

**AGRICULTURE AND  
SOIL AND WATER CONSERVATION  
IN EASTERN BURKINA FASO**

**a first appraisal**

**David Niemeijer  
Valentina Mazzucato  
August 1995**

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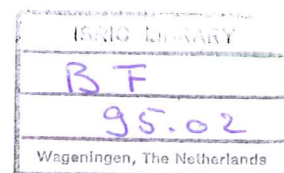
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| 11 | L. Stroosnijder                                     | Population Density, Carrying Capacity and Agricultural Production Technology in the Sahel. Paper presented at the 1994 Danish Sahel Workshop, 6-8 January 1994, Sandberg Manor, Sønderborg, Denmark  |



# Agriculture and Soil and Water Conservation in Eastern Burkina Faso

a first appraisal



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3 August 1995

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## Acknowledgments

Our work (and life) in Burkina Faso has been facilitated by numerous people and organizations. Amongst others we would like to thank in Ouagadougou the Antenne Sahélienne and the EFSIMA team of the INERA. In Fada N’Gourma we would like to thank his majesty Yuabli, king of the Gourmantché, the DRET and its director Mr. Alexis Kaboré, the CRPA de l’Est and its director Mr. Adama Ouedraogo, the APRG and its director Mr. Mathieu Sawadogo, the ATT and its director, the SPA Gourma and its chef Mr. Michel Thiombiano, the CRRA de l’Est (INERA) and its director Mr. Hamidou Traoré, and the Fada Meteorological Station. In Bogandé we would like to thank the SPA Gnagna and its chef Mr. Lassina Sanou. We cannot mention each and every one of the staff of these organizations in particular, but would like to mention Mr. Adama Sourwema who is in charge of research and development for the CRPA for helping to introduce us to the relevant organizations and being our principal contact at the CRPA.

In particular we would like to thank the people that went along with us into the field: Mr. Jules Tendemba (SPA Gourma), Eli Thiombiano (ATT), Delouaga Lankoandé and Kanfieni Naigni (APRG), and, of course, our interpreters Ms. Mariama Lankoandé and Mr. Anatole Y. Thiombiano.

Last but not least we would like to thank all the villagers and their chiefs who took the time to answer our questions and work with us. If it were not for their cooperation field research would have had little meaning.



## Summary

This report is based on a first 4 month visit (March-June 1995) to Burkina Faso of a four-year research project entitled 'Development of a Systems Methodology for the Analysis of Indigenous Soil and Water Conservation in the African Sahel'. It presents a general description of the basic characteristics of the research area in eastern Burkina Faso with respect to agriculture and soil and water conservation, as well as the patterns of change experienced in the past decades. The mission selected four principal villages and 2 secondary villages as the sites for their study. These villages are Tiambaragou, Samboanli, and Tampagdi in the Gnagna province and Pentouangou, Kpendema, and Binadeni in the Gourma province. The report presents the characteristics of these villages as well as the indigenous and promoted soil and water conservation practices found in the villages.



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# 1 Introduction

The present report is based on a first 4 month visit (March-June 1995) to eastern Burkina Faso that will be part of a multi-year research project. This project entitled: 'Development of a Systems Methodology for the Analysis of Indigenous Soil and Water Conservation in the African Sahel' started in February 1994 and will continue until February 1998. The first year was mainly used for a literature review on indigenous knowledge and soil and water conservation, but also included a reconnaissance visit to Burkina Faso to select a research area (Niemeijer 1994). Based on the findings of that mission Burkina's eastern region was selected as the most appropriate study area (see map 1).

The main reasons for selecting this area were: 1) presence of a large variety of indigenous soil and water conservation practices; 2) relatively low intervention level; 3) presence of degrading densely populated areas in the north and relatively untouched low population density areas in the south; 4) out-migration in the north and in-migration in the south; 5) dynamic area with many processes of change operating concurrently and affecting SWC practices; 6) good accessibility during the rainy season from Ouagadougou (220 km); 7) Good accessibility of north-south and east-west axes.

For practical reasons our research will concentrate on the Gourma and Gnagna provinces and especially on the area within 100 km from Fada N'Gourma (see map 2). Though the Tapoa is at least as interesting as the other two eastern provinces the distance from Fada N'Gourma is too great to include this province in our study.

This report presents a first appraisal of the agriculture and soil and water conservation activities in the research area. It is based on some of the literature on the region as well as on fieldwork carried out between April and June 1995. Fieldwork included exploratory visits to 26 villages in the region followed by more in depth work in the four selected principal research villages.

The report starts with a general description of the research area. This section discusses the climate, the geomorphology and soils, and the agriculture. The second section deals with some patterns of change that have occurred in the last decades. Next the characteristics of the research villages are discussed, followed by a description of both indigenous and promoted soil and water conservation practices.

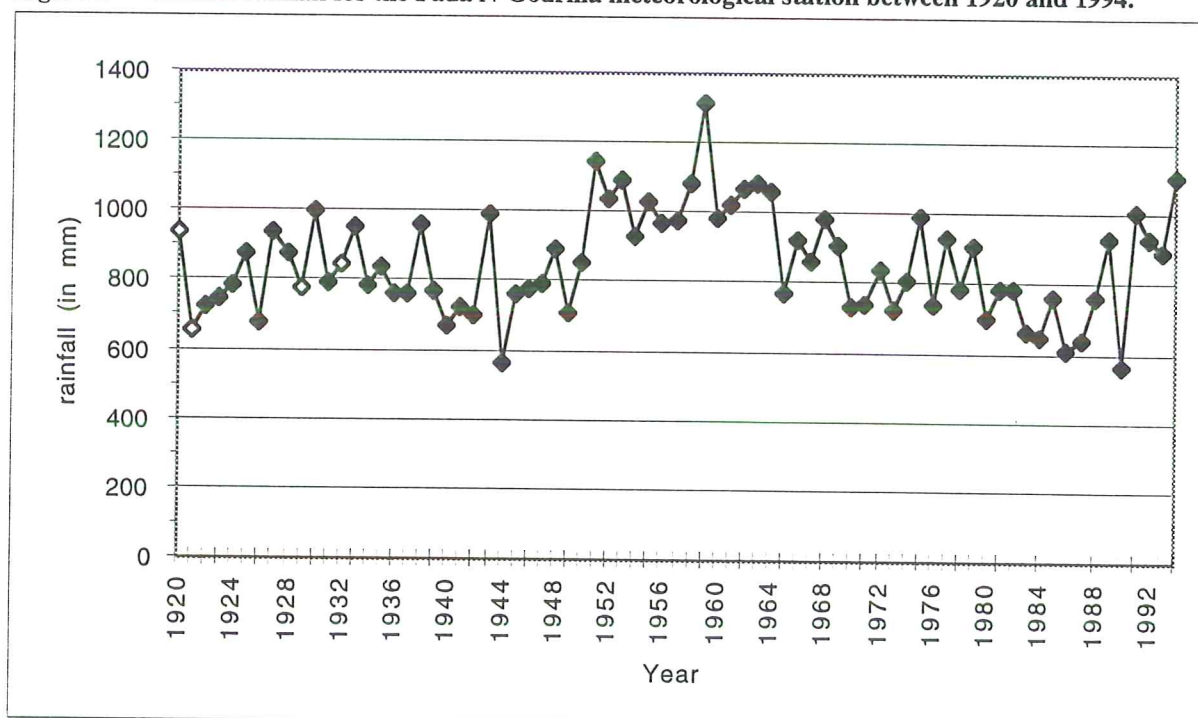


## 2 General description of the research area

### 2.1 Climate

The southern part of the research area falls within the sudano-sahelian zone with rainfall between 600 and 900 mm. The northern part of the research area touches the sahelian zone with a rainfall of less than 600 mm (Laclavère 1993). The long-term average annual rainfall (1922-1994) for Fada N'Gourma is 860 mm, with lows between 1922 and 1950 (805 mm), between 1965 and 1979 (845 mm), and an extreme low between 1980 and 1990 (715 mm). High rainfall periods were recorded between 1951 and 1964 (1060 mm) and between 1991 and 1994 (990 mm). Figure 1 shows the annual rainfall for Fada N'Gourma between 1920 and 1994. It shows that the most severe drought years were 1944 and 1990, while 1951, 1959 and 1994 were among the wettest years recorded.

**Figure 1** Annual rainfall for the Fada N'Gourma meteorological station between 1920 and 1994.



Source : Direction Météo in Ouagadougou and for 1994 the Service d'Etudes et Planification in Fada N'Gourma.

Note : Years with white diamonds indicate that at least that amount of rainfall fell in that specific year.

#### 2.1.1 Rainfall spatial variation

There is a considerable rainfall gradient between the northern part of the research area and the southern part of the research area. As can be observed from table 1 this rainfall gradient is much stronger between Bogandé and Fada N'Gourma than between Fada N'Gourma and Pama (see map 3 for these locations).



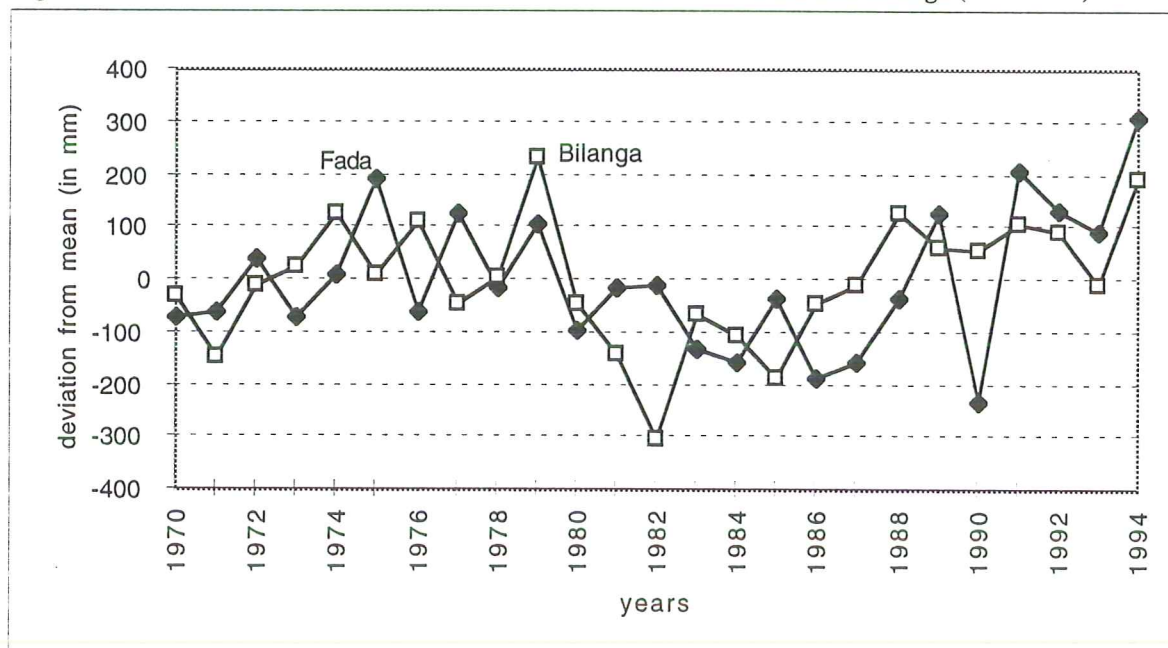
**Table 1** Average annual rainfall between 1970 and 1994 for selected stations

Location	Rainfall (in mm)	Difference from Fada N'Gourma (in mm)	Distance from Fada N'Gourma
Bogandé	535	-265	115 km NNW
Bilanga	645	-155	70 km NW
Yamba	700	-100	25 km N
Fada N'Gourma	800	0	
Komin-Yanga	830	+30	45 km SSW
Pama	845	+45	95 km SSE

Source: Direction Météo in Ouagadougou and for some figures between 1988 and 1994 the Service d'Etudes et Planification in Fada N'Gourma.

Note: Not consistently observed years have been excluded from the calculations; data for Yamba and Pama end at 1991.

Not only the amount of rainfall varies from north to south, but also the dry and wet years show considerable spatial variability. A drought year in Fada N'Gourma does not necessarily imply a drought year in Bilanga or Bogandé. Figure 2 illustrates this point. Sometimes wet or dry years coincide between Fada N'Gourma and Bilanga, such as the wet year 1979 when the stations received respectively 105 mm and 235 mm more than average. In other years rainfall for the two stations contrasts markedly. In 1990, for example, when Fada N'Gourma experienced a serious drought with a deviation of -235 mm from the mean annual rainfall, Bilanga received 60 mm above the average.

**Figure 2** Deviations from mean annual rainfall for Fada N'Gourma and Bilanga (1970-1994)

Source: Direction Météo in Ouagadougou and for 1993-1994 the Service d'Etudes et Planification in Fada N'Gourma.

Even between neighboring stations there is a considerable spatial variation, especially in the low rainfall years. Table 2 presents some data for 1987, 1990, and 1991 from four selected rainfall stations (maintained by the SPA Gnagna). Though the accuracy of the data is limited, it is clear that within distances of 10 to 20 km rainfall may vary as much as 50 to 200 mm within a single season. This variation is quite important as it can represent up to 25% of total rainfall or it can mean a difference between a good harvest and a bad harvest.

**Table 2** Rainfall spatial variation around Bilanga

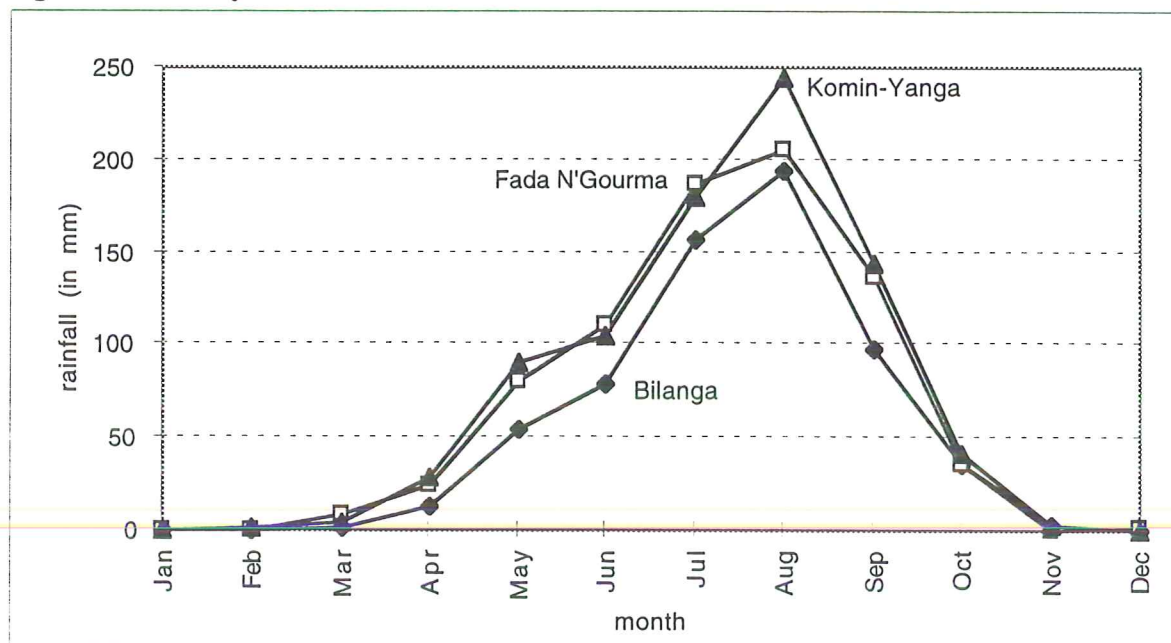
Station	Rainfall 1987 (in mm)	Rainfall 1990 (in mm)	Rainfall 1991 (in mm)	Distance from Bilanga
Piela	457 (-160)	463 (-195)	592 (-48)	20 km NNW
Bilanga	617	658	640	
Bilanga-Yanga	?	>257 (-401)	534 (-106)	10 km SW
Botou	540 (-77)	>491 (-167)	>370 (-270)	25 km SE

Source: Service d'Etudes et Planification Fada N'Gourma.

Note: Figures between brackets indicate the difference from Bilanga. The reliability of the observations is limited and might cause some of the spatial variation observed in the figures.

### 2.1.2 Rainfall temporal variation

Rainfall is concentrated in a single summer rainy season that starts in April-May and ends in October. Figure 3 shows the monthly rainfall distribution for a station in the north (Bilanga), one in the center (Fada N'Gourma) and one in the south (Komin-Yanga) of our research area. The difference between Fada N'Gourma and Bilanga are greatest during the first part of the season, while the difference diminishes in the peak month. In contrast, the difference between Fada N'Gourma and Komin-Yanga is most apparent during the August peak. In Fada N'Gourma about 50% of the precipitation falls in July and August and about 85% falls between June and September. The rainy seasons generally show a slow start between April and June and a quick end between September and October. This pattern is related to the movements of the Inter-Tropical Convergence Zone (I.T.C.Z.). The I.T.C.Z. takes considerably longer to move northwards from the equator than to move southwards again in August-September.

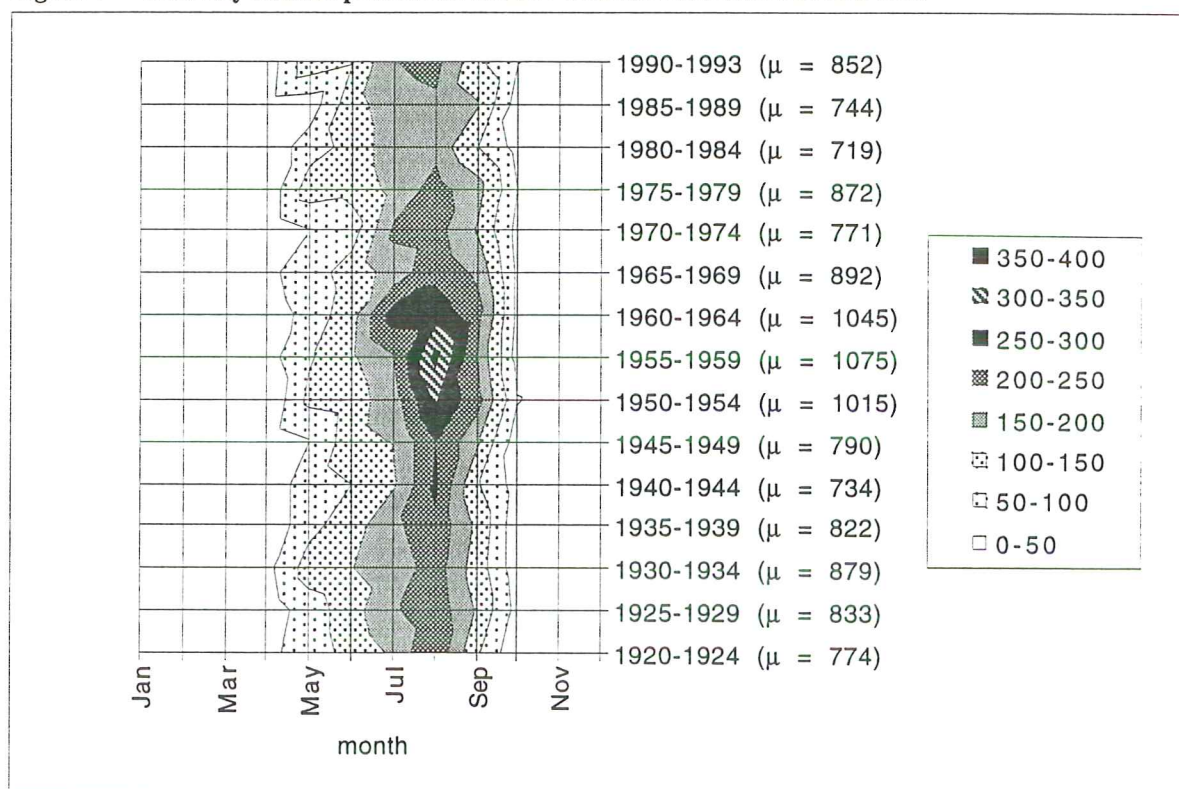
**Figure 3** Monthly rainfall distribution between 1970 and 1994 for three selected stations

Source: Direction Météo in Ouagadougou and for 1994 the Service d'Etudes et Planification in Fada N'Gourma.

Figure 4 shows the temporal variation in the monthly rainfall pattern. The rainfall distribution had a very pronounced peak in August from the early forties until the mid-sixties. Then the peak diminished in size from over 350 mm in the late fifties to just over 200 mm in the late seventies, to disappear altogether in the dry eighties. Only in the early nineties the August peak once again appears with over 200 mm.



**Figure 4** Monthly rainfall pattern for Fada N’Gourma between 1920 and 1993



Source: Direction Météo in Ouagadougou.

Note: The mean annual rainfall is given between brackets.

### 2.1.3 Other climatic data

For Fada N’Gourma the mean monthly insolation varies from 220 hours in August when cloudiness is common to 290 hours in the generally clear skies of January and February. By the end of the dry season (April-May) daily maximum temperatures may reach over 40°C, while in the winter months (December-February) the daily minimum temperatures go down to 15°C to 20°C. During the later period relative humidity levels are between 20% and 40%, while they may reach saturation at the peak of the rainy season in August. Average monthly wind speeds are low and range from 1.2 m/s in September to 2.5 m/s in June. Evaporation is generally high and Class A pan monthly potential evaporation generally exceeds rainfall except for the wettest months of the year. It ranges from 150 mm in August-September to over 300 mm in March-April (INERA 1993).

## 2.2 Geomorphology and soils

Like much of Burkina Faso the eastern region is underlain by the Pre-Cambrian basement complex. In this area the basement complex mainly consists of syn-tectonic granites, some post-tectonic alkaline granites, and some stretches of NE/SW oriented metamorphic intermediate and basic rocks, schists and quartzite. The latter materials are frequently covered by extensive laterite caps (Laclavère 1993).

Except for the occasional granite inselbergs (rock outcrops) and the more regularly occurring ranges of laterite covered hills the area is almost flat with slopes of at most a few degrees. The average altitude is around 300 meters above mean sea level. Most, if not all, rivers in the region are ephemeral, and while some carry water throughout the rainy season others consist of sporadic large discharges following major rain storms. There are no natural lakes, but in recent years an increasing number of artificial lakes (*barrages* and *retenus d'eau*) have been constructed, mainly along roads. Nevertheless many depressions (*bas-fonds*) contain water



throughout the rainy season which make many roads and tracks impassable for several months.

There are four major soil types in the research area: 1) the immature erosion soils on gravelly parent material (*sols peu évolués d'érosion sur matériau gravillonnaire*); 2) the (lessivied) tropical ferruginous soils on sandy and loamy parent material (*sols ferrugineux tropicaux peu lessivés et lessivés sur matériau sableux, sablo-argileux et argilo-sableux*); 3) the vertisols on alluvium or clayey parent material (*vertisols sur alluvions ou matériau argileux*); 4) the tropical eutrophic brown soils on clayey parent material (*sols bruns eutrophes tropicaux sur matériau argileux*) (Laclavère 1993).

The first, the immature erosion soils, have a low physical and chemical fertility. The soils are limited in depth, are sandy and gravelly, have a low water holding capacity, and have low nutrient levels. They occur mainly north and east of Fada N'Gourma. The second group of soils, the tropical ferruginous soils, have a greater soil depth, better water holding capacity, but have lost much of their original chemical fertility through extensive leaching. Especially the topsoil is low in nutrients and is easily physically degraded upon cultivation. These soils occur mainly west and south of Fada N'Gourma, though there are also some patches north-east of Fada N'Gourma. The third group of soils, the vertisols, are rich in nutrients, but are difficult to work and most crops suffer from water stagnation. The vertisols occur mainly south and south-west of Fada N'Gourma. The fourth group of soils, the tropical brown soils, are among the best soils of the region, they are generally rich in nutrients, while their physical structure is much better than that of the vertisols. They are generally deep and have a good water holding capacity. They occur generally in patches north and east of Fada N'Gourma.

### 2.3 Population

The Gourmantché form the majority of the inhabitants of the eastern region. There are two smaller ethnic groups that traditionally live in the area: the Yaama and Zaosé. The Yaama live southwest of Fada N'Gourma in the area of Komin-Yanga, Yondé and Soudougui, whereas the Zaosé live west of Fada N'Gourma in the area around Diabo and Tibga. In their customs and language the Yaama are more closely related to the Mossi than to the Gourmantché. The Zaosé probably have an origin that can be traced back to various ethnic groups such as the Bissa, the Yaama, the Gourmantché and the Mossi (Madiega 1993). The Fulani (*Peulh*) are an important minority throughout the area. Many villages have an associated Fulani quarter, usually a few hundred meters from the Gourmantché quarter(s).

In the last 10 to 15 years there has been a considerable in-migration of Mossi in search for land. Between 1985 and 1991 the Gnagna received almost 4,000 immigrants (1.7% of the 1985 population) from other provinces of Burkina Faso, among them some 1,000 from the Mossi plateau. In the same period the Gourma received 10,250 immigrants (3.5% of the 1985 population) from other provinces, that mainly settled in the rural areas. The largest group, some 6,550, came from the Mossi areas (INSD 1994). Especially south of Fada N'Gourma numerous Mossi have settled in existing and newly formed villages.

Migration to and from neighboring African countries is also an important phenomenon in the region. Between 1985 and 1991 some 2,000 people (0.9% of 1985 population) returned from or came from neighboring countries to the Gnagna and 5,800 people (2% of 1985 population) returned to or went to the Gourma province (INSD 1994).

Table 3 gives the population figures from the 1975 and 1985 census. If the figures are accurate there has been a considerable population growth between 1975 and 1985 for both provinces. The population of the Gnagna almost doubled (190%) in ten years because of natural population growth and immigration. The population of the Gourma increased much less with 150%.



**Table 3 Population in the Gourma and Gnagna (1975 and 1985 )**

Population	Gnagna (8600 km <sup>2</sup> )		Gourma (26613 km <sup>2</sup> )	
	1975	1985	1975	1985
Urban		0		20 857
Rural		229 152		273 378
Total	122 828	229 152	192 331	294 235
Density (inh./km <sup>2</sup> )	14.3	26.6	7.2	11.1

Source: 1975 census and 1985 census.

Although the Gourma province is approximately 3 times as large, it has only 30% more inhabitants than the Gnagna province. The difference is even more marked if we consider that 7% of the Gourma population is urban, that is, lives in Fada N'Gourma. As a consequence the population pressure is much higher in the Gnagna with a density of 26.6 inhabitants per km<sup>2</sup> in 1985 compared with 11.1 inh./km<sup>2</sup> in the higher rainfall Gourma province for that same year.

## 2.4 Agro-ecological zonation

According to INERA (1993) the region covering the Gourma and Gnagna provinces may be divided into two major zones that correspond more or less with the province boundaries.

**Table 4 Zonation of the research area**

Characteristic	North (Bogandé & Bilanga)	Center (Fada N'Gourma & Yamba)	South (Komin-Yanga & Pama)
Long-term mean annual rainfall	400-700	700-900	> 900 mm
Soils (in order of importance)	lithosols on laterite or granite; lessivied or leached gravely ferruginous soils; tropical eutrophic brown soils	immature gravely erosion soils on laterite or granite; lessivied or leached gravely ferruginous soils; lithosols on laterite or granite; tropical eutrophic brown soils; vertisols	lessivied or leached gravely ferruginous soils; tropical eutrophic brown soils; vertisols
Vegetation	tree savanna to bush savanna	tree savanna	tree savanna and open forests
Ethnicity (in order of importance)	Gourmantché, Fulani, Mossi	Gourmantché, Mossi, Fulani	Gourmantché, Mossi, Fulani
Population density (inh./km <sup>2</sup> )	20-50	10-20	<15
Availability of land	limited	medium	good
Level of degradation of natural resources	strong	medium	limited
Particular crops	sorghum, millet, maize, peanuts, irrigated rice, vegetables	sorghum, millet, maize, peanuts, cassava, vegetables	sorghum, millet, maize, peanuts, cassava, yam, sweet potato, vegetables
Migration	emigration	emigration & immigration	immigration
Commercial exchange	limited	medium	limited

Source: This table is derived from INERA (1993), ORSTOM (1976), and field observations.

Their 'Zone Nord' corresponds with the Gnagna province, while their 'Zone Centre-Sud' overlaps with the Gourma province. Looking at the region in more detail we would like to

propose three zones, North, Center, and South. The general characterization of these zones is given in table 4.

Our research concentrates on the Central and Northern zone, to which most of the information given in the subsequent paragraphs pertains.

## 2.5 Agriculture

For the large majority of the population agriculture forms the most important source of their livelihood. For the Gourmantché and the Mossi this first of all concerns arable farming, though livestock keeping is becoming a very important second for many families. For the Fulani livestock raising is still the prime livelihood activity, but arable farming is gaining an increasing importance.

### 2.5.1 Crops

The most important cereal crops of the region are sorghum and millet, both in terms of the area sown and the contribution to the family's diet. Most families also grow some maize. The area under rice cultivation is slowly growing. Other important staples are cassava, sweet potatoes mainly in the south, and yams in the very south. Other important crops are cowpeas, voandzou, peanuts, cotton (mainly in the south), and tobacco. Cowpea is usually grown in association with sorghum or millet. Tobacco is often sown in association with maize by the time the first cobs are harvested. Soya, sesame, okra, and rosella are often grown by women on home gardens or sown in rows in-between other crops. Some villages grow vegetables during the dry season such as (in order of importance according to production): tomatoes, onions, hot peppers, cabbage, eggplant, water melon, lettuce, and carrots. The highest production of these vegetables comes from the Gourma province (CRPA 1980-95). Primarily the men cultivate these garden crops.

The agricultural season begins in April -May with land preparation. New fields and fallow fields are cleared of shrubs and (to some extent of trees). Those who have plows may plow their field, while others manually till the soil in those areas with extensive herb growth. Depending on the onset of the rains sowing takes place in May-June and is followed by a few weeding rounds. Harvesting occurs from August to December depending on the crops and the timing and amount of rainfall received.

Bush products and tree-crops also form an important source of food and cash. Some trees like mangos and guava are grown in orchards or are planted around the concessions, while other trees naturally occur in the area. Among the most important trees are the karité or shea-butter tree (*Butyrospermum parkii*), the néré (*Parkia biglobosa*), the raisinier (*Lannea microcarpa*), and the baobab (*Adansonia digitata*). In practice, however, there is hardly any tree, bush, or herb that is not used for some purpose, be it for food or for medicinal uses. Processing and collection of these natural products is an important dry season activity.

### 2.5.2 Livestock

A distinction can be made between poultry that is kept by virtually all families, small stock that is kept by the majority of families, and large stock that is kept by those who can afford it. Poultry mainly consists of chicken, and often guinea-fowl, but may also include pigeons, and in a few cases ducks. Small stock concerns goats, sheep and pigs, while large stock mainly involves cattle. Donkeys and in a few cases horses are also kept in the area. Table 5 contains some livestock figures for the Gnagna and Gourma provinces.



**Table 5** Livestock figures for the Gnagna and Gourma (early nineties)

Species	Gnagna	Gourma
cattle	249 700	277 800
sheep	220 700	265 200
goats	394 000	339 400
pigs	3 100	16 700
donkeys	10 400	16 600
horses	800	1 000
poultry	640 900	630 400
TLU	205 525	224 690

Source : INERA (1993).

Note : TLU or Tropical Livestock Units were calculated as follows: camel = 1, cattle = 0.7, sheep = 0.05, and goats = 0.05.

From table 5 it follows that livestock densities are almost 3 times higher in the Gnagna, with 23.9 TLU/km<sup>2</sup> than in the larger Gourma province where they are only 8.4 TLU/km<sup>2</sup>. The only exception are the pigs. In the southern Gourma province pigs are more widely held than in the Gnagna. From table 6 we can see that (with the exception of pigs) people in the Gnagna have consistently more livestock than those of the Gourma. This can be explained by the different agro-ecological conditions between the provinces. The poor soils and low rainfall levels of the Gnagna means that many soils are better suited as pastures than as agricultural fields.

**Table 6** The estimated number of animals per person

Animals/person	Gnagna	Gourma
cattle	1.1	0.9
sheep	1.0	0.9
goats	1.7	1.2
poultry	2.8	2.1

Source : INERA (1993) and the 1985 population census for Burkina Faso.

### 3 Patterns of change

What follows is based on responses obtained in general village meetings held during our visits to the Gnagna and Gourma provinces as well as from individual meetings with people from our four principal study villages. People were asked what were the most important changes that had occurred during their lifetime.

Five main categories of changes resulted. The first is the increased importance of money which we found to be equally important in the north as in the south. The second relates to the deterioration of the environment. Although this was mentioned in both provinces, the effects of deteriorating environmental conditions on farming practices is more pronounced in the Gnagna province whereas the effects of migration the other consequence of a deteriorating environment, are stronger in the Gourma province. The third major change was an overall increase in services provided to the villagers throughout the north and south. The fourth change relates to both provinces (and possibly the country as a whole), that is, the changing roles of state and traditional authorities. Finally, the fifth change is the creation of a number of natural reserves in the south of the Gourma province, affecting villages bordering the reserve.

#### 3.1 The increased importance of money

The most frequently given answers point to the increased importance of money. In general this has led to greater specialization, the possibility to consume a wider range of products, the loss of knowledge of certain artisanal skills and agricultural practices, and the gain in knowledge concerning new agricultural practices.

Approximately half a century ago virtually every family grew cotton, just enough to make clothes for its members. The women would spin the cotton and the men wove it. Now instead, most people buy their material (called *pagnes*). Many have stopped growing cotton “and besides,” as an 83 year old woman explained, “the young ones wouldn’t know how to even if they wanted to.” In several villages we encountered abandoned mounds where once men dyed their *pagnes* with indigo.

New crops are being cultivated as a result of their cash value. Rice cultivation has increased as it earns more cash than does cotton. Certain tree species such as the mango, guava, papaya and banana trees are now being grown due to the cash earned through the sale of their fruit. Women also cultivate soya which they did not previously and sell it transformed into *soumbala*, a sort of bouillon cube made of local ingredients used to flavor sauces.

People also mentioned that they are selling more of the millet and sorghum that they cultivate. They explained that they need the cash to buy other goods. Women in particular have gone from working uniquely in the homestead to selling in markets. In general they sell condiments such as *soumbala*, baobab leaves, fish (smoked or fresh depending on the season), hot peppers, rosella, yeast, salt, pepper, tamarind, and shea butter, all used in the sauces that accompany the traditional plate of *tô* (a meal made of sorghum, millet, maize or cassava). Women explained that much of their time is now dedicated to this petty commerce (*petit commerce*) and thus they have no time to do some of the activities that they used to conduct such as spinning cotton. Older women often made fun of the younger ones who couldn’t spin.

Another product that is now sold more is livestock. People explained that whereas formerly they used to keep their livestock especially for its byproducts, now they sell their livestock. This in part explains the increase in numbers of livestock that people own, especially cattle. Since the devaluation of the franc CFA in 1994 livestock has become an even more lucrative activity with the possibility to earn strong foreign currency in countries such as Ghana and Nigeria.

The increased flow of cash in a household has resulted in the purchase of more consumer goods. Whereas people used to cook with earthenware, now most pots and pans are made of



aluminum and bought on the market. Agricultural equipment such as the daba (hoe) is also generally bought on the market. As a result, blacksmiths are less frequently encountered in villages. Furthermore, the traditional blacksmiths that processed raw laterite ore into iron have altogether disappeared since the beginning of this century. Women always cited as an important change being able to clothe their children. Western-style clothing is now available in even secondary markets such as Bilanga Yanga.

International migration, which seems to be more frequent in the Gnagna province, is also a phenomenon related to the increased importance of money. Often young men leave their village to go to Ivory Coast or Niger where opportunities for work are greater. The men go to earn money to accomplish well defined goals: to buy a bicycle, to buy modern clothes, to construct a house, to earn a dowry. This international migration seems at times to cause a type of generational conflict which did not exist earlier. The old folk complain that the young do not take care of them anymore. They leave the elders to cultivate by themselves and the money that they earn seldom goes to benefit the household.

### **3.2 Deterioration of the environment**

Another important change occurring in the lifetime of people interviewed that was virtually always cited was the deterioration in the environment: poorer soils, less rain, and fewer trees. This has consequently changed the way in which people farm as well as their patterns of settlement.

#### *3.2.1. Changes in farming practices*

Poorer soils are the cause of declining yields. Consequently farmers have increased the area that they cultivate. Fields are now larger, meaning that labor time has increased for those farmers who have not purchased plows. There is less land available to leave fallow and thus fallow periods have declined or have been eliminated altogether. As fields are cultivated for longer, the soils become 'old' more quickly. Weeds grow fervently on old soils thus increasing weeding tasks of farmers.

Poorer soils have led farmers to conservation practices that were not previously practiced by their parents. These practices vary by area but in general the application of manure on bush fields and the use of grass mulch are new practices that some farmers now practice. Other soil and water conservation measures such as stone, wood, or stalk bunds are used with greater intensity in the Gnagna than they were approximately half a century ago.

With the decrease in rainfall and the diminishing soil fertility on the higher grounds more and more farmers are cultivating the depressions (*bas-fonds*). Where water does not stagnate for too long sorghum is grown, but in the areas receiving extensive inundations rice cultivation is increasing in importance as is the cultivation of vegetables. In the Gourma, with many areas cultivating rice for the first time, farmers have begun to use earth bunds to retain water on their fields.

The clearing of more agricultural land, the increased need for fodder for the greater numbers of livestock, and the rise in demand for firewood due to an expanding population, have led to fewer trees. Greater livestock numbers has also forced farmers to protect their crops from animals by encircling their fields with branches or fences made of stalks. This is particularly so with cassava fields.

Some farmers have also begun to use plows within the last 25 years.

#### *3.2.2. Patterns of settlement*

The general deterioration of soils has led people to migrate in search of newer, richer soils. The part of the Gourma province south of Fada N'Gourma has received a large influx of



migrants. Mossi have settled there who come from areas around Ouahigouya, Kaya, Boulsa and Koupéla (see maps 1 and 3). Gourmantché coming from the Gnagna province and the Gourma province (north and west of Fada N'Gourma) have also settled there. As a result many new villages have been created within the last 10 - 15 years south of Fada N'Gourma.

Desertification and the increased population pressure have pushed herders southward in search for water and grazing lands. Fulani transhumants are extending their grazing paths southward so that they reach the south of the Gourma province. Other Fulani have settled in the Gnagna and more recently in the Gourma provinces and are cultivating as well as raising livestock. The need for land to satisfy the needs of both agriculturists and pastoralists has led to some social conflicts between the Gourmantché and Mossi on the one hand and the Fulani on the other.

Another aspect of new social patterns of settlement relates to settlement within one village. As people are obliged to cultivate fields further and further from their homes, '*campements de culture*' are formed where people camp by their fields for the entire agricultural season. An increasing phenomenon, which was already mentioned by Swanson (1978) in his study of Gourmantché agriculture, but has intensified over the years, is that these '*campements de culture*' become permanently settled, and become a '*quartier*' or neighborhood of the original village. After some time some of these neighborhoods become villages in and of themselves.

### **3.3 The increased availability of services**

In general, more services and facilities are available to villagers. Women always mentioned the availability of modern medicine through health clinics as well as mid-wives as constituting a big change in their lives. However, when probed further it seemed that not many village women actually gave birth with a mid-wife present due to the time that it would take to get from the village to a health clinic.

Two technologies which have improved the life of women are deep wells and/or water pumps, by making drinking water closer by and of better quality, and the grinding mill, by reducing the time spent pounding grain.

Literacy courses have spread to villages through the work of local NGOs. Villagers seemed to value becoming literate.

### **3.4 The changing roles of state and traditional authority**

During the rule of the late Gen. Thomas Sankara, between 1983 and 1987, traditional forms of authority were abolished. In the eastern region this meant the withdrawal of power from the king of the Gourmantché as well as from the village chiefs in his kingdom. These traditional authorities were replaced with administrators at the province level and administrative delegates at the village level. This gave a chance for people dissatisfied with the chiefs or enemies of the former chiefs to turn against them while at the same time the new authorities were not recognized by villagers. The result varied by village: in some the chief was well liked and continued to exert his authority, in others the delegate was accepted, in others confusion reigned. One of the more visible consequences was that new settlers no longer asked a chief's permission to settle into an area

With the coup of now President Blaise Compaoré traditional forms of authority were reinstated, however the positions of delegates were not abolished. The two forms of authority coexist within the same village. Officially the delegate must report to the state but within the village one often finds the delegate consulting with the chief before acting.



### **3.5 The establishment of natural reserves**

In the south of the Gourma province, a number of natural reserves and a small classified forest were established between 1954 and 1957 (see map 3). This has had various consequences for the inhabitants of the area. Those who lived in the natural reserve had to resettle outside of the designated areas.

Since the recent creation of hunting reserves, more foreign hunters (especially from Europe) have come to the area. These hunters sell their meat to the villagers at reduced prices. The villagers in turn consume it or sell it on the local market.

Hunting legislation made a hunting permit mandatory and thus discouraged villagers to use the reserve as they had previously done. Villagers explained to us that they do not hunt (although we think that some hunting does occur clandestinely), nor fish, nor collect honey anymore, all of which were activities they used to conduct in the reserve.

## 4 Characteristics of the research villages

Considerable effort was put into the process of village selection. We wanted to choose villages that were not along the main routes, but still more or less accessible during the rainy season. The amount of current outside intervention should be limited and the villages should to the degree possible be representative of their area. Based on these and other criteria we visited a total of 26 villages within a 120 km radius around Fada N’Gourma (see map 4). During these visits we were accompanied and introduced by someone from the CRPA or a local NGO.

Of these 26 villages four villages were maintained as principal research villages (from north to south: Tiambaragou, Samboanli, Pentouangou, and Kpendema) and two as secondary research villages (Tampagdi and Binadeni). Three villages were selected in the Bilanga area 80 to 100 km north of Fada N’Gourma and three villages were selected in the area south of Fada (5-60 km). This will allow us to observe the effects of differences in population density, land degradation, rainfall levels, and migration on indigenous soil and water conservation practices. Table 7 gives a summary of the characteristics of the four principal research villages.

Most of our future activities will concentrate on the principal research villages, while the secondary research villages will be used for students to work in and to verify some of our findings for the principal villages in a slightly different setting. The village Tampagdi, for example, was mainly selected because the villagers are very active with soil and water conservation, but in contrast to the other villages are primarily Fulfulde speaking black Fulani and Mooré speaking Mossi. This makes it an ideal village to determine the cultural specificity of some aspects of soil and water conservation and natural resource use.

**Table 7 Summary of the characteristics of the principal research villages**

Features	Tiambaragou	Samboanli	Pentouangou	Kpendema
Department	Bilanga	Bilanga	Fada	Fada
Coordinates	12°33'00" N 0°07'15" W	12°30'00" N 0°04'15" W	11°55'45" N 0°25'0" E	11°36'15" N 0°27'15" E
Rainfall (1970-1994)	645	645	800	835
Population 1985	208	?	565	?
Age	>100 years	>100 years	>100 years	10 years
Number of quarters	2	3	2	9
Ethnic groups	Gourmantché & Fulani	Gourmantché & Fulani	Gourmantché & Fulani	Gourmantché & Fulani
Intervention	non	rural school since 33 years	CRPA since 10 years	CRPA for 5 years, 3 years without, CRPA began again in 1995
Physical characteristics	hilly with gravely soils	slightly hilly with sandy soils	large depression and gravely soils	rich loamy soils
Selection criterion	most isolated	rural school	old village in the south	recently established

Source: fieldwork, Direction Météo in Ouagadougou, population census 1985.



## 5 Soil and Water Conservation practices

Throughout the area soil and water conservation practices may be observed, even in those areas with rich soils and low population pressure. Most of the practices that will be discussed in more detail below are not limited to a specific agro-ecological setting, nevertheless the extend to which these practices are applied is clearly related to rainfall, soils, slopes and population pressure. This means that the further north one goes the larger the area of application becomes. In the following sections the indigenous and the promoted practices will be presented.

### 5.1 Indigenous practices

The indigenous practices may be subdivided in three categories: 1) the construction or engineering practices, 2) the agronomic practices, 3) and the management practices. The first group, the engineering practices, consist of those practices that involve the construction of a barrier to conserve water and/or soil. The second group consists of agronomic practices that enhance the conservation of soil and water, through the way they are done. The third group involves those practices that do not involve construction, but do require some specific effort to enhance the humidity and fertility of the soil.

Table 8 lists the indigenous soil and water conservation practices that were observed in the research area during a first appraisal. As far as the engineering practices are concerned it must be noted that most of the bunds are seldom more than a few meters in length. They are primarily used to prevent excessive erosion around a rill or gully. So far full-length (stone) bunds have only been encountered in the northern part of the research area. There you may find several long stone bunds on a single field. In those areas the soil is generally more gravely, the slopes are more pronounced, and rainfall is lower. In the area around Bilanga a series of ancient stone bunds have also been encountered. These are said to date back to a dry period of several generations ago.

**Table 8 Indigenous soil and water conservation practices in the research area**

Kind of technique	Technique (English)	Technique (French)
Engineering	wood bund	diguette en bois
	earth bund	diguette en terre
	stone bund	diguette en pierre
	stone bund (full-length)	diguette en pierre (grand)
	grass strip	bande enherbée
Agronomic	use of varieties	utilisation de variétés
	variation of planting distance	variation des distance des poquettes
	crop rotation	rotation des cultures
	inter cropping	association des cultures
Management	mulching with grasses	paillage en paille
	mulching with branches	paillage en branche
	mulching with stalks	paillage en tiges
	application of household refuse	application des ordures ménagères
	organic manure	fumure organique
	burning of stalks	brûler les tiges
	fallowing	jachère
	fallow regeneration	régénération des jachères
	parking of animals	parcage des animaux

Source : Fieldwork.

The agronomic practices are widely applied in the area and do not seem to be limited to a specific geographical area. The management practices are also widely used throughout the



area, but some forms of mulching appear to be more widespread in the north, most notably the use of grass mulch. Farmers here say that they observed the use of grass mulch in neighboring Mossi areas such as the Namentenga and Kouritenga provinces. They recognized the utility of the application of a grass mulch and started to use the technique in the mid-eighties. A technique that may warrant some explanation is 'fallow regeneration'. The way the land is cleared of vegetation before cultivation does stimulate regeneration as soon as the land is put under fallow again. Shrubs are seldom uprooted, but usually chopped some 25 cm above ground level. The branches are usually burned around the trunk. As little as a few weeks after the first rains young sprouts already begin to grow around and on the trunk. This means that put under fallow again at a later stage the shrubs are able to recuperate relatively quickly, at least a lot quicker than if they would have to grow from a seed again.

While stalks can be put to many different uses (building, forage, cooking) there seems to be no shortage of stalks in the research area as yet. This differs from the central Mossi plateau where stalks are often required as animal forage or for cooking (Slingerland and Masdewel 1995). As a consequence stalks are often left on the fields after the harvest. Depending on the thickness of the stalks, their quantity, and certain aspects of the physical and chemical condition of the soil stalks are either removed from the field before sowing (through burning) or kept on the field as a mulch. On poor soils farmers prefer to leave the stalks and in this way gain additional organic matter. Often farmers gather stalks to put them on the most degraded spots, where crust formation inhibits proper crop development. This way they hope to enhance the soil structure through organic matter input, but also through increased humidity. Where the soil is in good condition and the stalks are large many farmers frequently prefer to burn the stalks to increase the soil fertility, but more importantly to prevent them from covering and killing the young plants and to prevent the farmers from injuring themselves while working the soil with the hoe. If there are not too many stalks and the field is plowed, the stalks are often left on the field to be incorporated into the earth with the plow.

Organic manure and household refuse is often gathered together in the land preparation phase and deposited in piles on the fields. It may be transported to the fields in calabashes or with a small cart. Before sowing the piles are spread out over the field. Organic manure and household refuse is used mainly on the village fields where maize is grown.

Among all these soil and water conservation practices, farmers tend to focus on the soil conservation rather than on the water conservation aspects (see also Niemeijer 1994). While farmers consider the (perceived) decrease in rainfall as a serious problem leading to lower yields, they generally speak of fertility enhancement and erosion control when talking about the soil and water conservation activities they undertake. For example, the fact that bunds are usually limited to the immediate surroundings of a rill or gully are indicative of the fact that the erosion control aspect is considered more relevant than the water conserving aspect of bunds (which would require full length bunds). The same is true for the various forms of mulching. Soil fertility enhancement and improvement of certain aspects of the physical structure of the soil is more often mentioned as a reason for applying mulch than the increased humidity (which farmers widely see as a positive side-effect).

Many, if not all, of the indigenous soil and water conservation practices found in the research area are not unique to that part of Burkina Faso (see Niemeijer 1994; Dialla 1992). The fact that most of these practices know a very wide geographic distribution would suggest a considerable antiquity of at least some of these practices. Villagers indeed mentioned that these indigenous practices have been used by their parents and grand-parents. It is, however, too early to determine to what extent these practices were used in the past and which practices were abandoned and/or picked up at a later stage.

## **5.2 Promoted practices**

Several soil and water conservation practices are promoted by the extension service (CRPA) and some of the local NGOs, most notably the APRG. Among the promoted practices are the



full length stone bunds (*diguette en pierre*, but more often called *cordon pierreux*). In the area around Bilanga the APRG has been very successful in promoting these stone bunds. Grass mulching (*paillage en paille*) is also promoted as are manure pits (*fosse fumière*) and the use of mineral fertilizer (such as Burkina Phosphate).

A more detailed analysis on the promoted practices will be given in a later report.

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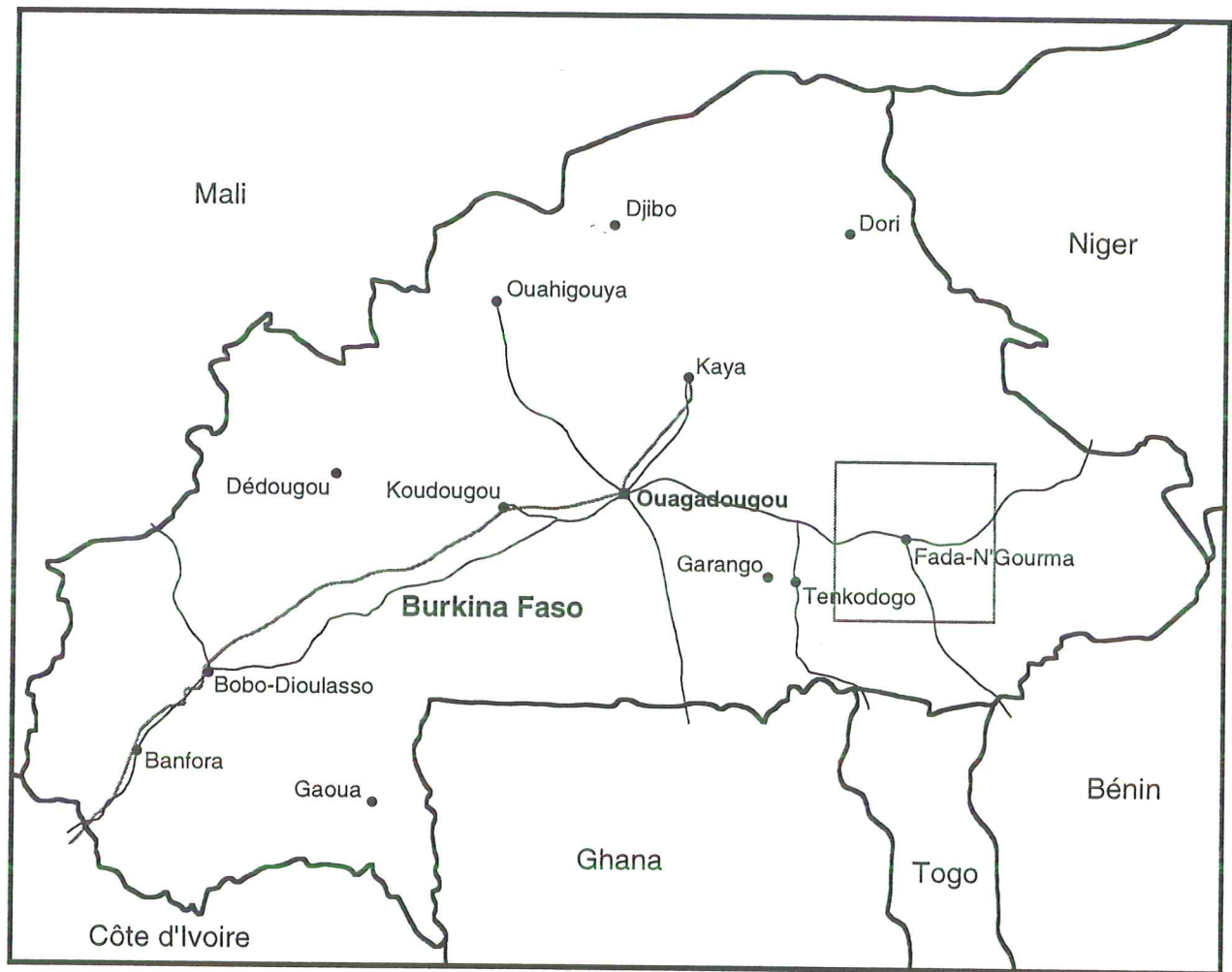


## 7 Appendix

### 7.1 Research activities to date

7 March 1995	Arrival in Ouagadougou
8 March to 6 April 1995	Visiting research institutes and ministries in Ouagadougou; consultation of secondary documents; search for a house in Fada N'Gourma; buying furniture and a kitchen outfit for the house; preparing house; moving into the house.
7 to 17 April 1995	Presenting ourselves to and establishing contacts with the local institutes (CRPA, SPA, SEP, CRRA, Environnement) and NGOs (APRG, TinTua) in Fada N'Gourma; presenting ourselves to his majesty Yuabli, king of the Gourmantché; interviews with potential interpreters.
18 to 27 April 1995	First round of village visits to select research villages; field tests of potential interpreters.
28 April to 15 May 1995	Second round of villages visits to select research villages (in both rounds together a total of 26 villages were visited once or twice); final selection of interpreters.
16 May to 16 June 1995	Visit to the Fada Meteorological Station and Direction Météo (Ouagadougou); four visits to each of the four principal research villages to make village picture books; village mapping in one of the research villages; supervision and installation of a Dutch student in one of the secondary research villages; participation in an ICRA workshop at the CRRA; presentation and discussion of our activities and findings with the local institutes and NGOs.
17 to 23 June 1995	Presentation and discussion of our activities and findings at the Antenne Sahélienne; preparation of questionnaires; instruction of our interpreters/field assistants over their work during our absence.
24 June 1995	Return to the Netherlands.

**Map 1** Burkina Faso and the research area

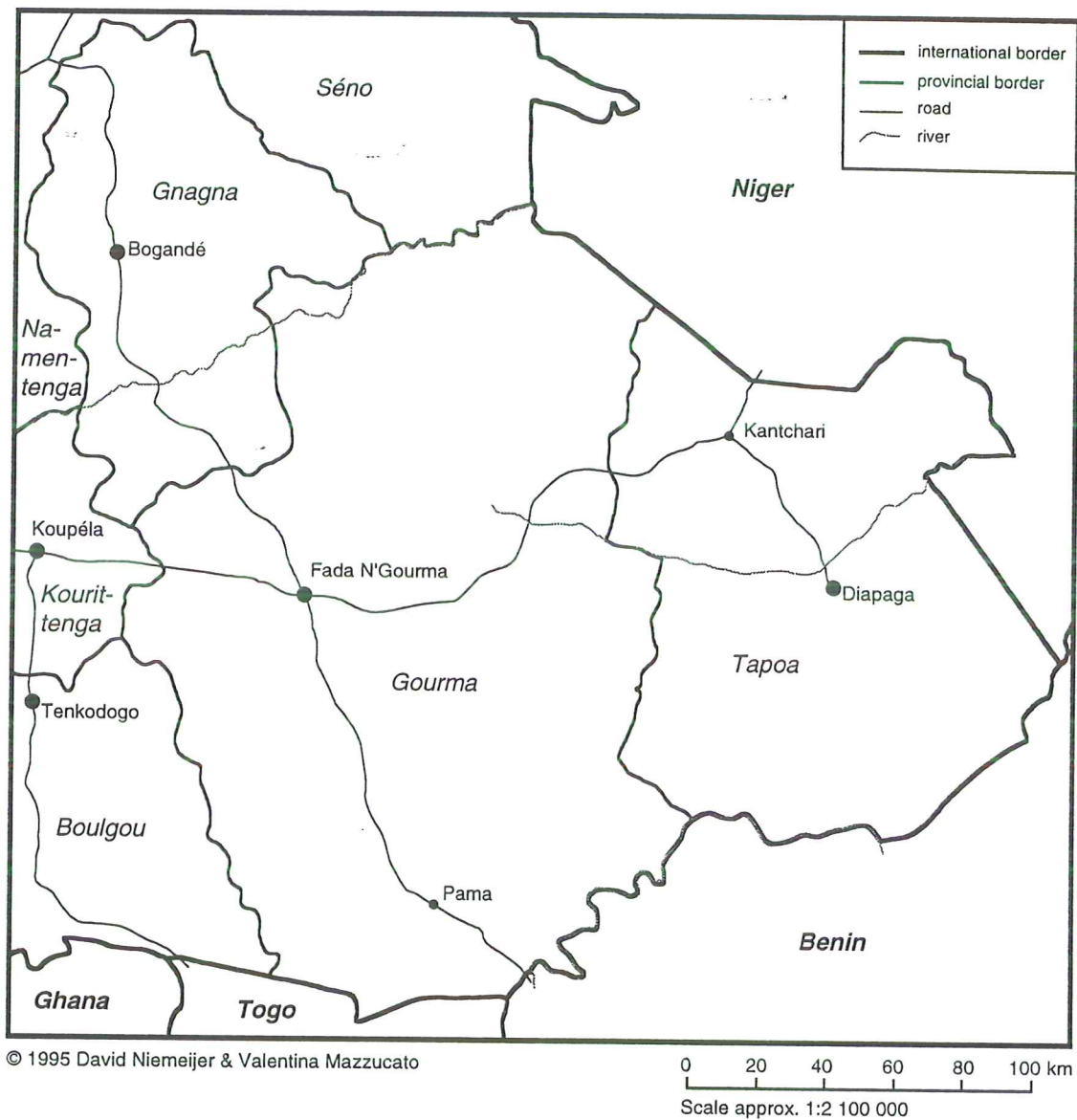


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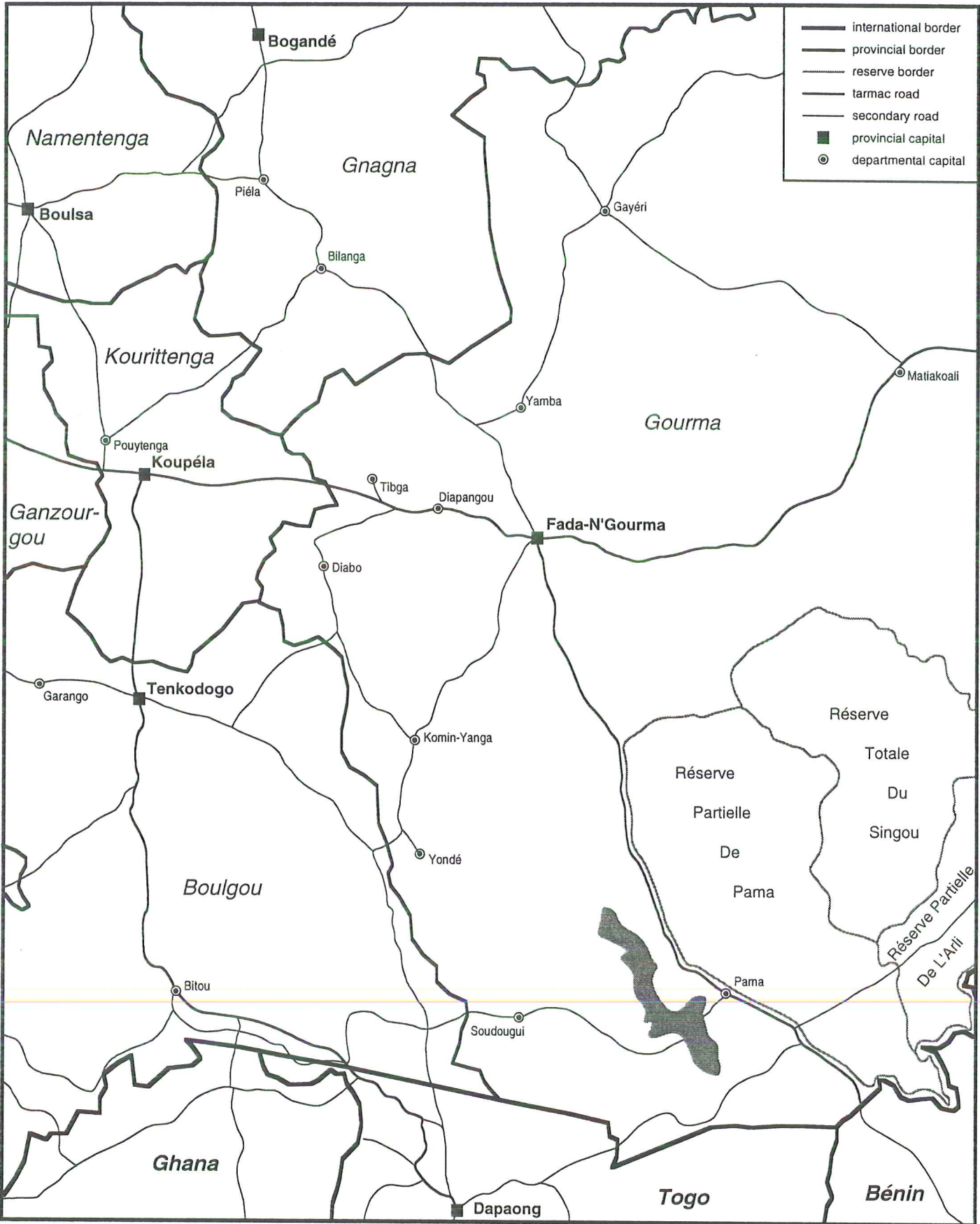
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**Map 2** Burkina Faso's eastern region

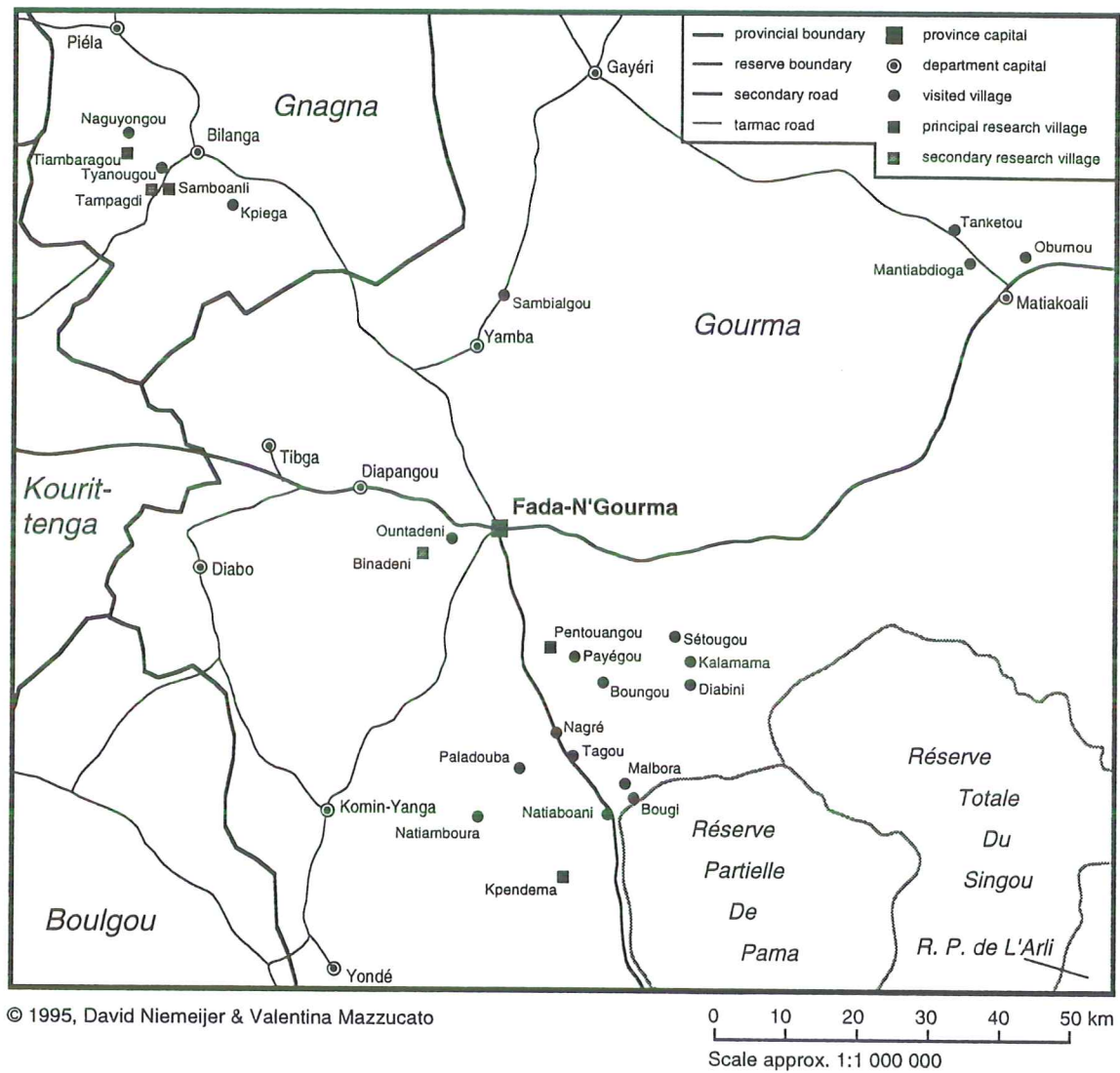


Map 3 The area around Fada N'Gourma





Map 4 The research area





## PUBLICATIONS DEJA PARUES:

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#### Publications de l'Antenne (suite)

- |    |  |  |
|----|--|--|
| 12 | A. Mando,<br>W.F. van Driel &<br>N. Prosper Zombré | Le rôle des termites dans la restauration des sols ferrugineux tropicaux encroûtés au Sahel. Contribution au 1er Colloque International de l'AOCASS: Gestion Durable des Sols et de l'Environnement en Afrique Tropicale, Ouagadougou, 6 - 10 décembre 1994  |
| 13 | A.H.M. Schutjes &<br>W.F. van Driel                | La classification locale des terres par les Mossi: paysans et pédologues parlent-ils le même langage ? Contribution au 1er Colloque International de l'AOCASS: Gestion Durable des Sols et de l'Environnement en Afrique Tropicale, Ouagadougou, 6 - 10 décembre 1994                                    |
| 14 | H.B. Tammes,<br>R.B. Kaboré &<br>W.F. van Driel    | L'effet de la matière organique sur la formation des croûtes et l'érosion des sols sableux au Burkina Faso. Contribution au 1er Colloque International de l'AOCASS: Gestion Durable des Sols et de l'Environnement en Afrique Tropicale, Ouagadougou, 6-10 décembre 1994                                 |
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| 16 | J.J. Kessler                                       | Usefulness of the human carrying capacity concept in assessing ecological sustainability of land-use in semi-arid regions. In Agriculture, Ecosystems & Environment 48 (1994) 273-284  |
| 17 | J.J. Kessler<br>P. Laban                           | Planning strategies and funding modalities for land rehabilitation.<br>In: Land Degradation & Rehabilitation, Vol. 5, 25-32 (1994)   |
| 18 | A. Blokland<br>L. Stroosnijder                     | Sustainable agriculture and food security - a challenge to farmers, research and development in the Sahel. Chapter 4 from: Development-related research collaboration. A second look at the role of the Netherlands, C. Schweigman and I.A. van der Werf(eds), Royal Tropical Institute, Amsterdam, 1994 |
| 19 | J. de Graaff<br>L. Stroosnijder                    | L'évaluation économique des mesures CES au Sahel (présenté lors des 11ème Journées du Réseau Erosion "L'environnement humain de l'érosion, 20-22 septembre 1994, ORSTOM/E.N.S. St. CLOUD-Université PARIS VII)   |
| 20 | E. H. van Haften<br>F.J.R. van de Vijver           | Psychological consequences of environmental Degradation  |
| 21 | L. Stroosnijder                                    | Quantification of nutrient erosion; Conference on Erosion and Land Degradation in the Mediterranean  |

#### Rapports des étudiants (violet)

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|-----|-----------------|---|
| 1   | M. Rietkerk     | Les différences locales du sol et la capacité de régénération: une étude pour la régénération des écosystèmes sylvo-pastoraux Sahéliens, dans la Forêt Classée de Yabo (Burkina Faso)   |
| 2   | S.J.T. Poutsma  | Geografische Informatie Systemen en bodem- en waterconservering: een praktijkvoorbeeld  |
| 3   | J. van Etten    | Mesures de rendement dans les Bas-fonds de Damana, Kawara et Moadougou, rapport de stage  |
| 4   | A. de Wit       | L'effet du bilan hydrique sur la croissance des arbres tropicaux: une étude sur la distance optimale des diguettes à l'aide de quantité d'eau utilisée par l'Acacia Seyal   |
| 5   | A. Florijn      | Etude sur l'impact hydrologique des digues filtrantes sur l'humidité volumétrique du sol dans le bas-fond de Noh  |
| 6A  | H.B. Tammes     | Carte des états de surface du bassin versant de Solmiougou  |
| 6B  | H.B. Tammes     | L'effet de la matière organique des sols sableux de Burkina Faso sur la formation des croûtes et sur l'érosion  |
| 7   | F. Kologo       | Evaluation des techniques de restauration des sols dans les zones sylvo-pastorales de la province du Sanmatenga   |
| 8   | A. Belemviré    | Contribution à l'étude de la cartographie des états de surface et à l'estimation de la biomasse ligneuse aérienne à partir de l'image Landsat Thematic Mapper. Essais de Mesures radiométriques au sol. Etudes menées au Kaya   |
| 9   | S. Idi          | Evaluation des contraintes socio-économiques et techniques des plantations villageoises dans le Sanmatenga: étude de cas  |
| 11  | M. de Haas      | Assessment of aggregate stability of Sahelian soils from Burkina Faso   |
| 12  | O. van Dam      | Recherche du sol et de la télédétection à Kaya, Burkina Faso  |
| 13  | J.C. den Boef   | Les mesures de conservation des eaux et du sol dans trois villages de la province du Zoundwéogo.  |
| 14  | P.A.J. Schaper  | Les mesures de conservation des eaux et des sols dans trois villages de la province du Sanmatenga   |
| 15  | A.R. Vriend     | Un inventaire agro-socio-économique des ménages du plateau central du Burkina Faso  |
| 16  | M.C. Minnaard   | Une étude sociologique sur la coopération autour des mesures des conservations des eaux et des sols, dans un village Mossi, Burkina Faso.   |
| 19  | T. Slaa         | Contribution à la classification des espaces sylvo-pastoraux au niveau villageois dans le Sahel   |
| 21a | A. Bleumink     | La goutte qui se fait déborder la surface: une recherche indicative à l'influence du climat local sur la dégradation des états de la surface  |
| 21b | A. Bleumink     | La goutte qui se fait déborder la surface, supplément: les données obtenues de la station météo   |
| 23  | K.O. Trouwborst | Soil moisture reserve development at soil-water conservation measures in Burkina Faso   |
| 24  | I.H. Janssen    | De invloed van korsten op afstroming en nutriëntenverliezen in de Sahel   |
| 25  | L. Timmer       | Collaborer pour conserver? Une étude sociologique sur les relations de collaboration et les activités collectives dans un quartier d'un village Mossi sur le Plateau Central du Burkina Faso, avec un accent sur les mesures de conservation des eaux et des sols et sur les groupements. |
| 26  | L. Coolegem     | Recherche des intensités de la pluie dans trois stations au Burkina Faso  |



## PUBLICATIONS DEJA PARUES (SUITE):

### Rapports des étudiants (suite):

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|-----|---|--|
| 27  | L.A. Timmer                                     | Une étude sur les buts et les types de taille du néré ( <i>Parkia biglobosa</i> (Jacq.) Benth.) et la relation avec sa structure   |
| 29  | A.T.A. Loozekoot                                | A plusieurs mains l'ouvrage avance! Une étude socio-économique de Barcé, Yakin et Salmintenga, trois villages dans la province de Zoundwéogo au sud de Burkina Faso  |
| 29a | A.T.A. Loozekoot                                | Land degradation, population pressure and agricultural intensification   |
| 30  | J.D. Wijnhoud/A.J. Otto                         | Physical properties of soils in the Kaya area, Burkina Faso  |
| 31  | C.M.J. Jans                                     | Les occupations et les revenus des plusieurs ménages au Burkina Faso   |
| 32  | E. Elkenbracht/A. ten Holte/<br>L. Otter/T.Slaa | Remote sensing and soil science of the Kaya area (Burkina Faso)  |
| 40  | F. Elskamp                                      | Les petits ruminants dans trois systèmes d'élevage dans la région de Manga, Burkina Faso.  |
| 42  | J.A.J. Roovers                                  | Etude des arbres fruitiers du Burkina Faso: DETARIUM MICROCARPUM: étude d'un arbre fruitier: sa phénologie, son milieu et son utilisation. Et: PARKIA BIGLOBOSA: un essai sur la taille.   |
| 44a | M. Kempkes                                      | Analyse financière des cordons pierreux. Cas d'étude de Tagalla, province du Sanmatenga au Burkina Faso.   |
| 44b | M. Kempkes                                      | Enquête socio-économique menée dans la province du Sanmatenga au Burkina Faso durant la période sèche de 1994. Les résultats et leur analyse.  |
| 49  | R. Geelhoed                                     | Les pertes de nutriments dans le ruissellement et le sédiment et l'importance relative d'entraînement  |
| 50  | S.I. Hillenaar                                  | Infiltration characteristics of some selected sites in Zoundwéogo, Burkina Faso.   |
| 51  | J. Suurmond                                     | Rôle de l'élevage dans la zone traditionnelle de la province du Zoundwéogo.  |
| 52  | G. Bazie<br>T. Quedraogo                        | Analyse agro-économique des activités de fertilisation<br>Le comportement des populations rurales face aux nouvelles techniques de gestion des ressources naturelles; L'exemple de la mise en défens du village de Zanamogo (Province du Bam, Burkina Faso). |
| 57  | A-M. de Ruiter                                  | Le rôle du bétail dans le financement d'un ménage rural.   |
| 58  | A.A.C. Jellema                                  | Faire une carte d'utilisation de la terre à l'aide de données-Landsat-TM, de photographies aériennes, et d'observations sur le terrain.  |
| 61a | M.Z. Steenis                                    | Deriving sub-pixel soil characteristics in Northern Burkina Faso with spectral unmixing  |
| 61b | M.Z. Steenis                                    | Remote sensing and GIS as tools for establishing a vegetation map and a pilot tree suitability map in the province of Sanmatenga, Burkina Faso.  |
| 64a | L. de Boer                                      | Genesis of iron crusts in Burkina Faso.  |
| 64b | L. de Boer                                      | Nutrient status of two water catchments in Burkina Faso.   |
| 70  | C. Lafay/C. Ranson                              | Le Paillage: Étude de la prise de décision du cultivateur et des contraintes rencontrées.  |

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