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A future for the Mandara mountains, North Cameroon

Wouter T. de Groot

In cooperation with
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Colophon

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Part 14: A future for the Mandara mountains, North Cameroon

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Contents

Appendices

Preface

This booklet presents the synthesis of the project “Local knowledge and local action in the Mandara mountains, North Cameroon”. The project encompassed the studies of one Dutch and two Cameroonian PhD researchers, which were carried out from 1994-1998. The project was co-funded by the Netherlands-Israel Development Research Programme (NIRP), while fellowships from WOTRO (the Netherlands) and the French government were granted for the work of Zuiderwijk and Hiol Hiol, respectively. What is presented here as the project results refers to all the activities of the researchers, irrespective of their funding source. The emphasis is, however, on policy-relevant issues.

NIRP aims to encourage development-related research focused on socio-economic and cultural change. Being policy-oriented in nature, NIRP aims to make the results of research accessible to anyone interested in solving the problems investigated. The target groups for such knowledge include policy makers, representatives of non-governmental and donor organisations and the scientific community. With this aim in mind, the Publication Board has launched the NIRP Research for Policy Series as a channel for the publication of “user-friendly” summaries of more than 30 scientific reports.

The Publication Board wishes to thank Dr. Mirjam A.F. Ros-Tonen for editing this booklet. Thanks are also due to Howard Turner for revising the English.

Last but not least, the Publication Board wishes to thank the research team for the successful completion of this study. It would like to pay particular tribute to Prof. Dr. A. Rawitz whose tragic death in 1995 was a terrible blow to the project.

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I. General information

I.1 Framework of the study

The Mandara mountains in North Cameroon have one of the world's most complex farming systems supporting up to 200 people per square kilometre in spite of the sandy soils and a semi-arid climate. The Mafa, who constitute the most numerous ethnic group living in the Mandara mountains, have a wealth of agro-ecological knowledge. This knowledge, which is strongly related to their traditional belief system is, however, not static. They adapt their knowledge to changing environmental, demographic, socio-cultural and political-economic conditions by carrying out experiments with new crop varieties, cropping and cultivation techniques and by interacting with outside extension agents.

During the past few decades, a major population redistribution has occurred in the Mandara mountains. Forced by increasing population pressure and land scarcity in the mountains, rising aspirations and a need for cash and attracted by the political stability and the establishment of government services in the lowland region (schools, medical centres), large numbers of mountain dwellers have been migrating to adjacent plains. This out-migration to the plains has been accompanied by changes in the land-use patterns of both the plains and mountains. On the plains, migrants are adopting more extensive farming practices in comparison with the intensive land-use practices in the mountains. These newly adopted farming practices have increased the risk of erosion and degradation of the lowland soils, which are mainly incoherent and sandy. Furthermore, lots of the farmers on the plains appear to be reluctant to make the necessary investments to combat environmental threats.

In the mountains, the out-migration of mostly young people may threaten the very existence of the labour-intensive terrace system. At the same time, commercial cotton growing is rapidly expanding in the mountains, which may lead to soil destruction. Indigenous knowledge may be losing its traditional strength and value, at least in the eyes of many young and cash-oriented farmers, and this process is reinforced by

parastatal and government extension agencies, the technological packages of which often contain elements that are detrimental to the environment.

This study addresses the implications of seasonal out-migration and expanding cotton growing for the viability and sustainability of the local farming system. It is a synthesis of the policy relevant results of three studies which together formed the project "Local knowledge and local action in the Mandara mountains, North Cameroon".

The study area comprises the mountains around Gouzda and the adjacent plain around Koza in the semi-arid North of Cameroon.[1] The Mandara mountains have a long history of settlement and have often provided refuge for people fleeing hostile invaders from the plains, such as the Fulani and the Mandara. As a consequence of its settlement history, the region is one of the most populous of Cameroon.

The Mandara mountains form a chain of deeply dissected hills rising out of the surrounding plains to a maximum height of about 1,500 m. The soils of the region are generally young, sandy and shallow, hence their low fertility and water retention capacity. The rainfall regime of the region is unimodal with rainfall occurring between April and October and with a maximum in July and August. The average rainfall lies between 800 and 1,100 mm per year, but is highly variable and localised. Storm intensities occur of up to 70 mm per hour. Such torrential storms obviously carry a large risk of soil erosion, and very good soil management is required to ensure sufficient infiltration. Even then, the average evapotranspiration rates of 1,750 mm per year indicate that the water availability for crop production is subject to considerable uncertainty.

One of the salient features of the agricultural systems in the Mandara mountains is the use by local farmers of traditional soil and water conservation techniques. Among these are the construction and maintenance of stonewall terraces, stone bunds, channels and wells, as well as the use of biological processes such as agroforestry, composting, mulching, multiple cropping and crop rotation. Local farmers in the Mandara mountains have been implementing these soils and water conservation techniques for generations and have been successful, so far, in maintaining an adequate level of soil fertility.

[1] Intermediate slopes are rare in the area and are not dealt with in this booklet, except for a few references to the work of Hiol Hiol (1999) under the term "foothill". Hence, what is referred to as a "mountain" here is extremely steep, and what is referred to as a "plain" is extremely flat.

I.2 Objectives and research questions

The original research objectives of this study were:

- to gain insight into the dynamics of local knowledge with respect to soil and water conservation in Mafa society and into how this is influenced by external agencies or by male and female farmers themselves;
- to appreciate indigenous agricultural knowledge, *e.g.* by comparing it with current scientific knowledge;
- to answer the question of how this knowledge, together with economic and institutional factors, influences the actual decisions of farmers;
- to test and refine participatory research techniques that will serve the integration of indigenous and scientific knowledge systems, based on cooperation in the field between farmers, scientists and agricultural extension workers.

In line with these objectives, the original research questions focused on the nature and dynamics of indigenous knowledge; the interaction between farmers and extension agents in relation to local soil and water conservation; the present state, effectiveness and efficiency of indigenous soil and water conservation and local decision making in this respect.

In this booklet, the focus is on the long-term and policy relevant aspects of the aforementioned questions related to the complex and terraced mountain-farming system. This system has supported the Mafa for many centuries, up to the present very high population densities. Until recently, this farming system was almost entirely oriented towards family-level autonomous subsistence, supplying each household with a wide variety of products needed for daily life, but almost no cash. As already mentioned, the colonial powers, having pacified the plains and in an effort to bring the Mafa under the wings of civilisation and taxation, started a policy of settlement on the plains. The resulting process of Mafa leaving the mountains has recently been reinforced by the need for cash and services, inciting increasing seasonal migration of mountain dwellers to work in town or agriculture elsewhere. The mountain farming system, however, needs many hands to remain viable. The first policy relevant question is therefore:

1. Will the farming system survive despite the seasonal migration, or will it collapse as has happened elsewhere in the mountains? This question will be addressed in Section II.3.

On the plains adjacent to the mountains, farmers started out with an extensive, fallow-based farming system. The plains are now filling up,

however, and farmers are being forced to reduce their fallow periods and appear to be finding it very difficult to keep up their agricultural income, hence they are forced to work for others or migrate again, to the south. This brings us to the second policy relevant question:

2. Rapid soil degradation is said to be at the root of this, but is this really true? Could a return to the mountains be a viable option for some farmers? This question is the focus of Section II.4.

From approximately 1993 onwards, commercial cotton growing has been a rapidly expanding activity in the mountains. On the one hand, this may be seen as an omen and a threat, because cotton is often a vehicle not only for cash but also for total (fertiliser-based) soil destruction. On the other hand, cotton may be perceived as the great opportunity to bring life and people back to the mountains. This brings us to the third policy relevant question:

3. Will the recent growth in cotton farming in the mountains save or destroy the mountain agriculture? This question is addressed in Section II.5.

I.3 Methodology and elaboration of the research

The three studies that formed part of this project each had their specific scope and design, so there is no uniform methodological path which led to the findings presented in this booklet. Most of the information was gathered through informal and semi-structural interviews, although a wide range of other research methods were used as well. The following is a brief summary of the methodologies used in each study.

Zuiderwijk (1998), who focused on decision making by resource users with regard to labour investments and soil and water conservation and the influence of the way these actors are incorporated into the wider political-economic context, used the following methods:

- *Literature and document review.* Apart from scientific books and articles, a lot of documents and reports from various sources were consulted.
- *Participant observation.* This took place in different contexts and at different locations and provided an opportunity to compare what people say they do with their actual conduct. The participant observation prompted a lot of new questions which were then asked on the spot.
- *Field surveys.* A field survey covering nearly 100 farming households was held in 1993. The households were randomly selected along a transect from Ldama (mountain) to a point north of Koza (plain). This

baseline study was set up with the purpose to collect some basic quantitative information about farms and farmers and to get specific information *(e.g.* on household composition) that could serve as a basis for the labour allocation study. From the survey, 50 households were randomly selected for the labour allocation study. These households were then involved in the repeated surveys in 1994 and 1995.

- *Labour allocation study.* Fifty households which had been selected from the baseline study were visited by Mafa research assistants every eight days for two years (April 1994-April 1996). The aim of this study was to gain an insight into labour-time expenditure. The activities during the day preceding the interview were recorded for each household member.
- *Informal and structural interviews.* Most of the interviews were held with the respondents included in the survey and labour allocation sample, in order to compare qualitative and quantitative data. Topics covered in the interviews included, *inter alia*, farmer decision making on labour allocation, their perceptions of "good farming" *vs.* "bad farming", agricultural technology dynamics and attitudes and conduct with regard to seasonal migration. Non-farmers such as government officials, extension officers, village chiefs, schoolteachers and other key persons were also interviewed.

The focus of Hiol Hiol's study was on the structure and functioning of the cultivated terraces in the Mandara mountains (Hiol Hiol, 1999). With a view to drawing up an inventory of terrace types, he studied the slope angle, distance from houses and their location *viz.* the Koza plain. Terrace structural parameters were defined for each terrace type. These included:

- height and thickness of the terrace wall;
- diameter and shape of stones which made up the terrace wall;
- bench width and slope;
- other physical and biological techniques of soil and water conservation which can be found on the terrace;
- cultivated and non-cultivated plant species found on the terrace;
- a shape index and density of terraces at the hillside; and
- contouring by terraces.

The terrace efficiency was assessed at different spatial levels: the single terrace, the small farm plot, the Wischmeier plot and the small watershed. In the case of single terraces, soil moisture, soil depth and soil organic matter content were determined.

At 32 farmer plots – equally divided over the hillside and the foothills and with a surface of 5 x 20 m each – processes were applied in accordance

with a number of factors. On the hillside, two factors were considered (fertiliser and manure) and in the foothills three factors were used (fertiliser, manure and "W"-shaped soil tillage). Plots on the hillside were planted with millet, intercropped with peanuts, beans, sesame and *oseille de Guinée*. Plots in the foothills were planted with the same crops, except peanuts. On each plot, in addition to observing and measuring the soil water potential, soil moisture, chemical content of the soils, soil surface status and soil micro-topography, weeding and other agricultural practices by local farmers were monitored as well.

Four Wischmeier plots were used on a 30-34% slope to measure water runoff and soil loss. A Wischmeier plot is part of a slope, usually with a surface area of 100 m^2, which has been separated from the rest of the slope by low concrete walls, at the downstream side of which runoff water and washed-out soil are collected for measurement. Three of the selected terraces were terraced and planted the Mafa way with peanuts, sorghum, and *oseille de Guinée* and treated with manure and chemical fertiliser. They were compared with an 8-year-old fallow plot and a plot being farmed according to traditional practices. On each of the four Wischmeier plots runoff water, eroded soil, water potential, chemical soil content, rainfall and agricultural yields were measured.

In addition to the terrace study, Hiol Hiol sought to acquire sound knowledge of the physical environment by making a general description of soils, topography, climate, farming and soil and water techniques.

Ndoum Mbeyo'o (2001) focused on rural people's knowledge and how this was influenced by the farmer's home location and the frequency of contacts with outside extension agencies. To this end, he investigated five groups: the "isolated" farmers in the mountains, the "isolated" farmers on the plains, the non-isolated farmers in the mountains, the non-isolated farmers on the plains and the outsider extension agents that worked in the study area. He conducted structured interviews with 97 Mafa farmers from households selected along a transect from Ldama in the mountains to Koza on the plains. Topics addressed in the interviews concerned, *inter alia*, their level of traditional agro-ecological knowledge and the transfer of that knowledge. This level of knowledge was operationalised as the percentage of correct answers in the identification (in the local language) of soil types and a total of 17 plant species and the reported level of mastery of various soil and water conservation techniques (see Section II.2). Per selected household one adult male or female farmer and one young male or female farmer were interviewed.

Semi-structured in-depth interviews were held involving 17 of the most knowledgeable respondents from each group (mountain/plain, isolated/non-isolated, old/young) in order to collect qualitative information regarding Mafa traditional knowledge.

Structured interviews were also held with 42 mountain cotton farmers (all mountain cotton growers who could be located and identified as such during the fieldwork period) and 30 farmers from households which hosted the agronomic experiments carried out by Hiol Hiol (1999). Some informants were monitored within the framework of a participant observation.

All extension agents – both field workers and administrators – who were active in the study area and whose identity could be established were interviewed. This resulted in an opportunity sample of 55 respondents. A series of three semi-structured follow-up interviews were held with 20 chief executives of the extension agencies. Participant observation was also conducted in order to gain insight into the cultural interface between farmers and external agencies.

Other data collection techniques used included direct field observations and literature reviews for the collection of secondary data.

I.4 Theoretical orientation

I.4.1 Incorporation and sustainability[2]

The basic concepts in the study by Zuiderwijk (1998) are sustainable agriculture and incorporation. Regarding the first concept, Zuiderwijk takes as a starting point the definition of Reijntjes *et al.* (1992: 2), *i.e.* "the ability to maintain agricultural production through the maintenance of the agricultural resource base." He argues that traditional (or non-incorporated) agriculture has several structural features that tend to make it sustainable, such as occupational and biological diversity, dependence on fixed and limited internal resources, use-oriented production, an holistic and long-term view of the farm labour process (whereby the farmer takes local conditions, the past and the future into account) and high-quality type of labour. Together, these interrelated features are assumed to contribute to a high level of technical efficiency and – indeed – agricultural sustainability.

[2] This section is a condensed summary of the theoretical background of Zuiderwijk's study. For more details on the basic theoretical notions the reader is referred to the Chapters 1-2 of Zuiderwijk (1998).

This also applies to traditional Mafa agriculture. The Mafa use specific natural resource management techniques (especially soil and water management and biomass management) to facilitate the permanent and intensive use of the available natural resources. Traditional Mafa farming was – and largely still is – subsistence farming, based on a high-quality type of labour. Diversity is a resource in itself, the objectives of which are risk aversion, securing a diversified food supply and balancing time and labour demands. The importance of functional diversity materialises, for example, in the cultivation of multiple varieties of the major crops and in the cultivation of so-called "minor crops". At the occupational level, functional diversity means that people are not only agriculturists, but also hunters, gatherers, cattle raisers, craftsmen, etc.

The introduction of cotton farming caused some of these structural features to change and this brings us to the second basic concept in Zuiderwijk's study, *i.e.* incorporation. Galjart (1986) defines this as "a process whereby lower level systems *(e.g.* households, communities) become included in higher level systems" *(e.g.* markets and states). Usually, there is a distinction between market/economic incorporation and political incorporation. In the case of Mafa farming, the introduction of cotton cultivation meant that the farmers became integrated in external markets and an externally commanded industrialised production process.

At a higher level of abstraction, incorporation is a process of functional disintegration and reintegration; a transfer of functions which involves the restructuring of the direction, nature and content of social relationships *(e.g.* the introduction of paid labour and rented plots and dependence on the Cotton Development Corporation of Cameroon (SODECOTON) which supplies inputs and buys the product). The incorporation process implies functional specialisation, an increasing division of labour, and externalisation, *i.e.* the delegation of production and reproduction functions to external bodies (Long, 1986: 4). Other processes that are linked to processes of incorporation are:

- commoditisation, *i.e.* the process whereby exchange value comes to play an increasingly central role in the economy (Box, 1986: 100);
- horizontal concentration (the swallowing up of smaller firms by larger firms) and vertical concentration/integration (the merging of firms upstream and downstream in the product chain);
- standardisation of production processes and the associated increase in prescription and specification of quality standards for inputs and outputs;
- industrialisation or mechanisation and automation;
- scientification or the systematic and ongoing remodelling of productive activities along the lines of scientific design (Van der Ploeg, 1986).

As a consequence of all these associated processes, incorporation is also partly a process of destruction. It implies the elimination of subsistence farming, handicrafts, domestic activities and other activities which render lower level social systems such as households or local communities relatively autarchic (Hopkins and Wallerstein, 1982).

Incorporation, however, also involves integration, alongside disintegration. It involves deskilling and reskilling, decreasing internal dependence and increasing external dependence. It also means that the welfare of individuals is increasingly shaped by external institutions. Institutions like households may take on new forms and functions which are more in line with the requirements of functional specialisation (Wallerstein, 1984).

Several aspects of Mafa agriculture appear to fall outside this general image of incorporation. Others, however, do not. One major element in this respect is cotton cultivation (see Section II.5) that is characterised mainly by external prescription, standardisation and simplification. Seasonal migration, through which farmers become involved as labourers in the market economy, is another. Thus, farmers may become disconnected from the ecological knowledge and rationality of sustainable subsistence farming (Van der Ploeg, 1992: 21), and incorporation may lie at the root of loss of agro-ecological knowledge (Section II.3).

When looking at the effects of incorporation on natural resource use and management, the concept of the farm labour process appears to be central. Farm labour is the interaction between the direct producer, his objects of labour and his means (Van der Ploeg, 1990). The farm labour process is the link between the social organisation of production and natural resource use and management. Through the farm labour process, commoditisation and institutional incorporation are translated into new modes of natural resource use and management.

Zuiderwijk argues that studies on the impact of incorporation on agriculture should acknowledge the historical and locality-specific nature of the incorporation process and the role of intermediate and cultural factors. In the Mafa case, it should be acknowledged that the process by which they became incorporated has its own particularities. One striking particularity is the role of non-market institutions and mechanisms in shaping the farm labour process. This is related to the historical role that colonial and post-colonial states have played in agricultural development and incorporation in North Cameroon.

Another one is the interaction between migration and incorporation processes. The fact that incorporation took place in a kind of frontier

society (the plains), where physical, institutional and economic parameters were completely different from those which prevailed in the mountains and from those which are characteristic for smallholder agriculture, affected the impact in the incorporation process on the farm labour process in a number of different ways.

A third particularity is that the Mafa, by starting to cultivate cotton, made a direct leap from subsistence to dependent agriculture, thereby skipping the phase that Bolhuis and Van der Ploeg (1985) call "independent" agriculture.

I.4.2 Rural people's knowledge and soil and water conservation techniques[3]

As has already been stated, the introduction of science-based technology is an aspect of incorporation. How this relates to rural people's knowledge is the subject of the study by Ndoum Mbeyo'o (2001). As regards this knowledge, Ndoum Mbeyo'o follows Scheffer's (1965) distinction between prepositional knowledge ("knowing that") and procedural knowledge ("knowing how to do"). Prepositional knowledge in this study is, for example, the recognition by Mafa farmers of soils and plants, while procedural knowledge is their mastery of soil and water conservation techniques.

Another distinction is the one between critical skills and more routinely or automatic competencies. This difference appears to be congruent with the two ways of Mafa farming described by Zuiderwijk (1998), namely the *maya-maya* way characterised by active intelligence (see also Section II.1), and the *yao-yao* way characterised by routinely application of techniques.

Rural people's, or indigenous, knowledge[4] is defined as the knowledge that is rooted in a particular place and set of experiences, transmitted orally or through imitation and demonstration and situated within traditions that integrate the technical and the non-technical and the rational and the non-rational (Ellen and Harris, 1997). Rural people's knowledge is usually asymmetrically distributed and preserved within a particular community. Broadly speaking, this distribution tends to be influenced by age, sex, learning ability, economic and social class, social status, differentiated roles and the type of knowledge involved (Riley and Brokensha, 1988, cited

3 This section is based on N'doum Mbeyo'o (2001), Chapter 2.

4 Rural people's, or indigenous, knowledge also appears under the terms of "folk knowledge", "local knowledge", "indigenous technical knowledge", "traditional environmental or ecological knowledge", "ethno- ecology" and "people's science". These terms are often used interchangeably in the literature.

in Chambers, 1990; Brouwers, 1993). Rural people's knowledge is not static, but constantly changing through production, reproduction, discovery and loss and reinforced and adapted by experience, trial and error. For its retention and re-enforcement, rural people's knowledge needs repetition. It is not devolved through individuals, but through the practices and interactions.

Since the late 1950s, there has been growing recognition of the effectiveness and value of rural people's knowledge, for being grounded on detailed knowledge of the local environment and being directly related to rural people's life and subsistence means (Richards, 1986; Reij, 1991; Ellen and Harris, 1997). Rural people's experimentation and adaptation capabilities are limited, however. Brouwers (1993) argues that the process of adaptation of rural people's knowledge will, over time, reach a stage at which it might be difficult to go beyond the traditional setting. Reporting on Blaikie and Brookfield (1987), various authors argue that if indigenous knowledge and soil and water conservation were truly effective, there would not be the problems of food shortages and land degradation that are evident today (Reijntjes *et al.*, 1992; Critchley *et al.*, 1994). Some of the beliefs held by rural people may be false, counterproductive and even dangerous.

The introduction of modern science in local environments is therefore inevitable. Initially, this occurred through top-down interventions based on the Transfer of Technology thinking of the 1950s and 1960s. After the failure of these interventions, increasing emphasis was placed on participatory approaches to extension *(e.g.* the "Farmer First" and "Beyond Farmer First" perspectives) and rural development *(e.g.* the approach of *Gestion du Terroir Villageois* in the Sahel zone).[5] Communication and interaction between differentiated actors (farmers, extension agents, traders, researchers, farmers organisations, training institutes, etc.), peasant organisation and the development of platforms for the management of ecosystems are now generally being considered as essential conditions for sustainable innovation (Röling, 1994).

The debate over the distinction between indigenous and external technology or knowledge is still unresolved. The settlement of this debate is rendered complex by the fact that technology development at local level is a rather dynamic process, involving continuous borrowing from interveners and other communities. In response to the sharp distinction between the two knowledge types, Arce and Long therefore advocate the

5 This development is described in greater detail in Ndoum Mbeyo'o (2001).

actor-network perspective according to which processes like the creation, transformation, internalisation, use and reconstruction of knowledge take place in a social arena in which actors "build bridges and manage critical knowledge interfaces that constitute the points of intersection between their diverse life worlds" (Arce and Long, 1994: 77).

Change and adaptation are therefore essential features of technology development at local level. New ideas emerge from both the inside and the outside. Some of these ideas may be tried out by farmers, rejected or adapted before their integration into the local farming system. This also holds true for soil and water conservation techniques, of which African farmers use a wide array. The spread of these techniques and the degree of intensification vary greatly across geographical areas, as well as between ethnic groups living in areas with similar physical characteristics.[6] This may be explained by such factors as population density, investment and access to capital, return to soil and water conservation investments, market and infrastructure, security and tenure rights, and access to information and technology (Critchley *et al.*, 1994; Reij *et al.*, 1996).

With respect to the specific effects of population growth there are two possibilities. The *Malthusian* pathway is straightforward about what can happen if population densities rise on a fixed resource base. Soils will decline, and with them the incomes. People can only intensify agriculture by putting in more and more labour, until this finds its natural end and people are forced to leave the exhausted, eroded land.

Boserupian theory, on the other hand, states that a rising population density also provides an opportunity. Roads will be built, transaction costs will decrease and output prices will rise, thus giving farmers both the option and the motivation to invest in new, innovative land use types and crops, moving towards a new, more intensive and yet sustainable farming system.

There are also cases of neglect or even abandonment of indigenous soil and water conservation techniques. Causes of this decline, as reported by Critchley *et al.* (1994) include, among others:

- the exodus of labour which is needed for construction and maintenance (due mainly to more lucrative employment opportunities elsewhere);
- reduction of annual rainfall, rendering soil and water conservation techniques "unable to bridge the gap between plant water requirements and available rainfall" (p. 306);

[6] In the Mandara mountains, for instance, terracing is not practised by all ethnic groups. Some practise them only on hillsides, while others farm on unterraced hillsides.

- agricultural mechanisation *(e.g.* replacement of the hoe by the plough or a tractor) by which soil and water conservation techniques which depend on the hoe for implementation and maintenance may become obsolete.

In Part II of this booklet we will present more detailed information about the Mafa farming system and knowledge diffusion patterns, as well as the consequences of incorporation-related processes, such as seasonal migration and the introduction of cotton cultivation, for the sustainability of Mafa agriculture.

II. Results

II.1 Mountain and plain farming systems

In physical terms, the mountain farming system consists of three major parts:

1. The *terrace*, which is the physical backbone of the system. Its major function is the retention of soil and water.
2. On this basis, *nutrient and organic matter management* serves to keep the quality of the soils at a proper level.
3. Finally, *plant management* serves to get the most out of this in terms of production, risk reduction and the product diversity needed for autonomous subsistence. The term 'plant management' rather than crop management is used here to indicate that the Mafa mountain farmers know and treat almost every plant separately.

The farming system of the Mafa who have descended to the plain is different on all counts and will be dealt with at the end of this section. We will first deal with the mountain system in some more detail, on the basis of the work of Hiol Hiol *et al.* (1996), Hiol Hiol (1999) and Zuiderwijk (1998).

The typical terrace has a wall of up to one metre high, built of stones placed upon each other without binding material, in such a way as to attain maximum fit, density and strength. The average bench width is about two metres. There is considerable variety, however. Some terraces are as narrow as 30 cm, while some walls may reach up to more than two metres, especially at the sites where houses are built. A special terrace type, indicating land scarcity, is the *guilmeteteu*, which is built on bare rock outcrops, and to which soil is carried to fill the space behind the wall. Most terraces have a zero slope or a slight back slope (up to 4%) to ensure water retention. The orientation of the top of the walls is usually strictly horizontal, with the farmer adapting the wall tops every year, if necessary. Some terraces, probably those that have too much excess water during torrential rain to be retained safely, have a slight inclination leading to a perpendicular drainage channel.

The terraces are very successful water and soil retainers (Hiol Hiol, 1999). Yearly water runoff turned out to be very small, namely 3% of the yearly rainfall on the cultivated plots and virtually zero on the fallow plot. Water runoff was higher under torrential rains, rising to 20% of the storm's rainfall on the cultivated plots.[7] This 20% is, of course, the greatest danger for the terraces themselves, which may overflow and be washed away if runoff accumulates. The picture as far as erosion is concerned is comparable. Soil loss under the old fallow was measured as virtually zero, while the cultivated plots averaged 4 tons/ha per year (0.3 mm/y), which is very low.[8]

The low nutrient and organic matter levels in the soil are often a severe bottleneck in permanent cropping systems such as those in the Mandara mountains. They cannot take advantage of the regenerative effect of fallowing, nor generate the cash necessary to buy external nutrient supplements such as fertiliser. The Mafa farming system contains a number of very intricate mechanisms of nutrient and organic matter recycling that jointly act to minimise losses to such an extent that the system can be sustainable. Livestock, stabled up during the cropping season, is central to most of these; farmers see to it that every available leaf is fed to the animals and the dung is treated with great care to avoid quality loss before it is applied to the fields. Zuiderwijk (1998) reports another method, in which termites are used to digest millet and sorghum stalks (only to be fed to the chickens later). Farmers keep the various types of dung (from cattle, chickens etc.) separately, in order to apply them to different crops.

The major form of plant management in the mountains is the yearly rotation of sorghum *(Sorghum vulgaris)* and millet (various species). In even years all farmers plant sorghum, while millet is planted in every odd year. Although sorghum is the superior crop in almost all respects, the rotation is maintained for two reasons:

1. Sorghum is more sensitive to striga and other pests, and having no sorghum in the mountains for a full year avoids the pests' proliferation.

[7] Hiol Hiol (1998) compares the 3% with values of 14-54% measured by others more south in the piedmont *(i.e.* lesser slopes) but without terraces. It is not sure whether this comparison is fully valid, but the 3% is very low anyway.

[8] The same experiments as mentioned in the previous footnote measured soil losses four times higher.

2. The deep roots of the sorghum easily exhaust the soil and planting the shallow-rooted millet is therefore a kind of invisible fallow for the deeper soil layer, preventing soil degradation.

Besides these two staple crops, the Mafa plant an astonishing array of other crops, such as groundnuts, sesame, *bambara* groundnuts, beans, *oseille de Guinée*, *gombo*, pumpkins, eggplants, calabash, peppers, tiger nuts, tobacco, (irrigated) taro and rice and others. Most of them are planted in many varieties, all known by different names and having their specific uses. Each variety has its own way of planting and manuring, adapted to specific soil types and taking account of their susceptibility to drought and pests. Zuiderwijk (1998) reports on 15 'ancestral varieties' of sorghum, while Hiol Hiol (1999) mentions five varieties of tiger nuts.

Most of these crops are intercropped, *i.e.* planted together on the same terrace. This is not done randomly but instead there are a whole host of reasons governing the locations at which the various crops are planted. Legumes, for instance, are planted in a way that they work as a 'trap crop' for striga, while drought-resistant varieties are planted close to the terrace wall where the soil is dryer (Hiol Hiol and Mietton, 1998). Needless to say, such *ensembles* cannot be ploughed or weeded mechanically. Only the special mountain hoe that is long and pointed will do. Thus, farming becomes an intricate interplay of hands and brains. A farmer who is weeding, for instance, is not just weeding, but at the same time making little compost heaps at the appropriate places, improving the soil profile, doing some repair on a terrace, solving small-scale plant problems, applying manure where needed and so on. This is called *maya-maya*, the true Mafa way of farming.

Besides the food crops, several species of grass and shrubs are planted for fodder, roofs, ropes, medicine, fencing and other uses. Trees are also integrated into the farming system, carefully pruned to enhance their use and minimise their disadvantages such as shading. As reported by Zuiderwijk (1998), they generate firewood, fruits, soil fertility, forage, insecticide for seed storage, stabilise terrace walls and have several other functions. Hiol Hiol (1999) refers to an average of 70 trees per hectare in the study area, while this figure increases to 300 in the more western parts of the mountains.

As mentioned above, the farming system of the Mafa who have settled on the plains is totally different. The plough is used to prepare the soil, the crop is sown in lines and is not mixed so much with other crops and cotton

plays an important role in the farming system as a cash provider. Soil and water conservation measures are not used and the cattle are usually allowed to roam around freely, without their dung being gathered. Fertiliser and pesticides are used in cotton cultivation, supplied by the Cotton Development Corporation of Cameroon (SODECOTON), the cotton parastatal. SODECOTON plays an important role in the life of the plain farmers, because it also buys the cotton at a reasonable price, organises farmers into groups and delivers extension services for cotton and other modern crops, such as irrigated onions and S35 sorghum. Finally, the plains are characterised by increasing social differentiation, with large farmers expanding at the cost of the smaller ones, usually through the renting of fields.

Weeds are much more prevalent on the plains than in the mountains. This is one of the reasons that farming cannot be done *maya-maya*; the 'plains way' of farming is *yaou-yaou* ("fast-fast"), going along the straight sowing lines as rapidly as possible. This difference is not restricted to weeding but characterises farming as a whole. In Zuiderwijk's (1998) interviews with mountain and plain farmers about what is a good farmer, mountain farmers stress intelligence, independence, good land management and high land productivity. Plain farmers put much more emphasis on high labour productivity and economic objectives. Some of them retain a lot of the mountain values as well, such as the following farmer:

> "Farmers should work gently-gently *(maya-maya)*, but not too gently. What is important is that farmers have a passion [for farming] and ardour *('n 'wufe')*" (Kaldadak, cited in Zuiderwijk 1998: 236).

Others, however, simply say that "a good farmer is a farmer who has money" (Zuiderwijk, 1998: 230). The brainwork does not go into the terraces and plants, like in the mountains, but to the economic input-output analysis:

> "It is very necessary to calculate well before starting: how much for renting the fields, how much for paid labour, how much for renting the oxen and plough, how much for fertilisers. After the harvest you count the bags [the yield]. I note whether I have made a profit. If one does not know the costs and benefits then it is impossible. Even if I use my own oxen I include it in the calculation, because these are also expenses. The same goes for sorghum consumed by my family; I go to the market to see what I would have earned if I would have sold it" (Dzama, cited in Zuiderwijk, 1998: 242).

This quote also reveals the prevalence of hired labour and rented land and equipment on the plains. Note that there is no reference to sustainability; the motivation to keep up soil quality is low if a field is rented.

II.2 Patterns of knowledge diffusion

As mentioned in Section I.3, Ndoum Mbeyo'o (2001) interviewed 97 Mafa farmers concerning their level of traditional agro-ecological knowledge and the transfer of that knowledge. The level of knowledge was operationalised as the percentage of correct answers in the identification (in the local language) of soil types and plant species and the reported level of mastery of various soil and water conservation techniques. Table 1 shows the distribution of the level of traditional knowledge over the different household members and types of farmer, with 'type of farmer' defined as a combination of the location of the house (mountains/plain) and degree of cognitive isolation. This 'degree of isolation' was inferred from the answers of the farmers concerning, *inter alia*, their contact with extension agents and learning in village meetings. The numbers of respondents (n) have been mentioned in the cells in order to prevent conclusions being based on excessively low numbers.

Table 1 Number of respondents (n) and level of agro-ecological knowledge ('level'), as distributed over types of farmers and their position in the household

	Isolated in the mountains	Isolated on the plains	Non-isolated in the mountains	Non-isolated on the plains	Average level/ total (n)
Male head of household	level 90 (n = 1)	level 70 (n = 3)	level 74 (n = 5)	level 85 (n = 7)	level 82 (n = 26)
Female head of household	level 60 (n = 1)	level 73 (n = 3)	—	level 70 (n = 2)	level 71 (n = 6)
Other male hh. member	level 73 (n = 2)	—	level 75 (n = 3)	level 85 (n = 14)	level 82 (n = 19)
Other female hh. member	level 68 (n = 16)	level 79 (n = 13)	level 81 (n = 1)	level 78 (n = 3)	level 73 (n = 33)
Average level / total (n)	level 69 (n = 20)	level 77 (n = 19)	level 75 (n = 9)	level 84 (n = 36)	

We can draw a number of conclusions from this table. First, it shows that isolated farmers do not have more traditional knowledge, at least on this count, than non-isolated farmers, although the latter are much more exposed to non-traditional knowledge and culture. In fact, the non-isolated farmers on the plains even have the highest score. Secondly, the table

shows that women, on the whole, tend to be less knowledgeable than men in this test. The most important conclusion regarding knowledge diffusion relates to the transfer of knowledge between generations. Comparing the traditional knowledge levels of male heads of households with that of the other male household members, *i.e.* comparing roughly between fathers and sons, it appears that they have the same traditional knowledge level, except for those living under isolated conditions in the mountains. The table does not allow the same conclusion to be drawn for women because there are a lot of older women who are not heads of households, although other data does show that the same applies to them. In other words, there does seem to be a properly working transfer of traditional knowledge between the generations.

In order to investigate further what the structure of the 'transfer system' may be, respondents were also asked to mention what kind of things they had learned from a male or female source. Terrace maintenance was the most frequently mentioned item and almost equally shared between male and female sources. Other basic agricultural skills (weeding, sowing, seed conservation and manure application) also had a practically equal distribution over the sexes. All other items – and there were 41 of them – were taught (hence, most likely, mastered) by either men or women. Among them are household skills such as cooking as well as termite and poultry composting which are exclusively female tasks, while skills such as ridging on terraces and land preparation in general, life fencing and applying chemical fertiliser are (almost) exclusively male tasks.

The gender-oriented character of the knowledge system is revealed even more clearly if we focus on the personal links in knowledge transmission. Respondents were asked whether they learned from their mother/aunt, father/uncle, spouses, siblings, older men outside the nuclear family, and so forth. Table 2 reflects the result.

Table 2 shows that the mother-to-daughter and father-to-son links are the true main knowledge transmission lines. A minor father-to-daughter cross-link and some exchanges between siblings of the same sex co-exist with those within the household *(gay)*.[9]

[9] The *gay* is the nucleus and the pit of Mafa society and refers to both the compound, consisting of several small huts, connected by narrow and obscure corridors, and to the household, the nuclear family living in this compound. In a social sense, the *gay* is at the

Table 2 Transfer of knowledge from within and outside the nuclear family (%)

	Men (n = 57)	Women (n = 40)
Learning from within the nuclear family		
- from father or uncle	49	14
- from mother or aunt	4	35
- from spouse	1	3
- from sibling of other sex	1	-
- from sibling of same sex	4	5
Learning from outside the nuclear family		
- from older man	10	2
- from older women	1	3
- from male of same age	2	-
- from younger people	-	0
Learning from extension agents		
- from extension agents	35	3

Concerning sources of learning outside the nuclear family, the table shows that these transmission lines are very thin, although the 18% of men acknowledging a connection with older men outside the nuclear family may indicate that older men may sometimes act as a general knowledge source. That can only be said to apply to men because the table clearly shows a gender barrier in knowledge transfer.

Agricultural extension agents are well represented in the table, although they supply knowledge almost exclusively to male farmers on the plains. The large majority of the agents are *agents de suivi* (monitoring and extension agents), who are local young men employed by SODECOTON[10] and entering a farmer's life basically only if the farmer decides to grow cotton.[11] Backed up by the image of scientific knowledge, they are well accepted as knowledge sources, also by older men, and farmers indicate that they learn more from the extension agents than cotton growing only. Although many extension agents aim to adopt a more flexible style than the traditional top-down teaching and monitoring, farmers do not indicate that they ever taught something *to* them. In interviews held by Ndoum Mbeyo'o

same time a kinship group, a – virilocal – residence group, and the basic unit of production and consumption (Zuiderwijk, 1998: 95).

10 Recently, SODECOTON has started to decentralise the employment of *'agents de suivi'* to the village level.

11 SODECOTON extension agents also follow the cotton when grown in the mountains *(viz.* Section II.5).

(2001), one extension agent gave an example of something he had learned from a farmer and then taught to others. In such a case, horizontal diffusion of knowledge takes place by first going 'up' and then 'down' again.

In sum, it appears that (gendered) knowledge transfer is well embedded within the *gay*, but that it is held there as a treasure not to be shared with other *gays*, *i.e.* other nuclear families. Extension of formal agricultural knowledge works well for male cotton-growing farmers, but not for the others and not (yet) as a vehicle for spreading farmers' own knowledge among farmers *(e.g.* the results of farmers' experiments).

II.3 Seasonal migration

As we will see in more detail in the next section, incomes (in cash and kind) tend to be somewhat higher in the mountains than on the plains. Until the introduction of cotton, however, the mountain farming system did not produce any amount of cash compared to modern needs such as schooling, clothing and luxury items. In difficult circumstances, such as a drought, there may neither be enough food. Seasonal migration – "travelling to find money" – is therefore a logical response. If labour force leaves the mountains, however, what will become of the farming system? Will the terraces collapse and erosion set in? Will poverty, on balance, increase in the long run? This is the question of the current section, answered largely on the basis of Zuiderwijk (1998) and Zuiderwijk and Schaafsma (1997), supported by data from Ndoum Mbeyo'o (2001).

Based on the classification in Zuiderwijk (1998: 300), seasonal migration may be roughly divided into two simplified types:

- *Family- or mountain-oriented.* The male household member is leaving to find money for food or cash, bringing most of it back home and tuning the time of travelling as much as possible to the agricultural cycle. Even if the money brought back will seldom be more than F CFA 50,000 (US$ 80), it does make a big difference relative to the average income in the mountains of F CFA 170,000 (US$ 272) per household per year (Zuiderwijk, 1998: 306).
- *Self- or town-oriented.* The male household member is leaving to satisfy his own needs for cash or enjoyment. This often starts as early as at school age, in search of money to pay the fee. He may come back to the mountains as a young adult to contribute only very little to the household or even to eat from the family pot. Later he may be married but still stay away for most of the time, sometimes even refusing to

start his own household. Seasonal migration then has become an almost permanent escape from the obligations and drudgery of village life. Self-centred migration may evolve into family-oriented migration, especially after marriage.

All farmers interviewed by Zuiderwijk and co-workers agree that both types of seasonal migration have increased substantially over the last decades, mostly out of necessity, but also eased by improved infrastructure and growing social networks. Opinions of the farmers concerning the two simplified types of seasonal migration are fairly clear-cut: positive for the first and negative for the second (except, of course, for those involved in it).

The overall balance is, however, much more ambiguous. First, because people in practice seldom adhere to the simplified types. For instance, a woman talking about her husband:

> "When he was still a Christian and he found some money while travelling, he did not hide it, he showed it to me. But now he has started to drink, and he does not listen to God, he does not show me anymore" (Doukwoye, cited in Zuiderwijk, 1998: 311).

Secondly, the overall balance is set to a large extent by the relative numbers of those involved in family- and self-oriented migration. Thirdly, opinions differ with the degree to which a household is in need of food or cash, can afford one or two members to be away, or has alternative sources of agricultural income. On the whole, however, three perceived balances seem to prevail, one expressed often by women, one often by men and one by old people.

Women tend to focus more on the short-term cost and benefits of migration, tending towards an overall positive balance because the money, soap and clothes brought home are good and the extra labour that the other household members have to do is bearable.

Men tend to focus more on medium-term matters of soil fertility maintenance and terrace repair, and then tend towards an overall negative balance because precisely these tasks will be neglected due to migration.

Old people are downright negative about seasonal migration, pointing especially at the negative long-term consequences, for both the agricultural system and Mafa culture as a whole:

> "The bad farmer, he is always travelling to find money. He returns with empty hands. Normally he has no stable family" (Hawardak, cited in Zuiderwijk, 1998: 237).

We will now see if the research findings corroborate this set of ideas. As described by Zuiderwijk (1998), seasonal migration amounts to 200-300 days per household, on average, thus draining about 15-20% of the total labour force out of the household. The majority of the travelling family members consists of young men who are not heads of the household, and most of the travelling takes place during the dry season, hence not during the peak labour demands of planting, weeding and harvesting. Thus, the women appear to be right: seasonal migration cannot be very detrimental to the agricultural yields in the short term, when viewed on the average.

This is certainly different for poorer families, however, which are forced to migrate during the agricultural season due to acute food shortage. In these cases, the money they bring back may not compensate for the yield lost, leading to an even greater necessity to migrate in the next year. One farmer explains this vicious cycle as follows:

> "I have harvested 10 bags of sorghum. But would the whole family have concentrated on farming, I could have harvested 20 bags. [...] It is the lack of attention *[i.e.* labour] that explains the difference. [...] With the F CFA 40,000 I earned with travelling I cannot buy the 10 bags. But there was no sorghum left [early in the wet season], so I was obliged to leave, to find something" (farmer cited in Zuiderwijk and Schaafsma, 1997: 13).

A closer look at the figures reveals that the men are also right. The fact that migration is concentrated in the dry season implies that many men, sometimes including 50% of the heads of households (Zuiderwijk, 1998: 309), are away from the farm during several months in the dry season. The dry season is typically the season of medium-term investments in land and soil quality, such as terrace repair and manure management. Seasonal migration may therefore well be responsible for the soil fertility decline many farmers perceive, and be a threat to the sustainability of the terrace system.

Thus, migration in the dry season may well be the beginning of the vicious cycle described above. When people leave to find cash in the dry season, this does not have direct repercussions for the wet-season yields. After some time, however, the terraces and soil will become so neglected that soil degradation sets in, reducing the yields and forcing people to leave also in the wet season, triggering the vicious cycle.

What about the opinion of the old people? Even though criticising modernity is the natural role of the elders, they might well be right, too. Data of Ndoum Mbeyo'o (2001) show that migrants do not bring home significant agricultural ideas and, in the longer run, more and more young

men may become immersed in urban styles and aspirations, ending up like the following almost permanent migrant:

> "If my father and my [two] wives like this work [in the village], it is up to them to do it. If not, they can leave it. Me, I am hiding, I reside in the city far away from them.... I travel because my friends also travel and I see that they are well-dressed" (Riguidi, a 20-year old Mafa, cited in Zuiderwijk, 1998: 300).

This picture is all the more pressing because of the fragility of the Mafa knowledge system. Once a father-to-son transmission line in a family is broken, it cannot be repaired.

In sum, this appears to be the long-term picture: a mountain agriculture that begins to decline because the current seasonal migration already causes a slow, but steady, loss of soil fertility. This is motivating even more men to migrate out of this system that cannot be held up by the women alone. Finally, they will also be forced out, to end up in the urban or rural proletariat. Policy options to prevent this negative development will be discussed in Chapter IV, jointly with the issues of the next two sections.

II.4 Soil fertility decline on the plains

In order to have a background for the topic addressed in this section, let us first have a look at the situation in the Koza plain as compared to the mountains. When the Mafa first settled there, large areas of bush land were still present, enabling farmers to apply a relatively extensive fallow-based farming system – basically the same as still practised in the other plain areas of North Cameroon. Now that the plains have filled up, fallowing has become impossible for almost all farmers. As a result in 1994/1995 (Zuiderwijk, 1998: 214, 218, 225):

- Households on the plains, on the average, now hardly work more land than those in the mountains (8.5 *vs.* around 8 *quarts* per household, respectively).[12]
- Households on the plains, on average, apply more labour on each *quart* than in the mountains (69 *vs.* 46 days per year, respectively), especially because of the prevalence of weeds.
- In line with this, households on the plains, on average, spend more of their available time on agriculture (crops and livestock) than in the mountains (50% *vs.* 40%, respectively).

[12] One *quart* is 0.25 ha.

- Average net income (cash plus kind) on the plains is lower than in the mountains (F CFA 150,000 (US$ 240) *vs.* F CFA 170,000 (US$ 272) per household per year, respectively).[13]

Soil degradation is generally said to be the cause of this decline of livelihood circumstances on the plain. In order to find out to which extent this is really true, Schaafsma and Zuiderwijk interviewed 140 farmers on the Koza plain in 1997 (Zuiderwijk and Schaafsma, 1997). All the farmers indicated that soil degradation is indeed prevalent. This is not an allusion to some vague collective idea; the farmers relate the soil degradation to specific times and places (see the quotes below, which are from Zuiderwijk, 1998: 248-249). In the view of the farmers, the sandy *(wuyak)* soils are most susceptible to soil fertility decline, followed by the mixed sandy-loam soils *(brfened)* and so-called *gedbala* soils (soils with a crust; literally: hard-headed soils). *Drob* soils are considered to maintain their fertility, or lose it only gradually. They are usually mentioned as an exception, but they are scarce on the plains.

> "In the past, my grandparents cultivated a plot with a limited area, two or three *quarts*. Today, I cultivate a lot of acres but the yield is not sufficient. That's why I observe a decline in soil fertility" (old farmer in Gid-Wayam, cited in Zuiderwijk, 1998: 248).

> "It occurs gradually. I have a field which produced eight bags in the past. Last year I had only three" (farmer in Koza, cited in Zuiderwijk, 1998: 248).

> "I cultivate six *quarts*. Only two, of the *wuyak* [more sandy] type, are affected by soil degradation. The others are slightly affected. Those are a mix of *drob* and *gedbala* (Mafa farmer, cited in Zuiderwijk, 1998: 249).

Farmers attribute the soil degradation to several causes, the major ones being:

- the lack of fallows due to high population density;
- the use of the plough that exposes the deep layers and gives rise to erosion that carries away the smaller (most fertile) soil particles;

[13] Van Andel (1998), reporting on the nearby Mada ethnic group, gives figures of F CFA 113,000 (US$ 181) and F CFA 83,000 (US$ 133), for plains and mountain farming households, respectively. Due to different household sizes (6 and 5, respectively), the incomes *per capita* are somewhat more equal. It may also be noted that Van Andel's data are from 1993, and soil degradation, hence income decline, especially on the plains, continued since.

- the lack of manure and the use of fertiliser (the dose of which, farmers say, has to be increased every year because it does not stop soil degradation);
- the lack of soil conservation measures such as low ridges.

Despite this high level of awareness, farmers do not take soil-restorative action. How can you have enough manure if there is no bush land left for cattle to go to? How can you fallow land if even the current land is not enough? How can you do without the plough if all the available time is spent on agriculture already? Why would you make ridges on rented fields if your neighbour does not, meaning that a flood of water will come into your field anyway? Seen in this light, the old farming system in the mountains may well outlive the modern system of the plains.

What solutions could there be? We will consider two broad options named the Malthusian and the Boserupian pathways (see Section I.4), after the original theorists. Both scenarios are realistic, as studies in the study region and elsewhere in Africa show. The mountains, obviously, have once gone through a Boserupian transition even without external markets being present. Conversely, the situation on the plains shows many features of the onset of a Malthusian future, possibly not unlike the exhausted plains close to Mora that once were blossoming cotton areas. With this in mind, we can take a closer look at the situation on the plains, keeping in mind the differentiation between large farmers (with 15 *quarts* and more) and small ones (with 5 *quarts* or less).

Most farmers, even the large ones that should at least have some money to invest in improved land management, seem to be pursuing a Malthusian pathway, spending their money on renting more and more land from which they reap less and less, or taking back land that they rented out before. One medium farmer (category 5-15 *quarts)* explains:

> "When I observe soil fertility declining, I take three times as much ... When I came down from the mountain, I had only 3 *quarts* and we ate well. But I am young and I can cultivate 12 *quarts.* So to compensate the soil fertility decline I now rent more fields" (Ibraim, cited in Zuiderwijk, 1998: 264).

Farmers often call this strategy: "to go find a little everywhere". At the collective level, this strategy is now resulting in increasing land rental prices – increasing to F CFA 5,000 (US$ 8) per year for sandy soils and F CFA 10,000 (US$ 16) per year for *drob* – in spite of decreasing yields. A

scramble is going on for the *drob* fields, which are ending up in the hands of the rich.

A consequence of pursuing the Malthusian pathway is that small farmers (and medium farmers with large households) are starting to rely more and more on seasonal migration or on employment as rural labourers:

> "The fields have become sand because of erosion and the sorghum and groundnuts do not produce like before. [...] Last year I and my wives worked for others to earn money, and the children who were able left to find money, too" (Gimok, cited in Zuiderwijk, 1998: 275).

Others, especially the younger farmers, are seeking to follow their predecessors who have already been squeezed out at the low end of the scale of social differentiation: out-migration to Toubourou, the still sparsely populated area south of Garoua:

> "The number of migrants is increasing. They leave for Toubourou, Garoua. They leave because they have tried to cultivate and they did not find a good harvest" (Chief of Modogo, cited in Zuiderwijk, 1998: 277).[14]

Some Boserupian tendencies are visible on the Koza plains as well, however, especially with respect to large farmers who can buy access to land and grow irrigated onions. Onions require large investments in irrigation layout and pump, labour and fertiliser, but they can be very profitable for those who can take the risk. A particular hopeful sign is that young men also seem to have started investing money, earned during seasonal migration, in irrigated onions (Zuiderwijk, 1998: 271).[15]

The question arises as to why farmers do not return to the mountains. In terms of available land and average income this would not seem to be an

[14] Seen in a long-term perspective, the existence of this escape route is a very mixed blessing. There are no mechanisms in place that could prevent the whole *Malthusian* story from repeating itself in the new settlement area. And on the Koza plains, the presence of the escape route de-motivates farmers to invest in the land (the *Boserupian* transition). In the long run, a region such as South Mali, with comparable climate and soils but no escape route to the South within the same country, may end up better than North Cameroon.

[15] These and other aspects of the Malthusian or Boserupian future of the plains are part of an ongoing project carried out by a Dutch/Kenyan/Beninese/Cameroonian/Philippine team sponsored by NWO, the Netherlands.

attractive option, to which a minority seems to be open. Then why they do not go? Some quotes:

> "I am here [on the plains] because times have changed. Else, it would be better to live in the mountains. If you keep up the terraces there and weed the mountain fields well, it will yield more because the mountain soils are more productive. If times keep on getting worse here, I may decide to return to the mountains" (old small/medium farmer in Bzaou, cited in Zuiderwijk, 1998: 276-277).

> "I want to live on the plains because there is water there. In the mountains you have to climb high, carrying water all the way up, and that is difficult. But for production it is better in the mountains. [....] If there were water in the mountains, I would prefer to go there" (Hahad, old farmer in Djinglia, cited in Zuiderwijk, 1998: 276).

Other farmers do not consider the option of going back:

> "The people will not return to the mountains. On the contrary, the people will have to leave the mountains for the plains because there is no water in the mountains, and the people may leave the plain to go somewhere else [for instance to Toubourou]" (old farmer in Djinglia, cited in Zuiderwijk, 1998: 277).

> "I will not return to the mountains, because there is no water there. Even if there was water, I am already used to living here. I want to stay here. I cannot go to the mountains any more" (farmer in Kilda, cited in Zuiderwijk, 1998: 277).

It may seem remarkable that of all possible reasons one could imagine, the lack of water seems to be the key. It was the only substantial reason mentioned by the farmers and all of them do so (the farmer of the first quotation being the only exception). This becomes less surprising, however, if we note that in the mountains the average (year-round) time expenditure on fetching water is up to 4 hours per household per day, a burden almost exclusively for women (Zuiderwijk, 1998: 219). In the dry season, women have to go down and follow the dry river beds further and further until they reach water; these distances ultimately may run up to more than 5 km, added to which is the often protracted period of time spent waiting at the well site. Since the water is not only needed for the household but also for the animals, numerous trips a day are necessary and women often end up spending half of their waking hours fetching water in the dry season (Fikry and Tchala Abina, 1978).

Against this background, the ongoing EU-funded PDRM project *(Projet de Développement de la Région des Monts Mandara)* needs to be mentioned. Working through local contractors and farmer groups, and with the farmers themselves supplying all the labour and usually half the material costs, this project organised the construction of 60 water wells and 160 micro-dams in the mountains in 1998. The planning was to construct 200 and 400 dams in

1999 and 2000 respectively (Vandewalle, *pers. comm.)*. Clearly, this project is not only helping to improve the quality of life in the mountains, but also addresses a key element in ensuring that the mountains have a future at all.

II.5 Cotton cultivation in the mountains[16]

Cotton cultivation in the mountains took off in around 1993 and seems to have become extremely popular in recent years. As one farmer said: "Nowadays, there is cotton everywhere in the mountain". The first to start were farmers who were, in fact, farmers from the plains who shifted their cotton from the plain to the mountain fields they still owned. Nevertheless, the percentage of mountain cotton growers who also own fields (83%) or even a house (48%) on the plains is much higher than the percentage for mountain farmers overall (Ndoum Mbeyo'o, 2001).[17] However, since 17% of the cotton growers only own fields in the mountains, cotton has already crossed the barrier to the "full mountain dwellers".

> "Although the neighbours were not happy [with the cotton at first] because they knew nothing of the crop and the importance of cotton, [....] they observed that I earned my money and bought sorghum with it. Then they also started to cultivate cotton" (old farmer in the mountains of Modogo, cited in Zuiderwijk, 1998: 208).

Opinions on how best to grow cotton in the mountains still differ, but some aspects seem to be clear, all of which are positive for the crop's sustainability:[18]

1. The majority of farmers (70% in Ndoum Mbeyo'o, 2001) intercrop the cotton with legumes, especially beans; this is a much higher percentage than on the plains (Zuiderwijk, 1998).

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16 This section is based on data from interviews with cotton growers (n = 30) by Van Wijk in 1996 and by Schaafsma and Zuiderwijk (n = 21) early in 1997, as well as by Ndoum Mbeyo'o (n = 42) later in 1997. The first two will be referred to as Zuiderwijk (1998), the latter as Ndoum Mbeyo'o (2001).

17 In a random sample of Mafa farmers in the same region by Ndoum Mbeyo'o (n = 97) that contained both cotton growers and non-adopters, the percentage of mountain farmers who have also a house on the plains is only 5%. This indicates that the cotton growers, although increasing rapidly, are still a minority.

18 Although the number of interviews as such is large enough, a word of caution is necessary. First, because there has been no formal sampling procedure; the interviews were a case of researchers running into the new phenomenon. Secondly, the farmers themselves still only have a very short experience with the crop, which brings uncertainty in their actions and answers. Farmers cannot really explain, for instance, why some of them grow cotton in lines perpendicular to the terrace lines while others grow in lines.

2. Mountain farmers tend to use less fertiliser than those on the plains, but many farmers – probably the majority (70% in Zuiderwijk, 1998) – apply manure on the cotton fields, alone or mixed with fertiliser. This percentage is virtually nil on the plains.
3. Farmers do not use the plough in the mountains.

Cotton is doing well in the mountains. Almost all farmers state that they and the field officials of SODECOTON agree that the quality is very good, *i.e.* heavy and white, attributed to better harvesting practices, better soils, less dew and more wind in the mountains than in the plain. In addition, the average yields (300 kg/*quart)* seem to be 20% higher than on the plains. The gross margin per *quart* was about F CFA 31,000 (US$ 50) per year, on average (Zuiderwijk, 1998: 202).

There are a variety of reasons for growing cotton in the mountains but, according to Zuiderwijk (1998), most of them are related to cash procurement, the reduced productivity of millet (which always has been lower than sorghum) and the reduced opportunities for seasonal migration. A few examples:

> "The cultivation of cotton is to earn a bit of money. [....] Nowadays it is not good to cultivate only sorghum and millet, because times have changed. If it was not so I could cultivate sorghum and millet and in the meantime I could travel to earn money. But travelling does not bring in money anymore [...]. That is why it is necessary to cultivate cotton in the mountains" (Mafa mountain farmer, cited in Zuiderwijk, 1998: 194).

> "In the mountains the millet does not produce much. [...] So I decided to grow cotton. It is to have a little bit of money, and with that money I can buy four times as much millet as what I could have produced myself" (Mafa mountain farmer, cited in Zuiderwijk, 1998: 196-197).

Another frequently recurring reason given by farmers is that the application of fertiliser improves the soil in such a way that sorghum grows better the year after; it should be borne in mind at this juncture that growing cotton is the only way to ensure access to fertiliser on credit (from SODECOTON). In the interviews carried out by Ndoum Mbeyo'o (2001), farmers also frequently refer to the fact that they grow cotton because

following the terrace. And, logically, even more uncertainty surrounds their opinions concerning the sustainability of cotton growing. Even SODECOTON is ambiguous; the top-level is generally negative concerning cotton in the mountains, because of the longer-term risks such as food crop shortages, while the lower-level extension agents, focusing more on how well the cotton is doing at present, have a favourable attitude.

others do. We cannot assume that farmers do so without thinking of the more substantive reasons mentioned above, but it explains in part the rapid expansion of cotton since the first farmers started.

In the first quotation above, cotton cultivation comes to the fore as a way of counteracting seasonal migration. A lot of farmers refer to this link, although many others do not. The decelerating effect of cotton on migration is based on physical and financial reasons. Physically, cotton requires a high labour input; one cannot grow cotton and be away from the farm at the same time. Financially, the remuneration from cotton compares favourably well with that from migration. With a net earning of F CFA 30,000 (US$ 48) per *quart*, a farmer needs only two *quart*s to end up above the F CFA 50,000 (US$ 80) that seasonal migration, if successful, may bring. And two *quarts* of cotton (representing one quarter of their average total acreage) is exactly what farmers grow, on average (Ndoum Mbeyo'o, 2001).

Cotton has a bad reputation when it comes to sustainability, and for good reasons. It is the set of normal cotton-growing practices rather than the plant itself that tend to degrade a soil more comprehensively and more irreversibly than any other set of traditional crop practices. The fertiliser on which cotton culture depends plays a key role in the process. It helps replenish nutrients in the short term, but does not re-build organic matter in the soil. This substance depletes the soil structure, its nutrient-holding capacity crumbles and down go the agricultural incomes, thus reducing ever further the time and money farmers need to spend on soil restoration. The Koza plain, the story of which has been told in the previous section, is a case in point. The question of sustainability, then, is the most basic question concerning cotton cultivation in the mountains. It is also the most difficult to answer, especially because cotton cultivation is so new that no one, including the farmers themselves, has enough data to make a properly founded prediction. As a result, therefore, we can only approach the issue very tentatively.

The first thing we can note is that, as mentioned above, cotton management practices in the mountains are intrinsically more sustainable than those on the plains. But are they sufficiently so? First of all we are going to examine some of the questions and answers in the Ndoum Mbeyo'o (2001).

Question: *Did you notice soil fertility decline in your cotton field?*
Thirty-four respondents (85%) answered this question negatively, and 6 respondents (15%) affirmatively. The fact that only a minority of

respondents noticed a decline in soil fertility may be a soothing thought, but it should be kept in mind that these farmers have only grown cotton for a couple of years. How many respondents will fall into this category in a few years to come?

Question: *Do you believe that cotton yields will remain stable or decline?* Ten respondents (24%) thought that cotton yields would remain stable, 5 respondents (12%) that they would decline and 27 respondents (64%) were undecided or had no answer. These answers show that, on average, farmers seem to be reasonably optimistic at present, but the answers also reflect their considerable uncertainty. Moreover, it is difficult to be pessimistic about something you have just started to do.

Finally, we should consider the question of why cotton is doing so well in the mountains. This question was not asked explicitly in the interviews carried out by Zuiderwijk (1998) and Ndoum Mbeyo'o (2001) but one answer crops up frequently in the answers to other questions, as the following quotes show:

> "[Cotton produces well] because the soil still has strength. The cultivation of cotton has been introduced recently and for the cotton it was like a nourishment" (farmer cited in Zuiderwijk, 1998: 204).
>
> "[Cotton produces well] because we have been cultivating cotton on the plains for years while in the mountains it is new" (farmer cited in Zuiderwijk, 1998: 204).
>
> "In the past, when we cropped one *quart* with cotton in the plain we could earn F CFA 100,000 (US$ 160), but now one cultivates a full hectare and one barely finds one bag. It is because the soil has changed. The soil in the mountains has never had cotton" (farmer at Galdala, cited in Zuiderwijk, 1998: 197).

Implicitly, these farmers acknowledge the risk of non-sustainability inherent in cotton growing in the mountains.

If the cotton fails, what will save the farming system used by more than 200,000 people? This question is urgent enough to do more than simply conclude this section by saying that the issue of the sustainability of cotton cultivation in the mountains is undecided. Further research is urgently needed and some relevant recommendations are made in Section III.2. Policy decisions concerning the cotton in the mountains should be considered only after the clarification of the sustainability issue.

II.6 Conclusions

Returning to the three questions mentioned in Section I.2, the following may now be concluded.

Seasonal migration, although satisfying short-term needs without many short-term disadvantages, has a negative medium-term impact on the quality of soils and terraces and therefore tends to set off a vicious cycle of ever-increasing out-migration. This, in turn, reinforces the long-term trend of young men leaving the mountains which offers them very little (except food and dignity). The women cannot maintain soil quality and terraces alone, however, quite probably due to labour constraints. Seasonal migration should not increase much beyond its present levels.

The adjacent Koza plain, to which many Mafa farmers have migrated, is largely caught in a Malthusian pathway of ever-increasing soil degradation, poverty and out-migration. Farmers are basically aware that most incomes in the plain have already sunk below those in the mountains. The major reason for not returning, mentioned by all the farmers, is the lack of drinking water in the mountains.

Recently, cotton cultivation has started expanding rapidly in the mountains and this trend is continuing. Cotton grows well in the mountains and the product is of a high quality. Thanks to the good returns, cotton acts as a way of counteracting seasonal migration and this may serve a pivotal function in planning a future for life in the mountains. At the same time, cotton growing outside of the mountains is usually unsustainable and has already resulted in devastated areas. No-one knows, including the farmers themselves, whether the mountain way of cotton growing, albeit an improvement on the normal management practice, is good enough to prevent soil exhaustion and with that the collapse of the mountain system.

III. Discussion

III.1 Scientific relevance

The scientific relevance of the three dissertations (Zuiderwijk, 1998; Hiol Hiol, 1999; Ndoum Mbeyo'o, 2001) that form the basis of this more policy-oriented booklet lies primarily in the respective fields of rural sociology, soil and water science and extension science. They provide an insight into the Mafa farming and natural resource management system and their dynamics as influenced by migration and cotton growing. They also contributed new ways of integrating indigenous and scientific knowledge systems by indicating possibilities for cooperation between farmers, scientists and extension agents. New research methods and techniques were developed that enable farmers to express, share and extend their environmental knowledge, thereby strengthening their own research capacity. The studies further increased the applicability of environmental science theory and methodology. Finally, the project increased the scientific knowledge on soil and water conservation. As typical PhD dissertations, the studies will primarily function as sources for further, more theoretical work. Several steps have already been taken in this respect (see Appendix 2).

Although primarily policy-oriented, the scientific relevance of this integration is that it represents the only recent publication on the Mandara mountain area that focuses on a regional and long-term perspective, based on scientific results.

III.2 Recommendations for further research

There is a great need to set in motion a process that will put in place a type of policy that will give the future back to the mountains. Cotton growing, which could both save or destroy rural life in the mountains, plays a central role in this. A scientific cotton sustainability assessment is urgently needed, however. The interrelated key components of such a research project are:

- a relatively large number of detailed interviews with cotton-growing farmers, taking special care to include areas and farmers with a longer history of cotton growing in the mountains;

- measurements of soil characteristics, especially concentrating on fields with a long and short cotton history on various soils and under management practices, following the same fields over some years;
- the modelling of prediction-oriented soil nutrient and organic matter balances;
- the institutional and technical design of a "sustainability safeguard system" for the mountains, focusing primarily on cotton, but also including the other crops and their interactions, as part of the proposed knowledge system for sustainable development.

The methodology of this project should not only be geared towards direct applicability to the mountains concerned, but also to comparability with mountain situations elsewhere *(e.g.* Nigeria, Benin). It may even include a component relating to the Koza plains in order to come to grips with the cotton sustainability problem which is prevalent in the whole of the Sahel.

The national and local infrastructure for such research – SODECOTON, the Agronomic and Development Research Institute (IRAD), the University of Dschang (UDs) and the Environment and Development Research Centre of Cameroon (CEDC) – is essentially capable of a project such as this. Involvement of foreign soil and social scientists will increase the possibility of compiling international standards.

III.3 Practical applicability

The policy relevance of the three sub-studies is indirect. They will serve as valuable data collections for the argument and design of new policies directed at safeguarding the mountain system's sustainability.

Zuiderwijk's work will act as a source of data on migration, the tenure system, cotton growing, labour expenditures and other issues which are of great value for the prediction of development pathways under various policy designs.

Hiol Hiol's work has a more specific focus on soil and water. One point of relevance is that it shows the great efficacy of the Mafa terraces in terms of soil and water retention. Another is that it lays the scientific basis for understanding the mountain hydrology, which is of great importance for the long-term viability of the drinking water supply systems.

The work of Ndoum Mbeyo'o will be of great value in the design of a monitoring and extension system that is necessary as an early warning against possible soil degradation due to cotton growing in the mountains and also provides an insight into other aspects of the proposed co-managed knowledge system for sustainable development.

The policy relevance of the integrated research component is that it gives the core arguments and building blocks for a policy for the mountains that is a necessary reversal of the still prevalent emulation of colonial visions.

IV. Recommendations

In many respects, current policies concerning the mountains still emulate *de facto* those of the colonial powers, the basic policy notion being that the farmers should come down from the mountains to the plains and become part of mainstream society. This has resulted in a very low level of government services in the mountains, such as water and roads infrastructure, schools, extension services and so on. Previous concerns for improvements, resulting for instance in the establishment of the *Mission de Développement Integré des Monts Mandara* (MIDIMA), never really took off. As seen in the previous sections, a continuation of this policy will quite likely lead to more seasonal migration, a shift to out-migration, and finally the collapse of the terrace system. Apart from the enormous cultural loss and economic disinvestments this would entail, the issue will then be where these 200,000 people should go? To the Koza plain from where people are already out-migrating in large numbers? To the Garoua region where nothing is in place to prevent the Koza story repeating? The Mafa in Cameroonian society should not be integrated by bringing more Mafa to the plains, but by bringing Cameroonian society to the mountains.

The basic ingredients of a new policy for the mountains can simply be derived from the research results presented in this booklet. They are the following:

1. *To assess the sustainability of mountain cotton cultivation and act rapidly on the outcome*
   Cotton is the first key to the prevention of increased seasonal migration. At the same time, if the management practices in the mountains are not good enough, the mountains may become another cotton disaster region. Section III.2 outlines the urgent need for a sustainability assessment. If the outcome of such an assessment is negative, cotton cultivation in the mountains should be intensively discouraged. If the outcome is positive, the cotton option may be

strengthened in many well-known ways, *e.g.* in order to spread extension services not only to farmers who grow cotton, but also to those who have not yet started to grow the crop. If the mountain cotton is indeed of superior quality, SODECOTON could be invited to adapt its current grading system to include this extra quality, coupled with extra remuneration. This then would be good for quality farmers all over the cotton zone. In the mountains, the brake against seasonal migration would be reinforced and, on top of that, farmers would have a strong incentive to keep the soil as good as it is now.

2. *To establish water supply systems, supporting PDRM's ongoing effort*
Households in the mountains spend four hours per day fetching water for humans and cattle in steep terrain. It is not difficult to imagine how greatly the quality of life already has been improved by the PDRM project (see Section II.4) which is currently leading to the construction of hundreds of water wells and micro-dams. The procurement of drinking water not only greatly improves the quality of life but also addresses the systemic key issues of the mountains. It does so by preventing out-migration, inviting farmers on the plain to return, and by saving women's energy, part of which can then be channelled into production and sustainability. We do not know at present if the successful PDRM project needs further support, but if it does, this support should be provided.

3. *To bring government services and offices to the mountains*
This obvious policy component pertains to the whole range of normal government services such as schools, clinics, extension, cereal banks, small-scale credit, roads, communications and so on, brought to the mountains in a density that does justice to their population density. Research institutions, SODECOTON, churches and NGOs should be invited to follow the example or even take the lead. Besides the services themselves, this will also bring important employment opportunities to the mountains and, at a deeper level, a reversal of the idea that the mountains are excluded from development and are a place without a future.

4. *To establish a co-managed knowledge system for sustainable development*
The mountain farming system is a highly developed, knowledge-based system of which the inherent fragility, as in all highly developed systems, can only be counterbalanced by active and systematic

knowledge procurement. Local Mafa knowledge, developing only slowly and lacking a common pool is not geared towards the rapid external changes of modern times, while scientific knowledge systems are not yet geared towards the mountains. An intensified system of knowledge production and diffusion, co-produced and co-managed by farmers and scientists, therefore appears to be a highly effective investment in sustainability. Possible elements of such a knowledge system could be:

- to involve large numbers of farmers in the monitoring of the productivity and efficiency of current farming systems (using the farmers' own parameters as well);
- to add the "eyes of science", in other words to monitor what farmers cannot see easily, such as soil structure and chemical parameters;
- to manage a seed bank of traditional varieties and to continuously test these on farms, coupled with commitments to provide new varieties (including trees);
- to search pro-actively for improved and new management practices and thus create an active *(i.e.* farmer-to-farmer) diffusion of knowledge.

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Appendix 2

Follow-up of the project: capacity building and project-related publications

This project formed the basis for the PhD degrees of one Dutch and two Cameroonian researchers (Zuiderwijk, 1998; Hiol Hiol, 1999; Ndoum Mbeyo'o, 2001). Both Hiol Hiol and Ndoum Mbeyo'o are staff members at the University of Dschang. They have applied the knowledge they have acquired to their teaching, and their PhD status will strengthen the institutional capacity of the university, not least in the field of research. Proof of this is that Hiol Hiol acts as envisaged project leader in a project proposal submitted to the French CAMPUS programme. This proposal on the hydrological functioning of watersheds and water resource management in the Mandara mountains will greatly increase our understanding of the mountains' hydrology which, in turn, has a policy relevance for the design of water procurement systems.

Zuiderwijk's work on the Mandara mountains and plains has already functioned as a basis for a follow-up project, called "Transition of tropical agriculture". This project aims to build modelled theory on agricultural intensification, especially on the circumstances under which regions either sink away in a Malthusian poverty trap or innovate towards a sustainable intensive system. Zuiderwijk is presently one of the post-doc researchers in this project, which focuses on Benin and North Cameroon (Koza plain). The project is funded by NWO, the Dutch Science Organisation.

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