The land has grown old….
Time for changing practices?!

Soil fertility management by small-holder farmers in northern Ghana and its constraints

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Preface

This document is one of the results of a research project on “Smallholder entrepreneurship: a pathway to food security” under supervision of UN Hunger Taskforce member and associate professor of Wageningen University Hans Eenhoorn. The general research aim was to identify constrains that smallholder farmers in northern Ghana face in raising their agricultural production. This specific research was aimed towards soil fertility as an investment basis for entrepreneurship.
We have written this report in order to make accessible our research findings to NGOs, scientists, field workers and students both in Ghana and elsewhere. Our humble wish is that some of its information may contribute to your work or that of others, to whom you are encouraged to pass on the document. We would be grateful if you would share with us any comments or critiques on its contents.

We would like to give a special thanks to Amadou Ibrahim (Sceptical), John Kwase Emanuel (Mr. John), Rafael and Erik for being excellent translators, introducers in Dagomba and Frafra culture and research assistants. We thank Augustin Yelfaanibe for his wise comments on preliminary questionnaires. We thank all those from NGOs, research institutes and our Ghanaian friends for freeing up time to explain us the intricacies of Ghanaian culture and society. We would like to specifically mention: Cees Hageraats, Moses Nabila, Rafael, Erik, Broeder Dick van der Geest, Prof. David Millar, Rafael Flor, James library holder at TICCS, David Akongo, Kees van Veluw. Sincere gratitude goes out to Gertjan Becx, Guido van Hofwegen and Hans Eenhoorn. Without them the research would not have been possible.

But most of all we thank the Dagomba and Frafra farmers whom granted us the time for an interview: Te paya Pam! Barika!

We are fully aware that the expressed views of farmers on extension services and on the constraints they see for adoption, are also a discourse in which they want to portray themselves as hard-working, utterly poor, obediently following extension services, etc. The interviewed farmers had their own agenda, of coming across as socially respectable or as eligible for aid. Whilst we have done our utmost importance to find ‘objective’ answers to our research questions, this influence remains part and parcel of social science. With all modesty, we still hope to have added a little bit to the understanding of the northern Ghanaian farmers’ complex reality. “A” painting of their reality, keeping in mind that "Even if there was only one truth, you could still make a hundred paintings of it" (Pablo Picasso).

Summary

Many organisations (governmental and non-governmental) are actively promoting soil fertility measures like composting, agro-forestry, and increased manure use in villages in Northern Ghana. Adoption rates are low to very low for some practices. This may partly be due to a lack of understanding of the constraints these farmers face in changing their practices. This combined quantitative and qualitative research aims to provide some insights into these constraints.

We interviewed 232 farmers in two regions (Northern Region and Upper East) in Northern Ghana about their soil fertility management strategies. The questionnaire was based on literature review and contained questions on manure use, household waste use, compost making, use of cover crops, fallowing, improved fallows, use of leaves, tree planting, reduced burning, crop rotation, use of human excreta and anti erosion measures. When farmers indicated non-use of the measure they were asked for their reasons not to implement the measure. Besides their own practices, also practices of their parents were analysed to be able to see a possible shift in practices.

Almost all (94 percent) of the farmers face a decline in their soil fertility and over 80 percent see the lowering of the soil quality as an important threat to their farming activities. Continuous cropping – defined by them either as absence of long bush fallows or sometimes no fallow at all – due to increasing population pressure, is seen as the main cause for this decline. From today's generation of farmers, fallowing is practiced by only 61 percent of the farmers compared to 91 percent during last generation. Mineral fertilizers can be afforded – often in suboptimal quantities – by only around half of the interviewed due to high and rising prices.

Comparing today's with previous generation's practices, using manure (from 44 to 54 %), household waste (from 33 to 48 %) and composting (from 13 to 27%) are becoming more popular in Northern Ghana. Increasing population seems to be an important factor pushing this trend, since in most densely populated areas more farmers have adopted these "new" practices. Applying the measures seems not sufficient to stop the trend in soil fertility decline, as the farmers who adopt them are still unsatisfied with their soil. Improved fallow (5 to 4%) crop rotation (from 81 to 80%) and green manuring (from 12 to 14%) do not gain in popularity.

The constraints as seen by the farmers to implement measures are diverse and differ per measure and area. Farmers give as most important constraints for manure use: not having animals, the transport of the manure to the farm, and not being used to it. For the use of household waste and composting: lack of knowledge on composting, the labour requirements, and the transport of the material to the farm. For the use of cover crops: lack of knowledge, expensive and high risk of drought. For use of leaves: no knowledge, no suitable trees, no perceived benefit. For tree planting: availability of seeds, discouragement by high mortality, negative impacts of trees on crop production. For fallowing: high pressure on the land, clearing new land is laborious and costly, people come to beg for the land. For improved fallow: not having fallow land, no knowledge and no perceived benefit and sense of urgency.

Even supposedly low-input technologies demand investments of scarce resources as labour, land or money expenditure on animals or transport. Improved extension, which involves on-farm experimentation with farmers as co-researchers seems key to providing realistic alternatives. This might have to be accompanied by well-targeted small credit or grant schemes.

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1. Introduction

1.1 Problem description

1.1.1 Soil fertility as a constraint for development

Land degradation is seen as a major limiting factor for agricultural production and food security in large areas of Sub Saharan Africa (SSA) (Canadian Food Security Policy Group, 2007; FAO, 2001). Soils are affected by various types of degradation, including fertility decline. Soil fertility decline (also described as soil productivity decline) is a deterioration of chemical, physical and biological soil properties. The main contributing processes, besides soil erosion, are:

- Decline in organic matter and soil biological activity.
- Degradation of soil structure and loss of other soil physical qualities.
- Reduction in availability of major nutrients (N, P, K) and micro-nutrients.
- Increase in toxicity, due to acidification or pollution.

Soils in most SSA countries have inherent low fertility and do not receive adequate nutrient replenishment. Soil productivity in SSA is also constrained by aridity (low rainfall) and acidity. Consequently, yields are relatively low despite the high potential for improvement. When production increase has taken place, this has been obtained by cultivation of poor and marginal lands while the productivity of most existing lands has been declining (FAO, 2001).

As the main source of economic activity in SSA is the agricultural production, declining soil productivity means not only less food is grown but also that production of cash crops and income are endangered. Thus, rectifying land degradation and enhancing productivity through appropriate soil management and conservation can play a major role in achieving farm household food security and agricultural development. With population continuing to increase in all parts of Africa, the need to reverse these declining trends has become more urgent. However to achieve wider impact, soil fertility and productivity enhancement have to be supported by policies with regard to credit facilities, produce and input prices, access to markets and secure land tenure (FAO, 2001).

Also the Ghanaian Ministry of Food and Agriculture has identified soil fertility decline and soil erosion as major constraints to the desired growth rate (Cofie, 2005). Soils that support agriculture in Ghana developed on thoroughly weathered parent materials that have been leached over a long period of time. The two most commonly deficient nutrients are N and P, particularly in savanna soils (Clottey, 2006). As a result, their organic matter content is low (mostly lower than 1%). The build-up of organic matter is further limited by regular burning of crop residues and removal of residues for fuel, animal feed or building purposes.

Strategies to increase crop production through the use of mineral (chemical) fertilizer have been impeded by withdrawal of government subsidies on fertilizer and limited access to credit for farmers. Fertilizer imports declined from 45,000 ton in 1990 to 11,000 ton in 1994, and fertilizer use declined from 4.5 to 2.9 kg ha^{-1} between 1990 and 1996 23 (Cofie, 2005).

1.1.2 No easy fix to soil fertility decline

Mineral fertilizer is often too expensive for small holder farmers. The costs of inorganic nitrogen fertilizer at the farm gate is estimated to be between two to six times higher in sub-Saharan Africa than in Europe or North-America due mainly to higher transportation costs (Donavan, 1996; Sanchez, 2002). With rising fuel prices, also prices for mineral fertilizer will keep rising.

Besides, the addition of mineral fertilizer alone is not enough to retain a sufficient level of soil fertility. If the organic matter in soil decreases, the yield will also decrease, even if a lot of fertilizer is applied. This is due to degradation in the soil structure, a decreased capacity to retain nutrients and water, and an increase in acidity and susceptibility to pests and diseases though loss of soil flora and fauna.
In areas with very weathered, nutrient-poor soils in the tropics an integral approach that combines the application of small quantities of mineral fertilizer with an increase in the level of organic matter is seen as most promising (Schöll and Nieuwenhuis, 2004) (Ouedraogo, 2007)
A variety of other techniques exists to augment soil fertility:

- Mulching
- Green manuring
- Intercropping
- Green/ improved fallow periods
- Agroforestry
- Compost
- Manure (Schöll and Nieuwenhuis, 2004) (animal manure is recommended although human manure use is widespread in peri-urban Northern Ghana!(Cofie, 2005))
- Zero tillage

Adoption of these techniques (where not practiced traditionally like intercropping!) are often low (Bardaji, 2007). Poultry manure and cow dung are scarce (Quansah, 2001) and crop residues are used for fuel, feed or burning purposes. Besides, some of the techniques require a lot of labour. Also cultural taboos can form an impediment (it seems that in some villages there is a taboo on tree planting as this is the ancestor's task) (Bardaji, 2007). Bush fires can be very entrenched in cultural and religious traditions (Kirby, 1999).
In other words, improving soil fertility management cannot be simplified to credit policies for mineral fertilizer access, nor can it be achieved by a pure *teaching* organic methods of soil conservation. Since both methods are build on the false assumption that technology can be transferred independent from its context with farmers as passive adopters (Douthwaite et al., 2001).Participatory extension methods in which technologies are developed together with small farmers may offer more promising results.(Canadian Food Security Policy Group, 2007). Farmers are then not taught a 'package' of technologies, but are invited to experiment with different combinations of technologies (Clottey, 2006). Cultural and spiritual aspects could be incorporated in this process of Participatory technology development (PTD) (Millar, 1999) However, scaling-up is hard when using such methods.

1.2 Research aim

Our research aim is to give insight in the soil fertility management strategies of farmers in northern Ghana. It will also show the limiting factors hindering local smallholders to adopt soil fertility management strategies. This will be done by looking at the initiatives by farmers, extension services and development organizations that (have) take(n) place in northern Ghana.

1.3 Research questions

Our research question is:

1. What constraints do smallholder farmers face in trying to preserve or enhance soil fertility?
    a. Is soil fertility perceived as an important impediment for productivity by farmers? Do they perceive a decline in soil fertility? What do they think are the causes for this?
    b. What soil fertility techniques are practiced/ have been practiced in the past by different farmers?
        i. Animal manure
        ii. Use of compost and organic household refuse
        iii. Fallow and improved fallow
        iv. Cover crops
        v. Use of crop residues
        vi. Burning and non-burning
        vii. Crop rotation and intercropping
        viii. Use of human waste (faecal sludge)
        ix. Mineral fertilizer
    c. What are the impediments and chances according to the farmers of the above named soil fertility management techniques?
    d. What methods or initiatives on soil fertility have been introduced by extension services from government and NGOs? How do the smallholders evaluate these interventions?

1.4 Research strategy and methodology

Before departure to Ghana and in the first week after arrival, literature search was conducted on soil fertility management strategies in general and in northern Ghana especially. Together with expert interviews this formed the basis of developing the interview scheme.

Field research was carried out between March and July 2008. Within eight districts[1] of Northern Region and Upper East a total of 232 farmers were interviewed. Within the Northern Region the following districts were included: Gushiegu/Karaga, Savelugu/Nanton, Tolon/Kumbungu, Yendi, Tamale metropolis and to a minor extent West Gonja. In Upper East: Bolgatanga and Bongo and to a minor extent Kassena/Nankena. Within each district 5 or more villages were selected in which 4-5 farmers were interviewed (see table 1.1 for the villages and annex 4 for district maps). The villages were selected in such a way that they were more or less evenly distributed within the district.[2]

Also within the village we strived for representative samples. The farmers - 4 to 5 in every village- were intended to be selected as randomly as possible from different households spread over the village. Age of the interviewed varies, running from around eighteen up till around sixty years old.

[1] Or nine if we consider the recent split of the Gushiegu/Karaga district. In our data set no distinction was made between these two districts.

[2] The villages of Nwodua (Tolon-Kumbungu) and Wovo-Guma (Tamale Metropolis) however were not chosen 'randomly'. In Nwodua we knew that composting had been introduced and wanted to see whether this was still widely practiced, which it was. In Wovo-Guma we knew that burning out of animist traditions took place, see annex 1.

However, it was not uncommon that a chairman or one of the otherwise more important men in the village had to be granted the first interview. Besides, even more clear is the strong male bias in our research: in Northern Region only 6% of the interviewed were female farmers, in Upper East 25% were women. The even stronger male bias in the Northern Region was due to the difficulty of interviewing female farmers by male interviewers in predominantly Muslim communities. While making comparisons between the two regions, we have taking this gender disparity into account. This sometimes urged us to distinguish between the results obtained when including all interviewed and those that result from excluding female interviewed from the sample. Unless explicitly stated otherwise – and extra "male-only figures" can be found between brackets - all the interviewed are included in the tables.

Table 1.1 Villages included in the research by district and region

Region	District	Villages
Northern Region	Gushiegu/Karaga	Zinindo
	Savelugu/Nanton	Balshei, Sahakpalago, Libga, Dipali, Saakpuli, Dikpun, Dingoni, Chahayili.
	Tamale Metropolis	Taha, Wovo-Guma
	Tolon/Kumbungu	Tunayili, Dabogshe, Nwodua, Sabegu, Voggu, Kasuridabarshi (alternative spelling Kasulyiki Dabogshe)
	Yendi	Sanchebu
Upper East	Bolga	Sherigu, Shiega, Sumbrungu, Yorogo Yipaala, Zanterugu
	Bongo	Bogorogo, Gowrie, Samboligo, Walega, Yinduri, Zogo
	Kassena/Nankena	Nimbasinia Guinia

The farmers were asked about the ways they improve their soil quality. Questions were asked about manure use, use of household waste, compost making, use of mineral fertilizer, fallowing, improved fallow, use of cover crops, use of human excreta, crop rotation, anti-erosion measures, and non-burning practices. We asked the farmers to answer the question's taking into account last year's farming cycle (2007). Besides, they were often asked to answers whether their father/mother used the specific method when they themselves were children. When farmers were not performing the above mentioned practices to increase soil fertility we asked for their reasons for non-use. The full questionnaire can be found in Annex 2.

The interviews were conducted by us with the help of translators. Also we got the help from graduated University of Development Studies (UDS) students to collect the data.

Data were inserted and analysed in SPSS.

Besides, NGOs, GOs and research institutes were visited, namely:

- ACDEP (of which Savannah Farmer Marketing Company is part),
- ACDEP-partner "Mile 7" (talks on micro-credit, market access and soil fertility management),
- Soil Research Institute (talks on soil fertility management)
- Masloc (Micro-finance and Small loan centre, government led)
- Lowland Rice Development Project (extension, credit, cash crop, processing etc.)
- OIC (on their program helping deprived communities in soil management, post-harvest loss reduction etc)
- CARE International (on bush-fire management)
- Zasilari Ecological Farmers Project (ZEFP)

These interviews with experts from the field helped to revise our interview scheme and improve the quality of interpretation.

1.5 Description of the study area

The fieldwork of this research took place in two regions in Northern Ghana: Upper East and Northern Region (see Figure 1.1).

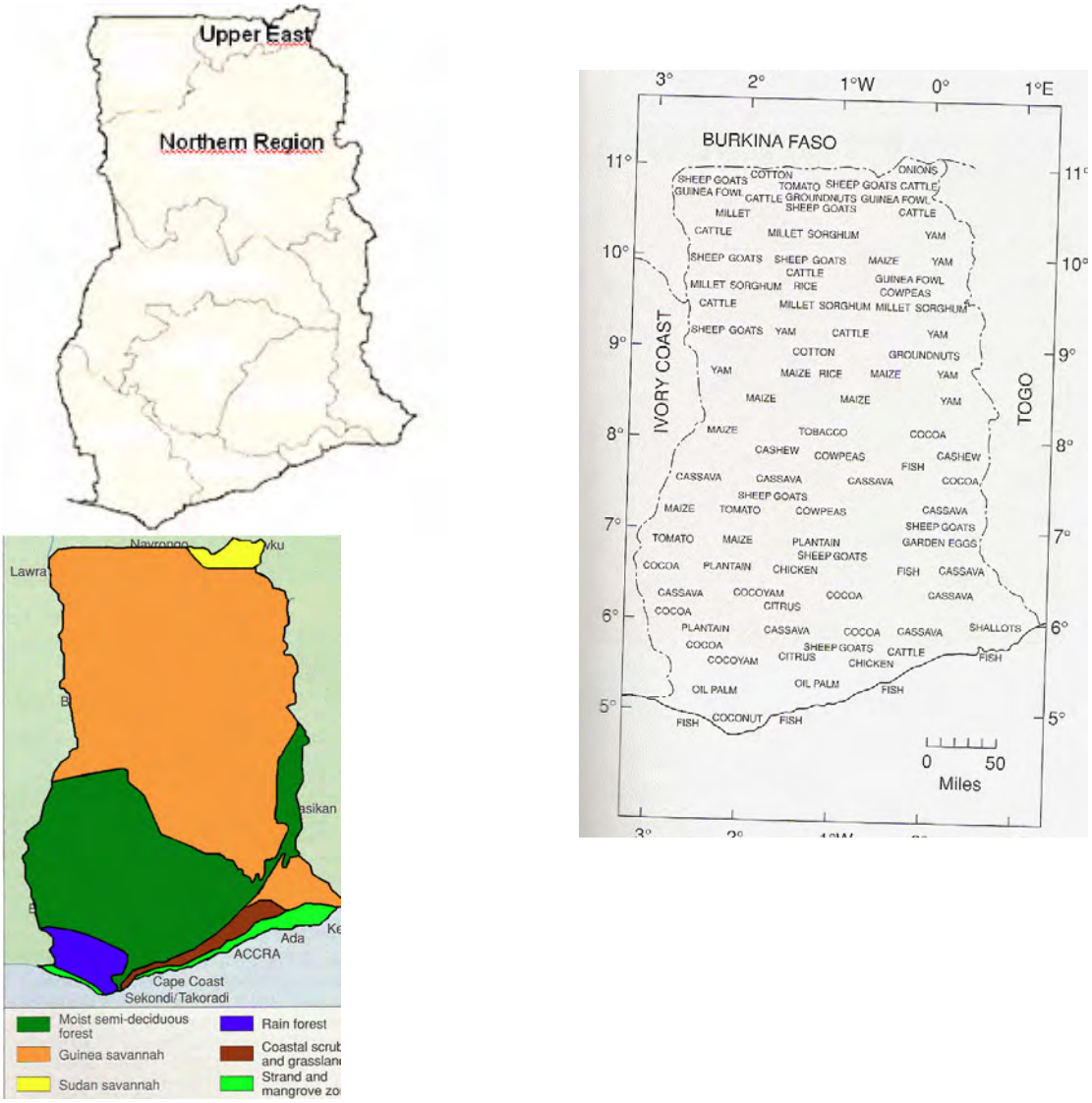

Figure 1.1Maps of Ghana[3]

1.5.1 Climate and vegetational zones

Northern Ghana has a semi-arid climate. Rainfall is erratic and varies from 1000 to1250 mm annually. Its annual pattern is unimodal and the raining season is from July till September. Rainfall is gradually higher in the south, where its pattern is bi-modal and two cropping cycles can be achieved annually. In the Northern Region the length of the growing season is on average about 220 days a year and in

[3] http://www.csuniv.edu/ghana/TLG%20Lessons%20Files/EffectofClimateonGhanasAgriculture.pdf

Upper East it is 190 – 209 days. The dry season from November till April includes a period with exceptionally strong winds, the harmattan.
The vegetation consists predominantly of grassland, especially savannah with clusters of drought-resistant trees such as baobabs or acacias. Northern region is wholly part of the Guinea savannah vegetational zone, Upper East mostly falls in the Sudan savannah, which is more arid and more influenced by the winds of the Sahara desert.[4]

1.5.2 Farming

Most of the people in the rural areas are farmers that live on or below subsistence level. By growing crops and keeping a few animals they mostly manage to produce just enough crops to feed themselves and their families, with small surpluses being sold to the market. Small ruminants and a few cattle are mostly kept as a "bank account" to be sold when hardship hits the family. In Northern Region maize is the most grown important crop together with yam, cassava, guinnea corn, groundnut, rice and in some villages soybean. The most important crops in Upper East are: millet (early and late), groundnut, guinea corn, rice, beans and bambara beans.

1.5.3 Population

Population densities are generally much higher in Upper East then in Northern Region although Tamale Metropolis is most densely populated (See Table 1.2).
Population in both Northern Region and Upper East have been increasing by 2,8, resp. 1,1 percent annually from 1984 to 2000 (Ghana Statistical Service, 2005), boiling down to a doubling of population in 26 resp. 63 years. Growth in Northern Region was even higher before 1984, calculated at 3,4 percent on annual basis between 1970 and 1984. Nowadays, population growth rates seem to lessen. Ghana's average growth rate in was estimated at 2.07% in July 2006 (FAO, from World Factbook) in July 2008 at 1.93 %.

Table 1.2 Population numbers of the visited districts (source: Ghana Statistical Service) and the average farm size of these district (source: interviewed farmers)

District	Population density (inhabitants per km^2)	Farm size including fallow land[5] (Acres)
Northern Region		
Gushiegu/Karaga	21	16,0 (n=29)
Yendi	32	16,1 (n=27)
Savelugu/Nanton	41	14,0 (n=29)
Tolon/Kumbungu	55	13,9 (n=20)
Tamale metropolis	408	9 (n=14)
Upper East		
Bolgatanga	155	14,8 (n=4)
Bongo	183	9,6 (n=9)

[4] http://www.fao.org/WAIRDOCS/X5426E/x5426e03.htm
http://en.wikipedia.org/wiki/Northern_Region,_Ghana

[5] Sizes of the total farmland are as indicated by the farmers. This information can only be used as indication of the size. It was not easy to define a total farmsize with the farmer. It was not easy to define a land size together with the farmers who are mostly illiterate and not always able to calculate. Since land sizes were not the main focus of our research we decided not to spend too much time in making the fit perfectly.

When comparing the population density with the farm sizes in as shown in table 1.1 a trend can be observed. In districts with the highest population density the farm sizes tend to be smaller and where population density is lower farm sizes tend to be somewhat larger.
Upper East and Northern Region furthermore differ with respect to the dominating religion. Upper East is generally Christian, while Northern Region has more adherents to the Islamic faith. Traditional African religion – animism – also plays a big role for many of the people.

2. Farmer's perceptions on soil fertility

The type of soils in the research area are classified as Savanna Ochrosols (sandy red uplands, where groundnut, soybean, maize are usually cultivated), and Groundwater Laterites (clayish white lowland where usually yam, maize, and if waterlogged, paddy rice is cultivated) and transition soils.

Of the interviewed almost 30 % indicated to be content with the quality of their soil (Table 2.1). Interviewees in Northern Region were considerably more content (38 %) than those in Upper East where only 10 percent of the farmers indicated satisfaction with their soil quality. In Yendi about two thirds of the farmers believe their soil is still "somehow strong" (Table 2.2). Dissatisfaction is greatest in Bongo; none of the interviewed was happy with the quality of their soil. Declining soil quality can be correlated with increasing population pressure. However, in Gushiegu/Karaga – the district with the lowest population density – less then a third of the farmers is satisfied; is this due to a poor inherent soil quality or a soil with a great sensitivity to degradation?

Both in NR and in UE most farmers (above 90 %) face a decline in soil quality.

Table 2.1 Percentage of farmers in EU and NR that is content with the quality of their soil. In the second column the percentage of farmers that face a decline in soil quality.

	Content?	Face a decline?
Northern Region	38 % (n=144)	93 (n=134)
Upper East	10 % (n=60)	97 % (n=61)
Total	29 % (n=204)	94 % (n=195)

Table 2.2 Percentage of farmers in the districts that is content with the quality of their soil. In the second column the percentage of farmers that face a decline in soil quality.

Region	District	Content?	Face a decline?
Northern Region	Gushiegu/Karaga	31 (n=29)	96 (n=28)
	Yendi	65 (n=34)	87 (n=31)
	Savelugu/Nanton	42 (n=36)	91 (n=34)
	Tolon/Kumbungu	16 (n=25)	91(n=23)
	Tamale metropolis	11 (n=25)	100 (n=23)
Upper East	Bolgatanga	16 (n=31)	100 (n=31)
	Bongo	0 (n=25)	92 (n=26)

Most of the farmers (over 80 %) see the low/ lowering quality of their soil as an important threat to their farming activities. A few farmers see soil fertility as a minor problem compared to other problems. They mention lack of rainfall, lack of money to buy mineral fertilizer or tractor services, weeds, scarcity of land, and unavailability of seedlings or labour, and animals that destroy crops as more important constraints.

The reasons for the decline in soil fertility as perceived by the farmers is presented in table 2.3.

Table 2.3Cause of the decline in soil quality according to the farmers (in percentage) Note: Sum of the percentages can be higher than 100 due to the multiple reasons named by some interviewed farmers for the decline in soil quality.

	Northern region (n=131)	Upper East (n=60)
Continuous cropping	70	50
Inadequate rain	7	37
Fertilizer use	7	
Cattle	6	
Tractor ploughing	3	
Non-burning	2	
Burning	16	20
Reduced vegetation	1	3
Erosion	1	7
Non fertilizer use		10
Non manure/compost use		17

Most farmers believe the decline in soil quality is due to the continuous cropping on the same piece of land without leaving the land to fallow: "Because of overpopulation we cannot leave the land to rest anymore and that is why the land becomes exhausted" is an answer that many farmers will give.

> "The soil has become old by the continuous cropping. It is like a woman: a mother who bore ten children does not look the same anymore as a young lady, a fresh wife".

Also the lack of rain is in the eyes of the farmers, especially in UE, a factor that decreases the quality and fertility of the soil. According to a farmer the lower rainfall leads to decreased plant growth and because of this less organic material that could decompose and enhance soil fertility. Others say:

> "It is the drought: a lack of enough rain makes the soil very hard"

Twenty percent of the farmers see burning as a reason for soil fertility to decrease. Some farmers tell that the first year after burning the soil is a bit better than it was before the burning but that this benefit from burning turns into a disadvantage in later years:

> "The land becomes acidic after two years of farming after burning it for preparation, the burning for preparation is the problem"

On the other hand, two farmers in NR believed non-burning to be a reason of low soil quality: "We don't have trees to burn in our farm anymore and as you know burning of trees helps to increase soil fertility"

In Northern Region where fertilizer is more commonly used (see Chapter 12), 7 percent of the farmers think that fertilizer has declined the quality of the soil: "Continuous use of fertilizer depletes the soil and makes the soil addicted to it". In UE not a single farmer spoke about the negative aspects of artificial fertilizer. On the contrary, 27 percent of the farmers in the UE thinks the soil quality had gone down due to the inability to replace nutrients (10 percent by fertilizer and 17 percent by manure/compost). In Northern region, this inability of replacing nutrients is mentioned not as a cause for fertility decline, but as a mitigating strategy that can unfortunately not be employed:

> "Soil fertility is not the main problem, the cost of fertilizer is. If a decline is accompanied by the ability to use fertilizer, it is not a problem."

In NR some farmers spoke about the negative aspects of (strange) cattle on the soil: "Cattle step on the land and makes it very hard to plough. It also affects the plant growth and the yield".
In Upper East problems with erosion are more severe. There erosion is more mentioned as cause of soil quality decline.

3. Livestock ownership and manure use in Northern Ghana

3.1 Use of animal manure as soil fertility management strategy

Table 3.1 shows the current use of animal manure by the interviewed farmers and the use of manure by their parents (of the same gender as the interviewed) during the interviewee's childhood. A substantial difference can be noted between the two regions: 90% of the interviewed in Upper East uses animal manure for soil improvement, while only an average of 40% of their colleagues in Northern Region do so. In table 3.2 we can see, how the lower average use of manure in Northern Region conceals major differences amongst its districts: while amongst the interviewed in Yendi only 11% used manure during the 2007 growing season, in more densely populated Tolon/Kumbungu this was 74%. (Not to conclude that population density is wholly explanatory as in the most densely populated Tamale Metropolis no more than half of the farmers used manure)

Table 3.1 Current and past use of animal manure by region in percentage.

Region	Animal manure use by farmer	Animal manure use by parent in past
Northern Region (n= 167)	40	18
Upper East (n = 62)	90	98
Total (n = 229)	54	44

Table 3.2 Current and past use of animal manure by district[6] in percentage.

Region	District	Current manure use	Past manure use
Northern Region	Gushiegu/Karaga (n=31)	29	29
	Savelugu/Nanton (n=45)	44	14
	Tamale Metropolis (n=22)	50	22
	Tolon/Kumbungu (n=31)	74	10
	Yendi (n=36)	11	17
Upper East	Bolga (n=31	87	97
	Bongo (n=27)	93	100

In table 3.3 we can see that this higher use of animal manure in Upper East is applicable to all specified types of manure: cattle, small ruminants, poultry and pig manure. In addition, several interviewed farmers in Upper East indicated the use of donkey manure. Rearing pigs is not common in the predominantly Muslim Northern Region. It should be noted that the figures for both regions would probably diverge even more, if the percentage of female farmers included would be equal[7]. A gender trend could be discovered in the figures (though not significant due to low sample size): although women and men answered equally to the question of whether they used *any* animal manure last year, women's access to cattle and small ruminant manure seems limited/hampered.

[6] Kassena/Nankena and West Gonja have not been included in this table due to the low number of interviewed in these districts.

[7] In Upper East relatively more women were interviewed.

Table 3.3 Current and past animal manure use specified by type of animal in percentage.

	Northern Region		Upper East		Total	
	Current use	Past use	Current use	Past Use	Current	Past
Cattle manure	23	15	80	97	39	41
Small ruminants	27	5.8	81	93	42	34
Poultry	22	4.2	80	97	39	35
Pig	0.7	0.0	31	10	10	3.4

In table 3.1, 3.2 and 3.3 we can see that in the past the difference between the regions was even more pronounced: while an even higher percentage of the earlier generation was using animal manure in Upper East (98%), in Northern Region this was much lower (18%). Could the slight decline in use of animal manure in Upper East, be explained by the slow recovery of the herds after the dying/and selling of animals during the big droughts in the end of the 1970's and beginning of 1980's? The Northern Region was historically seen less apt for cattle (and donkey and horse) rearing as Upper East due to the higher prevalence of tsetse induced bovine trypanosomoses (sleeping sickness)[8]. In the Northern region the significantly augmented manure use – a six fold increase in Tolon Kumbungu - is explained by the interviewed mostly as a consequence of declining soil fertility: "In the days of my father, the soil was still fertile so there was no need for manure application."

3.2 Animal ownership

Mean figures on livestock/ rural household (or in this case total amount of animals/ interviewed) give a false picture of the livestock actually owned by the majority of households. While the mean number of cattle owned per interviewed was around four, the majority of the interviewed in Northern Region owns no cattle at all. Distribution of cattle owned by households and by individual household members is highly unequal. This inequality also goes for small ruminant and pig ownership to a lesser extent.

In table 3.4 the distribution of livestock amongst the interviewed can be observed. While only a slight difference can be noted between the regions when comparing the total interviewed, the figures in brakes show how a quite distinct picture arises when the female respondents are excluded from our calculation. Women do customarily not own cattle. In Upper East a majority of the male interviewed owned at least one or a few cattle, with a median of two cattle/male interviewed (when women are included this is only half a cow/interviewed). In Northern Region the majority owned none at all, with a median of zero cattle/interviewed. Nonetheless, really big herds can be found relatively more in the Northern Region. This is also due to the presence of more Fulani families in the Northern Region (of which 3 were included in our research). Or is it the other way round: since there are some people with big herds Fulani are more attracted to the Region? We will come back to these cattle herding systems in paragraph 3.5.

[8] http://www.fao.org/wairdocs/ILRI/x5474E/x5474e0f.htm
C.I. Mahama H.A. Mohammed M. Abavana, I. Sidibé A. Koné S. Geerts, *Tsetse and Trypanosomoses in Ghana in the Twentieth Century: a Review* Revue Élev. Méd. vét. Pays trop., 2003, 56 (1-2) : 27-32 http://remvt.cirad.fr/cd/derniers_num/2003/EMVT03_027_032.pdf

Table 3.4Cattle ownership by region in percentage (figures in brackets are results when only male interviewed were counted)

Number of cattle owned/ per household	Northern Region (n = 133)	Upper East (n=57 incl. 43 male)	Total of male (n=170 male)
None	56	50 (37)	52
1 – 5	20	38 (49)	27
6 – 10	10	9.9	9.9
> 10	12 (includes 3 Fulani!)	3.4	10.5

Once more however, difference between districts (see table 3.5) within a region may be higher than between regions. When looking at the male interviewed, Tolon/Kumbungu is comparable to Bolgatanga in terms of the percentage of people owning at least one cow (more than 52 - 57%). In Yendi however 75% of the interviewed owned no cattle at all.

The dominant cattle breed in the north of Ghana is the small indigenous trypanosomoses (sleeping sickness) tolerant WASH (West African Short Horn). Towards the border with Burkina Faso, northern breeds, such as Zebu ('Fulani'cattle), as well as cross breeds, are increasingly found. These animals are notably larger and heavier and would thus produce considerably more dung. However, earlier data suggest, that these types of cattle do not make up more than 10 to 15 percent of the total (SNV, 2007).

Table 3.5 Cattle ownership by district in percentage (figures in brackets are results when only male interviewed were counted, this is not done in NR where leaving out females hardly had any influence)

Number of cattle owned/ per household	District	None	1 – 5	6 – 10	> 15
Northern Region	Gushiegu/Karaga (n=28)	57	30	6.7	6.7
	Savelugu/Nanton (n =33)	57	20	11	11
	Tamale Metropolis (n=18)	61	11	5.6	22
	Tolon/Kumbungu (n=25)	42	27	12	19
	Yendi (n=23)	75	4.2	13	8
Upper East	Bolga (n =27 incl.23 male)	56 (48)	41 (48)	0 (0)	4
	Bongo (n=26 incl.17 male)	54 (29)	27 (41)	15 (24)	4 (6)

For small ruminants we could reach more or less the same conclusion: when we account for the relatively higher number of female interviewed in the UE, there seem to be (NOT significant) more people that own at least one sheep or goat in Upper East (see table 3.6). The median number of small ruminants owned in NR is 7, while in UE this is 9 or 12 when women are excluded from the count.

Table 3.6 Small ruminant ownership by region (numbers in brackets are male respondents)

Number of small ruminants owned	Northern Region (n=137)	Upper East (n =57 incl. 43 male)	Total of mal (n=175 male)
None	23	21 (9)	19
1 – 6	26	23 (21)	25
7 – 12	20	19 (26)	22
13 – 18	11	19 (23)	14
> 18	20	18 (21)	20

Pigs were owned by none of the interviewed in NR, and by 30% of the male interviewed in UE, with an average of 4-5 pigs per interviewed. These differences can be explained by religion, as pork consumption and keeping pigs is prohibited in Muslim religion.

3.3 Influence of ownership on manure use

The lower use of animal manure in Northern region cannot solely be explained by lower livestock ownership (see table 3.7): about 61% of the interviewed in UE who did not own cattle still used cattle manure (against 7% in NR) and 31 % of those who owned more than ten cattle in NR still not used its manure (against 0% of non-use in UE). Also for small ruminants we could see this distinction (see table 3.8). Those who did not have their own livestock, either received manure from relatives or more often collected manure lying around.

Table 3.7 Cattle manure use (in percentage) in NR and UE for farmers owning no or more than 10 cattle

Cattle owned	Uses cattle manure	
	NR	UE
None	7 (n=73)	61 (n=28)
> 10	69 (n=16)	100 (n=2)

Table 3.8 Small Ruminant manure use (in percentage) in NR and UE for farmers owning no or more than 12 ruminants

Small ruminants owned	Uses small ruminants manure	
	NR	UE
None	6 (n=32)	46 (n=11)
> 12	65 (n=41)	100 (n=20)

3.4 Animal herding systems

Not all those interviewed that own cattle also have actual access to its manure. Table 3.9 shows the different herding systems in place in the regions and indicates where the cattle stay overnight and thus release most of their droppings. Amongst the interviewed in Northern Region who reported that they owned cattle, only 40% actually keep them in their own kraal or compound. We have reason to believe that for all cattle owners in NR this percentage is still overestimated, as many farmers who have their cattle staying with a relative simply did not report them as their property: “My father is still alive, so my cattle are under his custody, they are family property so I cannot report them as my property. Anyhow I have no access to the manure.” According to tradition most cattle belong to the family head – the eldest living male – and are to stay together in his herd, to be used only for family expenses like funerals, weddings etc.

Besides, in Northern Region, about half of the cattle owner’s gives their cattle to Fulani to herd. The Fulani herds the cattle of a few different cattle owners. In exchange for his labour, he can use both milk and manure. Large cattle owners sometimes engaged Fulani on an individual basis. Some owners made agreements with the Fulani to share the manure: the cattle are kraaled dynamically, alternating between the owner’s and the Fulani’s field. Many of our interviewed expressed that the main reason for hiring the services of a Fulani is the decreased availability of child labour due to schooling. Even though the relationship with the Fulani is sometimes bad – “They are thieves” – people do not often renounce the contract due to this labour unavailability. It has been suggested (SNV, 2007) that in districts with high population density, more people keep their cattle at home. Although this trend can be seen in our figures, it seems not to be a matter of rule (see Table 3.10): in Tamale Metropolis still around 40% of the interviewed gives his cattle to Fulani to herd. In Tolon-Kumbungu 80% keeps them at home, but according to the interviewed “we always herded our own cattle, Fulani-herding is not our custom”. In Upper East, it seems Fulani herding has never become a custom. This might be due to the

high population density, leaving little bush to roam faraway with the cattle. Or should it be explained by the religious differences between the two regions: was it easier for the Muslim Fulani to find employment in the predominantly Muslim Northern Region than in the Christian Upper East?
Only the two interviewed in Kassena/Nankena and one in Bolga reported free-ranging of cattle at daytime during the dry season. Zero-grazing seems not to occur.

Table 3.9 Herding system for cattle by region

Herding system/ Overnight staying	Northern Region (n=62)	Upper East (n=25)	Total (n=87)
Owner's kraal or compound	40	84	53
Fulani's kraal	42	0	30
Fulani's and owner's kraal, manure shared	6.5	0	4.6
Stay with relative	11	0	8.0
Stay with relative, manure shared	0	16	4.6

Table 3.10 Herding system for cattle by district

Herding system/Overnight staying	District	Owner's kraal or compound	Fulani's kraal	Fulani and owner's kraal, manure shared	Stay with relative	Stay with relative, manure shared
Northern Region	Gushiegu/Karaga (n=14)	21	57	7	14	0
	Savelugu/Nanton (n=17)	29	47	12	12	0
	Tamale Metropolis (n=8)	38	38	13	13	0
	Tolon/Kumbungu(n=16)	81	6	0	13	0
	Yendi (n=7)	14	86	0	0	0
Upper East	Bolga (n=12)	83	0	0	0	17
	Bongo (n=10)	80	0	0	0	20

For small ruminants the dominant herding system in daytime is free-ranging during the dry season and tethered or watched over (mostly by children of other household members) during the farming season. In table 3.11 we can see where the small ruminants stay at night. In Upper East, the dominant system is semi-intensive: small ruminants are confined during the night time in shed or compounds. In Northern Region about half of the respondents had their goats and sheep confined at night, the other half left them free-ranging also during night time (except during the farming season). Intensive systems with zero-grazing do not seem to occur for small ruminants either.

Table 3.11 Small ruminants overnight staying by region

Overnight staying	NR (n=103)	UE (n=34)	Total (n=137)
Confined in shed/compound	52	100	64
Free-ranging	49	0	37

Again, Tolon/Kumbungu district was an exception in its region (see table 3.12: 92 % had their small ruminants sleep in sheds year round. A semi-intensive system facilitates manure collection. In the districts with low population density like Yendi and Gushiegu/Karaga not more than 30% adopted a semi-intensive system.

Table 3.12 small ruminants overnight staying by district

Overnight staying	District	Confined in shed/compound	Free-ranging (except for farming season)
Northern Region	Gushiegu/Karaga (n=23)	30	70
	Savelugu/Nanton (n=24)	54	46
	Tamale Metropolis (n=13)	46	54
	Tolon/Kumbungu (n=24)	92	8.3
	Yendi (n=19)	26	74
Upper East	Bolga (n=19)	100	0
	Bongo (n=12)	100	0

Pigs are normally confined at night and during the raining season also in the daytime.

Figure 3.1 Zebu in Zinnindo, (Gushiegu/Karaga district, Northern Region)

3.5 Other reason for non-use of animal manure

When asked to those farmers who did not use manure – mostly in Northern Region – why they did not, several reasons were mentioned (see Table 2.13). Most mentioned reason was that they did not own animals. Another important reason was the difficulty to transport manure to the farms, which can be far away from the village. Farmers often lack means of transport like a bicycle or a donkey or oxen cart. The labour involved in collecting, transporting and spreading manure or in changing to a semi-intensive system of animal rearing was named as an third constraint. Besides, 12% of the respondents said that they were simply 'not used' to the idea of animal manure as a soil improver; "No-one does it here" or:

> "We normally follow the footsteps of our fathers, and they did not use manure either."

In less densely populated areas where the soil is still considered fertile by the interviewed farmers, they did not see the need for using animal manure; there was no perceived urgency of taking such a measure as other problems were deemed more urgent! This is important to realize for NGOs working in such an area. Although "objective" measures may show low soil fertility (in comparison not to nearby villages but to optimum levels), farmers are only interested in going to the 'hassle' of changing practices when they themselves perceive low soil fertility as truly (one of) their major constraints in securing food production! One farmer told us: "They (NGO ASIBA) come to teach us on how to use the manure of the small ruminants by constructing sheds etc. But actually, our biggest problem is that we lack the money to expand our acreage – clearing, tractor services – the rest we can do ourselves".

Moreover, if low soil fertility is really considered a major problem, then using animal manure is not always considered as a solution. Of the interviewed 6% actually believes animal manure (or sometimes a specific type of animal manure) harms the soil by making it 'acidic'. Since Dagbani uses the same term (*botcha)* for both 'acidity' and for 'witch weed' (*Striga* ssp.), we later discovered that some of the farmers were not talking about pH levels, but that they believe that animal manure increases *Striga* infestation. Another 8% of the non-users also reported increased weed manifestation as a result of manure use. This is an important concern for these increasingly labour-restricted households.

Table 3.13 Indicated constraints for Animal Manure use (Total NR & UE)

Percentage of respondents	Constraint
38	No animals
14	Transport of the manure to the farm
12	Not used to it
12	The amount of work/ Labour
8	No sense of urgency
8	The weeds it brings
7	No access due to Fulani herding
6	The negative impact it has/ *botcha* soil
4	Other constraints
2	Prefer alternative ways to improve the soil fertility
4	Access limited to certain household members
2	Small quantity
1	Too expensive
1	No perceived benefit

Alternative uses of manure, like in plastering of walls or as fuel, were not named by the farmers as limiting the use of animal manure as soil improver. When explicitly asked some said that "that is such a small amount, we still have manure left that could have been spread on the fields". This seems to be the case indeed for Northern Region. In Upper East – where use of animal manure as fuel is said to be more common - such alternative uses may constrain quantity of manure used as fertilizer, but not the number of farmers applying *some* manure.

3.6 Comparison to literature

Our findings largely correspond with literature like Quansah (2001) which states that: For those who do not own cattle or use kraals, the predominantly nomadic husbandry system practiced in these areas renders manure collection difficult, labour intensive and costly. Further constraints to the use of manure include its low quality in the dry season and political discouragement of integrated crop-livestock systems, as reported by (Dittoh, 1999; Karbo et al., 1999; Millar, 1999)

The figures we found for cattle ownership however, are high compared to other sources. For a comparison see Annex 3.

4. Compost and organic household refuse use

4.1 Use of compost and household refuse in the regions and districts

We defined compost making as comprising some form of intentional management (active collecting of extra material like crop residues, leaves or manure; mixing; adding water or ash etc.) to improve the natural process through which microorganisms break down plant and animal material and build a more stable form of organic matter suitable for improvement to the soil. Thus defined, compost making is certainly not a habit for the majority of the farmers in Northern Region: 15% says he/she prepares it (see table 4.1). For them it is a new technique, introduced by MOFA extentionists ("Agric") and various NGO's. When they incorporated the taught technique, they would often adapt it to their needs and abilities. For example, many farmers complained about the hard work of digging compost pits and had decided to use heaps instead. In Upper East more than half of the interviewed farmers prepared compost, in Bongo this was more than 90% (see table 4.2).

Nevertheless, while not actively managed, in most villages one can find heaps of household refuse next to the compounds. In Northern Region, the decayed material from this heap is more often used than 'official compost' in compound farming and sometimes even transported to the bush farms. In other places, like in the village Zinindo (Gushiegu/Karaga district), this heap was left aside and never used for soil fertility improvement (see photo 4.1).

Figure 4.1 Large mount of unused manure and waste material in Zinindo (Gushiegu/Karaga district, Northern Region

Table 4.1 Use of compost and household refuse by region in percentage.

Region	Current use of compost	Current use of household refuse	Past use of compost	Past use of household refuse
Northern Region	15 (n=152)	27 (n=132)	2 (n=115)	2 (n=116)
Upper East	67 (n=46)	97 (n=46)	42 (n=43)	100 (n=42)
Total	27 (n=198)	48 (n=178)	13 (n=158)	33 (n=158)

In Tolon-Kumbungu compost-making is more popular and higher ownership of oxen facilitates its transport. In Yendi and Gushiegu/Karaga none of the interviewed prepared compost. In Yendi none even reported the use of household refuse: "Our lands are still fertile, so we have no time for that".

Table 4.2 Use of compost and household refuse by district in percentage.

	District	Current use of compost	Current use of household refuse	Past use of compost	Past use of household refuse
Northern Region	Gushiegu/Karaga	0 (n=31)	17 (n=29)	4 (n=27)	0 (n=28)
	Savelugu/Nanton	18 (n=45)	41 (n=29)	0 (n=27)	4 (n=27)
	Tamale Metropolis	9 (n=22)	32 (n=22)	0 (n=18)	6 (n=18)
	Tolon/Kumbungu	43 (n=30)	54 (n=24)	5 (n19)	5 (n=19)
	Yendi	0 (n=35)	0 (n=35)	0 (n=30)	0 (n=30)
Upper East	Bolga	52 (n=31)	94 (n=31)	29 (n=31)	100 (n=29)
	Bongo	96 (n=27)	100 (n=27)	74 (n=23)	100 (n=24)

4.2 Reason for not using compost and household refuse

The main reason (70%) given for not preparing compost was 'no knowledge of the technique', which included never having heard of compost-making or its benefits, or not knowing how to actually go about in its preparation. However, various do tell that extension officers or NGO's like OIC and Unicef came to show them how to prepare compost. Some others heard about it on the radio but had not seen it in practice.

Labour involved in the preparation was the second constraint (14%) and difficulty in transporting compost to the bush farms was seen as a third constraint (9%):

> "I have prepared it one year as I had heard it on the radio, and I carried it in bags on my head. But I fell ill due to the heavy work!"

Besides 7 % knew about compost preparation but did not believe it would prove beneficial:

> "Preparing compost is a waste of time" or "Fertilizer works way better".

About the same number of interviewed also did not feel compost making was urgent:

> "Our soil is not yet that bad to do so much work".

Some farmers in Northern Region laughingly remark that the quantities of organic matter they could collect would never be enough for their large fields:

> "For the peasants who have only a few acres at hand it is possible, but for us farmers it is not a useful technique."

Interestingly, in Walewale the Zasilari Ecological Farmers Project (ZEFP) led by David Akongo taught the farmers how they should appreciate the small quantity of organic material they *do* have, by applying it to bad spots in the field.

Table 4.3 Mentioned constraints for making of compost in the northern Ghana (n=142)

Percentage of respondents	Constraint
70	Lack of knowledge
14	Labor
9	The transport of the compost to the farm
8	No sense of urgency
6	No perceived benefit
6	Too low quantity
6	Not used to it
4	Prefer alternative measure
1	Too expensive
1	Other uses for the resource
1	Other constraints

Table 4.4 Mentioned constraints for use of household refuse in northern Ghana (n=101)

Percentage of respondents	Constraint
46	No knowledge
14	The transport of the waste to the farm
13	Labour
13	Unhygienic and mixed with indecomposable plastics
12	The quantity of the available material
10	Not used to it
6	No perceived benefit
4	Other constraints
2	Prefer alternative measure
2	Access limited to certain household members
1	No sense of urgency

Also for the simpler use of the household refuse heap, 'lack of knowledge' was the biggest constraint according to the interviewed: "I have never known that it is useful". Labour demand for collection and spreading and transport are constraints for the use of household refuse too. Besides, the interviewed remarked that the household refuse is normally a mixture of organic and inorganic components. Applying it to the fields would do harm through the presence of plastics. One interviewed even named the use of refuse unhygienic: "The children shit there". The quantity of organic waste was according to 6% of the non-users so low, that application would not make a difference. Another 6% said they were simply 'not used' to such a practice: "Our fathers did not show it to us."

5. Fallow

5.1 Practise of fallow in the regions and districts

Past systems of soil fertility management were based on long bush fallows within slash-and-burn agriculture. Nowadays, land is much scarcer and farmers cannot leave land fallow as long as their father were leaving it. In Upper East, this increased pressure on the land already kept about 30% of the farmers from fallowing one generation ago (table 5.1). Now, in Upper East and the densely populated Tamale district (table 5.2), more than half of the farmers even does not fallow anymore!

Also, fallow periods have shortened everywhere (to periods of 1 – 5 years) with averages in the different districts mostly under 3,5 years (see table 5.3) whereas in 1991 fallows of 4 – 6 years were still found (Quansah et al., 1991; FAO, 1991).

No significant relation could be established between gender and fallowing practise. However, we do believe that when pressure on the land is high (like in Bongo), women will often suffer first by having less opportunity to fallow. As it is the husband who assigns, women are more likely to receive the marginal lands. In general, we observed that women often grow crops that are less demanding to soil fertility like soybean and groundnuts. They themselves explained that these need less weeding and less fertilizer and are therefore chosen by the women that have less access to such resources.

Table 5.1 Current and past (one generation ago) practise of fallow by region (in percentage).

Region	Currently practising fallow	Past practise of fallow
Northern Region	70 (n=154)	98 (n=123)
Upper East	39 (n=61)	69 (n=42)
Total	61 (n=215)	91 (n=165)

Table 5.2 Current and past practise of fallow by district (in percentage). In brackets male interviewees only.

	District	**Currently practising fallow**	**Past practise of fallow**
Northern Region	Gushiegu/Karaga	87 (n=30)	96 (n=28)
	Savelugu/Nanton	60 (n=42)	97 (n=29)
	Tamale Metropolis	38 (n=21)	100 (n=17)
	Tolon/Kumbungu	58 (n=24)	100 (n=18)
	Yendi	94 (n=35)	100 (n=30)
Upper East	Bolga	36 (n=31)	67 (n=21)
	Bongo	39 (n-47) (n=26 incl.17 male)	65 (n=17)

Table 5.3 Fallowing practices in districts in Northern Region and Upper East. Farmers without fallow land were excluded in the calculation.

District	Years farmed	Years fallow	Fallowing/ Farming ratio[9]	Total Farm size[10] (Acres)	Land in production [2] (acres)	Fallow land[2] (acres)
Northern Region						
Gushiegu/Karaga	5,1 (n=25)	3,1 (n=26)	0.6	16,0 (n=29)	10,3 (n=31)	5,1 (n=27)
Yendi	3,9 (n=24)	3,5 (n=23)	0.9	16,1 (n=27)	8,7 (n=31)	7,8 (n=27)
Savelugu/Nanton	4,7 (n=21)	3,0 (n=20)	0.6	14,0 (n=29)	10,0 (n=38)	7,7 (n=22)
Tolon/Kumbungu	2,8 (n=11)	2,0 (n=11)	0.7	13,9 (n=20)	9,2 (n=24)	4,7 (n=18)
Tamale metropolis	3,2 (n=7)	2,7 (n=8)	0.8	9 (n=14)	7 (n=18)	3 (n=5)
Upper East						
Bolgatanga	6,6 (n=10)	4,8 (n=10)	0.7	14,8 (n=4)	10,1 (n=4)	5,2 (n=6)
Bongo	3,3 (n=9)	2,5 (n=9)	0.8	9,6 (n=9)	7,4 (n=9)	2,2 (n=9)

5.2 Constraints for longer fallows

Most important reason (see table 5.4) for not fallowing anymore or not to leave land fallow for longer periods of time is the population pressure.

> "We have become many, and the land has to be divided by all" or "I have given away the land as they came to beg for it".

In connection with this, some interviewed were afraid to leave land fallow (or to leave it fallow for more than just a few years) as this might encourage others to come and beg for it. Losing access rights because of possible reallocation of land by the "tengansob" or "tendana" as Van der Geest (2004) found by one of his interviewed was not mentioned as constraint to leave land fallow.

For those farmers who still had land available, the costs and labour involved in clearing virgin land or long fallow stands to bring them in rotation was often prohibitive.

Table 5.4 Mentioned constraints for fallowing in the Northern Ghana (n=128)

Percentage of respondents	Constraint
86	Pressure on the land
11	Clearing of virgin land or long fallow stand is costly / laborious
7	People come and beg for it
4	Access limited to certain community members
2	Other constraints
2	No sense of urgency
1	Prefer alternative measure
1	Labor

[9] Calculated by dividing the years of fallowing by the years that were farmed.

[10] Sizes of the total farmland, land in production and fallow land are as indicated by the farmers. This information can only be used as indication of the size. It was not easy to define a land size together with the farmers who are mostly illiterate and not always able to calculate. Since land sizes were not the main focus of our research we decided not to spend to much time in making the fit perfectly.

6. Improved fallow

6.1 Practice of improved fallow systems

Prinz (1986, 1987) defines an improved fallow as "a targeted use of planted species in order to achieve one or more of the aims of natural fallow within a short time or in a smaller area. Traditionally fallows take several years to restore fertility. Natural vegetation is slow in reaching the peak of biological productivity. By contrast, fast growing trees - if correctly identified and selected, planted and managed in fallows - can grow and mature within a short time. These tree species can enhance soil fertility by bringing up nutrients from lower soil layers, litter fall and atmospheric nitrogen fixation. At the end of the fallow period the trees are harvested and the biomass that is not useful as fuel wood is returned to the soil. The development of short-duration 'fertiliser trees' is necessitated by the fact that long-term fallowing (20 to 30 years) is no longer feasible and medium-term natural fallows (5 to 10 years) do not adequately replenish soil fertility."[11]

We asked farmers whether they enriched their fallows by planting fast-growing trees, shrubs or vines. Such systems of improved fallow were hardly practiced by the interviewed. Only in the village of Nwodua (where Unicef and UNDP Africa 2000 Network has been working), some farmers planted nitrogen-fixing trees (acacia, albizia) or other fast-growing tree species like neem on their fallow lands which they would eventually cut down, using its stems as firewood and its leaves to fertilize the soil.

6.2 Constraints for the adoption of improved fallow systems

Since 30% in Northern Region and around 60% in Upper east did not fallow land mostly due to pressure on the land, they could not practice improved fallow either. The second constraint (see table 6.1) to adopt such a system, was according to the interviewed a 'lack of knowledge on improved fallow systems'.

(Expected) mortality of the seedlings of species that could be used for improved fallow (acacia, mucuna, pigeon pea etc.) would discourage other interviewed farmers from adoption. High mortality would be due to bushfires, drought or animal browsing of the seedling, crops or trees. Animal browsing would take place as just after the major crops are harvested, animals are left free to roam again as this reduces labour to feed and herd them. Longstanding crops are thus affected, unless you would have the labour available (for example children) to protect them. This seems to be done only by a few people and is than based on the importance of the crop – like pigeon pea - for food or cash reasons.

Of the interviewed 14% did not see the need for/ or benefit of improving fallows:

> " It is enough to just let the grass grow. This will decompose and enrich the soil."
> "There is no need, because the fallow itself is improving the soil."

Interestingly, another 7% even believed it would have a negative impact on the soil fertility:

> "It is a crazy idea! The planted crops/trees will take up the available nutrients".

[11] http://www.icrafsa.org/innovations/improved_fallows.html

"It defeats the purpose of fallowing, which is to let the soil rest. Then let it rest, instead of planting something again!"

The system of improved fallow thus seems to oppose a traditional logic that has worked well over generations in an extensive system of land-use.

Besides, the interviewed complained of the extra costs and labour involved in improved fallows:

"I leave so much land fallow as I do not have the means to work it, so then how would I be able to afford extra tractor services or labour to plant something on the fallow land?"

Maybe NGOs or research institutions could promote improved fallow systems that also reduce or eliminate "witch weed" (*Striga* spp), thus eventually reducing labour demand.[12] However, the question is still if the initial labour investment can be made: in the planting year of improved fallow species, the extra labour or seed investment has to compete with immediate needs (food, schooling etc.).

Table 6.1 Mentioned constraints for improved fallowing in the Northern Ghana (n=178)

Percentage of respondents	Constraint
46	No fallow land
28	No knowledge
14	No perceived benefit or no sense of urgency
7	Mortality due to bushfires
7	Mortality due to grazing
7	Too Expensive
6	Negative impact
4	Labor
3	Not used to it
3	No seeds available
2	Short Raining season
1	It is a crazy idea
1	Prefers alternative measure

[12] Like Sesbania was promoted in Zambia http://www.icrafsa.org/innovations/improved_fallows.html

7. On the use of cover crops or green manuring

7.1 Use of cover crops or green manuring in the regions and districts

In this research we have defined a cover crop as a legume crop grown before the main cereal crop, thus increasing the cereal yield by improving the fertility by adding organic matter and nitrogen to the soil. About 15% of the interviewed in NR and less than 9 % in UE makes use of cover crops. The crops usually used for this are cowpea, *sanʒi* (Dagbani name for dark red/ purple beans), bambara beans, soybean or any other type of beans. In Balshei a few farmers have experimented with Mucuna (*Mucuna pruriens*) before planting rice last year, taught by the Lowland Rice Project. Whether they will continue the practice depends especially on whether they will be provided with more seeds.

7.2 7.2 Reasons for not using cover crops

Of those who do use cover crops, no one is growing a crop that *only* serves soil improvement. Only in the experimentation with Mucuna soil improvement is the *main* purpose of planting the cover crop. Normally the reason is expanding production and yield of a useful crop (first priority being human consumption, second might be forage) by fitting two crops on a field in one raining season.

Several respondents become very fierce when the suggestion is given of growing a crop *purely* to improve the soil or next crop's production by ploughing it under:

> "It is a crazy idea. How can we waste food like that when we are hungry?" or "It is madness to grow anything else than food!"

Besides a lack of knowledge, most important reason for non-adoption of cover crops is that it is too expensive:

> "This is clearly a measure for the rich farmers. We cannot afford to hire tractor or oxen services twice. Nor can we spend on extra labour or seeds."

Once again, scientists can argue that *in the long run* the use of cover crops is profitable. This message however is useless to farmers who have no access to credit or for whom credit entails huge risks. It is the short-term, initial investment that is prohibitive to adopt the measure.

Farmers feared the risk of drought – which some believe has increased in the last ten years – hitting the main cereal crop, when this is grown late i.e. after a cover crop:

> "The rainy season is too short and the rains too unpredictable; drought might hit your maize of millet afterwards".

Others believed cover crops would simply not be beneficial to them.

Table 7.1 Mentioned constraints for use of cover crops in northern Ghana (n=123)

Percentage of respondents	Constraint
29	No knowledge
28	Too expensive
28	Risk of drought/ short raining season
14	No perceived benefit
9	Labour
6	Crazy idea
3	No seeds/seedlings available
2	Not used to it
2	Other constraints
1	No sense of urgency
1	Population pressure
1	Leaves of the beans used for feed
1	Mortality due to animal browsing

8. Use of leaves and tree planting

8.1 The use of leaves and tree planting in the regions and districts

Using the leaves of trees to improve soil fertility is done by a minority of the farmers and is more popular in Upper East as in Northern Region (although as always Tolon-Kumbungu is the exception with popularity similar to UE). If leaves are used these are mainly leaves from the neem tree, albizia and acacia. Farmers are divided over the good or bad impact that sheanut leaves have on the soil. Teak, cashew and locust bean (*dawedawe)* leaves are sometimes thought to be beneficial. Very few farmers (in Nwodua, Dabogshe and Zogo) have even started planting trees that they think are beneficial for the soil. However, planting trees *only* because of their benefit for the soil is not normally done, as is well described in literature (Ajayi, 2007) For example, neem can be used for neem oil extraction and the leaves fertilize the compounds or are given to the animals for feed. In Dabogshe, a farmer had introduced Moringa last year and the youngster had enthusiastically nursed young trees this year. Even though they acknowledged the good influence this tree could have on the soil, they were primarily interested in the cash earnings that could be achieved by selling its seeds.

Table 8.1 Use of leaves to improve soil fertility in Upper East and Northern Region.

Region	Use of leaves to improve soil in percentage
Upper East (n=59)	34
Northern Region (n=155)	13
Total (n=214)	19

As can be seen in table 8.1 tree planting – of any species, not with the specific aim of improving the soil - is more popular in Upper East, even though space is more limited because of dense population. Tree planting seems logically related to (firewood) scarcity. A farmer in Yendi: "Why would we plant trees, when there still are many?"

Most popular trees to plant are mango (for fruit), teak (for timber) and neem (for roofing, animal feed, oil extraction and as a side-effect soil fertility improvement).

In Upper East there is a significant relationship[13] between gender and tree planting. While of the 15 women interviewed only 49% had ever planted a tree, more than 80% the man had done so. Could it be that planting trees is more of a male than a female task or that a woman cannot plant a tree by her own decision?

Table 8.2 Tree planting in Upper East and Northern Region. Numbers between the brackets are percentages when only male farmers are included.

Region	Planting of trees in percentage
Upper East (n=60 incl. 44 male)	73 (82)
Northern Region (n=92 incl. 84 male)	35
Total (n=152)	50

8.2 Reasons for not planting trees or using leaves to improve the soil

As can be seen in table 7.3, 33 percent of the farmers has never heard of the possibility of using leaves to improve the soil fertility or they do not know which tree could be used as such. Besides 27% (in

[13] (on 0,05 level)

Upper East even 46%!) of the farmers simply says that there are no or no suitable trees in his/her field or surroundings from which the leaves could be used as such.

> "We only have sheanut trees and they do not improve the soil." Or "I do not have leaves myself and it is not allowed to gather leaves on other people's field."

About one fourth of the total group of interviewed farmers is not convinced of the benefit of the use of leaves. In Northern region it is about one third of the interviewed farmers, while in Upper East this is only 5 percent.

Besides, gathering leaves demands labour and as an old man says "nowadays you cannot ask your children to take on such tasks. They will run to the South if you do so."

In Upper East, 11% of the interviewed preferred alternative measures for soil improvement like compost or manure.

Table 8.3 Mentioned constraints for the use of leaves in northern Ghana (n=142)

Percentage of respondents	Constraint
33	No knowledge
27	No (suitable) trees in the field
24	No perceived benefit
11	Labour
6	Not used to it
5	No perceived urgency
2	Other use for the resource
3	Dangerous animals that hide between the leaves
3	Prefer alternative measure
2	The transport of the leaves
2	Leaves have a negative impact on crop production
1	Crazy idea
1	Mortality due to bushfires
1	Other constraints
1	Low quantity of the leaves
1	Local law
1	Population pressure
1	Availability of seedlings

8.3 Planting trees

When we look at the reasons for the interviewed farmers not to plant trees, the lack of knowledge and the unavailability of seeds and seedlings are named as the major constraints. Especially in Northern Region part of the farmers (19% versus 6 % in UE) believed that tree planting in and along the fields has a negative impact on crop production. They fear the competition between trees and crops for sun light, water and nutrients, even when trees are kept short. Also in Libga, a village where extension was given on agro-forestry, this opinion still held sway. In Dipali, two farmers told how they use the trees that come up naturally. They explain their current shift from upland to lowland maize cultivation and how they think they will regenerate the abandoned upland:

"You see we used to burn the trees in the farm as to increase the fertility. But then we had burnt all the trees, none was left. Now we leave the piece of upland so that new trees grow, which we then again can burn. We will leave it for some 2 years."

That makes the idea of planting and protecting trees to improve soil fertility a 'crazy idea' to them, indeed! For another substantial group (14% in NR, 13% in UE), there is no sense of urgency to plant trees:

"There are enough trees around, so why plant more" or "Besides the soil in the compound is fertile enough, so why should I plant trees?"

The high mortality of seedlings is discouraging for the planting of trees. Seedlings are often destroyed due to drought, animal browsing or bush fire.

Of the interviewed 8% point at the pressure on the land, which make it difficult to reserve space for tree planting as this decreases the land left to farm on.

In literature and field worker's reports, taboos on tree planting have been reported. Some say the ancestors do not allow for the planting of trees, as this is not the task of the living. The taboo is sometimes said to be only applicable to indigenous trees, so that 'white-man's trees' are not bothered by it. The saying that "if you plant a tree you will die", may come from the more rational-sounding "If you plant a tree you will die before you see the fruit." (Kirby, 1999:132)

In our interviews, only in one village – Wovo-Guma (Tamale Metropolis) – two interviewed acknowledged the current existence of a taboo on tree planting, which could be circumvented by letting a stranger or a Fulani plant the tree. This is what they had done when wanting to plant shade trees in front of their compounds. In other villages, people referred to this taboo as something of the past. A farmer in Dabogshe (Tolon/Kumbungu):

"No, you can plant whatever you want. It is the opposite; our religion teaches us that if you plant a tree and others benefit from it – for example from the shade – than God will reward you. We have planted many trees and no-one has died… These are taboos from the olden days."

In other villages they point at the mango and cashew plantation, to show that they are not afraid to plant trees.

Table 8.4 Mentioned constraints for planting of trees in Northern Ghana (n=73)

Percentage of respondents	Constraint
30	The availability of seeds
27	No knowledge
16	Trees have a negative impact on crop production
15	Mortality of trees due to drought, bushfires, and animal browsing
14	No sense of urgency
8	Land constraint
7	No perceived benefit
5	Not used to it
4	Labour
1	Crazy idea

9. Burning

9.1 The practice of controlled and uncontrolled burning

Burning has always been and still is (and will probably remain to some extent) part of farm management in Northern Region. Table 9.1 shows which burning practices farmers use. Burning is generally a more "popular" in Northern Region as it is in Upper East. In Upper East, 37% of the interviewed acknowledge the use of controlled burning in their farm management, either practiced just after harvest or – more often – before ploughing and sowing. In Northern Region 65% of the interviewed 'keeps his/her fields tidy' by burning. Some only burn those crop residues that "do not want to decompose, like the guinea corn and maize stalks", others burn all the crop residues and some even burn all the vegetation on the field. Most put the crop residues or slashed vegetation on a heap to make it easier to control the burning, but some 15 % of those who burn, sets the field itself on fire.

Besides this controlled burning, uncontrolled burning of the fields, including the fallow land takes place. In most communities, bush fires are rampant: yearly burning of the fallow land takes places for about three quarter of the interviewed. They will often express that it is not them who set the fallow land on fire, but that it is someone else's fire that has 'run wild'.

The distribution of fallow land burned by bush-fires is even greater between the districts than between the regions: the interviewed in Bongo and Tolon-Kumbungu reported least incidences of burning (around 30%), 75% of the interviewed in all other districts reported their fallow lands being burned.

Table 9.1 Burning practices by region

a)Burning by the owner of the field

Region	**Burning after harvest (in percentage)**
Upper East (n = 57)	37
Northern Region (n = 151)	65
Total	57

b)Burning after harvest

Region	**Burning after harvest (in percentage)**
Upper East (n = 56)	4
Northern Region (n = 151)	15
Total	12

c)Burning before ploughing

Region	**Burning before ploughing (in percentage)**
Upper East (n = 56)	36
Northern Region (n = 151)	56
Total	50

d) Burning on the field or on heaps

Region	**Heap burning**	**Field burning**
Upper East (n = 22)	91	9.1
Northern Region (n = 83)	83	17
Total	85	15

***e)* Burning of the fallow land**

Region	Burning of fallow land
Upper East (n = 40)	65
Northern Region (n = 121)	79
Total	76

Table 9.2 shows what would be the ideal burning frequency according to the interviewed. Less than 10% of the interviewed is satisfied with the current regime of burning or would even want more burning. On the other hand, "only" 62% of the total interviewed and 57% of the interviewed in Northern Region thinks that burning should be abandoned all together!

Table 9.2 Ideal burning frequency according to the interviewed

Region	No burning at all	Less burning	As much as happens now	More burning
Upper East (n=58)	74	12	9	5
Northern Region (n=122)	57	38	3	3
Total	62	29	5	3

9.2 Reasons for burning

In table 8.3 the reasons for burning as given by the interviewed are shown. Most farmers (about 60%) told us they use burning – whether controlled or uncontrolled - as a way of preparing their land. After fallow – so in Northern Region mostly before planting yam – it is hard labour to clear the land without setting fire to the field or at least burn the residues after slashing. Without burning the crop residues, especially maize and guinea corn stalks that do not decompose easily, "the tractor operator will not enter your field as he is afraid to screw up his machine".

> "Look, when your room is dirty, wouldn't you like to clean it? The same goes for the land…"

In a few villages[14], people told us they collect the crop residues to use as fuel for cooking.

In many communities uncontrolled bush fires are rampant, with more than 70% of the interviewed reporting their fallow land being burned (almost) each year. However, almost none of the interviewed says he himself burns his fallow land. In Northern Region 25 % of the interviewed blames others of burning the bush, their crop residues and the fallow land:

> "Unscrupulous people come and set the bush on fire".

When asked who these 'unscrupulous people' are, "hunters (especially from Tamale)" are blamed most. About 7% of the interviewed acknowledged that they themselves participate in this hunting and burning too.[15]

> *Adam the vegetable seller from Tamale on hunting*: "You hear the sound of drums from the trucks leaving the city, the men sitting on the high walls? The men go out to hunt. I have participated myself in the past. You have to pay your passage (come and leave) like for about 1 cedi and then you can hunt as much as you want. But the gong beater, he takes care of your security, so you have to give part of your prey to him."
> Q: "But how do you know where to go, where the game is?"
> Adam: "The villagers tell us, they even invite us to come and hunt. So that once they have started to farm, the animals will stay away from the crops."
> Q: "I have heard that fire is used, to gather the animals to hunt. Can you tell me about that?"
> Adam: "Yes, it happens. But fire is used anyhow by the farmers to make sure their crops will grow and the bush does not reach their fields. When we arrive to the hunting site, the leaders will tell us not to use fire, but some do."

[14] Malshegu (Tamale), Zogo (Bongo), Sherigu (Bolgatanga), Sumbrungu (Bolgatanga)

[15] It is likely that more of them participate, but in many communities know the stance of NGO's and extension officers on the issue. Even with creative interviewing it is hard to always get honest answers on this sensitive question (see further Annex 1).

Apart from this, "young mischievous lads" can be the instigators. Lastly, the Fulani are sometimes named as they would want to make sure the sprouting of new grass.
Of those that burn, 18% in NR and 26% in UE believed it is beneficial to the crops or the soil to burn the crop residues or even the entire vegetation. They said:

> "The ash will make the land fertile".

Yam is often named as a crop for which burning is necessary. This is explained in two ways: "Yam is the first crop after fallow. Thus by then the vegetation has become high" but also "Yam is a root crop which needs a deep, loose soil. This is achieved by burning."
15% Mentions the threat of dangerous animals as a reason to burn:

> "We have to protect ourselves against snakes and scorpions."

Plague animals as rats, mice or insects is another minor reason for burning and so is getting rid of weeds.
It is the belief that sheanut and locust bean trees need to be "heated": a (controlled) fire is made around their stem so as that the tree will drop its leaves. This is explained in two ways. Some say it is done to "increase production of the tree", as if the burning urges the plant to produce more. Others say it is done to "protect the trees from wild fires" later in the season, when the tree is in a sensitive phase (with buds or flowers), thus increasing production in an indirect way. [16]
Some interviewed even name the destruction of economic trees as one of the important disadvantages of uncontrolled fire. Another problem caused by the fire is the accidental burning of yam and cassava seeds that were stored in the bush farms. Farmers therefore often burn small strips around their fields as protection: "fire belts".
In a minority of the villages like Taha and Wovo-Guma (Tamale Metropolis), burning is also part and parcel of an important cultural or social event. Many habitants of other villages and of Tamale told us they join in these celebrations. We describe more on these celebrations and the cultural or animist aspects of bush-burning in Annex 1.

Table 9.3

Percentage of respondents	Reason Reasons for farmers to burn in northern Ghana (n = 135)
59	Land preparation
22	Others will burn
19	Beneficial for crop/soil
15	Dangerous animals
7	Hunting myself
4	Plagues
4	Used to it
4	Fire protection
4	Fruiting of economic trees
2	Cultural event
2	Get rid of weeds
2	Other constraint

*Pcsy = 7 mensen (related to yam (5%)

[16] Blench & Dendo (2004) say about this: "It is generally accepted that the yield of shea trees is greater if the grass around them is burnt early in the year. This might be to reduce competition for nutrients, but may also stimulate fruiting directly."

9.3 Comparison to literature

Our findings correspond largely with literature like Quansah (2001). Traditionally, wide-spread dry-season burning of vegetation was practiced in this area. Burning as a labour-saving tool and to prevent weed infestation is now being brought into question and many development agencies now advocate non-burning. In the communities, however, it is less a question of burning or no-burning but rather when, where and how to reduce its negative impact.(Aalangdong OI et al., 1999) Anti-bushfire campaigns have been held, and some farmers in the north have made a conscious decision to cease bush burning with the aim of regenerating organic material.(Millar, 1999). David Sumbo from CARE International explained how they their campaign against bush-fires is based on community processes in which agreements are made to stop indiscriminate burning, but in which the community also defines for which reasons it is deemed necessary and thus allowed to burn.

10. Crop rotation

From the 145 farmers in Northern Region that were asked whether they performed crop rotation or not, 89 percent answered that they did. In Upper East only 57 percent of the farmers performed crop rotation. In Northern Region part of the farmers had started growing soybean fairly recently as a new legume crop in the rotation. Common rotations are for example: yam-maize-yam or yam-maize-groundnut-yam or soybean-maize-cassave-groundnut-maize.

This significant difference[17] can be partly explained by the fact that in Upper East farmers, are producing only very few different crops. In some cases a farmer only grows millet. This is due to the scarcity of land in Upper East, where plots are smaller than in Northen Region *and* to a strong preference which seems present amongst most interviewed farmers to grow the crops that are consumed most. The argument these farmers make against crop rotation is that they would have to start growing crops that they don't eat. "We need all the food that we grow" is what you often hear in Upper East.

Besides, seeds from crops that farmers have not grown before or of which the seeds have 'been eaten during the dry season' are often too costly or unavailable to them.

Table 10.1 shows the reasons farmers have not to adopt crop rotation.

In general the most heard argument against adopting crop rotation is that each crop performs best on a certain place with a specific soil. Almost all farmers in Upper East grow the millet next to their house because the soil is generally most fertile in that place.

Another constraint that is mentioned by the interviewed is lacking knowledge.

Table 10.1 Mentioned constraints to perform crop rotation in northern Ghana (n=41)

Percentage of respondents	Constraint
34	Each crop requires its specific soil
24	Too expensive
20	No seeds/seedlings available
15	No knowledge
12	All the food is needed
10	Population pressure
7	Prefer alternative measure
7	Not used to it
5	Other constraint
2	Labour
2	No sense of urgency

Besides crop rotation, intercropping is a way of managing soil fertility that is widespread amongst the interviewed farmers. In Northern Region 68% (n= 122) of the interviewed and in Upper East 61% (91 % when also early millet combined with late millet is seen as intercropping) (n=56) of the interviewed said that they did intercrop their main maize and millet crop[18]. Intercropping combinations that occurred in Northern Region for maize: maize-guinea corn (very common), maize-millet, maize-yam and less common maize-groundnut, maize-pigeon pea, maize-cow pea or other beans, maize-rice and

[17] At the 0,05 level.

[18] Besides growing maize and millet as a main crop, farmers often reported intercropping small quantities of maize within their yam, cassava or other fields.

maize-okru. In Upper East for millet: millet-maize, millet-beans and millet-sorghum and less so millet-vegetables.

In several villages (amongst others Saakpuli, Balshei, Dingoni) we were told by the farmers that when they demand a loan for seeds, fertilizer or tractor-services for a crop like rice or soybeans they are not allowed to intercrop in this field. From a point of few of soil fertility management this discouragement of intercropping seems not advisable!

11. Use of human excreta

In both Upper East and Northern region the use of human feces is not commonly practiced. None of the interviewed used human faces in bulk, although a few mentioned that they are "freeing themselves" on the farmland. Many farmers tell that they heard about possibilities to buy faecal sludge in bulk from septic tanks from the city but none of those farmers explored whether they themselves have the possibility to obtain this as farm input. Table 11.1 shows that farmers see the fact that there are no toilets to collect the faeces to be the largest constraint to use human excreta. In some villages, NGOs had constructed common toilets, but it often seems they were not often frequented. Besides the toilet's constructions "does not permit collection".

Another logical constraint is that they consider the use as unhygienic:

> "It is not clean" and "If I would use it on my farm nobody would eat from your food anymore".

Buying the faeces would be another constraint. "we don't have money for that" is what you often hear, but actually none of the farmers knew what the price of faecal sludge would be, and many of them do spend large amounts of their money on artificial fertilizer.

Also the faeces are not available to the farmers or are not available in the quantity the would need it for farm application. Not being used it and not having the knowledge on it are other constraints mentioned.

Besides this 5 percent of the farmers says the Islam forbids them to have direct contact with human faeces or touch it with their hands.

NOTE: We are not the one advising farmers to use human faeces. Farmers are fully right when speaking about hygiene constraints. There are huge health risks in the use of untreated or fully decomposed human faeces in agriculture. However, since earlier research (Cofie et al., 2005) claimed that this the use of human waste is a wide spread practise in northern Ghana we did not want to exclude this strategy of soil fertility management.

Table 11.1 Mentioned constraints for using human excreta in farm practices in northern Ghana (n=167)

Percentage of respondents	Constraint
33	No toilet
27	Not hygienic
23	No money to buy it
13	Not available to me/ Quantity
7	We are not used to that
6	I don't know about the use of it
5	Islam forbids me
4	Means of transport to the farm
3	No urgency
1	Other

12. Use of anti erosion measures

By many farmers erosion is seen as a serious problem. In Upper East erosion is more serious because of the hilly landscape. There, 86 percent of the interviewed (n=59) tells to have problems with erosion versus 69 (n= 124) percent in Northern region. From this 86 percent in Upper East, 94 percent tries to minimize the problem by taking measures against. In Northern Region only 64 percent of the farmers with erosion problems takes measures.

Most common measures against erosion are the creating of waterways, weeds/ stones in bounds, terracing, contour farming/ploughing. Also mentioned were the use of trees or shrubs and fallowing.

The overall heard constraint in taking measures was that the interviewed did not know what to do against erosion. Some were having the perception that you just could not do anything against it because the water was just too much: “If it comes, you cannot stop it!” and “you cannot control the water, it is natural” and “I don’t know what to do against it, I allow the water to take what it wants.”

Figure 12.1 Sheet erosion in Malshegu, Northern region.

13. Mineral fertilizer

13.1 The use of mineral fertilizer

Mineral fertilizer is used by around 56 percent of all interviewed, more so in Northern Region (68%) than in Upper East (23%). Lowest use of mineral fertilizer is in Bongo (12%) and highest in Tamale Metropolis (96%). Fertilizer was almost never applied on all crops. Neither did all of the users apply the recommended dose of 3 bags/ha, lower quantities from a few bowls till 2 bags per ha were also usual. Mineral fertilizer was mostly applied on the maize and rice crop, and occasionally on millet, tomatoes, onions, ground nut, soy bean or mango trees. It was predominantly used on the bush farms and to a lesser extent on irrigated land, not very often on the compound.

The lesser use of mineral fertilizer in Upper East could be due to lower incomes, but could also have to do with the lower cost-effectiveness of using mineral fertilizer in drier areas.

Women have even less chance of purchasing fertilizer then men; in our research we found a significant[19] gender effect. Women often chose to grow crops that need less fertilizer, like groundnut or soybean. These crops also require less weeding.

Figure 13.1 Use of mineral fertilizer in Upper East and Northern Region (in brackets male interviewees only).

Region	Use of mineral fertilizer in percentage
Upper East (n=57 incl. 42)	23 (26)
Northern Region (n=166)	68 (70)
Total (n=223)	56 (61)

Region	District	Current fertilizer use
Northern Region	Gushiegu/Karaga (n=32)	69
	Savelugu/Nanton (n=45)	69
	Tamale Metropolis (n=22)	96
	Tolon/Kumbungu (n=30)	70
	Yendi (n=35)	46
Upper East	Bolga (n= 29)	24
	Bongo (n=25)	12

13.2 Reasons for non-use of mineral fertilizer

Farmers acknowledged that it was not physically hard for them to access fertilizer; it was readily available in stores and on the market. However, prices are sky-rocketing, with the price of fertilizer having more than doubled between the farming seasons of 2007 and 2008[20]. When asking farmers on was they saw as the most limiting factor to agricultural production, the lack of capital to pay for traction (tractor or oxen services) and fertilizer were their main concerns.

[19] At 0,05 level

[20] At the end of April 2008 the price for one bag (50 kg) was the following: NPK (15-15-15): 34.6 GhC (=US$) and Ammoniasulphate: 28.1 GhC. In May this increased by approximately 20%.

Continuous use of fertilizer is by some (nine farmers) named as a reason for soil decline. However, it is normally not a reason to stop its use, as farmer in Zinindo explains:

> "Fertilizer is beneficial for now, but as time passes it will be bad. But what can we do? If we want yield we have to apply it."

Moreover, by most farmers fertilizer is seen as the solution, not as the problem as a farmer in Dikpun stresses:

> "Soil fertility is not the main problem, the cost of fertilizer is. If a decline in soil fertility is accompanied by the ability to use fertilizer, it is not a problem."

Application of mineral fertilizer is the most well known method of fertility improvement spread by extension. Many interviewed would spontaneously mention the recommended dose of 3 bags/ha: 2 bags of NPK and 1 of Ammonium sulphate. Lack of knowledge is therefore not a reason for non-use. On the contrary as a farmer we encountered on the bus explains….

> **Talk on the bus to a farmer from the Carega district**
> "The biggest constraint to agricultural production is that you guys do not come to give us fertilizer anymore. The white men has told us for a lot of times that we had to use fertilizer. Now they come and tell us we should not. But unless you educate us on these other methods for just as long as you have been teaching us on fertilizer, we will keep asking for fertilizer. For other methods there are so many constraints. The tractor is stopped by the crop residues, composting I have no time for. Even in the dry season I am occupied by trading. When I go to the farm that they, I cannot go to the market to earn money, so what will I eat in the evening?"

14. On extension services

Lack of knowledge is named by the farmers as an important constraint for the adoption of new soil fertility management practices. However, in most villages some form of extension services is provided either by MOFA (Ministry of Food and Agriculture) or by NGO's like Unicef, UNDP Africa 2000 network, Worldvision, School for Life, CAPSARD, Lowland Rice project, OCI, ADRA (Adventist Development and Relief Agency), cotton company, soy bean groups etc. Many of these organizations include soil fertility management techniques in their services.
Interviewed farmers often expressed complaints about these extension services. Firstly, many claimed that the extension officers only rarely came by or that they only visited a few farmers:

> "When I want to ask advice I have to go myself to the village on the main road, they do not come to this remote village"
> "They pick out only a few farmers with which they work. And these farmers do not tell us what they were taught."
> "They never actually come to our fields. They just gather the community to explain."

They also complained that the proposed solutions are not adapted to their situation:

> "If only they could give us the money to actually follow their advices."
> "The solutions that they propose are for rich farmers. We sit in the back, knowing that we could never follow the prescriptions."

This is rather remarkable as we are not talking about mineral fertilizer application but about so-called 'low input techniques'. As we concluded in previous chapters, the farmers themselves do not regard them as 'low input' as they may not directly demand cash, but they do require high labour input, ownership of animals or cash. Labour, especially during the cropping season, is scarce and costly to hire!
Projects by NGO's or MOFA are also often seen as unreliable. Numerous are stories like:

> "They told us to build sheds and afterwards we would receive small ruminants to use their manure. We build the sheds but they never came back"
> "We would receive credit for tractor services or seeds, but we are now at the start of the rainy season and they have not arrived."

Another reason for loss of confidence in the messages by NGO's are negative past experiences:

> "We were told that it would be good to plant cashew trees. But later on it appeared that there was no market for the cashew. So we tore down the trees or leave the seeds to rot."

Two other examples show a somehow more profound lack of trust, as it favours reliance on divine fate rather above trust in 'development' efforts:

> *An old farmer tells me politely that the agricultural extension officer's advice has always been very beneficial to them. When I probe him by stating that many farmers have in fact told me the opposite, he sighs and admits:*
> "You know, God has its time and man has its time. But man cannot change God's time. So the extension officer came once to tell us that that year we should expect early rains, and we should start sowing early. But the rains did not come and the crops died in the field. So I have lost faith in such advice."

"They have told us we should be investing in our farms. See it as a business. So one guy in this village, put a lot of labour and investment in his farm. He rented tractor services to expand the farm. He had prepared compost and manure and carried it all to the fields with the rented cart. Then the rains did not come and he lost the harvest. He is in great debts now."

Another young farmer adds, when asked why he does not take a loan to raise his production: "You see it is about having God on your side. You can have God with you one year and have a good harvest. Then you do not have to go in for a loan. Another year, you could have a big farm and have all the inputs bought with your loan. But when God is not on your side, you will still have a bad harvest."

It is hard to judge whether with better extension adoption rates would always be higher. Maybe a safe conclusion is that yes, good extension is an important condition for change, but it is not the only one! Without a sense of urgency, ability to invest in soil fertility and high enough expected benefits; extension will not do the job. For example, in Libga, even when there had been a lot of extension on soil fertility techniques and people complained of bad soil fertility, only increased use of manure was seen as a viable option.

On the contrary, when expected benefits are high enough, new practices sometimes spread spontaneously, in absence of formal extension, through informal exchange and innovative individuals. This was the case of *moringa* tree nursing in Dabogshe (Tolon-Kumbungu) as moringa seeds were considered an interesting cash crop.

As we have seen in chapters on tree planting and improved fallow, the estimation of potential benefits is indeed often done on traditional logic that has in some cases become slightly 'outdated' in the face of new pressures. However, the utmost respect is required to build a dialogue with the farmers on these issues and to win their willingness to experiment together. Finding new ways not by teaching, but by weaving new patterns out of old knowledge of which part of it may still work and out of new knowledge adapted to the local circumstances.

15. Conclusion and discussion

In answer to our research questions as defined in Chapter 1.3 we can conclude that:

15.1 Soil quality and decline

Around 80% of the farmers we interviewed in northern Ghana see low or declining soil fertility as an important problem compared to other problems they face running their farm business. Farmers are most content with their soil quality in Yendi (65% satisfied) and least so in Bongo (none of the interviewed satisfied). A decline in soil fertility is noted by almost all (94%) the interviewed farmers. Normally 'continuous cropping' – defined by them either as absence of long bush fallows or sometimes no fallow at all – due to population pressure, is seen as the main cause for it.

15.2 Changing soil fertility practices?

In figure 15.1 an overview is given of the current and past[21] use of soil fertility management techniques in Northern Region and Upper East.

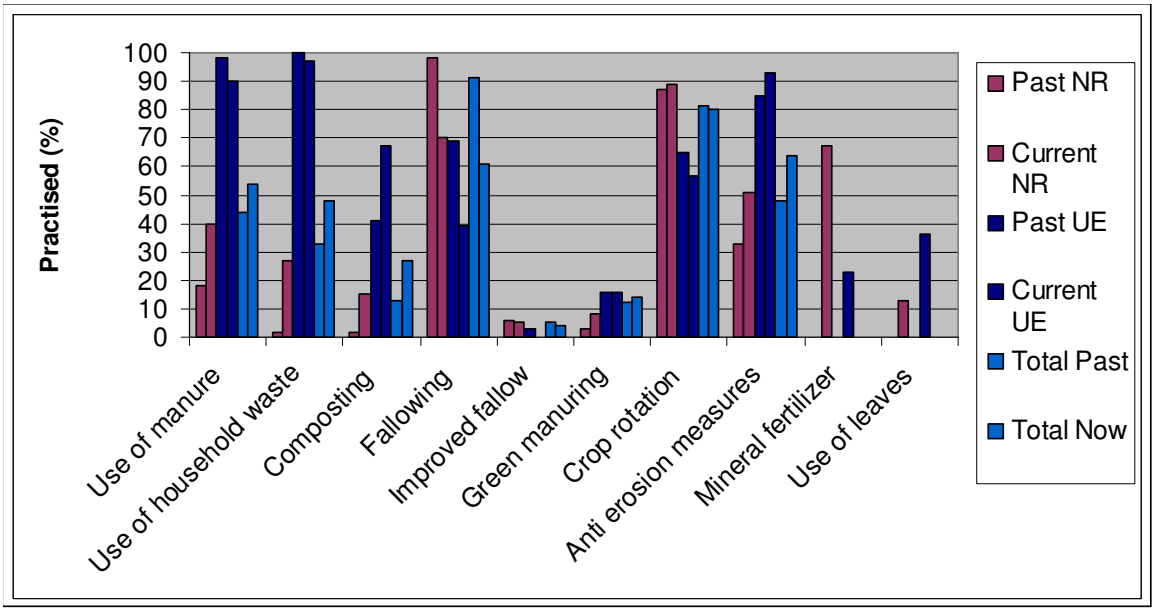

Figure 15.1 The current and past use of several soil fertility management strategies (the exact numbers can be found in annex 3, Table 3.I)

Traditionally, soil fertility management was based on long periods of (bush)-fallow. A majority of the farmers also practiced and practices crop rotation and intercropping. Wide-spread dry-season burning of vegetation has been used as a labour-saving tool and to prevent weed infestation.
The possibility to fallow has strongly declined and so has the length of fallow periods due to population pressure. Slowly, a transition takes place from an extensive land use system towards more intensive land use systems as land becomes scarcer in quantity and in quality. In an intensive system, land is partly substituted by extra labour or capital input per area unit.

[21] Based on the question "Did your father/mother use this method when you were still a child?"

Mineral fertilizer – as a capital-intensive method to increase fertility - was widely introduced by extension services in Ghana and subsidized until the early 1990's. In Northern Region 'lack of money to buy fertilizer' combined with 'high and rising costs of fertilizer' was next to 'lack of money for tractor services' named by farmers as the main impediment to raise their agricultural production. In Northern Region around two third of the interviewed farmers still manages to apply some (although often lower quantities than the recommended dose) mineral fertilizer to their main cereal crop. In Upper East only around a quarter of the interviewed applied mineral fertilizer.

Extension by (N)GO's is increasingly directed to offering alternatives and/or complements to the costly mineral fertilizer. These alternatives substitute capital for labour, assuming the relative abundance of labour amongst poor households. Part of these techniques - the use of animal manure, the use of household refuse or conscious compost making – are popular to very popular in the in Upper East, but much less so in Northern Region. Within Northern Region, in Yendi these techniques are practised least frequently, in Tolon-Kumbungu most. Bongo is the district with highest adoption rates. Nonetheless, also where adoption of these techniques is high, farmers are still not satisfied with the quality of their soils; the measures taken seem not to be sufficient to stop the trend of soil decline.

Improved fallowing is hardly practised and the use of eatable green manures or cover crops is practised by a very small minority. In Upper East, tree leaves to increase soil fertility are used by a significant majority. 'Full fledged' agro-forestry systems however were hardly seen in the visited communities in northern Ghana.

Anti-erosion measures are taken by half of the interviewed in Northern Region and by more than 90% of the interviewed in the erosion-prone Upper East. Contrary to earlier literature findings, we did not observe the use of human excreta or sewage sludge to improve soil fertility.

Controlled burning of (part of the) crop residues or vegetation is still part and parcel of farm management as acknowledged by 65% of the interviewed in Northern Region and 37% in Upper East. Besides, three quarter of the interviewed witness their fallow lands 'being' burned (almost) yearly. In a few the research communities bush-fires are effectively banned.

15.3 Impediments to adoption

Lack of knowledge is named as a major impediment by farmers for many of the new practices. Extension services are often flawed, not reaching the entire community, being directed at some of the leading figures or better-off farmers. However, also where extension services or NGOs did come to give agricultural advice, adoption was often low.

For fallowing population pressure is the main impediment and for mineral fertilizer the capital investment. But also supposedly low-input techniques demand an investment in form of labour (where labour is very scarce!), transport means, animal purchasing and some land. This investment is deemed too high by the non-adopters of these techniques who therefore often consider them 'techniques for the rich'. Costs can be too high in an absolute sense: one simply does not have the means to buy more animals, a donkey cart to carry compost or manure or seeds for fertilizer trees. This problem may be overcome by small credit or grand schemes.

But often the practices may be costly in a relative sense: they are deemed too high compared to the urgency of the problem or to the expected benefits. Some believe that either the soil is not "that weak yet" or that it will be more profitable to spend labour and money on tractor services and weeding to expand or maintain acreage. Investments in other farm activities or non-farm activities like handicrafts, petty trading but also social events might be considered more rewarding.

Besides some proposed practices contradict culturally entrenched 'logic' that has served well for many generations. Thus, when one strongly believes that trees have negative influence on crops and that only rest will rejuvenate the soil, improved fallows and agro-forestry seem to be "crazy ideas!" Extension should not ignore or despise such believes, but make them explicit in an atmosphere of respect, which is the first step towards making them negotiable. Facilitating farmers active experimentation with different techniques may be more effective than prescribing them a package. After all, "to see is to believe"! Besides, on-farm experimentation with farmers as co-researchers will produce techniques more viable in their context with its specific constraints (like labour scarcity…) than when they are developed in the dream world of experimental stations.

Farmers acknowledge the relative difficult acceptation of newly introduced practices and often say: "We are used to follow the footsteps of our fathers, who did not do this either". Nevertheless, although change may be slow, dynamism is present as we can see by the change over generation in soil fertility management practices. The adoption of mobile phones in Africa is a good example of showing that even the poorest are willing to change (and able to make the investment!) if something is judged sufficiently gratifying!

The ban of bush-fires and a better management of controlled fire have the extra constraint that it is not something an individual farmer can successfully decide on. This therefore asks for a community process with sufficient attention to both agronomic or livelihood concerns but also animist and cultural aspects.

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Annex 1. On the Bugli Moγu celebration or the cultural (animist) aspect of bush-burning

By Jenneke van Vliet

Bugli Moγu

On ten minutes motorbike from Tamale centre the village of Taha is situated, followed by another ten minutes is Wovo-Guma. I went for interviews to Taha by chance (visit 17-05-2008), and visited Wovo-Guma (Visit: 10-06-2008) on purpose to find out more about the religious aspect of bush-burning. After the harvest these villages join in a "festival" called Bugli Moγu (not to be confounded with the Bugum fire festival!!). This is also the name of the shrine of Taha. Moγu means 'bush'. As the chairman of Wovo-Guma explains: "After harvest we organize ourselves and invite people from other places like Tamale as well to join in the celebrations. When this time comes the chief will find kola nuts to go to the chief of Taha and the chief of Tamale who will now announce the celebrations in the market. A specific place is burned for the God and sacrifices are made to him. Yes, this is land that is also used for agricultural purposes. Afterwards we hunt. Yes, there are still a lot of animals to hunt. For the hunting a very big land with bush is burned. But it starts with burning the specific land for the Gods. None of the land will be kept unburned, unless you have made fire belts around it. Between the villages, people will start to light the fire from all different angles. It is a very old tradition and it has remained unchanged. No, it would not be a problem for the God if we set less bush on fire, but for the people it will be, they will not allow it!"

The chief (very old) later on explains: "It is a very old tradition that we grew up to meet from our ancestors. When the time comes after harvest, when the grass has become very dry, I go to announce with the chief of Taha and the chief of Tamale. Everyone comes to Taha to give sacrifices to the Gods. You see the God itself is in Taha, we have only have a representative of the God [placed against the nayili (house of the chief) a stick with a egg-like shape on it with feathers plastered on it]. So there we make sacrifices and then the drums are played and a lot of dancing takes place. Then we bring back the representative of the God to Wovo-Guma where again we perform rituals – it is me the chief that performs them - and have a big party with dancing and drumming. The day afterwards the burning takes place.

But it is a misunderstanding that the Gods demand us to burn the whole bush! The Gods only want us to burn a little bit under the sheanut trees and the dawedawe (locust bean) trees, so as to grant us bumper harvest. Not to burn whole fields! However the youngsters are unscrupulous and they burn the whole place to hunt. I am not in line with that, as just catching small animals does not justify setting the whole bush on fire. Sometimes even the Gods are burned in the fire. That is a taboo. The youngster that has done it has to report himself and his family needs to make a sacrifice, otherwise he will certainly die. No, the chiefs of Taha and Tamale are not in line with the massive burning either. They even organize sometimes to put the fire off. But the problem is that the youngsters do it secretly. Yes there are punishments, but how to catch them? Somehow the people start to become more aware…. But to be honest I think it will never change as the youngsters are difficult to control."

Another major shrine in the region is situated in the village Kulaa. This shrine is named Chun Chung Moγu and the same type of rituals are set to occur there. I am not entirely sure whether it takes place at the same time, but it seems to be like that.

It seems that bush-fires do not only take place straight after the festival, but also at unexpected times in the season. “You have to make sure you get all your crops in after harvest or protected by fire belts [like the late maturing pigeon pea, the yam and cassava seeds] otherwise they get burned any time during the dry season.”

Ambiguity

Another major reason for the bush-burning was for the inhabitants of Wovo-Guma that this would protect them from snakes. Old man: “I do not care for hunting, but if we would not burn the bush, the snakes would bite us. Then, the women could not even go out in the bush to collect shea nut.”

What I found very interesting is that all the respondents in Wovo-Guma acknowledge the bad effect the burning has on the fertility of the soils/ seem well aware of the damage that it causes. “Only some controlled burning on heaps could be done, but bush fire is really destroying the fertility. “ “There is a place that is fenced and does not become burned, it is very very fertile!” “Ideally for the soil, it is not done”. (On the other hand, it is not named by them when asked early on in the questionnaire for the causes of the fertility decline which they say they experience and of which they say it is one of their major problems! The answer on that question is always “continuous cropping due to population pressure”). So: informing them on the bad effect on the soils alone will never do to convince of changing the tradition.

Answers on my questions are often ambiguous or straightly contradictory (not just on this subject of course… answers changing from one day to another can drive every researcher crazy here ;-). I thought this had to do with their perception that I as a white woman would want them to stop bush-burning and for that reason they would never acknowledge that it is they themselves who burn but always others. But then they explained to me that they even do this to one another: “Someone would be sitting as we are sitting now talking to me. Then he would go into the bush and drop his cigarette. He then would return to me and sit with me and say “Look the bush is burning again. Who would do such a thing?”

Ibrahim, a friend of us who works as a watch man close to TICCs in Tamale, when chatting about my visit, reacts: “I do not think that the chief is against the hunting, as he himself does not hunt as he already is an important person [hunting is a prestige question!], but the hunters always sent him bush meat. And before the hunting starts it is the chief who makes the necessary sacrifices to the Gods to ask permission for the hunting. ” “It is true that when hunting trips are organized, the leader often asks the people not to use fire. And the chief indicates a limit for the burning, saying that this field may be burned, but these ones not as we want to use them for wood fallowing.”

Illogic?

It does make me wonder: do the benefits of bush-fire still weigh up against the disadvantages for them? Is the negative impact on the soil fertility less than the foregone snake bites? Do they weigh them at all in the rational way as I think of it??

Bush fires seems to them ‘inevitable’: “Others will always set the place on fire. Even if I do not want it, others will do it”. “We grew to meet the bush-fire from our fathers, so how can I say whether it is good or bad?”

Or should we compare it with practices in our own societies, such as smoking cigarettes, that destroys our lungs but we continue to do it and are angry when the government makes it increasingly difficult

on us? Or with the fireworks that cause accidents, money-wasting and environmental damage yearly but continues all the same?

Especially when I look at the young people, I see joy in their eyes and smiles on their mouths when they talk about the hunting and the fire. Could it be that they really enjoy the excitement of this great party / the hunting where other entertainment is scarce? When asked if they cannot hunt without using fire, like using traps, they answer: "With traps you only catch the bigger animals, not the mice."

Is it not like Kirby (1999: 133) says: "One may distinguish between the benefits that accrue to the individual versus that will accrue to the community as a whole .Whereas the entire group can plausibly benefit in the long run from non-burning policies the individuals or household groups stand to benefit more in the short-run from the burning. This can be confirmed by asking Anufo men why they burn. Here are a sampling of their answers [comparable to what we found among the Dagomba!!]: 'I burn because it clears the bush'. 'I get meat for my family!; 'I am free to walk in the bush'. 'My wife can easily go for firewood.' Etc. etc. But by these answers we should not be misled into thinking that we now understand why they burn. Though these may or may not actually be true, the point is they would burn anyway. Such responses usually show greater adaptation to the interviewer than to the ecology. They are mere 'reasonable' parries given to troublesome experts to fend off the 'reasonableness' of the their unacceptable proposals to stop burning. In the end, distinguishing between the long term and short term benefits in the minds of the Anufo, only affect their decisions about when to burn or what to burn now and what to leave for later. They do not affect the notion of burning itself. Even if it were economically non-viable to burn the 'bush' (as it is now quickly becoming around the Chereponi area) it still would be (and in fact is) burnt; and vice-versa, if it were made worth their while as individuals do not burn the bush, it would still somehow 'get' burned."

Kirby furthermore points at the long history in which it was necessary to fight the bush as it stood for great danger with its wild animals. With the fire as protective power, with trees (apart from a few useful ones) as a threat to humanity as it harboured all those animals, diseases and bad spirits. Did it not use to be the same for us in the West? Only when we had destroyed all wilderness around us, we came to value it and wanted it back. Although rather in the form of small, safe patches of man-managed natural parks than in its original chaotic appearance.

Kirby (1999: 131) once more stresses the importance of the 'irrational aspects' of bush-burning, or maybe one should say logics that have become obsolete… : "Attempts to change destructive social habits [like bush fires] by using logical arguments, workshops or demonstration farms are only partly solutions. The Anufo [and many other communities in Northern Ghana] do not view bush-burning as a harmful habit. Although some are aware of some of the harmful effects which we know to be caused by the burning, they may or may not see the association. Part of the reason is the rapid speed with which these changes have taken place. They say, 'our fathers have always been burning but those problems have come only recently.' It is analogous to the way in which up until now, having a large family has always been valued as part of the solution rather than a part of the problem itself." [My note: In subsistence agriculture, where land scarcity is not an issue, large households are normally better off. Once, land scarcity comes in or modern 'needs' like schooling or pharmaceutical medicines arrive, having many children becomes a burden instead of a blessing. However, wealth is here still measured in having many wifes and many children… It is as if 'a transition of values and behaviour' lags behind the transition in conditions. Probably just like in European history..]

Change

Though Kirby words sound true to my ears, we should not generalize or think that culture is static either. In none of the other communities where I or my interpreter was interviewing, people have responded that they burn in order to appease their Gods. It could be because they did not want to tell

us, but that seems unlikely to me as the people in the Taha and Wovo-Guma are very frank about their tradition. In the other communities they would acknowledge that burning took place ("By unscrupulous people, mischievous lads or the neighbor") but for other reasons: hunting, labour reduction, protection against snakes, increasing production of economical trees etc. Only in Balshei one of the elderly responded that although they themselves do not have that tradition, they go to Taha to participate in the celebration. What can be observed in the different communities is the dense vegetation around the shrines: burning it is probably a taboo in all the villages.

In some other communities (Nwodua, Dabogshe in Tolon-Kumbungu) uncontrolled burning was effectively banned after people had come to realize that they did not have enough pastures for the animals to feed on anymore in the dry season or that it affected their development negatively. The control was secured by bylaws, voluntary fire brigades and rather serious punishments (up to 2 years exclusion from access to farm land). A farmer Dabogshe: "For us it is the other way round, God does not want us to be disturbing the animals in the bush. He sees everything." While in Nwodua a farmer says: "We have stopped burning and that has nothing to do with religion. We just think it is not good for development."

What definitely becomes clear, is that the decision to stop burning can never be an individual one (someone else will simply burn for you then…), so that it would mean a community process.

Annex 2: Interview scheme

Questionnaire on soil quality issues:

A) General Information:

District:……..

Village:……..

Name farmer:……. Age: …….. Gender: Male/Female

Occupation: Major…… Minor……..

B) Crops and crop yields:

Crop*	Maize					
Acreage**						
Harvest*** two years ago						
Intercrop? ****Yes/no						

* In this line fill in the main crops the farmer grows

** Amount of acres that are covered with this crop

*** Yield in bags per acre

**** Does the farmer intercrop the crop with other crops

C)Soil Fertility:

1. Are you happy with the quality of your soil?

Yes/No [ ]

2. Do you face a decline in soil fertility?

Yes/No [ ]

If yes, What do you see as the cause(s) of this problem?

……

……

3. Compared to other problems related to farming, is poor soil quality an important problem in your eyes?

Yes/No [ ]

If not, Why Not?

……

……

D) Animal Manure:

4.a) Did you use any kind of animal manure on your farm last year?

Yes/No [ ]

If yes, was it on your compound farm, bush farm or on both? …….

5. Did your father use animal manure on his farm, when you were young?

Yes/No [ ]

If yes occurs in question 4 or 5, complete the following table:

	You: [Yes/No]	Your father: [Yes/No]
a. Cattle manure		
b. Sheep manure		
c. Goat manure		
d. Poultry manure		
e. Pig manure		

If no in question 4a: Why don't you use manure on your farm?

……

……

Are there other reasons for not using manure on your farm?

……

……

Livestock:

Fill in the following table:

What kind of animals do you own? (if cows are owned, mention of its are wash or sebu)

How many of them do you own?

Owns:	number:	Who herds them?	where do they stay overnight?
1. Cows			
2. Sheep			
3. Goats			
4. Pigs			

E) Household waste/ Refuse

6. Did you use household waste/ refuse on your farm last year?

Yes/No [ ]

If yes, Did you use the refuse on your compound, your bush farm or on both?

……

If no, Why didn't you use household waste/ refuse on your farm?

……

……

Are there other reasons for not using household waste on your farm?

……

……

7. Did your father use household waste/ refuse on his farm, when you were young?

Yes/No [ ]

F) Composting: (See what is meant by composting in the guide to questionnaire)

8. Did you prepare compost for your farm last year?

Yes/No [ ]

If yes: How many bags or bowls of compost did you prepare last year? ……. Bowls/ bags (…….bowls per bag) and;

Did you apply the compost on your compound, your bush farm or on both?

…… and;
How did you get to learn how to prepare compost?
……
……
If no, Why didn't you prepare compost?
……
……
Are there more reasons for not preparing compost?
……
……
9. Did your father perform composting, when you were young?
Yes/No [ ]

G) Fallow:
10. Did you leave land fallow last year?
Yes/No [ ]
11. Do you experience an increasing pressure on the land?
Yes/No [ ]

How many years do you farm on the land before leaving it fallow? ……..
How many years do you leave it fallow? ……..

Total acres of land: ……..
Total acres in production: …… Total acres fallow:…….

Did your father leave land fallow?
Yes/No [ ]
Were the fallow periods of your father longer then yours?
Yes/No [ ]

Why don't you leave your land longer fallow?
……
……
Are there more reasons why you do not leave your land longer fallow?
……
……

H) Burning
Some farmers told that some crops do not perform well without burning before sowing, what is your experience with this?
……
……

12. Do you burn after harvest?
Yes/No [ ]
Is this before or after the last rains?.....

13. Do you burn before ploughing?
Yes/No [ ]
Is it only the stalks of the maize and guinea corn, or do burn all the vegetation?.....
How do you burn your crop residues: on field or heaps…….

14. Do you or others also burn your fallow land?
Yes/No [ ]

Which of the following would be good for your soil?
More burning, As much burning as happens now, Less burning or No burning at all?
……

Why don't you stop burning? Or: Do you have other reasons for burning?
……
……
Are there other reasons why you do not stop burning?
……
……
16. In some communities people burn to appease gods….is this also the custom in your community?
Yes/No [ ]

I) Improved Fallow:
17. Did you practice improved fallow last year?
Yes/No [ ]
If yes which crop did you plant on your fallow land? ……..

If not: Why not don't you practice improved fallow?
……
……
Are there other reasons why you do not practice improved fallow?
……
……
18. Did your father practiced improved fallow, when you were young?
Yes/No [ ]

J) Cover crops:
19. Did you make use of cover crops last year?
Yes/No [ ]
If yes, which crop did you use as cover crop?……..
If not: Why don't you use cover crops?
……
……
Are there more reasons that you do not use cover crops?
……
……

20. Did your father use cover crops, when you were young?
Yes/No [ ]

K) Weeds:

21. When weeding, did you leave the picked weeds on the cropland last year?
Yes/No [ ]
If not: Why didn't you leave the slashed weeds on the cropland?
……
……
Are there other reasons why you don't leave the slashed weeds on the field?
……
……
22. Did your father leave slashed weeds on the field, when you were young?
Yes/No [ ]

L) Crop rotation

23. Do you perform crop rotation?
Yes/ No [ ]
If not: why don't you perform crop rotation?
……
……
Are there more reasons why you don't perform crop rotation?
……
……

24. Did your father perform crop rotation, when you were young?
Yes/No [ ]

M) Anti-erosion Measures

25. Do you have problems with erosion?
Yes/No [ ]

26. Do you take measures to prevent/ minimise erosion?
Yes/No [ ]
If yes, what methods did you put in place?
……...
If not: why don't you take anti-erosion measures?
……
……
Do you have more reasons why you do not take measures against erosion?
……
……
27. Did your father take anti erosion measures, when you were young?
Yes/No [ ]

N) Use of leaves, trees:

28. Did you collect the leaves from trees to use them on your farm to improve the soil quality last year?

Yes/No [ ]

If not, Why don't you collect leaves or litter from trees?

……

……

Are there other reasons why you do not collect leaves or litter from trees?

……

……

If no on question 28, after filling in the reasons, go to question 32!

If Yes on question 28, continue:

From which tree(s) did you use the leaves on your farm? .....

29. Do you plant these trees for this reasons?

Yes/No [ ]

If yes, did you plant them on your compound, bush farm or both?.....

If not, Why don't you plant trees for this reason?

……

……

Are there more reasons why you do not plant trees?

……

……

32. Do you plant trees?

Yes/ No [ ]

If yes, which?.....

33. Is tree planting a task for the ancestors/ strangers?

Yes/No [ ]

<u>O) Human Excreta</u>

33. Did you use human excreta on your farm last year?

Yes/No [ ]

If not: Why don't you use human excreta on your farm?

……

……

Are there more reasons why you don't use it?

……

……

<u>P) Mineral Fertilizer</u>

34. Did you use mineral fertilizer last year?

Yes/No [ ]

If yes; How many bags did you use last year? …….

On which crops?……

Did you apply it on your bush farm, compound farm or both? ……..

Q) Other inputs:

Do you make use of other inputs or do you use other methods to improve the soil fertility.

…….....
…….....
…….....

R) Constraints to higher production

Mention two crops where you would like to produce more of:

1. …….
2. …….

What are your constraints to produce more of crop 1?

…….....
…….....
…….....

Explain why!

…….....
…….....
…….....

What are your constraints to produce more of crop 2?

…….....

Explain why!

……...……
…….....

Annex 3: Tables

Table 3A. Mentioned constraints for crop rotation in Northern Region (n=16)

Percentage of respondents	Constraint
38	No knowledge
25	Each crop requires its specific soil
25	Too expensive
13	Not used to it
6	All the food is needed
6	Population pressure
6	Prefer alternative measure

Table 3B. Mentioned constraints for crop rotation in Upper East (n=25)

Percentage of respondents	Constraint
40	Each crop requires its specific soil
32	No seeds/seedlings available
24	Too expensive
16	All the food is needed
12	Population pressure
8	Prefer alternative measure
8	Other constraint
4	Not used to it
4	Labour
4	No sense of urgency

Table 3C. Mentioned constraints for the use of leaves in Northern Region (n=105)

Percentage of respondents	Constraint
38	No knowledge
20	No (suitable) trees in the field
30	No perceived benefit
11	Labour
4	Not used to it
4	No perceived urgency
5	Other use for the resource
4	Dangerous animals that hide between the leaves
3	The transport of the leaves
2	Leaves have a negative impact on crop production
2	Crazy idea
2	Mortality due to bushfires
2	Other constraints
1	Low quantity of the leaves
1	Population pressure
1	Availability of seedlings

Table 3D. Mentioned constraints for the use of leaves in Upper East (n=37)

Percentage of respondents	Constraint

46	No (suitable) trees in the field
19	No knowledge
11	Labour
11	Not used to it
11	Prefer alternative measure
8	No perceived urgency
8	Other use for the resource
8	Other use for the resource
5	No perceived benefit
5	Local law
3	Leaves have a negative impact on crop roduction
3	Low quantity of the leaves

Table 3E. Mentioned constraints for planting of trees in Northern Region (n=57)

Percentage of respondents	Constraint
33	Knowledge
25	The availability of seeds
19	Trees have a negative impact/effect on crop production
14	No sense of urgency
14	Mortality of trees due to drought, bushfires and animal browsing +
7	No perceived benefit
7	The pressure on the land
5	Not used to it
4	Labour
2	Crazy idea

Table 3F. Mentioned constraints for planting of trees in Upper East (n=16)

Percentage of respondents	Constraint
50	The availability of seeds
19	Mortality due to Water shortage
13	No sense of urgency
6	Knowledge
6	Trees have a negative impact/effect on crop production
6	Not used to it
6	Labour
6	No perceived benefit

Table 3G. Reasons for farmers to burn in Northern Region (n = 112)

Percentage of respondents	Constraint
59	Land preparation
25	Others will burn
18	Beneficial for crop/soil
18	Dangerous animals
10	Hunting
4	Fire protection
4	Fruiting of economic trees
3	Plagues

3	Used to it
2	Cultural event
3	Other constraint : get rid of residues, for ashes: soap, fresh grass
1	Get rid of weeds

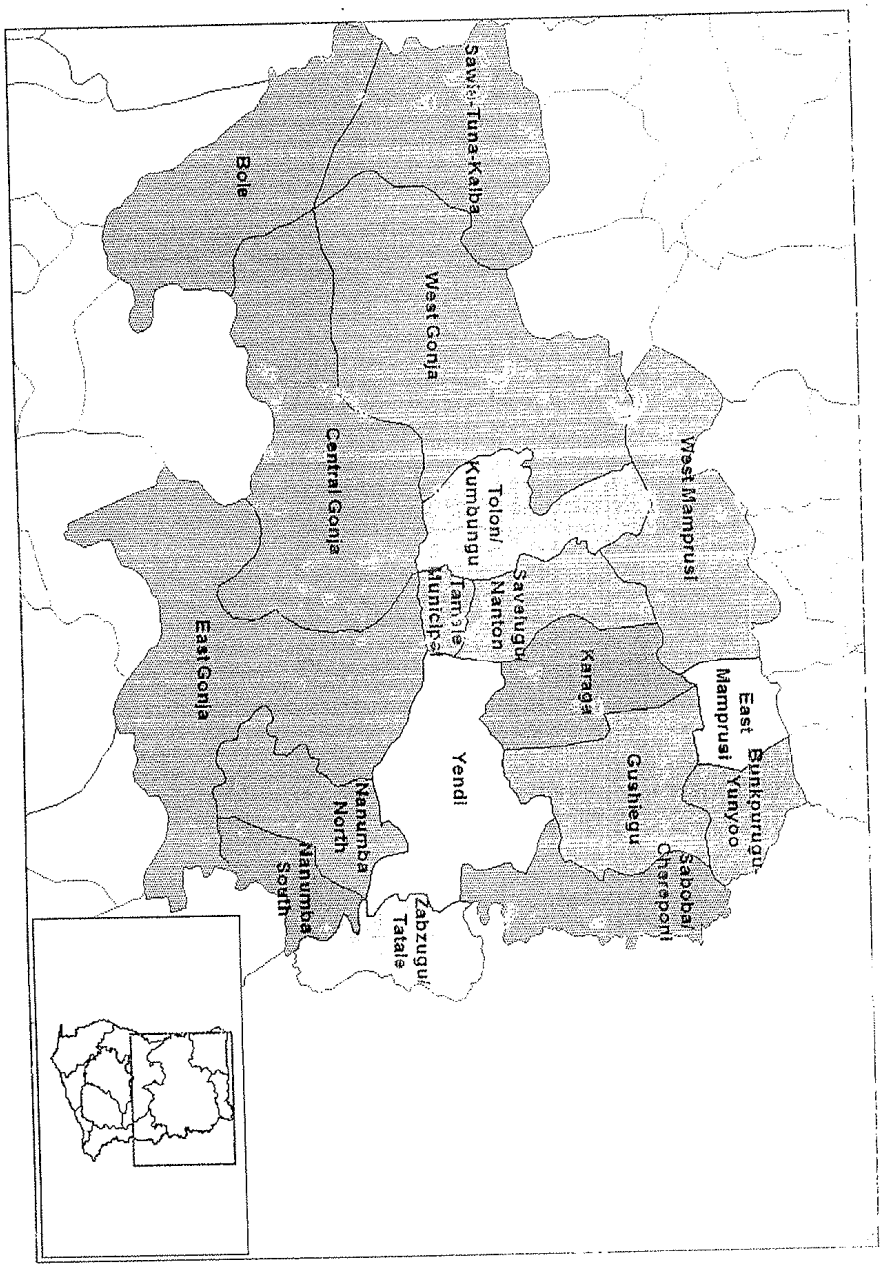
Table 3H. Reasons for farmers to burn in Upper East (n = 23)

Percentage of respondents	Constraint
61	Land preparation
26	Beneficial for soil/crop
13	Plagues
13	Used to it
9	Hunting
9	Get rid of weeds
4	Cultural event

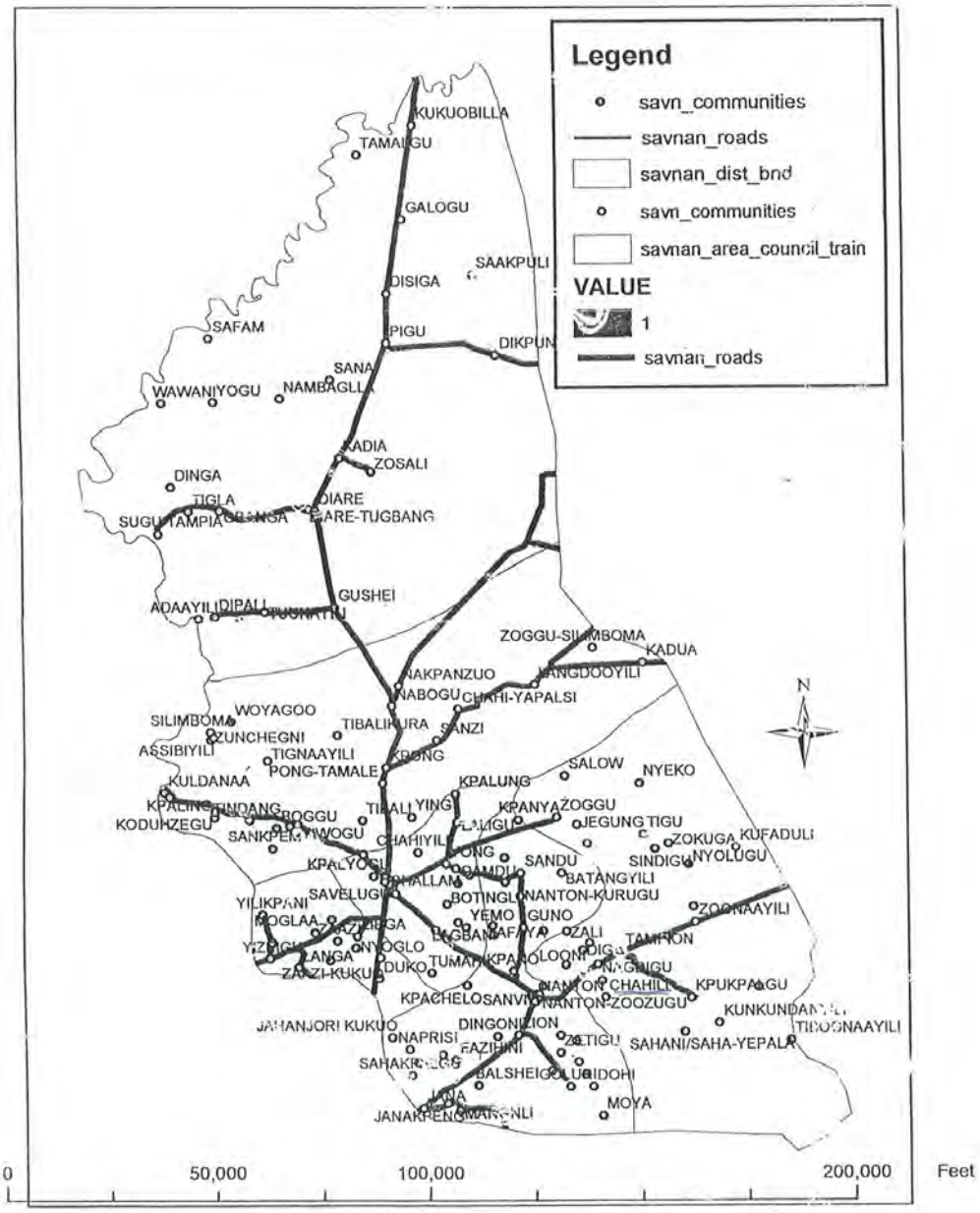
Table 3I. Soil fertility management strategies and its adoption in Northern region, Upper East and average of last generation and of current generation (in percentage).

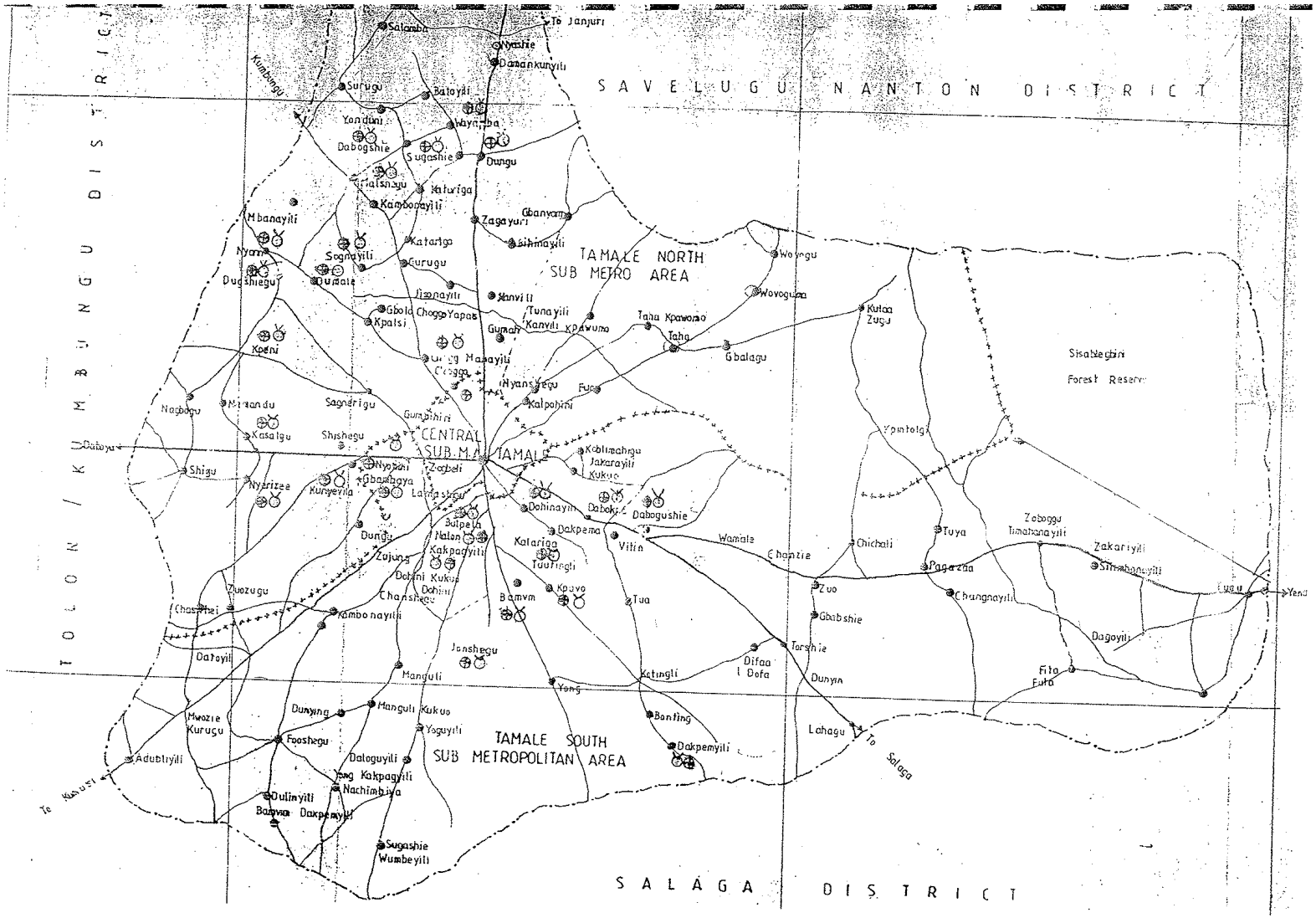
	Use of manure	**Use of household waste**	**Compost use**	**Fallowing**	**Improved fallow**	**Green manuring**	**Crop rotation**	**Mineral fertilizer**	**Use of leaves**
Past NR	18	2	2	98	6	3	87		
Current NR	40	27	15	70	5	8	89	67	13
Past UE	98	100	41	69	3	16	65		
Current UE	90	97	67	39	0	16	57	23	36
Average Past	44	33	13	91	5	12	81		
Average Now	54	48	27	61	4	14	80	56	19

Anex: 4 Soil maps:

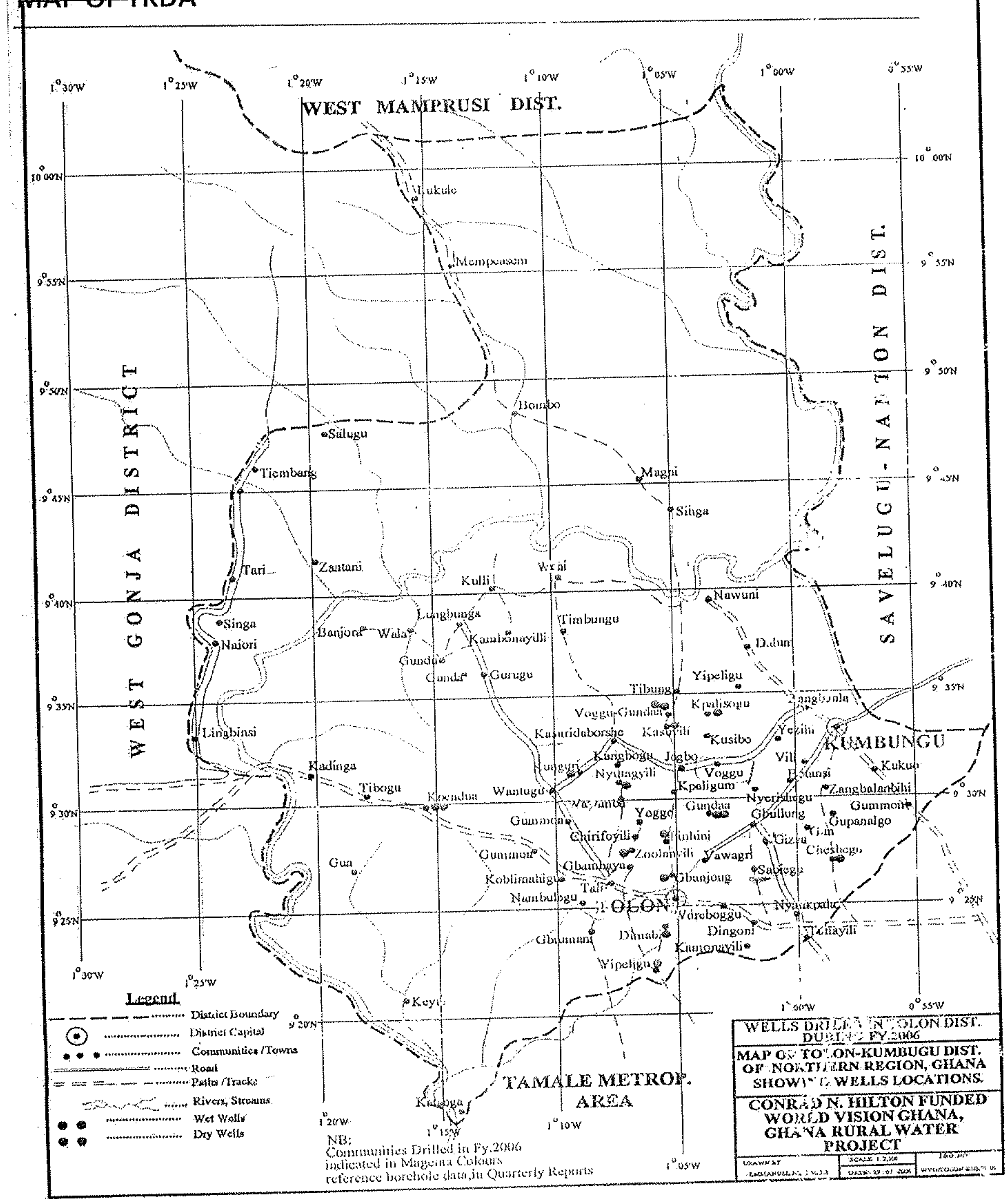


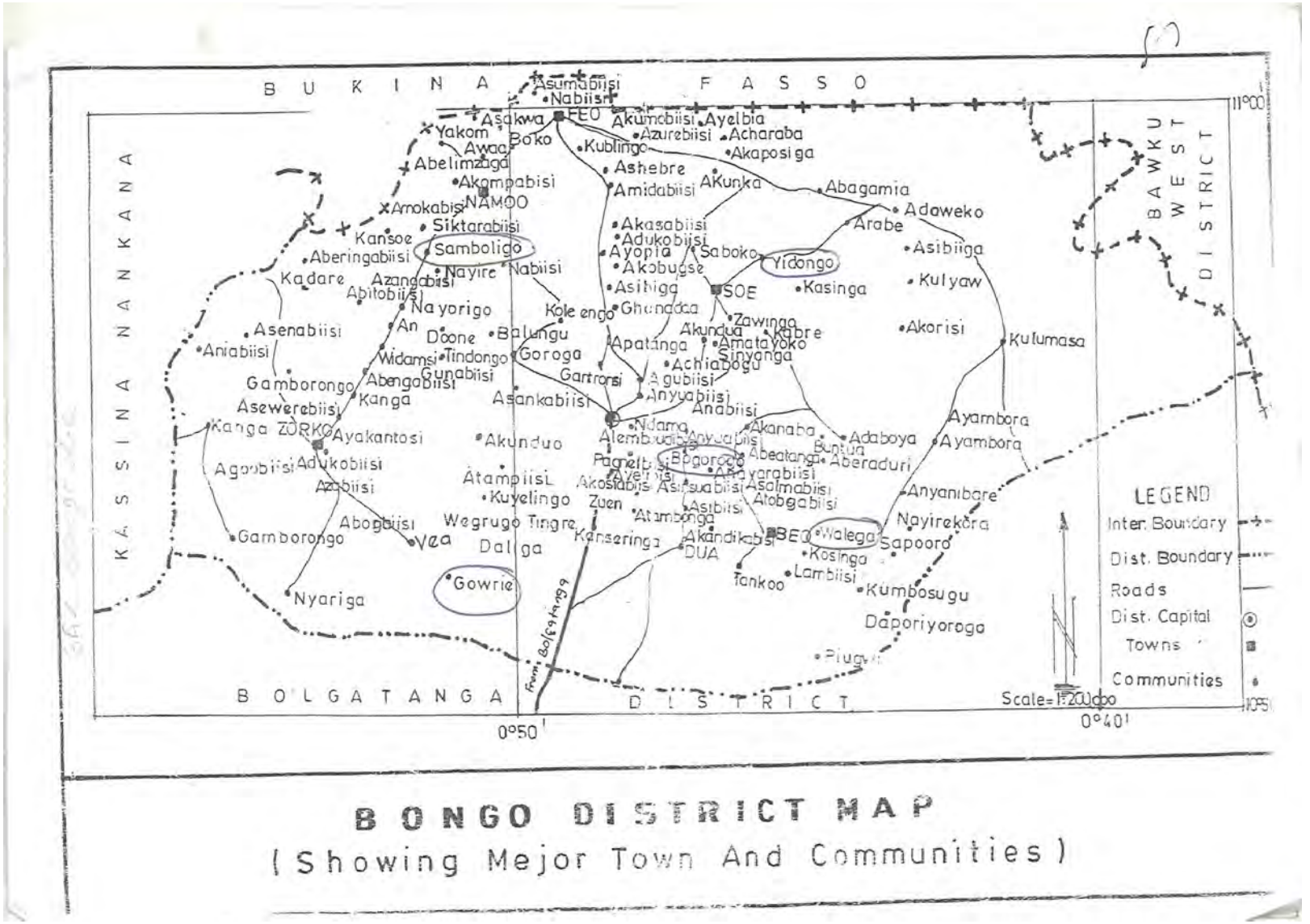
SAVELUGU/NANTON COMMUNITIES




TOLON / KUMBUNGU DISTRICT
SAVELUGU NANTON DISTRICT
TAMALE NORTH SUB METRO AREA
TAMALE CENTRAL SUB M.A.
TAMALE SOUTH SUB METROPOLITAN AREA
SALAGA DISTRICT
Sisaleghini Forest Reserve
Salambo
To Janjuri
Nyashie
Danaankunyili
Kumbungu
Surugu
Baloyili
Yondani
Dabogshie
Sugashie
Dungu
Katuriga
Kambonayili
Mbanayili
Zagayuri
Gbanyam
Sihimayili
Katariga
Sognayili
Gurugu
Dugshiegu
Dumale
Jisonayili
Kanvili
Tunayili
Gbolo Chogo
Yapas
Kpalsi
Gumah
Kanvili Kpawumo
Taha Kpawumo
Taha
Gbalagu
Wovogu
Wovogu-Kan
Kutaa Zuzu
Kpeni
Nagbogu
Mirandu
Sagnerigu
Kasalgu
Shishegu
Gumbihini
Kalpohini
Nyansigu
Fuo
Kpintolg
Dabeyu
Shigu
Nyorizee
Kunyevila
Nyohini
Gbashaya
Zogbeli
Lamashegu
Kobilimahgu
Jakarayili
Kukuo
Dohinayili
Dabokpa
Dabogushie
Dakpema
Vitin
Wamale
Chantie
Chichali
Tuya
Zoboggu
Timahanayili
Zakariyili
Pagazaa
Shimabagayili
Chungnayili
Zuo
Gbabshie
Tarshie
Dagoyili
Difaa I Dofa
Dunyin
Fita Fufa
Yend
Bulpela
Nalon
Kakpagyili
Tuutingli
Dohini Kukuo
Dohini
Chanshegu
Bamvim
Kpavo
Tua
Zuozugu
Chashegu
Kambonayili
Janshegu
Mangoli
Ketingli
Yong
Bonting
Dakpemyili
Lahagu
To Salaga
Dunying
Mangoli Kukuo
Mwozie Kuruga
Yagayili
Fooshegu
Adubiyili
Dabogyili
Kakpagyili
Nachimbiya
Dulinyili
Bamva
Dakpemyili
Sugashie Wumbeyili
To Kanvili
Datoyili

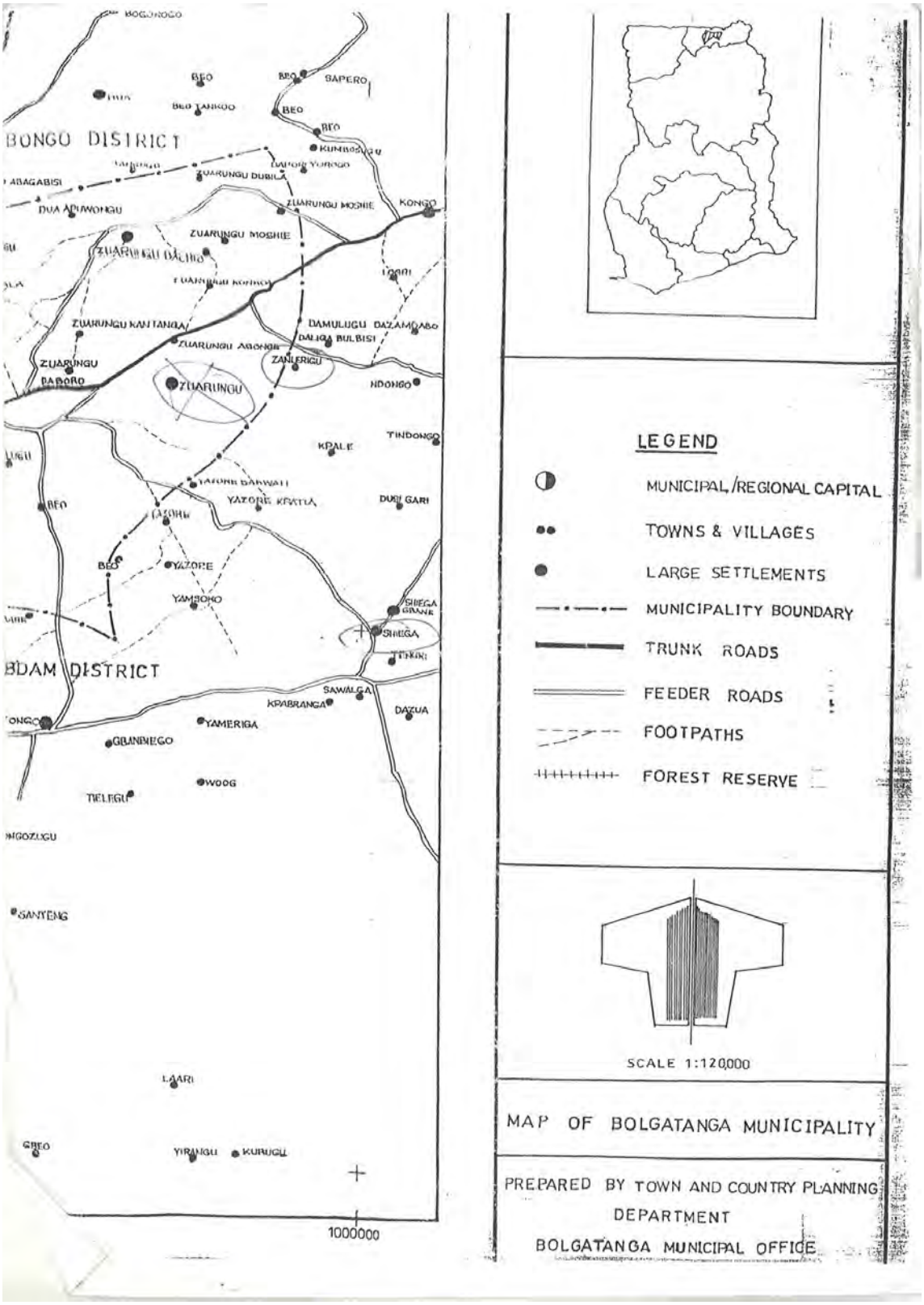
MAP OF TKDA

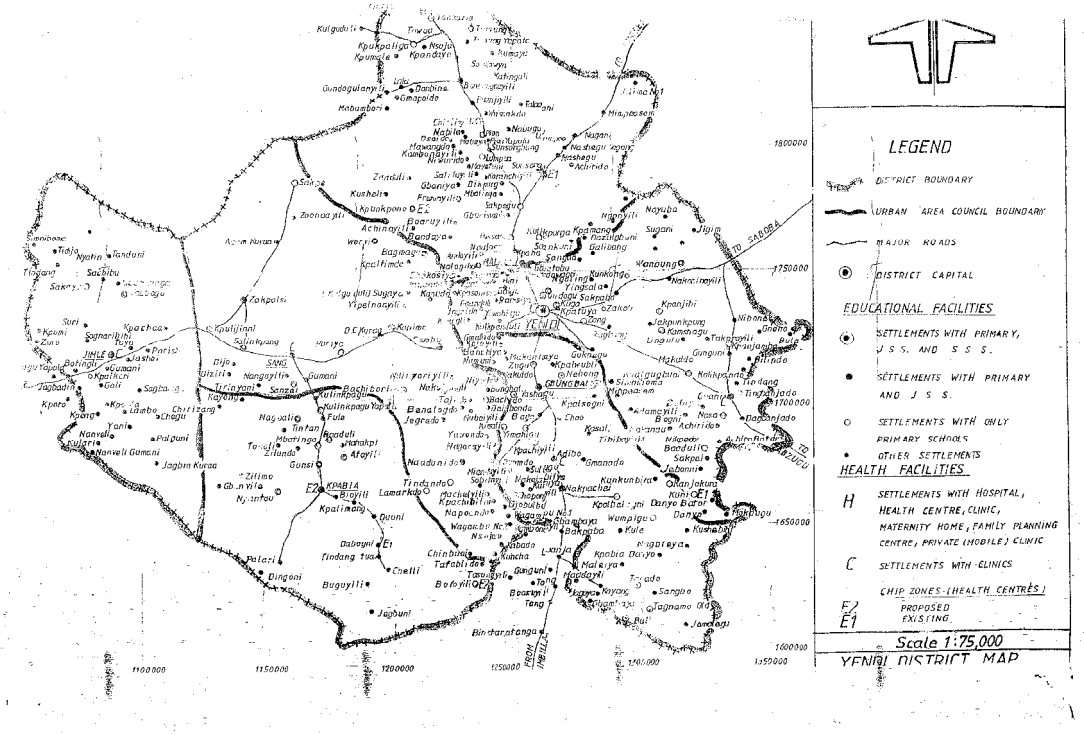

WEST MAMPRUSI DIST.
WEST GONJA DISTRICT
SAVELUGU - NANTON DIST.
TAMALE METROP. AREA
KUMBUNGU
TOLON
Legend
District Boundary
District Capital
Communities /Towns
Road
Paths /Tracks
Rivers, Streams
Wet Wells
Dry Wells
NB:
Communities Drilled in Fy.2006
indicated in Magenta Colours
reference borehole data in Quarterly Reports
MAP OF TOLON-KUMBUGU DIST.
OF NORTHERN REGION, GHANA
CONRAD N. HILTON FUNDED
WORLD VISION GHANA,
GHANA RURAL WATER
PROJECT
Kukuo
Mempeasem
Bombo
Salugu
Tiembang
Magni
Siiliga
Zantani
Tari
Kulli
Nawuni
Singa
Nafori
Banjon
Wala
Lungbunga
Kumbonayilli
Timbungu
Gundu
Gurugu
Yipeligu
Tibung
Lingbinsi
Kadinga
Tibogu
Kusibo
Jogbo
Kpaligum
Voggu
Yoggo
Gundaa
Gbullung
Gupanalgo
Zangbalanbihi
Gummoili
Chirifoyili
Zoolanyili
Yawagri
Sabiegu
Gbanjong
Gua
Koblimahigu
Nambulogu
Tali
Dingoni
Dimabi
Kamonayili
Gbumani
Yipeligu
Keyi
Kaboga
Tuchayili
Nyankpala



BONGO DISTRICT MAP

(Showing Mejor Town And Communities)


BONGO DISTRICT
BEO
SAPERO
BEO TANKOO
KUMBOSIGU
ZUARUNGU DUBILA
ZUARUNGU MOSHIE
KONGO
DUA ADIAWONGU
ZUARUNGU DACHIO
ZUARUNGU KANTANGA
DAMULUGU DAZAMOABO
ZUARUNGU ABONGO
DALIGA BULBISI
ZANLERIGU
ZUARUNGU
BAROKO
NDONGO
TINDONGO
KPALE
YAZORE BARWATI
YAZORE KPATILA
DUSI GARI
YAZORE
YAMBOKO
SINEGA
BDAM DISTRICT
SAWALGA
KPABRANGA
DAZUA
YAMERIGA
GBANMEGO
WOOG
TIELEGU
SANYENG
LAARI
YIRINGU
KURUGU
1000000
LEGEND
MUNICIPAL/REGIONAL CAPITAL
TOWNS & VILLAGES
LARGE SETTLEMENTS
MUNICIPALITY BOUNDARY
TRUNK ROADS
FEEDER ROADS
FOOTPATHS
FOREST RESERVE
SCALE 1:120,000
MAP OF BOLGATANGA MUNICIPALITY
PREPARED BY TOWN AND COUNTRY PLANNING DEPARTMENT
BOLGATANGA MUNICIPAL OFFICE


LEGEND
DISTRICT BOUNDARY
URBAN AREA COUNCIL BOUNDARY
MAJOR ROADS
DISTRICT CAPITAL
EDUCATIONAL FACILITIES
SETTLEMENTS WITH PRIMARY, J S S. AND S S S.
SETTLEMENTS WITH PRIMARY AND J S S.
SETTLEMENTS WITH ONLY PRIMARY SCHOOLS
OTHER SETTLEMENTS
HEALTH FACILITIES
H SETTLEMENTS WITH HOSPITAL, HEALTH CENTRE, CLINIC, MATERNITY HOME, FAMILY PLANNING CENTRE, PRIVATE (MOBILE) CLINIC
C SETTLEMENTS WITH CLINICS
CHIP ZONES (HEALTH CENTRES)
PROPOSED
EXISTING
Scale 1:75,000
YENDI DISTRICT MAP