural measures.

scientific name	Adja name
Cholorophora excelsa	Loko
Cochlospermum planchoni	Agbonékoun
Dialium guineense	Tôtouê
Millettia thonningii	Tchiti
Parkia biglobosa	Ewa
Pennisetum violaceum	Avouchiké
Spathodea campanulata	Dada

Annex 5: Varieties of 9 crops as identified by Adja farmers
(Source: Dangbégnon C, Brouwers JHAM 1991c *Systèmes de classification paysans des sols, variétés de plantes cultivées, composantes du climat, maladies et parasites des cultures sur le plateau Adja (Bénin)*. Faculté des Sciences Agronomiques, Cotonou)

Capsicum pepper (yébési)
adôlôgbô, efanbési, gbohoungodoui, gbôssoungo, tchannouyébési, yébésiahoué, yébésiwliwli

Cassava (koutou)
agnikidi, akla ('cassava coming from Accra'), atchiyi ('white petioles'), atchiyou ('black petioles'), awonlikoutou, digawouboto ('higher than the owner'), djakplé, doazannoufinto ('fix a date to satisfy the creditor'), dohoué, fintonongbadji ('creditor wait for me'), gbézékoutou (variety coming from Gbézé), ghanakoutou ('cassava from Ghana'), globokoutou (has the form of 'globo'), gnonhouté, hadoukla, hlakpété, houngbassé, houla, kanlikoutou, kanyitémê ('easy to process after boiling'), kôflounwa, kondodoukou ('go to the field, eat and die'; also named awonlikoutou, Awonli is a village in Nigeria), koutou-akpayi ('tuber

with white color'), kpindévi, lébékpé, lokossa ('cassava from Lokossa'; Lokossa is the provincial capital)

Cow pea (agnou)
agnoudjon, agnouhoui, azagnou, botôgbohoungboé, damadami, djagnou, djahikpô, eguégogo (also named société), gbôkpôbo, gbôlékpomê, hounlétchivé, katché, klouékanmégnou, kpodjiguédé, sévérine, séwlévô, sokoto, vitamine, vounonhognou, '55' ('a variety which gives 55 pulses')

Groundnut (azin)
azibgan ('groundnut of our ancestors'), azindjon, botobi, tonnon

Maize (bafo)
akpayigbô, bafogbali, bogan, carderbafo (also named gogolékomé), djakpé, djongbo, gbahouê, gbogboui, houlétchivé, koungblaha, tala, tokpoué, yaou, yovobafokoun

Oil palm (edé)
edé, fandi, sédi

Okra (fétri)
aklafétri ('okra from Accra'), didamandji, efanfétri, ehoué, ewli, fétribali, gbotrou, gohoudidi (also named godidi), gogolékômé, hli, hotoui-hotoui, houétan, houizo, houlétchivé, kéyanou, kpaké

Pigeon pea (ekloui)
houédénou, houlétchiton, kpéhounguéli

Tomato (yovogbo)
afingbo, ahogbo, gbotouli, kponmi, montokoun, sodatchou, tohounvi

Annex 6: Wild plants considered useful by the Adja
[Note: only a selection is given of weeds considered useful by Adja farmers. For more detail: cf. Dangbégnon C, Brouwers JHAM (1991b) '*Les feuilles font beaucoup de travaux'. Connaissances floristiques endogènes sur le plateau Adja (Bénin)*. Faculté des Sciences Agronomiques, Cotonou. Flora used: Hutchinson J, Dalziel JM, Hepper 1954-1972 (Vol I-III) *Flora of West Africa*. Whitefriars Press, London; and De Souza S 1988 *Flore du Bénin*. (Tome 3) Imprimerie Notre-Dame, Cotonou.]

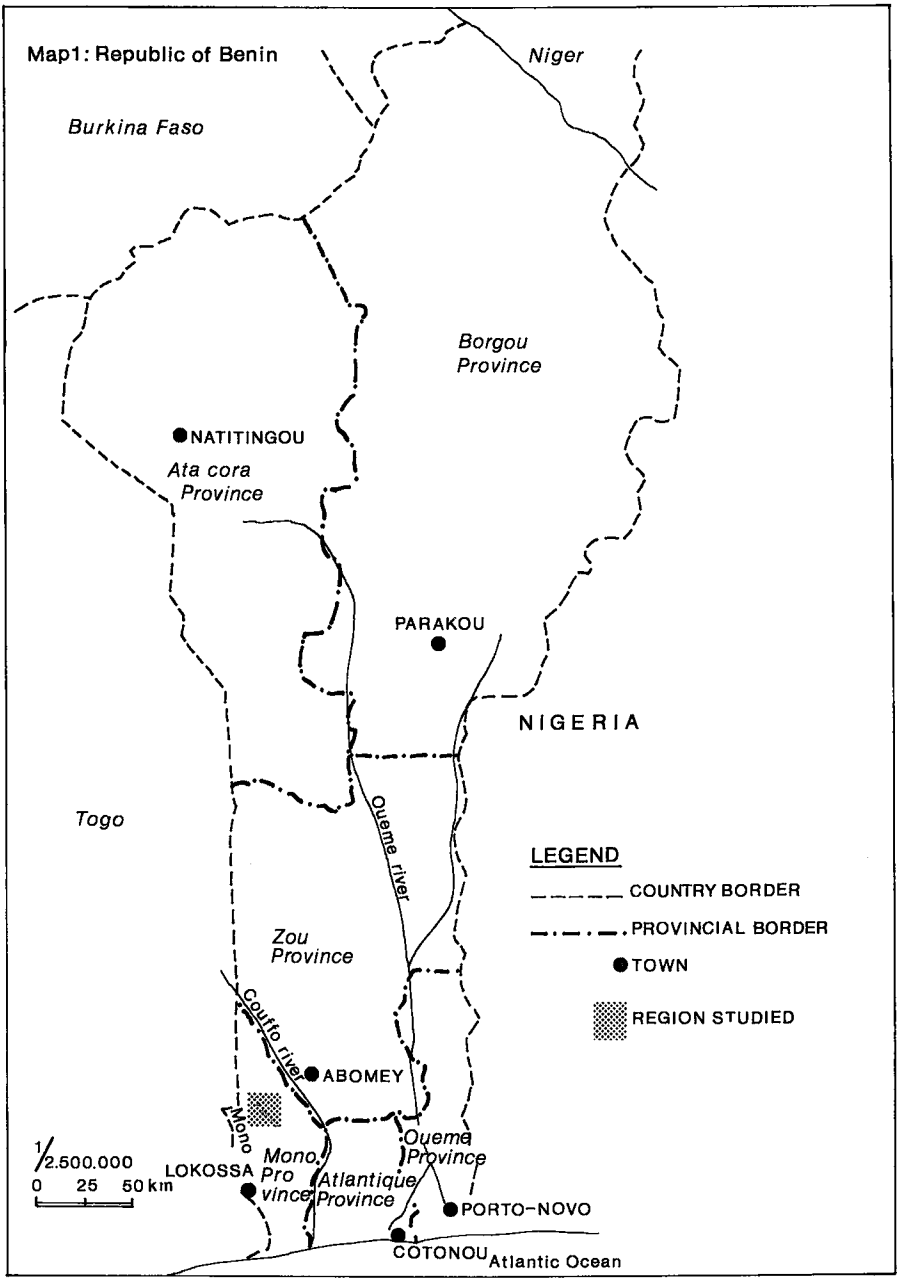
Legend:

a: noxious plant
b: indicator of high soil fertility
c: indicator of low soil fertility
d: plant used to gear agricultural activities
e: plant used for seed storing
f: vegetable
g: fodder
h: plant used for medicinal purposes
i: plant used for magical or religeous purposes
j: plant used as pesticide

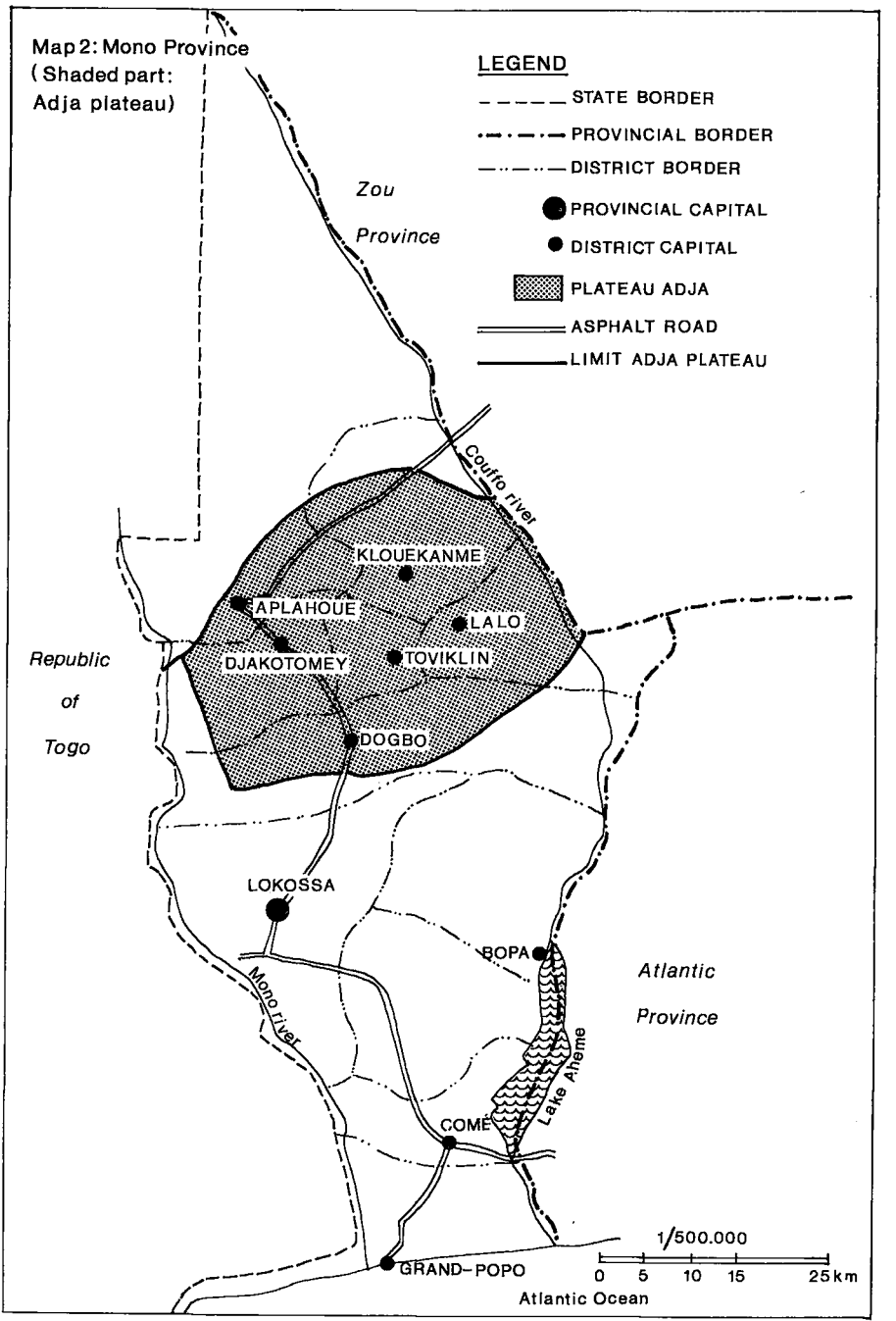
Scientific name	Adja name and use
Abrus precatorius	Djindjinkidjin h
Abutilon mauritianum	Tabazitchi h
Acacia pennata	Awan a, b
Acanthospermum hispidum	Kloklogoui h
Adansonia digitata	Lagba f
Aeschynomene indica	Chchivématcha i
Ageratum conyzoides	Shikagbé a, b
Albizia zygia	Jiwa a
Alchornea cordifolia	Touvouman f,h,i
Allophyllus africanus	Atchiabaton f
Alternanthera sessilis	Gomi a, f
Amaranthus hybridus	Kaya f
Amaranthus spinosus	Chivégbé g
Amarenus phyllanthus	Ahoun h, i
Aneilema aequinoctiale	Gblétomakoui a
Azadirachta indica	Saboulagbé e, j
Blumea aurita	Avouchiké a, h
Bombax brevicuspe	Kpatchadéhoui h
Bridelia ferruginea	Ehonman e, h
Byrsocarpus coccineus	Shitogboui c, h
Calopogonium mucunoides	Kpassahon b
Canthium horizontale	Logbo h
Cassia hirsuta	Laloui-assoutô e, h
Celosia argentea	Sôman f
Chlorophora excelsa	Loko d
Citrus sinensis	N'tchi j
Cochlospermum planchoni	Agbonékoun d, h
Commelina spp.	Botômakoui a, c
Cyperus rotundus	Efiôgbé a, c, g
Desmodium ramosissimum	Zéna-ali i
Dialium guineense	Tôtouê d, f, h
Digitaria horizontalis	Ekoui a, c, g
Dracaena arborea	Agnan g, i, j

Elaeis guineensis	Baya e, g
E. guineensis var. idolatrica	Fandi i
E. guineensis var. virescens	Sedi i
Ehretia cymosa	Zonmali h
Erythrina senegalensis	Ahouitchi g
Euphorbia hirta	Anôshigbé h, i
Fagara zanthoxyloides	Ehé e, g
Grewia lasiodiscus	Hanlangogoui a, b, g
Imperata cylindrica	Ebé a, e, g
Ipomoea asarifolia	Aflaman h
Jatropha multifida	Tintouigbé h
Lactuca taraxacifolia	Ontou a, b, f, g
Leucaena leucocephala	Yovocassia g
Lonchocarpus cyanescens	Zounzoun i
Mallotus oppositifolius	Gnantchivi a, b, c, e
Mariscus alternifolius	Ekouitagba a, c, g
Martynia annua	Azizafin i
Melochia corchorifolia	Lonloui f
Millettia thonningii	Tchiti d, h
Momordica charantia	Djouké a, b, h, i
Momordica cissoides	Voyi b, f
Morinda lucida	Tchikiman a, b, g
Moringa oleifera	Kashiman f, h
Newbouldia laevis	Aflaman e, g, h, i
Ocimum canum	Hodjo f, i
Ocimum gratissimum	Gnandodouisu f, h, i
Parkia biglobosa	Ewa d
Pennisetum violaceum	Avouchiké a, d
Phyllanthus amarus	Ahoun h, i
Physalis angulata	Gbantou a, b, h
Piliostigma thonningii	Aklô h
Portulaca quadrifida	Adri a, c
Sida cordifolia	Sodémi f
Solanum nigrum	Egbouê f
Spathodea campanulata	Dada d
Spondias mombin	Koukoman g, h, i

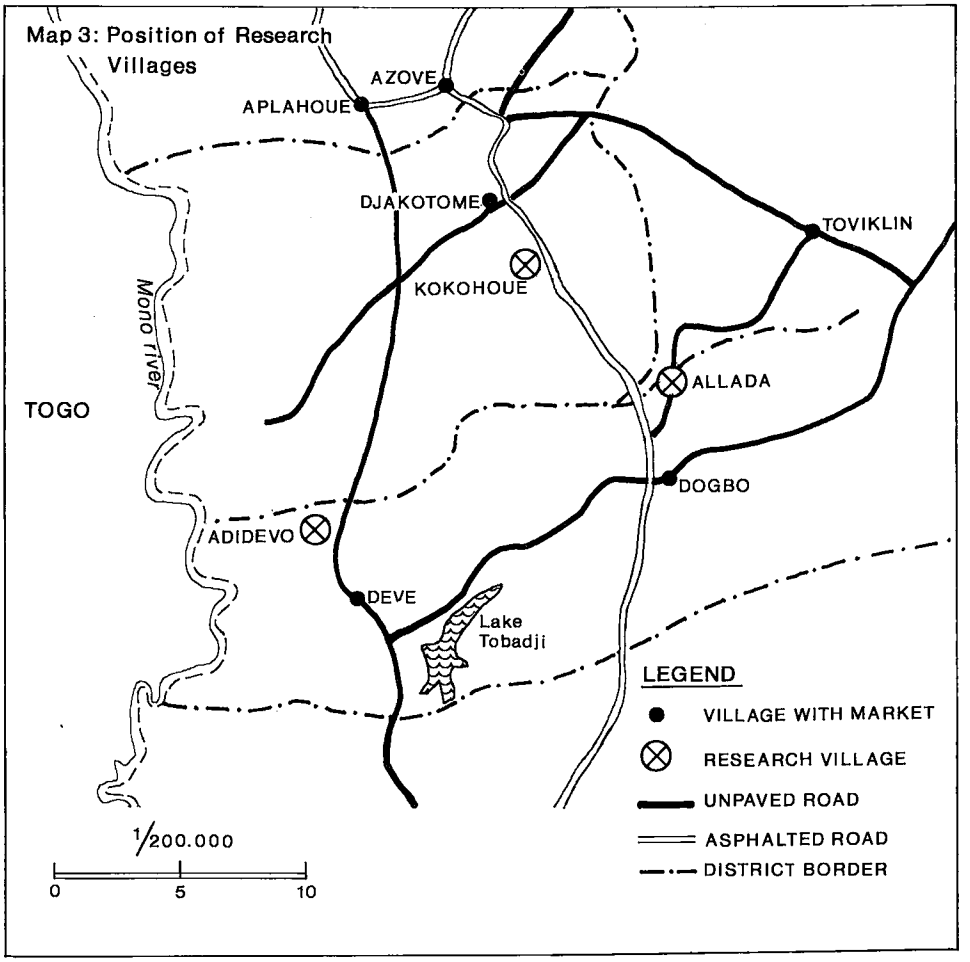
Stachytarpheta cayennensis	Hanlankpokpoui f, h
Talinum triangulare	Glazoui b, f, g
Triumfetta cordifolia	Djaboboui f
Vernonia amygdalina	Loman f
Vernonia cinerea	Hounchikonou h, i
Waltheria indica	Louwatchi h



Annex 7: Maps **Map 1:** Republic of Benin



Map 2: Mono Province



Map 3: Position of research villages