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Measuring the Burden of Disease and Returns to Education in Rural West Africa

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Ralph Würthwein

Measuring the Burden of Disease and Returns to Education in Rural West Africa

The Collection and Analysis of Mortality, Morbidity, and Socio- Economic Data in the Nouna Health District in Burkina Faso

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Preface

The success of health economics and its guidance for health policy heavily rests on the availability of reliable empirical evidence on the demographic, economic, and epidemiological environment, on behavioral relationships, and on the impact of policy interventions. For Sub-Saharan Africa, especially the epidemiological situation is unclear, since comprehensive systems of mortality and health statistics are often absent.

The economic analysis of health naturally places a special focus on the interrelation between health and economic well-being: the overall disease burden decreases when a country grows richer, and the share of communicable diseases decreases in the process of economic development, whereas the share of non-communicable diseases increases. In those parts of Sub-Saharan Africa that are mainly dominated by traditional subsistence farming, however, it is difficult to examine questions of income and health for simple fundamental reasons. A vital prerequisite for an empirical investigation is the thorough and accurate measurement of income. Yet, both the measurement of the burden of disease and the measurement of income are research tasks that are far from being fulfilled for Sub-Saharan Africa. A further issue that is related with economic well-being and health is education. For poor rural regions predominated by traditional subsistence farming it is far from clear whether investments in human capital are worthwhile.

The present study addesses this research gap by producing empirical evidence on the measurement of the burden of disease, the structure of income, and returns to education in rural West Africa. Concretely it deals with the collection and analysis of mortality, morbidity, and socio-economic data in the Nouna Health District in the North-West of Burkina Faso. The study was accepted as a doctoral thesis at the University of Heidelberg. Earlier versions of some of its chapters have been published as working papers or in international journals.

Essen, June 2003

Rheinisch-Westfälisches Institut
für Wirtschaftsforschung

Christoph M. Schmidt

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Furthermore, I am grateful to all the staff of the *Centre de Recherche en Santé de Nouna*, especially to *Bocar Kouyaté*, *Adjima Gbangou*, and *Yazoumé Yé* who not only naturally played a major role in establishing the Nouna Health District Household Survey, but who also helped me to understand and cherish the Burkinabé culture and population.

Last but not least I would also like to thank my colleagues *Boris Augurzky*, *Martin Biewen*, *Michael Fertig*, *Manuel Frondel*, and *Jochen Kluve* for providing a productive, co-operative, and cheerful working atmosphere.

Ralph Würthwein

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Introduction and Overview

The success of health economics and its guidance for health policy heavily rests on the availability of reliable empirical evidence on the demographic, economic, and epidemiological environment, on behavioral relationships, and on the impact of policy interventions. For Sub-Saharan Africa, especially the epidemiological situation is unclear, since comprehensive systems of mortality and health statistics are often absent (Kaufman et al. 1997; Cooper et al. 1998). There is a growing literature on the design and analysis of health surveys (e.g. Aday 1996; Korn, Graubard 1999), indicating the increasing demand for health surveys in academia and politics.

The *economic* analysis of health naturally places a special focus on the interrelation between health and economic well-being (e.g. Grossman 1972; Deaton, Paxson 1999; Smith 1999). On country level, for example, two well-documented empirical findings demonstrate the relation between health and well-being: (i) the overall disease burden decreases when a country grows richer, and (ii) the share of communicable diseases decreases in the process of economic development, whereas the share of non-communicable diseases increases – a phenomenon known as the *Epidemiological Transition* (Murray, Lopez 1996a). In those parts of Sub-Saharan Africa that are mainly dominated by traditional subsistence farming, however, it is difficult to examine questions of income and health for simple fundamental reasons. A vital prerequisite for an empirical investigation is the thorough and accurate measurement of income. Thus, both the measurement of the burden of disease and the measurement of income are research tasks that are far from being fulfilled for Sub-Saharan Africa.

A further issue that is related with economic well-being and health is education. A seminal paper on the relationship between health and schooling is provided by Grossman (1975). He states that the often observed high correlation between health and completed years of formal schooling can be interpreted in three ways that are not necessarily mutually exclusive: (i) increases in schooling lead to an increase in health, (ii) increases in health lead to a higher demand for formal schooling, and (iii) there is no causal relationship between

schooling and health but other exogenous factors such as physical and mental endowments affect both health and schooling. He suggests to model the relationship between health and schooling in a demand model for health or in a recursive system of human capital formation where the demand for schooling and the demand for health are simultaneously determined.

T.P. Schultz (1999) takes up the human capital concept that comprehends both health and schooling as investments in human capital and analyzes the effect of human capital investments on income in Sub-Saharan Africa. He states that both the level of education as well as the health status of the population are lower in Sub-Saharan Africa than in other regions of the world. He argues that these conditions do not only reflect the lower level of development in Sub-Saharan Africa, but also help to explain that lower level and suggest a set of policies for improving Sub-Saharan Africa's standard of living. Using data from two *Living Standards Measurement Studies* (LSMS) (Grosh, Glewwe 1998), he reports coefficient estimates of returns to education for Ghana (1987–89) and Côte d'Ivoire (1985–87). In his analysis, *wage* returns for schooling are examined. For rural Sub-Saharan Africa, though, labor markets in the classical sense hardly exist. Therefore, an interesting question with regard to poor, rural regions of Sub-Saharan Africa is: are investments in human capital worthwhile in a region that is predominated by traditional subsistence farming?

T.W. Schultz (1975) argues that the value of schooling in farming depends on the opportunities that farmers have to modernize their production. Therefore, he concludes, in areas with traditional agriculture, there are no significant gains in output from schooling. Empirical research partly confirms the perception of low returns to education in poor subsistence economies with traditional agriculture. Psacharopoulos (1994) estimates that the return to education is lowest (6.4 %) in low income countries. For Sub-Saharan Africa in particular, he estimates a return to education of 5.9 %. There exist only few studies on Sub-Saharan Africa, though.

This thesis intends to produce empirical evidence on the measurement of the burden of disease, the structure of income, and returns to education in rural West Africa. It deals with the collection and analysis of mortality, morbidity, and socio-economic data in the Nouna Health District in the North-West of Burkina Faso. The thesis consists of five chapters[1]. In part, the thesis has been written while I was financed by the Sonderforschungsbereich 544. They profit extensively from the collaboration with the *Nouna Health Research Center (Centre de Recherche en Santé de Nouna,* CRSN) which implemented the

[1] Two of them have already been published as articles in international peer-reviewed journals (*Journal of International Epidemiology* and *Health Economics*), and one has been published in the working paper series of the Sonderforschungsbereich 544 Control of Infectious Diseases – a research grant of the Deutsche Forschungsgemeinschaft.

Nouna Health District Household Survey (NHDHS) in the field. Within the Sonderforschungsbereich 544, I was responsible for the design of the NHDHS. In collaboration with members of the CRSN and staff of the *Department of Tropical Hygiene and Public Health of the University of Heidelberg*, I developed the questionnaire and was responsible for the pretest, the time-frame, and various practical aspects of the survey. Furthermore, I was responsible for the supervision and cleaning of the data in Heidelberg and for the compilation of a final Stata version with which the empirical results of chapter 5 have been produced.

In chapter 1 the design and the implementation of the NHDHS is described. Chapter 2 depicts the cleaning of the raw data and the construction of income data. Chapter 3 presents a study on the measurement of the burden of disease. The study uses mortality data collected by the CRSN between 1997 and 1999. Chapter 4 deals with some methodological problems of the measurement of the burden of disease, whereas in chapter 5, returns to education are estimated using NHDHS data.

There are practically no papers in peer-reviewed journals that deal with the conceptualization and implementation of a sound survey, even though a sound survey is *the* crucial basis for any sound empirical research. Therefore, the intention of chapter 1 was not only to describe the design and the implementation of the NHDHS, but to suggest a prototype for the collection of morbidity and household data. Furthermore, I placed a strong focus on what research on survey methodology has contributed to the respective matter (e.g. questionnaire writing) and on the theoretical aspects of the particular topic that was to be assessed (e.g. nutritional assessment). Ultimately, this focus on survey methodology also led to a reference list that can be used as a comprehensive bibliography on the essential aspects of survey and questionnaire design[2].

Existing surveys usually either focus on socio-economic issues (like the LSMS of the World Bank) or on the mere collection of epidemiological data (like the existing systems of vital statistics). However, most questions in health economics can only be answered in a multi-causal, complex setting. For this reason, the NHDHS was designed as a multi-topic survey that simultaneously comprised extensive data on socio-economic status, a variety of questions on health issues, and a detailed record of epidemiological data.

Very few mortality data are available for Sub-Saharan Africa. The primary sources of information are model-based extrapolations and national statistics (Murray, Lopez 1996a; WHO 1998). Unfortunately, the latter either report hospital statistics which are most probably subject to severe underreporting,

[2] Readers interested in the separate reference list can download the working paper version at www.hyg.uni-heidelberg.de/sfb544/neues.htm.

since in Sub-Saharan Africa large shares of the population have no access to hospital care, or the reported statistics are essentially just informed guesses (Kaufman et al. 1997). In addition, there is only a small number of population laboratories that provide information on mortality, usually for rather small geographically well-defined areas (e.g. Kelly et al. 1998; INDEPTH 2002). The situation is still worse for morbidity data. Clinical morbidity data threatens to be even more strongly biased than clinical mortality data (since the population seeks hospital treatment only for some severe diseases) and even less data collection has been accomplished thereupon. The NHDHS intended to fill this gap. It comprises a module on morbidity that combines the collection of population-based data on reported illness with the effort to diagnose morbidity on the basis of symptoms.

But obtaining a high quality data set for quantitative analysis is an endeavor that demands more than a sound survey design. Unfortunately, such an undertaking can fail at a lot of different stages. The data and the data base themselves are a crucial step in that process. Chapter 2 deals with the supervision, cleaning, and transformation of the data into a usable data set once the data entry has been accomplished. The different data collection activities of the CRSN are described as well as the original data base as provided by the CRSN. The supervision process of the data was a difficult task. In the beginning, I developed a supervision protocol that included a systematic communication between the CRSN and Heidelberg. Even though the CRSN welcomed this initiative, the CRSN unfortunately never sent a supervised version of the raw data. Thus, I started to clean the data with regard to internal consistency, obvious errors, and some feed-back I got in personal communication with the CRSN.

A special focus during the transformation of the raw data was placed on the construction of income data out of the different income-relevant parts of the raw data. To completely and accurately assess income in the subsistence economy of Nouna, the questionnaire comprised questions on all potential income sources: (i) the agricultural production of the harvest, (ii) money income through the sale of agricultural products, (iii) money income through salaries and commerce, (iv) transfers and pensions, and (v) the stock of animals. To cross-check the income data, expenditure data were also collected.

The results of the data cleaning process were reassuring. The data seemed to be internally consistent and consistent with national data sources. The data on illiteracy rates, income, age and sex distribution, and other demographic characteristics such as religion and ethnic group confirmed what members of the CRSN staff would have presumed without knowing the exact numbers. Depending on the specific variable used (I constructed eleven different income variables depending on reference period and content), mean annual per capita

subsistence income ranges from 69–86 $ (Table 5). The overall adult illiteracy rate is 75.5 % (Table 15), and the age distribution exhibits the pyramidal pattern typical for developing countries (Figure 9). Roughly 62.7 % of the population are Muslim, 30.8 % are Christian, and 6.5 % report to follow traditional beliefs. Compared to other rural regions of Burkina Faso, the Nouna area exhibits a big mixture of ethnic groups. The biggest ethnic group are the Dafing, constituting almost half of the population. The remaining 50 % of the population are formed by the Bwaba (20 %), the Mossi (13 %), the Peulh (9 %), and the Samo (8 %).

Chapter 3 and chapter 4 deal with the measurement of the burden of disease (BOD) in Sub-Saharan Africa. In the World Development Report 1993 (World Bank 1993), the World Bank published a compilation of BOD figures for the eight World Bank regions of the world. As health status indicator, a new health measure was introduced – the Disability Adjusted Life Year (DALY). This health measure was mainly developed by Murray (1994). The DALY is a composite health measure that combines the disease burden caused by years of life lost due to premature death (*YLL*) and years of life lived with a disability caused by a disease (*YLD*). It thus integrates health loss caused by mortality and health loss caused by morbidity in one single health measure. The DALY is calculated as

$$DALY(r,k) = \int_{x=a}^{x=a+L(a)} Dkxe^{-\beta x} e^{-r(x-a)} dx.$$

The parameter a is the age of the individual at the onset of the disease or at the time of death, respectively. $L(a)$ is the duration of the disease or the remaining life expectancy at age a. D is a disability weight that is 1 if the individual died and a number between 0 and 1 if the individual contracted an illness. The parameter r is the discount rate, and k and β are the parameters of the age weighting function. Despite a broad discussion in the literature on the methodological and ethical drawbacks and implications of the DALY (e.g. Barker, Green 1996; Anand, Hanson 1997), the DALY has attracted considerable attention in the epidemiological as well as in the health economics literature (e.g. Kothari, Gulati 1997; Arnesen, Nord 1999).

In 1996, the *World Health Organization* and the *Harvard School of Public Health* published the *Global Burden of Disease Study* (GBDS), a series edited by Murray/ Lopez (1996a). In the first volume of this series, detailed BOD figures for 1990 are published for the eight World Bank regions of the world. Additionally, projections for the year 2000 are given. The GBDS aims at informing decision makers on global and regional level about the global and regional health situation and thus intends to influence priority setting and policies in the health sector. Because of the lack of measured BOD data for Sub-Saharan

Africa in particular, the GBDS figures for Sub-Saharan Africa relied on extrapolations of South-African data and on epidemiological models and expert guesses.

In chapter 3, I am presenting the results of a study where the model-based BOD figures of the GBDS are validated using measured BOD data of the Nouna Health District. For Nouna, only mortality data was available. Thus, *YLL* were used as health indicator. The *YLL* figures of the GBDS were compared with *YLL* figures for Nouna. The Nouna data exhibit the same qualitative BOD pattern as the GBDS results regarding age and sex. I estimated that 53.9 % of the BOD is carried by men, whereas the GBDS reported this share to be 53.2 %. A comparison of the age distribution of the BOD of Nouna with the respective distribution resulting from the GBDS figures for Sub-Saharan Africa is depicted in Figure 6. The ranking of diseases by BOD share differs substantially, though (Table 8). Malaria, diarrhoeal diseases and lower respiratory infections occupy the first three ranks in the Nouna study as well as in the GBDS, only differing in the respective order. But protein-energy malnutrition, bacterial meningitis and intestinal nematode infections occupy rank 5, 6 and 7 in Nouna and rank 15, 27 and 38 in the GBDS.

To investigate the influence of different age and time preference weights on my results, the BOD pattern is again estimated using, first, *YLL* with no discounting and no age-weighting, and, second, mortality figures. The results are not sensitive to the different age and time preference weights used. Specifically, the choice of parameters matters less than the choice of indicator. The conclusion of the paper is that local health policy should rather be based on local BOD measurement instead of relying on extrapolations that might not represent the true BOD structure by cause.

Chapter 4 deals with a methodological issue of the measurement of the BOD in DALYs. The GBDS presumes that disability weights are universal and equal across countries and cultures (Murray, Lopez 1996a). In a recent commentary, James/Foster (1999) argue that health is so influenced by culture and economic differences that agreement on universal disability weights may prove to be impossible. Furthermore, a recent study among health professionals in 14 countries ranking a set of 17 health states with regard to their severity concludes that the resulting rank order differences are large enough to shed doubt on the assumption of universality of disability weights (Ustun et al. 1999). This indicates the need for measuring local disability weights across nations and/or cultures.

The question arises as to whether existing valuation instruments can be used to elicit such locally-meaningful disability weights (Power et al. 1999). The authors of the GBDS, argue that utility measurement techniques such as Time-Trade-Off (TTO), Standard Gamble (SG), and Person-Trade-Off

(PTO) are cognitively demanding and become increasingly difficult to use with less educated individuals: "If large scale empirical assessments in many different countries to inform health state valuations for the global burden of disease are to be achieved, instruments that are reliable and valid for populations with widely varying educational attainments need to be developed" (Murray, Lopez 2000).

In chapter 4 this point of view is shared and argued that there is a need for locally-meaningful valuation instruments, i.e. to evaluate BOD-relevant disease states by culturally-appropriate instruments, including meaningful health state and disability scenarios and feasible scaling procedures (Sommerfeld et al. 2001). Little research has been done in developing countries on the development of such instruments (e.g. Fox-Rushby et al. 1995; Amuyunzu et al. 1995; Kirgia 1998; Sadana 1998). The chapter asks whether a health state valuation instrument can be developed that produces meaningful disability weights for population groups with lower levels of formal education attainment as, in our case, that of rural Burkina Faso. We introduce a culturally-adapted Visual Analogue Scale (VAS), and evaluate the instrument using the psychometric concepts of practicality, reliability and validity (Brazier, Deverill 1999).

We assessed the reliability of our valuation instrument by performing the valuation exercise in four teams consisting of lay people and three teams of health professionals. Additionally, the valuation exercise was repeated four weeks later to assess test-retest reliability. The divergence between the assessment teams was acceptable for most of the health states that were rated. Moreover, the results were stable over time. Construct (convergent) validity of the weights was studied by a comparison of the results of the implicit rank order following from the valuation exercise resulting in disability weights with an explicit rank order exercise. The Spearman rank correlation coefficient equaled 0.86 and 0.94 for lay people and health professionals, respectively, indicating that both panels were consistent in their evaluations, and thus understood the valuation procedure. Based on these results, it can be concluded that the scale values derived at the level of the assessment teams are sufficiently valid and reliable. We suggest to use this instrument for BOD studies on a broader scale.

Chapter 5 is addressed to a more orthodox economic study question. As outlined above, both health and education can be regarded as investments in human capital. These investments in turn have an effect on the individual's income potential. Chapter 5 investigates whether the investments in education have a noticeable effect on income in a setting that is predominated by traditional subsistence farming. Departing from a simple OLS model for the standard *Human Capital Earnings Function* (HCEF) proposed by Mincer (1974), I tried to identify the return to education in the poor, rural subsistence economy

of Nouna. To estimate the causal effect of education on income, I employed different identification strategies such as a Panel approach, Instrumental Variables (IV), a selection model, and a model of household income.

In the Nouna area, individuals face high opportunity costs of education since their decision framework is to either work on the family farm to guarantee food supply for the current year, or to attend school and be unproductive in the short run. The Nouna area exhibits a crude death rate that is as high as 14.2/1000. The child mortality rate amounts to 33.6/1000 (Kynast-Wolf et al. 2001). To give a comparison: the estimates of the United Nations for the United States are 8.5/1000 and 8.3/1000, respectively (www.grid.unep.ch/data). The political implication of the study question is readily at hand: Is education a feasible policy to foster economic growth in a very poor subsistence economy, or is rudimentary economic development a necessary prerequisite to be able to benefit from formal education at all.

There exist only few studies on the return to education in Sub-Saharan Africa. Ram/ Singh (1988) estimated returns to education for Burkina Faso in the order of 8–10 %. Their results are questionable, though, since they rely on 51 observations only. Siphambe (2000) presented a more recent study for Botswana (Southern Africa). Using data for 1993/94 on 3,608 households, he estimated a return to education of 12 % for men and 18 % for women. Controlling for family background – the education of the household head was used as control variable – these estimates drop to 3 % and 14 %, respectively. Furthermore, his findings support increasing returns to education. The highest return is attained for upper secondary level (185 %), the lowest for primary education (7 %). Lower secondary education has a return of 83 %, and tertiary education 38 %.

The data set I was using to estimate returns to education covers 1,751 individuals between 20 and 50 years of age. These individuals comprise 689 households. The data have been collected in June 2000 and February 2001. A special advantage of the data is the detailed measurement of subsistence and disposable income (cash income). I estimated separate returns to education for men and women who are not household heads, and for male household heads. Furthermore, I estimated returns to education for subsistence income and disposable income. Subsistence income was roughly cash income plus the value of the self-consumed part of the harvest which constitutes around 80 % of total income. Estimating separate returns for subsistence income and disposable income allowed to additionally investigate the hypothesis that the returns to education should be higher for disposable income than for subsistence income since education should have a greater effect on the individual's ability to generate money income than on the individual's productivity on the family farm.

The data situation of Nouna is not untypical for a big part of Sub-Saharan Africa, especially for the poorer regions of Sub-Saharan Africa where rich and

complex data sets are scarce. I thus believe that this thesis can fill a research gap in contributing to the empirical evidence on the private return to education in poor, rural subsistence economies.

Similar to the findings of Card (1999), the OLS models seem to provide very useful results despite the common critique of their usefulness to detect causality. They are very close to the results of the selection models and the models of household income, and therefore do not necessarily seem to be biased if one believes that the more advanced models provided consistent estimates of the private return to education. The comparison of the coefficient estimates for disposable income and subsistence income confirms the working hypothesis that the returns for the former are higher than those for the latter. Formal education seems to have a bigger impact on the productivity of labor that generates cash income than on the productivity of traditional farming. Nevertheless, also for those individuals who mainly gain their income from traditional farming, returns to education are noticeable.

For subsistence income – which is the income magnitude that matters most for the vast majority of the population – the return to education for men who are not household head was estimated to be around 4–6 %. Women experience a considerably higher return to education with roughly 15 %. The estimate for the return to education for male household heads amounted to 10–12 %. For men who are not household heads, the results confirm the findings of Psacharopoulos (1994): Education seems to have a lower return in Sub-Saharan Africa. But a more differential investigation of the issue reveals that for other demographic groups, there are returns to education that are as high as in Western countries. Even in a community that is dominated by subsistence farming, women and household heads seem to benefit as much from education as participants of modern labor markets.

Again similar to the findings of Card (1999), the IV results are higher than the results of the OLS models. For the Nouna data, though, the increase is a bit large, shedding doubt on the validity of the instruments used. The coefficient estimates for men, women, and male household heads are 49 %, 40 %, and 8 %, respectively.

For the OLS models that use dummies for the different education levels, I find extraordinarily high returns to education for alphabetization programs. For subsistence income, the estimate for men is 20.7 %. The estimates for women and male household heads are 19.1 % and 49.9 %, respectively. Thus, from a policy perspective, alphabetization programs seem to be a very effective and efficient way to both raise the education level and the income of a country's population. Furthermore, the results confirm the findings of Siphambe (2000) concerning the increase of the returns to schooling with education level. For male household heads, the coefficient estimate for primary education is 6.1 %,

the estimate for secondary education is 16.9 %, and the estimate for superior education amounts to 23.5 %. Because of the lack of observations for superior education for men and women who are not household head, I could only estimate the return to education for primary and secondary education for these demographic groups. The respective figures for men (women) are 4.8 % (13.1 %) and 9.6 % (18.7 %).

These findings raise the question why people invest so little in education if investments in education are that profitable. One obvious reason is that the inhabitants of the Nouna region just cannot afford it. Moreover, in the absence of functioning credit markets, it is not possible to finance education through borrowing money. The results therefore entail the policy implication that there is room for public interventions in the education sector.

Chapter 1

The Nouna Health District Household Survey (1): Suggesting a Prototype for the Collection of Morbidity and Household Data[1]

1. Introduction

The success of health economics and its guidance for health policy heavily rests on the availability of reliable empirical evidence on the demographic, economic and epidemiological environment, on behavioral relationships, and on the impact of policy interventions. For developing countries, especially the epidemiological situation is unclear, since comprehensive systems of mortality and health statistics are often absent (Cooper et al. 1998). There is a growing literature on this issue (e.g. Aday 1996; Korn, Graubard 1999), indicating the increasing demand for health surveys in academia and politics.

Nonetheless, there are practically no papers in peer-reviewed journals that deal with the conceptualization and implementation of a sound survey, even though a sound survey is *the* crucial basis for any sound empirical research. Our ambition was to fill this gap by trying to describe the design and implementation of the *Nouna Health District Household Survey* (NHDHS) with a strong focus on what research on survey methodology has contributed to the respective matter (e.g. questionnaire writing) and on the theoretical aspects of the particular topic that is to be assessed (e.g. nutritional assessment). Ultimately, this focus on theory also led to a reference list that is likewise meant to serve as a comprehensive bibliography on the essential aspects of survey and questionnaire design.

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Furthermore, existing surveys usually either focus on socio-economic issues (like the Living Standard Measurement Studies (LSMS) of the World Bank (e.g. Grosh, Glewwe 1995 give an overview of the existing LSMS studies) or on the mere collection of epidemiological data (like the existing systems of vital statistics). However, most questions in health economics can only be answered in a multi-causal, complex setting. For this reason, we designed the NHDHS as a multi-topic survey that simultaneously comprises extensive data on socio-economic status, a variety of questions on health issues (demand for health care, treatment choice, costs, and quality), and a detailed record of epidemiological data (morbidity by cause).

Very few mortality data are available for Sub-Saharan Africa (SSA). The primary sources of information are model-based extrapolations and national statistics (Murray, Lopez 1996a; WHO 1998). Unfortunately, the latter either report hospital statistics which are most probably subject to severe underreporting, since in SSA large shares of the population have no access to hospital care, or the reported statistics are essentially just informed guesses (Kaufman et al. 1997). In addition, there is only a small number of population laboratories that provide information on mortality, usually for a rather small geographically well-defined area (e.g. Kelly et al. 1998; Würthwein et al. 2001a; INDEPTH 2002). The situation is still worse for morbidity data. Clinical morbidity data threatens to be even more strongly biased than clinical mortality data (since the population seeks hospital treatment only for some severe diseases) and even less data collection has been accomplished thereupon. The NHDHS intends to fill this gap. It comprises a module on morbidity that combines the collection of population-based data on reported illness with the effort to diagnose morbidity on the basis of symptoms.

The chapter is organized as follows. While the second section concentrates on questions of survey design, section 3 addresses practical aspects and field procedures. Section 4 introduces the questionnaire in detail, and section 5 concludes with an outlook on further research.

2. Survey Design

2.1 Institutional Background of the Survey

The NHDHS is collected by the *Nouna Health Research Center* (*Centre de Recherche en Santé de Nouna,* CRSN), a research institution that is directly subordinated to the *Secretary General of the Ministry of Health of Burkina Faso.* It is located in Nouna, the administrative capital of the province of Kossi, in the North-West of Burkina Faso. Kossi embraces the Nouna Health District, an area of 7,464 km^2, populated by roughly 240,000 inhabitants and equipped with a district hospital, a medical center, and 16 CSPS (*Centre de Santé et de*

Promotion Sociale) – the basic health care facilities in the Burkinian health system.

The CRSN maintains a *demographic surveillance system* (DSS) that covers the population of 41 villages (the catchment area of four CSPS) and the town of Nouna – altogether a population of roughly 55,000 inhabitants – and serves as the sampling frame of the NHDHS (for more information about the DSS, see INDEPTH 2002). In June 2000, a representative sample of 800 households was drawn from the study population of the DSS. These households will be followed through time, with individual panel waves to be collected at intervals of approximately 3 months.

2.2 Questionnaire Layout

The survey has a modular structure, allowing to easily introduce new and exclude existing modules in the course of the study. Currently, five separate questionnaires can be distinguished, each corresponding to a different module:

- The *main questionnaire* collects information on those individual characteristics that can be easily collected in the framework of a household roster (e.g. parental relationship, sex, age, and ethnic group) and on housing, water supply and sanitation.
- Module 1: the *socio-economic module* gathers information on income and assets of the household, on household expenditures, and on the nutritional status of the household.
- Module 2: the *morbidity module* collects epidemiological data (reported morbidity), and information on the severity of the respective disease, its treatment and the demand for health care thereby initiated. Furthermore the coping strategies of the household with respect to their financial situation and to the household's work- load are investigated.
- Module 3: the *module on preventive care and general health* collects data on the use of preventive care and family planning.
- Module 4: the *anthropometric module* solely assembles the respondents weight and height.

2.3 Time Frame of the Survey – Capturing Seasonality

To capture seasonal variation, all modules of the questionnaire are administered twice a year, once around the peak of the *hungry season* (June/July) and once around the peak of the *harvest season* (December/January). A usual year in the study region is characterized by strong economic fluctuations that are typical for a number of developing countries (Chen 1991; Sauerborn et al. 1996a; Moore et al. 1997). After the harvest around November/December

stocks are built up and the households experience a time of relative prosperity. But starting from this point in time, food supplies start to decrease and at the onset of the rainy season, when the work in the fields starts again, people are regularly short of food and experience a time of hunger at a time of the year when they have to work the hardest.

In addition, seasonality can also be observed with respect to morbidity and mortality. During the rainy season, there is a high incidence of malaria, the major cause of death in the Nouna Health District (Würthwein et al. 2001a). And around February, the dry and dusty climate fosters lower respiratory infections, the third-most frequent cause of death in Nouna. To increase the observation frequency for epidemiological information (some diseases are very rare events), and to capture this seasonal variation, the morbidity module is additionally administered in spring and autumn.

2.4 Sampling

The NHDHS is designed as a panel survey. The households sampled for the initial survey wave are followed through time. The sample selection procedure is a two-stage cluster sampling, with each household having the same probability of being selected (for details on this sampling method see Levy, Lemeshow 1999). In a first stage, clusters of households were selected (7 clusters in Nouna and 20 clusters in the 41 villages), and in a second stage, respondent households were selected in each cluster. No elaborated stratification was applied, since no adequate stratification information was available. The only basic strata used was the distinction between the subset of households resident in Nouna itself and the subset of households residing in one of the 41 villages of the study population. Since the elementary sampling unit is the household, the sample proportions of rural households and Nouna households reflect their respective fractions in the DSS (Table 1).

The DSS identified $M_V = 4{,}630$ households in the 41 villages of the study region, representing a fraction of 62 % of all households, and $M_N = 2{,}802$ households in Nouna, constituting the remaining 38 %. In epidemiological studies,

Table 1

Calculation of Sample Size in Each Strata

	Villages	Nouna	Total
Households in the DSS	$M_V = 4{,}630$	$M_N = 2{,}802$	$M = 7{,}432$
Fraction of the respective strata	$M_V/M = 62$ %	$M_N/M = 38$ %	100 %
Households to be sampled in the respective strata	$m_V = 800 \times 0.6 = 480$	$m_N = 800 \times 0.4 = 320$	

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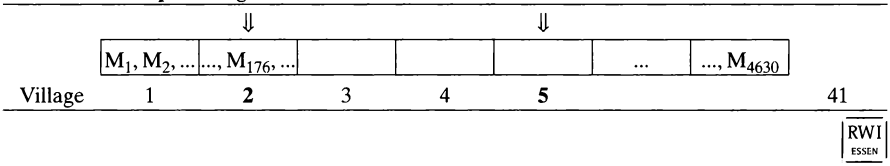
Figure 1

Selection of Sample Villages



the sample size is often chosen according to a required significance level at which a pre-formulated hypothesis could either be rejected or accepted (Bland 1995). Since the NHDHS was not intended to solve one research question alone, we resorted to other considerations. Using existing health surveys and the LSMS studies as a benchmark, the sample was chosen to be representative for the population under study, and sample size was also determined by cost considerations (Tibouti et al. 1993). We fixed our sample size to be 800 households, which is roughly 10 % of the study population. Compared to the LSMS surveys, this is a rather small sample size. Currently, the smallest LSMS sample size is 800 households in Kagera, Tanzania (www.worldbank.org/lsms/guide/select.html). But compared with the study population, a sample of 10 % is fairly high and it is not to be expected that the population of the Nouna Health District is extraordinarily heterogeneous, most probably the contrary is the case.

With a sample size of 800 households, $m_V = 480$ households were sampled in the rural area and $m_N = 320$ households in the semi-urban area of Nouna. Since the sampling process is slightly different between the rural subset and the Nouna subset, we shall first describe the sampling process of the villages. In the first step of our two-stage cluster sampling, a subset of 18 villages was selected for further sampling. Two numbers K (number of clusters) and L (cluster size) were chosen such that $K \times L = m_V$, the number of households that had to be sampled out of the rural subgroup. We fixed L to be 24 and thus K resulted to be 20. To select the villages, the villages were ordered alphabetically and within each village, the households were ordered sequentially, resulting in a list of the form as shown in Figure 1.

Initially, a uniform random number in the interval $[1;M_V/K]$ was generated to determine the starting household. In our case the realization was 176, thus indicating that the household M_{176} was selected. Since household M_{176} resided in village two, the first cluster of households had to be drawn in village two. To identify the next cluster, the fixed length of $M_V/K = 231.5$ (illustrated by the two arrows in Figure 1) was added to 176, thereby identifying the next cluster, and so on. In this manner, exactly K clusters were chosen. In our case, this pro-

cedure resulted in the selection of 18 villages; 3 villages contained 2 clusters and 15 villages contained only one cluster.

To select the households in each village, households were drawn out of an urn in front of the villagers to demonstrate that the selection was a random process and that the respondents of the household survey were not chosen for political reasons or to give a special benefit to some that is withdrawn from others.

In Nouna, the sampling process was much simpler. Nouna is divided into seven administrative town districts. Each of the seven sectors was regarded as one cluster. Because of the resulting big cluster size, each cluster was selected. Out of these 7 clusters we sampled proportionally to the number of households living there. Again, to demonstrate that the selection was a random process instead of a political selection, the member households of the survey were drawn out of an urn in front of the residents of each sector.

2.5 The Link to the Demographic Surveillance System

A special characteristic of the NHDHS that might not be feasible for any survey is its direct link to the DSS. Apart from its role as the sampling frame for the NHDHS, the DSS also constitutes an important partner data base to the NHDHS. Every individual who is surveyed in the NHDHS is also registered in the DSS. To guarantee that the data bases are corresponding, the main questionnaire of the NHDHS is printed out with the information from the DSS already included in the respective fields. Plus, some empty extra lines are added where the required information for new household members can be entered. During the data entry of the completed questionnaires, a special software procedure checks whether the individual has a valid entry in the DSS. If not, the information on the individual has to be updated in the DSS data base.

2.6 Additional Information Outside the Survey

The LSMS surveys typically include additional questionnaires apart from the household questionnaire. Examples in case are community questionnaires, price questionnaires, and questionnaires for health care facilities, schools, and pharmacies (Grosh, Glewwe 1995). Beyond doubt, this supplementary information can be crucial for the analysis of specific research issues. In the case of the NHDHS, this additional information is largely available outside the original survey. The information on prices, for example, can be extracted from the Burkina Faso price surveys that are delivered by the INSD (*Institut Nationale de la Statistique et de la Démographie*). And information on community facilities is readily available, since the data-collecting research institute is residing in the area.

3. Practical Aspects and Field Procedures

3.1 Definition of some Fundamental Concepts

Practical experience shows that during the data collection stage in the field, theoretically clear-cut concepts like a household or a compound often are a source of confusion (Scott et al. 1980). Even the determination of the date of birth can cause difficulties in a setting where only a very small fraction of the population possesses a birth certificate or identity card. Therefore, a clear definition of these basic concepts is imperative.

A *village* or a *community* is an entity made up of human dwellings and considered as an administrative unit by the political administration.

A *compound* is a conglomeration of buildings surrounded or not by a fence. In general, the inhabitants of a compound are bound by family ties and a head of compound can be defined. However, compounds can also be only spatially grouped buildings, inhabited by several households that are not otherwise linked together.

The *household* is the basic socio-economic unit within which the various members are related. Generally, household members live together in houses or compounds, share their resources, and jointly satisfy their needs under the authority of a *household head*. The members of a household set up a social group with which the individual identifies itself. Usually, household members are bound through family ties, this needn't be always the case, though (for a detailed discussion of the definition of a household see Bender 1967; Casley, Lury 1981).

Two types of households can be distinguished: the ordinary household and the institutional household. An *ordinary household* usually consists of a husband, his wife (or his wives in the case of a polygamous household), their children if they live together with their parents, and their parents or other relatives who live with them. Servants of a household are treated as household members if they don't form a household of their own, according to the rules set out above, and if they sleep and take their meals in the household they are working for. Moreover, in SSA it is very common that foster children belong to the household.

An *institutional household* consists of a group of people living together under special conditions. Generally they don't belong to the same family, but they use the same installations which an institution places at their disposal to provide for their essential needs (housing, food, etc.); examples in case are monasteries, boarding schools, or missions. However, in such institutions, one will probably find individuals who live autonomously and separately from the institu-

tional household, and who maintain familial ties. These individuals constitute an ordinary household and are surveyed as such.

The *date of birth* was determined either based on birth certificates (only in a relatively small number of cases), or through comparison with persons of a similar age, where a birth certificate was available, or using a "local events calendar" which incorporates seasonal landmarks, feasts, political events, and village events (e.g. initiation rites, death of a village headman, famines, etc.) Moreover, a variable for the level of precision is recorded in the data base. The variable takes on a *D* if day, month and year are known, a *M* if month and year are known, and a *Y* if only the year is known or at least estimated.

3.2 Selection, Training, and Supervision of the Interviewers

Proficient interviewers are a prerequisite for the successful collection of any survey (Casley, Lurey 1981). They are the intermediary between the respondents and the designers and analysts of the survey. The interviewers do not only need cognitive skills to be able to understand the survey objective and the questionnaire. They also have to be sociable, trustworthy and familiar with the cultural setting in which the survey takes place. Preferably, they should speak the respective local language of the respondents. At least they have to speak the "lingua franca" of the region (in our case Dioulla) if there exists one.

For the NHDHS, all interviewers received one week of training, directly before the first wave of the survey was launched. A detailed interviewer manual was compiled that describes the objectives of the survey, and the role and the tasks of the interviewers. It also provides some methodological information and a comprehensive explanation of the structure and the contents of the questionnaire and on how to fill it out. Every interviewer was required to read the manual and to keep it as a source of reference during the field work.

Moreover, supervisors accompanied the interviewers during the survey in the field. Interviewers were requested to contact them throughout the data collection period if they had any questions. Since the survey started in the rural area, the interviewers stayed together overnight in the survey villages allowing them to discuss any occurring problems with the supervisors and with each other. The supervisors were permanent staff members of the CRSN. All of them held a university degree. Since they were involved in the development of the questionnaire and already have gained experience with other surveys undertaken by the CRSN, they could serve as a competent backup for the interviewers.

3.3 Pretest

Before the finalization of the questionnaire, a preliminary version was field-tested. Such a pretest is a crucial step in the process of the questionnaire development. It verifies whether the respondent's answers really reveal what the analysts had in mind while designing the questionnaire (Grosh, Munoz 1996). To collect different experiences with the questionnaire, ten trained interviewers administered the questionnaire to 30 households outside of the study region (to avoid that the same households might be part of the pretest and subsequently also of the actual household survey).

The interviewers had to write a detailed report on potential problems and inconsistencies, and whether the respondents could understand the questions properly. Furthermore, we instructed the interviewers to specify if respondents were giving answers that would only fit into the "Other-Categories". Repeatedly given answers of this kind were added as pre-coded answers in the final version of the questionnaire.

3.4 Sensitization of Respondents

In a typical survey, it is the interviewer who establishes the first contact with the household. He is supposed to introduce himself, to explain the objectives of the survey, clarify why the household has been chosen as a respondent household, and to try to create some confidence that the obtained information will be dealt with confidentiality and not be used for tax purposes (Grosh, Munoz 1996). The interviewer has to fulfill a very difficult task here. He should try to create a friendly and honest atmosphere that helps to reduce strategic bias and dishonesty. At the same time, he should be authoritative enough to avoid non-response and to get the respondent's full attention during the whole interview.

In reality this task might in fact prove to be too difficult for the interviewer to accomplish. Furthermore, in a rural area of a developing country a sensitization at the level of the household appeared us to be culturally inappropriate. Roughly 90 % of the population in the study area are illiterate. Important decisions are often not taken at the level of the household but at community level. Therefore, we preferred a sensitization procedure that comprised several phases:

In a first step, the authorities (local and province administration) were informed about the planned survey. Subsequently, right before the initial survey of the NHDHS was launched, sensitization meetings were carried out – altogether 36 meetings in the villages and 8 in Nouna. In the villages, a first get-together with the whole village population was arranged to explain the objectives of the survey and to select the respondent households. In a second meeting

with the sampled households, the objectives of the survey were explained in more detail, the questions that were going to be asked were clarified and the households were asked for their cooperation. In Nouna, a first sensitization meeting was organized including the political and religious leaders of Nouna and the delegates of the seven town districts and the different churches and religious communities. A second gathering was conducted in the sectors to sample the households and to discuss the survey into more detail. Even if this sensitization procedure implies much more effort than leaving the sensitization to the interviewer, we believe that with respect to the data quality that can be obtained, it is worthwhile doing it.

3.5 Quality Control

The best survey and questionnaire design is useless, if the collected data finally contains a lot of errors. Therefore, different quality control procedures were implemented at the various stages of the survey. During the field phase, the supervisors checked all the questionnaires for completeness and consistency. Generally, in all surveys of the CRSN, a random sample of 5–10 % of the households is re-interviewed by a supervisor. On the one hand, this random control procedure is able to detect errors in the questionnaires of the re-interviewed households. On the other hand, it creates a subtle pressure on the interviewers to work cautiously because they never know which interview will be rechecked.

During data entry, a system of systematical, mutual control was implemented. In a randomly varying sequence, one data entry clerk checked the work of the other. In addition, the data entry routines contained a set of logical checks which made it impossible to enter e.g. numerical code in alphabetical fields or values that lied outside a pre-defined range. Further consistency checks included the verification of a part of the collected information through the comparison with the DSS data.

3.6 Data Base

As mentioned above, there exists a close link between the data base of the DSS and the data base of the NHDHS. Both data bases are written in Microsoft Access. Instead of using a simple spread sheet, a relational data base model was developed, storing the collected information in a set of tables that can be regarded as separate entities with identifiers and attributes. To analyze the data, the relevant tables have to be linked, using either the standard MS Access query procedures or the programming language SQL (*Structured Query Language*). The requested data can also be extracted from the Access data base and converted to other data formats, like the Stata data file format, plain ASCII or any other imaginable data format, using standard transfer software, e.g. StatTransfer or DBMS Copy.

4. Questionnaire

Sheatsley (1983) points out that "unlike sampling and data processing, questionnaire design is not a science or technology but remains an art." There are some principles for designing a high-quality questionnaire (Ainsworth, van der Gaag 1988; Bradburn, Sudman 1991), but the variation of research questions and the cultural and economic environment in which the survey is conducted, make an intimate knowledge of the population under study an important prerequisite for the development of the questionnaire.

Preferably, the questionnaire for a multi-topic survey such as the NHDHS should be designed within a team of experts of different fields and adapted specifically to the particular situation in the study area. The team that developed the NHDHS questionnaire included physicians, public health experts, demographers, economists, anthropologists, and statisticians. Some of the contributors originated from the study area, others had gained experience with surveys in other regions of Africa. The content of the questionnaire was discussed for several months in different teams. Nevertheless, a major workload and overall responsibility for the content, the design, and the layout of the questionnaire was carried by the author. An English translation of the full questionnaire is given in the Appendix.

4.1 General Remarks

Even if the design of a questionnaire "remains an art", and as such an innovative and creative process, there are some common difficulties that have to be faced, and some rules of thumb that can be followed (Grosh, Glewwe 2000):

Choice of variables and choice of interview questions
Naturally, the first important issue in the development of a questionnaire is the specification of the survey variables (Aday 1996). If one is only concerned about the quantification of an already specified relationship, it is clear which variables to choose. But if the relationship itself shall be uncovered, we have to allow for some creativity in the assignment of potential determinants. The omission of crucial variables might endanger the successful analysis of a specific problem. On the other hand, supplementary questions are costly – not only in the sense of raising the pecuniary costs but also in raising the respondents burden and fatigue and thus endangering the quality of the responses to the other questions of the questionnaire.

To be able to select the survey variables, one needs to have a clear notion about the research objectives (Peeters 1988), and a thorough overview of the literature of the respective field (Sheatsley 1983). Preferably, the potential analyst(s) of the survey should be included in the development of the questionnaire to prevent that the selection of variables is done on the basis of com-

mon sense alone. Knowing the state of the art of the literature prevents the omission of key variables and points to further variables of interest.

Another difficulty that only arises in practice and not in theory, is the problem of getting from the variable or the concept to the survey question. The most prominent example in this context is "income". Measuring income is much more complex than simply asking "How much do you earn?" A whole series of questions has to be asked and much accuracy has to be exercised on completely measuring the different sources of income with their respective time horizon (annual, monthly, hourly) and the respective unit of reference (household income, family income, or personal income).

Another concern are questions that potentially lead to non-response or unwillingness to cooperate and respond truthfully. They should be avoided or if they are indispensable, they should at least be asked in the most sensitive way possible.

Type of questionnaire
It is not possible to use a self-administered questionnaire when most of the respondents can't read and write. In the NHDHS, we opted for an interview questionnaire with structured, closed questions and pre-coded answers printed on the questionnaire. Structured, closed questions help reducing the length of the interview while still collecting as much information as possible. Pre-coded answers facilitate data entry. If the answers are not printed on the questionnaire, it is possible that interviewers start avoiding the effort of always consulting the code book, but develop their individual set of commonly used replies, finally resulting in interviewer bias.

Additionally, we were concerned about a clear layout with unambiguous and precise interviewer instructions. This helps in filling out the questionnaire and consequently reduces interviewer errors, probable frustration of the interviewers and the length of the interview (Grosh, Munoz 1996).

Sequence of questions
The order of questions should be logical both to the interviewer and to the respondent to preserve their motivation and cooperation. The interview should start with easy questions to develop a comfortable working atmosphere. However, the more difficult questions should be asked early enough before the respondents get tired. Furthermore, punctuating the interview several times by a change of topic maintains the respondents' interest. The NHDHS therefore has four modules, the first one being a module that simply collects demographic characteristics, the second one contains the more delicate questions on income and agricultural production, and the third and forth module are highly structured ones that are designed to quickly assess epidemiological data and data on the demand for health care.

Wording of the questions, interviewer bias, and respondent bias
One of the fundamental principles of questionnaire design is simplicity of language. The questions should be unambiguous and clear. Two possibilities of how the questions are asked can be distinguished, both carrying their own potential for bias:

To avoid interviewer bias, the questions can be asked in a standardized form that leaves no scope for changes on the part of the interviewers. This standardization can reduce the variability created through the random variation of wording each interviewer might introduce. It can be used if the questions are simple enough and it is likely that all respondents will understand them. If this is not the case, *respondent bias* is likely to occur. Since the respondents might misunderstand the questions or interpret the question in their own way, even more "noise" can be introduced (Bradburn, Sudman 1991).

In the setting of the NHDHS, where most respondents did not receive much formal education, we directed the interviewers to explain the questions to the respondents just as the respective situation required. They were instructed to take care that the respondents fully understood what they were asked. We wanted to ensure that the concept behind the question was uniformly understood rather than asking a uniform question that might be understood in many different ways.

Language of the questionnaire
To ensure that all ethnic groups encounter the same interview situation, ideally, the questions should be translated in every language spoken in the field (Ainsworth, van der Gaag 1988). For logistic reasons we couldn't translate the questionnaire in all the local languages but had to resort to on-the-spot translation by the interviewer. There is a *lingua franca* that most respondent households understand (Dioulla), nevertheless we tried to always select interviewers that were capable of the respective local language. Additionally, a few parts of the questionnaire, for example the list of diseases, are available in Dioulla.

Design of responses and response alternatives
A general rule is that pre-coded answers should be comprehensive and mutually exclusive. Moreover, "Don't know" and "Other" categories are usually recommended (Schwarz, Hippler 1991) to avoid item non-response. We trained interviewers to use these categories only when really necessary and not because respondents (or interviewers) were too lazy to make an effort. Another problem one should be aware of, is that the order of response alternatives can influence the respondent's answer (Schwarz, Hippler 1991). Finally, whenever recall periods were used (for example "assessment of money income of the last month"), they were designed to be as short as possible and as long as necessary (Deaton 1997).

Respondent rules
During the data collection in the field, it is tempting for the interviewers to let somebody else give the answers for a household member who is currently not at home. To avoid this, respondent rules were set out. Each adult had to respond to questions concerning himself. The best-informed parent or caretaker (usually the mother) was asked to respond for children and the best-informed adult(s) (usually the woman or women responsible for cooking) was inquired on questions related to food consumption and nutrition.

Recall periods
A difficult trade-off has to be solved here. On the one hand, it is tempting to measure the whole period under investigation to get all the analytically relevant information. On the other hand, extended recall periods potentially introduce bias, since the respondents only remember salient and recent events. Therefore, two recall periods have been used in the NHDHS: the last month and the five months preceding the last month. Like this, the whole six months between two survey waves are covered. Nevertheless, the responses to the last month are most probably more accurate. The quality of the information on the longer recall period still has to be verified.

4.2 Main Questionnaire

The main questionnaire of the NHDHS serves as the starting point of the interview. It identifies the respondent's household and contains the household roster. It comprises the following four sections:

I. Identification of the household
The first page of the NHDHS questionnaire serves the identification of the household. Since the DSS data base already contains information on every household of the NHDHS, some fields (like the household ID and the village name) are already filled out when the questionnaire is printed. Other fields serve control or administrative purposes, e.g. the supervisor signs the questionnaire after having checked for consistency.

The field *Sample* indicates if a household is part of the ordinary sample of the household panel that was selected at the beginning of the survey or if it might belong to an extra survey for other purposes. One example is a planned project where parts of the NHDHS questionnaire shall be administered to households where a death occurred to be able to analyze both the potential determinants of mortality and the short and long term consequences of mortality.

II. Household roster
The household roster contains a complete list of all household members as recorded during the last *Vital Events Registration* (VER). The information on rank, name, individual identification number, kinship, sex, date of birth, ethnic

group, religion, education level, marital status, and occupation is printed out with the questionnaire. The rank is a serial number that each recorded household member got during his first interview to facilitate – together with his name – his identification across the different pages of the questionnaire.

For kinship, two columns are reserved, in order to try to represent the whole kinship pattern. The first column records the parental relationship, and the second column displays to whom this relationship exists, e.g. brother of individual possessing rank 1 (usually the household head) or son of individual with rank 3 (for example the second wife of the household head). In the first place, kinship is recorded in relation to the household head (mother, brother, or wife of the household head). But children are related to their mother, which for example allows to keep track of the education of the mother, a variable that is often used in the analysis of specific research questions (e.g. estimation of a health production function).

Extra lines are added to write down the respective information for new household members who eventually entered the household since the last VER. During data entry, this information will be updated in the data base of the DSS. Furthermore, also to update the DSS data base, the household member's *State of residence* is recorded, and if the household member died since the last VER. As state of residence, two alternatives are possible: a household member can be either *resident* or *absent*. An individual is absent if he is a household member by definition (see paragraph 3.1), but was absent the night before the survey interview. Otherwise, he is resident.

Additional to the information concerning the DSS, the household roster collects all information that can easily be recorded within such a framework: information on analphabetism, tobacco consumption, appreciation of one's own health state in general and three filter questions that are asked to select those individuals eligible for the morbidity module.

III. Housing
The objective of this section is to provide information on the household's housing. To some extent this reflects the well-being of the household. Moreover, it can serve as an indicator (or part of an indicator) for the household's hygienic situation and the density of the household's living arrangements. These factors can be possible risk factors for the health status of the household members, and should be assessed as such.

IV. Water and sanitation
The questions of this section represent (together with the section on housing) the hygienic situation of the household. Since hygiene cannot be measured on a cardinal, continuous scale, measurement alternatives have to be developed: One measure could be an indicator comprising different aspects of hygiene,

e.g. food, housing, water and sanitation. Another alternative could be an expert rating (preferably one and the same expert rates the hygienic situation of all households on a scale).

The NHDHS offers the opportunity to employ both measures and to evaluate them against each other. Since for logistic and cost reasons it was not possible to have a totally consistent expert rating, we resorted to interviewer judgements on a five-point Likert scale. To ascertain a certain level of consistency, rating criteria were discussed and example households were evaluated as part of the training of the interviewers.

4.3 Socio-Economic Module

The relationship between health and wealth plays a prominent role in the health economics literature (e.g. Duncan, Strauss 1997; Smith 1999). The same holds for the relationship between nutritional status and health (e.g. Alderman, Garcia 1993; Lee et al. 1997). The socio-economic module gathers data on assets, income, expenditures and the nutritional situation of the household. It comprises the following four sections:

I. Assets of the household
Section I tries to measure the wealth of the households of the study population. As opposed to the household's revenue, which refers to a recurring stream of income, wealth in this narrower sense reflects the asset situation, originating from past savings, inheritance or gifts. In the Nouna area, firstly, people are very poor and there are not many assets to consider, and secondly, since there is not much to store, not many alternatives were developed how to store wealth. There is practically no banking system. Land doesn't belong to individuals but to the traditional clan and can't be sold nor rented.

In the rural area, buildings can neither be sold nor rented. In Nouna itself, houses can be rented or sold but there is no well-functioning market for realty. It would have been very difficult to place a money value on buildings. Consequently, we decided to not collect data on real estate as part of the household's asset situation.

The most common store of purchasing power in the study area of the NHDHS is livestock. Domestic animals represent accumulated savings. And with regard to livestock, property rights are well-defined. Every household member can own animals and the best way to assess a household's livestock is to ask every household member separately what she or he possesses.

In addition to the information on livestock we collected information on durable goods (agricultural tools, transportation vehicles, etc.), since these are also likely to represent the economic well-being of a household. The information

on goods and animals can serve as components of a wealth indicator, supplemented by adequate information on the respective prices. Yet, we didn't ask the respondents to give a money value for their goods and livestock, since we, firstly, expected that the respondents might not be able to give reliable answers, and secondly, we believe that pricing each good and livestock would increase the respondent's burden excessively. Hence, when analyzing the data we will have to assign market prices that were collected outside the NHDHS.

II. Household revenue
Approximately 80 % of the study population lives from subsistence farming. Agricultural production is the most important source of revenue. Since there is only one annual harvest, the subsection on the *agricultural production* is administered only in the December/January wave. In the study area, it is common that different household members cultivate their own piece of land and thereby gain their own income. Thus, every household member above ten years of age was asked to specify what he cultivated and in what quantity.

Typically, a big part of the agricultural production is directly consumed by the household itself. But some is also used to generate cash income. Section 2.2 of the questionnaire assesses *money income through the sale of agricultural products.* Two recall periods are used: the last month and the five months preceding the last month. The responses to the last month are most probably more accurate, but nevertheless the whole year is covered. The same principle for recall periods is used to collect data on transfers and pensions and on other money income (especially salaries and trade).

III. Household expenditures
Household expenditures are surveyed simply by asking every economically active household member, i.e. every household member above ten years of age, if he spent money on any item of a list that is read to the respondents. Again, two recall periods are used (see above). In the rural area, money expenditures are so sporadic that it should be possible to remember them for a longer time. Besides, a longer recall period will also balance out big fluctuations in the expenditure pattern, which are quite common in the area, e.g. because of religious expenditures, expenditures for ceremonies (gifts for funerals, marriages, and baptisms) or the purchase of fertilizer or seeds.

IV. Food and nutrition
When assessing nutritional status one preliminary remark is important. There is a logical distinction between the assessment of the nutrient or dietary *intake* and the assessment of the *outcome* (Gibson 1990). Nutritional input concerns itself with the amount and quality of food eaten by the individual in question. The crucial variable is the energy or calorie intake. By contrast, output variables are different anthropometric measures such as body weight, height, body fat and muscle mass. In terms of output measures, a further distinction is made

between measures of past, chronic malnutrition, such as stunting, and measures for current, acute malnutrition, such as wasting (Waterlow 1992).

In general, outcome variables measure nutritional status with respect to the subject's well-being. For instance, if the respondent displays a better *Body Mass Index* (BMI), this usually indicates that the individual is well-nourished (Shetty, James 1994). This need not necessarily be the case, though. A poor health can also lead to a low BMI even if the dietary intake is high (Martorell 1982). Diarrhea, for example, is a prominent case in point. There is a vast literature on the interdependent relationship of health and nutrition (e.g. Behrman, Deolalikar 1988; Tomkins, Watson 1989). To be able to isolate which variable influences which, it is necessary to assess both input and outcome at the same time. As outcome measure height and weight of all household members are recorded in a separate anthropometric survey (see paragraph 4.6).

As far as the measurement of the dietary intake is concerned, two different dimensions of unsatisfactory food consumption have to be considered, namely malnutrition (not the right food) and undernutrition (simply not enough food), each having slightly different implications for health policy. Assessment methods include the clinical examination of food composition. Unfortunately, these methods are not feasible in our context, mainly for logistic reasons. An alternative method is a food consumption survey. There is an extensive literature on how to conduct such surveys (e.g. Cameron, van Staveren 1988; FAO 1990; Thompson, Byers 1994). One of the major implications of this literature is that measuring dietary intake is a demanding and complex task. Common techniques are food recalls or food frequency tables. Usually these surveys are implemented as single-topic surveys done by nutritionalists interested solely in the nutritional situation of a population or specific high-risk subgroups of a population.

The NHDHS tried to find an easy way to measure dietary intake without increasing the respondent's burden in a way that endangers the quality of the resulting data set as a whole. In discussions with members of the CRSN we believe that we found a way to at least build categories of nutritional status. We decided on a food frequency table. The data thus collected represents the nutritional situation of the household as a whole, the intra-household allocation of food is not assessed. Though this information would undoubtedly be very valuable, the extra effort that it would demand appears to be prohibitive.

4.4 Morbidity Module

To obtain a comprehensive overview of the burden of disease (BOD), the morbidity module collects data on handicaps, and on chronic and acute diseases. Additionally, the cause of the disease or handicap, and its duration and severity are recorded. This information can be used as input in summary meas-

ures of the BOD by cause, for example the *YLD* (for the technical basis of the measurement of health outcomes in general see Dolan 2000, for the *YLD* in particular see Murray 1996).

A question in the main questionnaire serves as a filter to identify the household members stating to have a health problem. Each health problem is recorded separately in one line of the questionnaire and gets an identification number that helps to identify the health problem or illness episode later on in the questionnaire. Since it is possible that one or more household members have more than one health problem, several lines can be used for one and the same individual.

An *Inventory of Handicaps* lists all household members who have one (or more) of the handicaps given by a pre-coded list of handicaps. They are asked what caused the handicap, how they got to know the cause of the handicap, and the date, when the handicap started. Furthermore they have to give a judgement about the limitations the handicap imposes on them on a pre-defined scale:

6: needs assistance for eating and personal hygiene

5: limitations in daily activities like preparing meals, house-keeping or looking after live-stock

4: can't work in the fields or do handicraft

3: limitations in several domains like recreational activities, sports, education, and reproduction

2: limitations in *one* of the domains given above

1: no limitations at all.

This rating of functional impairment was inspired by the work on disability weights as proposed by Murray (1994), as one possibility to reflect the severity of a handicap. The question on the cause of the handicap is meant to allow to calculate the BOD by cause, which permits to use the data for health policy purposes. A paralysis, for example, can be caused by poliomyelitis or by a traffic accident and has to be classified accordingly. The information on how the respondent got to know the cause of the handicap serves as an indication on the precision of the diagnosis. If it is obvious, as for example in the case of an accident, the handicap can be classified without any doubt, but if the respondent only presumes that for example his blindness was caused by onchocerciasis some caution might be indicated or extra information has to be collected.

A similar procedure is pursued while compiling the *Inventory of Chronic Diseases* and the *Inventory of Acute Diseases*. For each disease episode, information on the cause is collected and the duration and the severity of the health problem is assessed. As a first approach to classify the severity of the disease –

which can serve as a possible basis for the calculation of disability weights – the respondent is asked to offer his or her personal assessment (ranked from "very bad" to "not bad at all"). Individual judgements on such a 5-point Likert scale have been commonly used for the evaluation of different health states (McDowell, Newell 1987). The reliability and usefulness of this method has still to be verified for our study. Another potential building block of the assessment of the preferences over health states, which shall be reflected by disability weights, is the rating of the functional impairment the disease has brought about. For reasons of comparability, the same codes as for the inventory of handicaps are used here.

Instead of simply asking the respondent how long he has been ill, the commencing date and the date when the disease episode stopped are written down, together with a control question if the disease was over at the time of the interview or not. This procedure seems advisable in order to increase the precision of our measurements.

The *diagnostic methodology* used in the morbidity module requires special attention. On the one hand, it is crucial for the presentation of the BOD by cause which in turn has strong health policy implications, for example for priority setting. On the other hand, it is very difficult to get a reliable diagnosis solely with the instrument of a questionnaire. Nevertheless, in developing countries, where resources in the health sector are low and at the same time not much epidemiological information is available, questionnaires are a common diagnostic instrument, since they are both cheap and feasible (Barreto 1998). Validation studies of questionnaire screening methods draw an ambiguous picture of their reliability and validity, though (Kalter 1992).

The diagnostic methodology of the NHDHS permits the diagnosis of the cause of the health problem in three possible ways. First of all, the respondent is asked to report by himself what disease he is suffering from. In the literature, this method is called *reported illness* and has been used previously to measure morbidity in the absence of further information (e.g. Iowa Persian Gulf Study Group 1997; Curtis, Lawson 2000). To improve upon this approach, the respondent is also asked how he came to know the cause of his health problem. The answers to this question allow us to deduce the level of precision of the reported illness. If, for example, he says, that he got a diagnosis from a health personnel, we might accept it as a clinical diagnosis, since it represents the clinical standard of the area.

As a second diagnostic instrument, the respondent can report up to six of the most striking symptoms that accompany his illness out of a pre-compiled list of signs and symptoms. Diagnostic algorithms can then be used to detect the disease with a certain level of reliability and validity, e.g. if somebody has headache and fever and a stiff neck, then meningitis might be recorded as the

diagnosis. A third approach, which can't be used on the individual level, though, is the redistribution of specific signs and symptoms using a priori information. For example, from all the fever cases in our study region, epidemiological studies would hypothetically estimate that in comparable Sub-Saharan regions approximately 60 % are malaria, 20 % meningitis, 10 % influenza, etc. Such a-priori information still has to be collected, though.

The shortcomings of this diagnostic methodology are obvious, albeit in the context of the described situation in SSA with low health care resources and limited epidemiological information, the proposed methodology seems to be a feasible approach. In any case, the methodology is competitive to other approaches that have been used or described in the literature. Nevertheless, a validation study is in preparation and will be carried out in the course of the NHDHS project.

As a further building block of the calculation of disability weights, in section 4 (*Severity of Health Problem and how the Household Managed the Occurring Difficulties*) of the questionnaire some more questions on the severity of the health problem are asked. On the one hand, they can be used to check and balance the individual severity judgements. For example, if a respondent had judged the disease to be not very bad, but later he would have stated that it had threatened his life, some caution is warranted. On the other hand, the NHDHS allows to calculate disability weights on the basis of different aspects: personal severity judgements, functional impairment, interference on occupation and work, obstacle for social interaction, and threat of life.

Furthermore, section 4 collects information on the household costs of illness. To be able to understand to what extent illness is not only a burden to the individual but also to the household, information is collected on the reduction of household productivity because the sick person and other household members who had to take care of him couldn't work or go to school. In this manner, the disease led to an impairment of the household's investment in human capital formation (see Schultz 1999 on the relevance of health and education as investments in human capital and the lack of these factors as a major cause for the slow growth in Africa). Moreover, coping strategies of the household are examined: on the one hand, how the household coped with the transitory reduction of the household's labor force and on the other hand, how induced expenditures were dealt with (Sauerborn et al. 1996b). Since time loss is an important component of the household's costs of illness (Sauerborn et al. 1995), the section *Helpers of the Sick Person* collects more detailed information on this issue.

In view of the fact that the *Demand for Health Care* plays a central role in health economics as well as in health policy, the morbidity module contains an elaborate section on this issue. For each health problem, information on three

treatment episodes can be recorded per line. If the respondent reports more than three treatment episodes per illness episode, naturally, the interviewer can use further lines. With this simple structure, it is possible to keep track of the possibility that one household member has several health problems which themselves have several treatment episodes without using too many different questionnaire sheets.

Furthermore, the possibility to link the specific disease, and the treatment and the demand thereby initiated allows to analyze disease-specific demand and treatment patterns. With the information thus collected, a variety of health-policy relevant questions can be answered. For example, the propensity to visit a traditional healer instead of a modern health care facility might vary across diseases. Last but not least, the expenditures and costs per treatment and per illness episode are recorded. This includes not only the costs of the treatment itself, but also transportation costs, time loss of the sick person and the caretaker, and the costs of the daily living at the place of treatment if applicable. Different treatment costs can thus be compared, and costs per specific disease can be calculated.

4.5 Module on Preventive Health Care and General Health

In developing countries, often the demand for health care mainly comprises acute, catastrophic care. In spite of this or one could also say particularly for this reason, a separate module collects information on preventive health care, such as vaccination, antenatal care and mother and child care. This module is analogous to the section on demand for health care of the morbidity module. Its aim is to get to know why individuals used preventive care, what kind of preventive care they were using, and what costs were invoked. This information can be very useful for health planning and health policy both at the level of the Nouna Health District and at a higher level in the ministry of health. Additionally, data on family planning are collected.

4.6 Anthropometric Module

As anthropometric measures weight and height are measured for each household member of the sample. For adults and children of two years or older the stature is measured: the subject is standing on a platform and its height is measured using a stadiometer. For children below two years of age the recumbent length is measured: the child is lying on its back and while applying gentle traction, the body length is measured using a wooden measuring board. The weight is taken with appropriate scales, one for adults and children 5 years and older and a more sensitive one for children below 5 years of age (Gibson 1990). The anthropometrists get a special training stressing the need for reliable and valid measurements, which shall be obtained through the use of high-

quality equipment, the perpetual readjustment of the scales and the accurate work of the anthropometrists.

In order not to overburden households during the survey rounds, the anthropometric module is carried out separately from the other modules. An anthropometric team visits the villages included in the sample and measures all household members of the household sample, using a list generated from the data base of the DSS/NHDHS. The equipment can be carried to a central place. The persons in question are asked to meet the anthropometrist there. This procedure is much faster and more efficient than conducting the anthropometric measurements during the household interviews. This would imply to carry the equipment from household to household while increasing the length of the interview and thus the respondents burden.

4.7 Additional Questions and Modules

The questionnaire described above will be the standard questionnaire of the NHDHS and is suggested as a frame of reference for surveys pursuing similar analytical objectives. It will not undergo major changes to guarantee comparability over time – a necessary prerequisite for the implementation of longitudinal studies. But apart from that, it is principally possible to include a few additional questions in one or more consecutive waves if a special topic is to be studied either for academic or health policy reasons. In the case of the NHDHS, for example, the wave in January 2001 included a module on the Willingness-to-Pay for a benefit package of a community-based health insurance scheme.

5. Conclusion and Outlook for Further Research

There exist a variety of data sets covering socio-economic data (Grosh, Glewwe 1998), and an increasing number of epidemiological studies are implemented in Sub-Saharan Africa (INDEPTH 2002). But to our knowledge, the combination of detailed epidemiological data (mortality and morbidity by cause), and a comprehensive collection of information on demographics, socio-economic status, nutrition, hygiene, and the demand for health care is a rather innovative undertaking. It not only allows the study of important topics in health economics, but also offers the opportunity to associate the burden of disease by cause with possible predictors, which opens an interesting perspective with respect to the need for reliable epidemiological data for SSA, as it permits conditional projections that probably possess a strong potential to be more specific and reliable than pure extrapolations on the basis of demographic data alone.

Further advantages of the NHDHS are its longitudinal design which potentially allows the identification of causal effects in cases where this is hardly possible in a cross-section setting. Moreover, seasonal variation is captured, firstly, with respect to the economic situation, since the survey takes place once in the hungry season and once in the harvest season, and secondly with respect to the epidemiological situation, since information on morbidity is collected four times a year (Sauerborn et al. 1996a). Previous experience of the health personnel of the study region shows that due to the climatic variation, a strong variation of diseases can be observed. In February, the dry weather and the hamattan, a hot and dusty wind blowing from the Sahara, favors the prevalence of respiratory infections, whereas the rainy season witnesses a high prevalence of malaria.

In spite of the novelties and the advantages of the NHDHS vis-à-vis other surveys, it is well-understood that the NHDHS also faces a series of problems, that have to be taken charge of. Apart from the usual pitfalls of surveys such as measurement error, respondent's bias, recall error, interviewer bias, missing values, etc. (Biemer et al. 1991), the NHDHS has to tackle a special difficulty concerning the measurement of the burden of disease by cause. Even diagnoses from trained medical personnel are not immune against errors. The diagnostic methodology implemented in the morbidity module sets a certain standard, but quite naturally will not be perfect. To be able to quantify the error that the morbidity measurement undergoes, a validity study at least for malaria, most probably the most frequent disease in the study area (Würthwein et al. 2001a), should be conducted to provide the appropriate figures for reliability and validity of the diagnostic instrument used.

Further research in the direction of the survey methodology employed, comprehends the ordering of questions. In a future wave, for instance, it is planned to move the question on the valuation of the respondents own health status from the main questionnaire to the module on preventive care and general health, to see if the respondent rates his own health lower after having talked about health questions. Intuitively this is to be expected, which raises doubt on the usage of this question as a proxy for the actual health state of respondents in several health surveys that don't take the pains to collect epidemiological data. Another interesting question will be to investigate in as much the interviewer judgements, e.g. on the cleanliness of the household's dwelling, are reliable and valid. It would be possible, for example, to validate the interviewer judgements vis-à-vis a cleanliness indicator constructed from clear-cut questions about hygiene, housing, and water supply (see section III and IV of the main questionnaire). Moreover, one could examine whether there are strong differences between the mean judgements of each interviewer. Under the assumption that there is no systematic bias with respect to the cleanliness of the households interviewed by each interviewer – which would hold if a random

assignment of interviewers and households was achieved – differences between the mean ratings would reveal a respondent's bias at this point.

Naturally, we are aware of the fact that the NHDHS might not be perfect. Nevertheless, surveys that combine socio-economic data and epidemiologic and health issues are hardly available or if they are available, they are not discussed in the research community. We believe that it is in fact surprising that – often enough contradicting – research results are discussed at length, while the underlying surveys are not regarded as a scientific topic. With this chapter, my co-authors and I are suggesting to discuss crucial aspects of survey methodology and propose the NHDHS as a prototype for the collection of morbidity and household data.

Chapter 2

The Nouna Health District Household Survey (2): From the Raw Data to the Analysis of Income

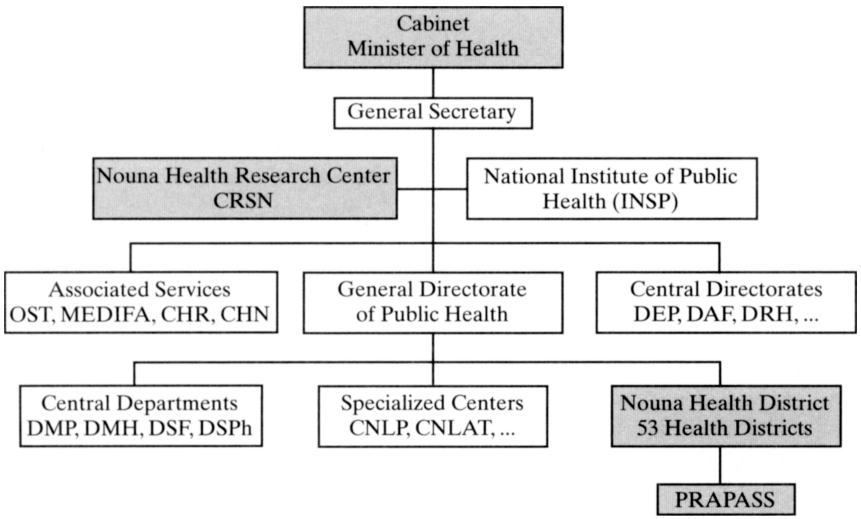
1. The Need for High-Quality Data

Obtaining a high quality data set for quantitative analysis is an endeavor that goes beyond merely writing down a questionnaire and interviewing a sample of households. Unfortunately, such an undertaking can fail at a lot of different stages. As described in chapter 1, apart from asking the right questions in the right manner, selecting a representative sample and qualified interviewers, and ascertaining the co-operation of the respondents to obtain honest, unbiased, and sensible answers, the data and the data base themselves need a lot of attention. The supervision process during the field phase of the survey and during data entry has been described in chapter 1. This chapter will deal with the supervision, cleaning and transformation of the data into a usable data set once the data entry has been accomplished.

After providing an overview of the different data collection activities of the CRSN (section 2.1), section 2.2 describes the original ACCESS data base provided by the CRSN. The following sections depict the supervision process (section 2.3), the collection of price data necessary to generate income variables and the documentation of the data (section 3.1), and the cleaning, re-coding, and transformation of the ACCESS data base into a reliable STATA data set (section 3.2). Section 4.1 documents how individual income variables have been calculated, whereas section 4.2 explains the calculation of household income and equivalent income. Section 4.3 explains how additional variables have been generated, and section 5 concludes with a brief description of the final STATA data set.

Figure 2

Organigram of the Burkinian Health System



2. Input: The NHDHS Collected by CRSN

2.1 Data Collection Activities at a Glance

Since the early 1990's, co-operations of varying intensity exist between the *Ministry of Health of Burkina Faso* and the *University of Heidelberg*. In 1992, a collaborative research and health policy project was established that carried the name PRAPASS (*Projet de Recherche-Action pour l'Amélioration des Soins de Santé / Research and Action Project for the Improvement of Health Care*). PRAPASS was mainly a collaboration between the *Nouna Health District* and the *Department of Tropical Hygiene and Public Health* of the University of Heidelberg. With the establishment of the *Sonderforschungsbereich No. 544 "Control of Infectious Diseases"* (SFB) in 1999, the co-operation was substantially extended. On the side of the University of Heidelberg, various project groups showed interest to conduct research in Burkina Faso. On the side of the Ministry of Health of Burkina Faso, the locally oriented PRAPASS project was closed down, making room for the *Nouna Health Research Center*, which was directly subordinated to the General Secretary of the Ministry of Health and endowed with much more resources than the former PRAPASS project (Figure 2).

Today, the SFB comprises multi- and interdisciplinary research projects in such diverse fields as health economics, public health, parasitology, molecular biology, medicine, and epidemiology, hence not only including different institutes and departments inside the University of Heidelberg, but also the Ger-

man Cancer Research Center (DKFZ), the European Molecular Biology Laboratory (EMBL), and the Center for Molecular Biology (ZMBH). Several of the project groups of the SFB co-operate directly with the CRSN, some of them using data, others even blood samples or mosquito genes that are collected in the Nouna Health District.

The projects that deal with topics in the domain of public health, epidemiology, and economics are mainly interested in demographic, socio-economic, and burden of disease data (mortality and morbidity data). These data basically result from three different data collection activities of the CRSN: the Demographic Surveillance System (DSS), the Verbal Autopsy System, and the NHDHS. The resulting data are stored in relational data bases. As data base software, Microsoft ACCESS is used. The data are usually stored in several ACCESS tables forming one ACCESS data base (for example the DSS data base). Each table collects the data of one special topic. The table DecesT of the DSS data base, for example, collects all relevant information on deceased individuals. Even though there exists a separate data base for each data collection activity of the CRSN, the data bases can all be linked in the sense that the information stored in one data base can be matched to the information stored in another data base. Additionally, the CRSN implemented plausibility checks that generally guarantee that the information of the different data bases are internally consistent. One individual should, for example, have the same village code (religion, sex, etc.) in all three data bases.

The Demographic Surveillance System
In its initial year 1992, PRAPASS implemented a *Demographic Surveillance System*. The DSS started with a first census that covered the population of 39 villages. At that time, these villages constituted the catchment area of three CSPS (*Centre de Santé et de Promotion Sociale*) – the basic health care facilities in the Burkinian health system. The first census was supplemented by a *Vital Events Registration* system recording births, deaths and migrations, and updated through a control census in 1993 and another one in 1998. In 1998, the mid-year population of the DSS was 31,280 inhabitants. In January 2000, the study population was extended, now covering 41 villages (the re-organized catchment area of four CSPS), and the semi-urban town Nouna. Today, the DSS covers a population of roughly 55,000 inhabitants (for more information, see INDEPTH 2002). Schedule 1 displays the different ACCESS tables of the DSS data base and the respective variables that each table includes[1].

The Verbal Autopsy System
One of the objectives of PRAPASS was to measure the impact of health interventions on the mortality of the study population. Whereas the DSS allows to

[1] Variables of minor analytical importance and variables that predominantly serve administrative purposes have been left out for ease of exposition.

Schedule 1

Content of the DSS Data Base

ACCESS Table	Variables
IndividualT	Individual Identifier (ID), Name of Mother/Father, ID of Mother/Father, Date of Birth, Sex, Ethnic Group, Religion
MemberT	Household (HH) Identifier (Village, Compound, Household in Compound, Sector), ID, Family Relations Inside Household
HouseholdT	ID and Name of HH Head, Geographical Information (GPS-Coordinates), Date of Entry of HH in the DSS, Provenance, Date of Exit of HH from the DSS, Destination
ResidenceT	ID, HH ID, Occupational Status, Employment Situation, Marital Status, Educational Attainment, Date and Cause of Entry in the DSS, Provenance, Date and Cause of Exit from the DSS, Destination
WomanT	ID, No. of Pregnancies, No. of Births, No. of Life Births
PregnanciesT	ID, Age, Date of Probable Delivery, Effective Date of Delivery, Status (Stillbirth, Life Birth)
MaternityT	ID, No. of Children, For Each Child: Date of Birth, Sex, Name, Status
DeathT	HH ID, Name, Sex, Date of Death, Age at Death, Cause of Death

RWI ESSEN

get an overview of the development of overall mortality, the evaluation of cause-specific interventions necessitates the assessment of the level and trends of cause-specific mortality. Therefore, already in the initial year 1992, a *Verbal Autopsy System* was developed as well. Whenever a death was recorded in the DSS, some 4–16 weeks later, a structured Verbal Autopsy (VA) questionnaire was administered to the best informed relative(s) of the deceased by interviewers of the PRAPASS team. While these interviewers had no medical formation, the questionnaires were appraised independently by two physicians. If the two physicians did not agree on the diagnosis, a third physician was consulted as a referee (for more information see Würthwein et al. 2001a; INDEPTH 2002).

As a result of the medical evaluation of the questionnaires, three causes of death were ascertained: the underlying cause of death, the immediate cause of death, and the associated cause of death. To give an example: let's assume an HIV-infected person develops AIDS and contracts a pneumonia. Before he finally dies, he attracts a worm infection. In this case, it is rather non-ambiguous that AIDS is the underlying cause of death, since he most probably would not have contracted a pneumonia if his immune system would have operated properly. Pneumonia is the immediate cause of death, since he finally dies because of a failure of his lungs. The worm infection is only an associated cause. It exacerbated the health status of the sick person but did not have a direct influence on his death. This distinction is not always that obvious, though. Especially in the case of nutrition-related diseases it might not always be obvious whether undernutrition, diarrhea, or a worm-infection that caused a diarrhea is the un-

Schedule 2

Content of the Verbal Autopsy Data Base

ACCESS Table	Variables
VA-DeathT	ID, HH ID, Sex, Date of Birth, Date of Death, Diagnosis of Physician 1, Diagnosis of Physician 2, Diagnosis of Physician 3

RWI ESSEN

derlying cause and finally led to the dehydration of the infant. The often-cited result of cause-specific mortality analysis that diarrhea is one of the major causes of death in the world (Murray, Lopez 1996a) illustrates the practical relevance of this discussion.

Today, the CRSN not only continues the PRAPASS VA system but is currently reviewing the methodology with respect to the disease classification system, the questionnaire and the field procedures. Schedule 2 displays the content of the prevailing VA data base of the CRSN. The author proposed to convert the old PRAPASS disease codes into an internationally accepted codification system – the *International Classification of Diseases, 10th Revision* (ICD 10) (WHO 1994b) and provided a preliminary conversion table.

The CRSN is a member of an international network of demographic field sites, called INDEPTH (International Network of Field Sites with Continuous Demographic Evaluation of Populations and Their Health in Developing Countries; see www.indepth-network.org for further information). Inside INDEPTH, the CRSN fosters the development of a protocol that standardizes the VA methodology to improve the comparability of the results obtained at the different participating sites.

In the literature, the potential and the limitations of VA methods are examined critically (Snow et al. 1992; WHO 1994a; Chandramohan et al. 1998; Ronsmans et al. 1998). On balance, it is argued that the VA method is the best alternative to assess cause-specific mortality in a situation where the majority of deaths occur without recourse to modern health care facilities. Würthwein et al. (2001a) analyzed the data of the VA system of the CRSN. Their main findings suggest that the data are plausible and internally consistent. The cause-specific mortality pattern confirms the results of the Global Burden of Disease Study (GBDS; Murray, Lopez 1996a) with respect to age and sex. Obvious discrepancies between the GBDS results and the results of the CRSN occur in the ranking of diseases with respect to the inflicted disease burden. These discrepancies are reasonable, though, and demonstrate that local health policy should rather be based on locally measured burden of disease data instead of model-based international data – a finding that is corroborated by the

results of other field sites (e.g. Chandramohan et al. 1998, who cite the results of three different field sites).

The Nouna Health District Household Survey
To be able to not only document mortality and morbidity levels and trends, but to also analyze their potential determinants and interdependency with socio-economic characteristics, the CRSN implemented a household survey. Before the implementation of the *Nouna Health District Household Survey* in 2000, PRAPASS had already been conducting a household survey at irregular time intervals between 1993 and 1996. Unfortunately, when the SFB started in 1999, it was not possible to access this data. The PRAPASS household survey had never been described properly. No detailed manuals and code books were available – neither of the field procedures, the questionnaire, and the sampling of the survey nor of the data base and the variables. Therefore, the CRSN and the SFB project leaders interested in socio-economic and morbidity data on an individual basis decided to establish a completely new household survey. The design, the field procedures, the sampling, and the questionnaire of the NHDHS are described in detail in chapter 1. The remainder of this chapter focuses on the cleaning of the data base and the creation of variables out of the raw data provided by the CRSN.

Further Data Collection Endeavors
Further data that the CRSN collects concern project-specific data. One SFB project, for example, collects data on children that have been sampled for a randomized controlled trial on the health-promoting effect of zinc supplementation (Müller et al. 2001). In principle, it would be possible to match these data to the data of the DSS, the VA system and the NHDHS. So far, nobody has taken up this opportunity. But further research activities could fill this gap to deploy the potential that the CRSN offers in its provision of high quality data.

2.2 Original Data Base of the NHDHS

The data base model of the NHDHS data base was developed in a workshop in Nouna in 2000, the main contributors being *Yazoumé Yé*, the IT specialist of the CRSN, *Adjima Gbangou*, the field coordinator of the survey, and *Bocar Kouyaté*, the director of the CRSN. The data base was designed as a relational data base as proposed by Codd (1990). In contrast to a hierarchical or a network based data base model, a relational data base stores the complete information in two-dimensional tables (the *relations*) with a fixed number of columns and an unrestricted number of rows. Each row of such a table is an *entity* possessing as many *attributes* as there are columns in the table.

The NHDHS data base consists of 22 ACCESS tables that can be linked together according to the purpose of the analysis, using key variables unique to

Schedule 3

Content of the NHDHS Data Base

Description	ACCESS Table	Key Variables	Carrier Variables
Date of Survey Field Phase	EnqueteT	Survey Wave	Beginning and End of Survey Field Phase (Date)
Permanent Household Characteristics	MenageT	Village Code, Number of Courtyard, Household Number, Sector (if household resides in Nouna)	Name and Individual ID of Household Head
Permanent Individual Characteristics	MembreT	Individual ID, Village Code, Number of Courtyard, Household Number, Sector	Rank (Consecutive Number Inside Household), Name, Family Status (e.g. *brother*), Related to Whom (e.g. *of Rank* # 2), Date of Birth, Sex, Ethnic Group
Varying Household Characteristics	SrcEnqMenT	Village Code, Number of Courtyard, Household Number, Sector, Survey Wave	Current Village Code/Number of Courtyard/Household Number/Sector, Individual ID of Household Head, Name and Individual ID of Respondent, Date of Visit, Code of Interviewer, Code of Supervisor, Code of Data Entry Clerk, Date of Data Entry, Consecutive Number of Household Roster Questionnaire Sheet
Varying Individual Characteristics	SrcEnqMembT	Individual ID, Village Code, Number of Courtyard, Household Number, Sector, Survey Wave	Current Village Code/Number of Courtyard/Household Number/Sector, Rank, Exit from NHDHS (Yes/No), Motive of Exit, Religion, Alphabetization Status, Educational Attainment, Occupational Status and Employment Situation (for first and second job), Marital Status, Smoking Dummy, Number of Cigarettes/Pipes, How Often, Health Status, Dummies for Acute Illness, Chronic Illness, and Handicap
Housing	HabitatT	Village Code, Number of Courtyard, Household Number, Sector, Survey Wave	Type of Housing, Nature of Walls, Nature of Roof, Nature of Floor, Number of Rooms, Type of Lavatory, Interviewer Judgement on Overall Cleanliness
Water & Sanitation	EauAssainisT	Village Code, Number of Courtyard, Household Number, Sector, Survey Wave	Source of Water in Rainy and in Dry Season, Type of Water and Trash Disposal, Number of Days Until Water Is Replaced, Type of Water Reservoirs, Type of Water Transportation, Interviewer Judgement: Trash and Animals in the Courtyard, Judgement on Cleanliness of Kitchen
Goods	MaterielT	Individual ID, Survey Wave	Rank, Dummy: Individual Owns Something (Yes/No), Goods in Question: Cart, Trolley, Bicycle, Moped, Motorbike, Car, Radio, TV, Telephone, Refrigerator, Modern Kitchen, Other Goods
Animals	AnimauxT	Individual ID, Survey Wave	Rank, Dummy: Individual Owns Animals (Yes/No), Animals in Question: Chicken, Sheep, Goats, Cows, Donkeys, Pigs, Horses
Agricultural Products	ProductAgriT	Individual ID, Survey Wave, Consecutive Number (Per Individual)	Rank, Type of Agricultural Produce, Dummy: Individual Cultivated Something (Yes/No), Quantity, Unit
Selling of Products	VentProdT	Individual ID, Survey Wave, Kind of Product Sold	Rank, Dummy: Individual Sold Something (Yes/No), Amount of Last Month, Amount of 5 Months Preceding Last Month

Schedule 3 (continued)

Content of the NHDHS Data Base

Description	ACCESS Table	Key Variables	Carrier Variables
Money Income	RevMonT	Individual ID, Survey Wave, Consecutive Number	Rank, Dummy: Individual Had a Money Income (Yes/No), Amount of Last Month, Amount of 5 Months Preceding Last Month, Source of Income
Money Transfers & Pensions	TransVersT	Individual ID, Survey Wave, Consecutive Number	Rank, Dummy: Individual Received Transfers (Yes/No), Amount of Last Month, Amount of 5 Months Preceding Last Month, Source of Money (e.g. *relatives, emigrated friends*), Destination of Money (e.g. *funeral, school fees*)
Expenditures	DepenseT	Individual ID, Survey Wave, Consecutive Number	Rank, Dummy: Individual Had Money Expenditures (Yes/No), Amount of Last Month, Amount of 5 Months Preceding Last Month, Type of Expenditure (e.g. *rent, health care*)
Food & Nutrition	AlimentationT	Village Code, Number of Courtyard, Household Number, Sector, Survey Wave	Amount and Frequency for the Following Food Groups: Cereals, Vegetables, Sauce, Salad, Fruit, Milk, Meat, Fish, and Bread (e.g. *1 kg of cereals per day*)
Handicaps	HandicapT	Individual ID, Number of Disease Episode, Type of Handicap, Survey Wave	Rank, Cause of Handicap, Who Told Cause (e.g. *mother, health personnel*), Date When Handicap Started, Limitation Caused By Handicap
Chronic Diseases	MalChroniqT	Individual ID, Number of Disease Episode, Disease Code, Survey Wave	Rank, Who Told Cause, Date When Illness Started/Stopped, Severity of Illness, Limitation Caused By Illness, 1-6 Symptoms
Acute Diseases	MalAigueT	Individual ID, Number of Disease Episode, Disease Code, Survey Wave	Rank, Who Told Cause, Date When Illness Started/Stopped, Severity of Illness, Limitation Caused By Illness, 1-6 Symptoms
Severity of Disease	SeveriteT	Individual ID, Number of Disease Episode, Disease Code, Survey Wave	Rank, Type of Handicap/Disease, Illness/Handicap Threatens Life, Constitutes a Social Problem, Affected Working Capability (Time), Aide Needed, Aide Lost Working Time, Arrangements to Cope with Loss of Working Capacity, Expenditures, Strategies to Cope With Expenditures, Could Not Attend School, Time Lost, Reason For Not Attending School
Demand for Health Care	SoinsT	Individual ID, Number of Disease Episode, Disease Code, Survey Wave	Rank, Treatment of Illness (Who, Where, Why, Quality), Expenditures (Transport, Stay, Health Care), Duration of Transport (Time Lost), Success of Treatment, Duration of Hospital Stay
Aide of Sick Person	AssistantT	Individual ID, Number of Disease Episode, Individual ID of Aide, Survey Wave	Rank, Type of Handicap/Disease, Individual ID of Aide, Rank of Aide, Time Lost
Preventive Health Care	SoinsPrevenT	Individual ID, Type of Preventive Care Used, Survey Wave	Rank, Dummy: Individual Used Preventive Care (Yes/No), Treatment (Who, Where, Why, Quality), Duration of Travel, Expenditures (Travel, Stay, Health Care), Strategies to Cope With Expenditures, Dummy: Family Planning Used (Yes/No), Method of Family Planning

the individuals (or households). This avoids an overly cumbersome storage of all available information in a single rectangular table. Schedule 3 provides an overview of the data base, listing the original French name of the ACCESS table, the *ACCESS Key Variables* that uniquely identify each row of the respective table, and the *Carrier Variables* that "carry" the information relevant for the analysis.

The tables are grouped according to the modules of the questionnaire. Starting with the information collected in the main questionnaire, the table continues with the socio-economic module, followed by the morbidity module and finally the module on preventive health care. Within the modules, the NHDHS data base distinguishes tables comprising household level information and tables that store data on individuals. On household level, the ACCESS table MenageT stores the time-invariant information on each household of the survey. Further household level tables are SrcEnqMenT, HabitatT, EauAssainisT, and AlimentationT. The remaining tables contain individual level data.

All tables that store household level data, the tables of the main module and some of the tables of the socio-economic module are 1:1-tables, i.e., apart from errors, each individual (or household respectively) should have *exactly* one entry in the table. The remaining tables are 1:*n*-tables where each individual should have *at least* one entry in the table. But for some individuals there are several rows in the table. If, for example, an individual receives transfers from different sources, the table TransVersT would contain one row for each transfer.

As *Individual Identifier* (Individual ID), a numerical code of 9 digits length is used. Unfortunately, there exists no numerical *Household Identifier* (HH ID). Instead, a sequence of geographical information is used, consisting of a numerical village code (42 if the household resides in Nouna), a numerical code for the courtyard inside the village or town, an alphabetical code to identify the household inside the courtyard, and a numerical code for the town sector (0 if the household resides in a village). Since this information is time-variant, the variables *CodVillage*, NumConcess, CodMenage, and NumSecteur are stored two times: once as identifying time-invariant ACCESS key variables in the table head of all tables that store household level data, and for the second time as time-varying variables in the body of SrcEnqMenT under the names CodVillageAct, NumConcessAct, CodMenageAct, and NumSecteurAct (Act stands for *Actuelle*).

To identify a row in one of the tables of the ACCESS data base, different variables are used depending on the content of the table. First, the Individual ID (or composite HH ID, respectively) identifies to whom the stored information belongs. If the information is time-variant, the variable SrcNumEnq specifies the respective survey wave. To identify the different rows for one and the same in-

dividual in 1:*n*-tables, *Entry Identification Variables* are used. Such an entry identification variable can either be a consecutive number, as NumOrd in ProductAgriT, which displays a "Zero" for the first item the individual has produced, a "One" for the second item etc., or a *Specification Variable* such as ProdAgPast in VentProdT, which specifies the agricultural produce that has been sold. If an individual sells *n* different agricultural products, he gets *n* rows, where each of the rows contains the relevant information for one sold product. If, for example, an individual produced maize, rice, and millet in wave 1, the table VentProdT contains three rows for this individual for wave 1: one where ProdAgPast reads "Maize", one with "Rize", and one with "Millet".

In the morbidity module, two variables are used to specify a particular disease episode of an individual. The variable CodMalad (or TypHandicap, respectively) identifies the type of disease (or handicap) an individual has contracted. Then, NumEpisode specifies as a consecutive number for each type of disease the single disease episode. An analogous logic applies to AssistantT and SoinsPrevenT, the tables concerned with the helpers of sick persons and with the use preventive health care.

2.3 Supervision Process and Its Limits

When the researchers in Heidelberg received the data from the CRSN, the first difficult question was: How should the quality of the data be assessed? So far, the design of the survey did not contain any propositions on this aspect. In a first step, a workshop consisting of *Heiko Becher*, *Hengjin Dong*, *Gisela Kynast-Wolf*, *Frederick Mugisha*, *Rainer Sauerborn*, *Gabriele Stieglbauer*, and *Ralph Würthwein* was convened to elaborate the necessary steps for the evaluation and supervision of the data base and to set out a protocol regarding the communication with the CRSN.

As a first approach, responsibilities for the different modules of the data were arranged and frequency listings were printed out to get a first impression of the data and to identify outliers and implausible records. To systematically address the process of data cleaning, the author developed a supervision system that encompassed several elements. The main element was the establishment of *Supervision Reports* (SR; Figure 3). Each member of the hence created supervision team would have to fill out a SR whenever he or she detected any errors or unclear records. The author then collected the reports and checked them together with a small team assembled by *Christoph Schmidt*. Checking the reports included i) verifying if the conveyed finding really constituted an error or just a misunderstanding on behalf of the SR team member, ii) the consolidation of the different findings, and iii) writing concise and easily understandable final reports for the CRSN. The idea behind this system was to meticulously report all detected errors of the data base and to describe them as

Figure 3

Heidelberg NHDHS Data Base Supervision Report

Version of the data base	Date of DB	Update Version	Date of Supervision Report
EM3.mdb	22.05.2001	Update brought by P. Reitmaier	11/10/2001

Findings related to Module 0

Person who found the error:		Ralph Würthwein		Person Responding to Error:	
Question Ref.-No.	Table(s) concerned	Variable(s) concerned	Problem in short	Error was dealt with	Response / Solution in short
11/10-004	MembreT	DATNAISS, PRECDAT NAISS	No information on date of birth (DOB) for some individuals		

Problem: For the individuals given below, there exists no valid information on DOB.
Suggested solution: Please go back to the questionnaires and check the correct value.
Suggested procedure for the future: Could you implement a logical check in the data base that prevents the entry of an obviously implausible DOB?

Details:
Individual ID: 204813450, 122974160, 130346503, 210396858, 204521473, 102926452

Detailed Response from CRSN:

clearly and simple as possible to give the CRSN supervision team the best possible support.

An important step within this system was the communication with the CRSN. The CRSN should understand the supervision team in Heidelberg as a service that is meant to support the work of the CRSN. Getting the full co-operation of the CRSN was very crucial for the success of the set up activities. *Würthwein* and *Becher* achieved that the CRSN established a protocol in Nouna consisting of the following elements: i) to avoid irritations, the whole communication concerning the supervision of the data should take place between *Yazoume Yé* and *Ralph Würthwein*, ii) the CRSN supervision staff promised to respond to the SRs within two weeks, iii) corrections of the data base would be done solely in Nouna, iv) the up-dated data base would be transferred to *Heiko Becher.*

A second element, in addition to the SRs, of the thus established supervision system consisted of the collection of questions concerning the content and the logic of the data base to avoid that each researcher addressed the CRSN team on his own behalf. Previous experience had shown that the CRSN team had often been hindered in their efficient work by the manifold requests and questions from the different SFB project groups. Additionally, a lot of questions could be solved within the supervision team.

A third element constituted the collection of suggestions and feed-back with regard to the field work of the survey. At different points, it became obvious

Schedule 4

Typical Errors in the Raw Data Provided by the CRSN

Error/Problem in Short	Tables Concerned	Variables Concerned	Description of Error/Problem
Implausible "Default" (DEF) values	All tables	All variables	The code "Default" should not occur at all in the data base. A default value indicates that the respective record has been left empty during data entry. Unfortunately, DEF codes are a common sight in the data base. In some cases, all records for one and the same individual contain default values, in other cases, a default value occurs only in selected variables.
Distinction between missing values and "0"-entries	ProductAgriT, VentProdT, RevMonT, TransVersT, DepenseT, SoinsPrevenT	All variables	In the specified tables, only the individuals with positive entries are recorded. If an individual did not cultivate or sell anything, for example, this individual does not get an entry in the table. If it were certain that all the individuals who do not have an entry in the respective table really are "0"-entries, there would be no problem. Unfortunately, because of potential missing values, this is not necessarily the case. To make things worse, some individuals who have a negative entry are recorded in the data base, which could indicate that all missing individuals really are missing values. This is unlikely, though, since for wave 1, for example, only 5.045 out of 6.380 individuals have an entry in the table PRODUCTAGRIT. The CRSN stated that missing individuals should be treated as "0"-entries.
Implausible coding as "Not Applicable" (NAP)	SrcEnqMembT	SAITLIREECRIRE NIVEAUINSTRUCT CODMATRIMO	The value NAP is only justified in well-specified cases, e.g. if the individual left the survey (in this case, the variable "Sortie" equals "Oui" and all variables except "Sortie" are coded NAP), if the individual is too young, or if an overleap variable indicates it (example: "Smoke" equals "No", then "Number of cigarettes" is coded NAP).
		STATUTOC CODOC1/2 SITUATOC1/2	For more than 1.000 individuals, the specified variables are coded as NAP, even though this coding doesn't seem to be justified.
		All variables	For three individuals, all variables are coded as "Not applicable".
		SORTIE	For some individuals with valid entries in other variables, the variable SORTIE is coded as "Not applicable". This variable can only be coded either as "Yes" or as "No". Other codes do not make any sense here.
Wrong survey wave number	MaterialT, AnimauxT, ProductAgriT, VentProdT, RevMonT, TransVersT, DepenseT AlimentationT	SRCNUMENQ	For some individuals, SRCNUMENQ indicates that the recorded information belongs to wave 2. However, the respective tables belong to the socio-economic module of the NHDHS which has not been administered in wave 2. In other cases, SRCNUMEN displays a survey wave number higher than 4, even though only 4 waves have been completed so far.
Missing information	AlimentationT	All variables	For some households, no entries in ALIMENTATIONT exist. The information on this sub-section is missing completely.
	SrcEnqMembT	SAITLIRE	For some individuals, no information on alphabetization status exist. The respective entry is either Non Applicable (NAP) or DEF (default value). Both entries make no sense at this point.
		All variables	Two individuals have no entries in SrcEnqMembT, even though they have valid entries in other tables of the data base.

Schedule 4 (continued)

Typical Errors in the Raw Data Provided by the CRSN

Error/Problem in Short	Tables Concerned	Variables Concerned	Description of Error/Problem
Wrong codes	MembreT	CODSEXE	Sex is coded as "default" value.
	SrcEnqMembT	CODMATRIMO	Marital status is coded as "Other", even though the "marital status"-codes are exhaustive.
		STATUTOCC	Occupational status is coded as "Other", even though the "occupational status"-codes are exhaustive. Occupational status is coded as "Not Applicable", even though the individuals are older than 11 and they did not exit the survey. Occupational status is coded as "None", which doesn't make any sense for this variable.
	AlimentationT	All "Freq"- and "Uni"-variables	For frequencies and units of measurement, wrong codes are used that are not given in the code book.
Inconsistencies and implausible values	SrcEnqMembT	NIVEAUINSTRUCT or DATNAISS	Individuals have information on educational attainment (primary school), even though they are not even one year old according to their DOB entry.
		CODMATRIMO or DATNAISS	Individuals are married according to the variable "marital status", even though they are below 10 years of age, according to DOB entry.
		STATUTOC or DATNAISS	Individuals are occupied (according to the variable "occupational status"), even though they are below 10 years of age, according to DOB entry.
	MembreT	CODPARENTE	One household has two household heads according to the variable CODPARENTE.
	MembreT and SrcEnqMenT	CODPARENTE and IDINDIVIDUCHM	One code of the variable CODPARENTE is "CHM" for household head. The variable IDINDIVIDUCHM stores the individual ID of the household head. For several cases, these two records differ.
	ProductAgriT, TransversT, RevMonT, DepenseT	NUMORD	For some individuals, the variable NUMORD starts counting from zero onwards, for others from one onwards. This creates confusion in detecting the total number of items per individual.
	AnimauxT	POSSEDAN	For some individuals, the variable POSSEDAN indicates that they possess animals, but in the remainder of the table, no animals are listed.
	AlimentationT	NOMB or FREQ	Some entries are implausible, since they, for example, indicate that a household consumes 22 kg of meat per day.
	MalChroniqT	DATDEBUT	For some individuals, incorrect date specifications are recorded, e.g. 01.10.6200
	MalChroniqT, MalAigueT	DATDEBUT, DATFIN	According to the entries given in DATDEBUT and DATFIN, for some individuals, diseases ended before they started.
Outliers	ProdAgriT, DepenseT, MonTransT, MaterielT, AnimauxT	QUANTITE, MONTM1, MONTM5	Some records seemed to be outliers. Examples in case are an individual who produced 3.117 tons of cotton, or other individuals who owned 9 cars or 93 horses. In the case of "9"-entries, it turned out that these were typing errors. Data entry clerks typed "9" instead of "99" (missing value).

that, for example, some interviewers (or respondents for that matter) seemed to systematically misunderstand some questions. In other cases, the questionnaire needed a review since codes did not seem to be comprehensive. Unsurprisingly, the supervision process of the data gave insights on how to further improve the design of the survey.

As expected, the supervision process of the raw data revealed a number of errors and inconsistencies that had to be dealt with. Schedule 4 provides an overview of some typical errors that have been detected. Currently, the CRSN is still working on the data base. Some errors have been fixed in Nouna, and others could be removed during the transformation from the original ACCESS data base into a STATA data set.

3. Improvements in Data Quality

3.1 Ascertaining Documentation and Additional Data

To help the potential analyst of the NHDHS data base to access the data, the author compiled a *Handbook for Analysts of the NHDHS Data Base*. The experience with the PRAPASS data showed that it is very difficult if not impossible to work with data that has not been described properly. Parallel to chapter 1, the handbook describes the survey design and the questionnaire of the NHDHS. Furthermore, the design and content of the ACCESS data base are depicted, followed by an overview of the different data base tables and a list of variables. Subsequently, all the variables are explained in detail. The handbook concludes with a comprehensive tabulation of all the codes used in the data base.

To be able to generate income and wealth variables, it was necessary to collect price data. The income and wealth data collected with the NHDHS consist of parts that are already expressed in money terms, and three items that are assessed in quantities: the amount of animals an individual possesses, the quantities of agricultural produce of the last harvest, and durable goods. The author developed the prototype of a questionnaire that the NHDHS staff was asked to adapt to the situation in the field. As respondents, key informants were selected who would be able to judge on the price situation at the respective village or town. In the future, it is planned to implement the thus established price survey as a routine task at all survey waves where the socio-economic module will be administered.

The prototypes for the price questionnaires are given in Table 2. The problem with the price questionnaires was that prices would vary depending on quality and age of the item in question, and on relative supply and demand conditions at the respective market place at the respective day, week, or season. For animals and durable goods, the prototype therefore suggested to assess a "regu-

Table 2

Price Questionnaire Prototypes

	Price Range		Mean Price	In the Case of Several Quality Categories					
				Low Quality		Medium Quality		High Quality	
	Min	Max	Regular	Price	Share	Price	Share	Price	Share
				Animals					
Chicken									
Sheep									
Goat									
Cow									
Donkey									
Pig									
Horse									
				Durable Goods					
Cart									
Plow									
Bicycle									
Moped									
Motorbike									
Car									
Radio									
TV									
Telephone									
Fridge									
Modern Kitchen									
				Agricultural Products					
			Box	Tub	Sac	Cart	Kilo-gram	Ton	Number
Millet									
Sorgho									
Corn									
Rice									
Fonio									
Peanuts									
Sesame									
Beans									
Peas									
Melons									
Tobacco									
Cotton									

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lar" price (depending on a definition of regularity that the staff of the CRSN would have to provide), a minimum and a maximum price, and alternatively up to three different prices if there existed some sort of quality categories for

one or the other item. For chicken, for example, a rooster has – on average – a higher price than a hen. If there existed price categories, the respondent should give a guess as to the percentage share of each category in the respective village or town. The staff in Nouna – familiar with the situation in the field – should then decide on the adequate questionnaire version for each of the items surveyed.

For agricultural produce, only the "regular" price was asked. For simplicity reasons, the price per unit was held constant, i.e. no rebate for higher quantities was taken into consideration. As such, only one price per unit was needed, plus some sort of conversion table that allowed the calculation of prices for all units coded in the data base.

After receiving the price data from the field, mean prices for each of the quantity items of the NHDHS were calculated. The price differences for the different villages were negligibly small, giving some confidence in the price information thus obtained. Comparisons with other price data from Uganda and from the FAO confirmed the price pattern across goods, and official price data from Burkina Faso did confirm the respective price levels.

3.2 Cleaning and Transformation

To be able to work with the data already before the supervision and cleaning process in Nouna would be finished, the author started to clean the original data base as good as possible without recourse to the questionnaires. Unfortunately, at the moment – six months after the supervision process in Nouna has been set off – it is not obvious whether the CRSN will ever commit the resources needed to finish the data cleaning. To really correct the errors described in Schedule 4, the CRSN staff would have to go back to the questionnaires, verify the corrupted entries and re-enter maybe 10 % of the data. Earlier replies to the supervision reports on behalf of the CRSN seemed to demonstrate that the necessity as well as the magnitude of this step is not well understood.

In addition to the cleaning process, the author's aim was to transform the data into a "ready-to-use" STATA data set. The final data set should be i) ready for analysis, ii) internally consistent and iii) as far as possible error-free. The information stored in the original ACCESS data base basically followed the pattern given by the questionnaires, which was in many cases not at all suitable for a quantitative analysis using different key variables. Analytically interesting variables had to be generated out of several different records that were sometimes even stored in different tables of the data base. The variable income, for example, should represent the money value of everything an individual earned for his living during a given period of time. Measuring income in a rural subsistence economy therefore necessitated the assessment of a variety of different income sources that had to be aggregated carefully.

Schedule 5

Main Do-Files to Convert the Original ACCESS Data Base into a Single STATA Data Set

	Filename	Purpose	Description
1	EM3.mdb	Conversion of the data format from ACCESS to STATA, split-up into the different waves.	EM3.mdb (the original ACCESS data base after data entry for wave 3 has been completed) is converted into 22 STATA files using the file format conversion software STAT/TRANSFER. The STATA files are then split up into 19 files for wave 1, 19 files for wave 3, 11 files for wave 2 (where only the main module, module 2, and module 3 are administered), and three time-invariant files.
2	AgrProd*.do ProdSale*.do MonInc*.do MonTrans*.do Expend*.do	Consistency checks of the data and preparation of rectangularization.	Deleting records that only contain default values if the respective individuals have additional valid records; renumbering of NUMORD from 1 onwards; deleting of records.
3	Reshape*.do	Rectangularization of the data.	The five 1:n-files are rectangularized such that each individual has exactly one record per table.
4	MoneyValues*.do	Assigning money values to the quantity information gathered for animals, goods, and agricultural products.	Outlier cleaning; treatment of "Zero"-cases; replacing quantity information through money information; calculation of one money value of the harvest for each individual; several income and expenditure components are identified and stored separately: 3 money income categories (pensions, regular income, occasional income), 3 sales categories (agricultural products, gardening products, animals), 7 transfer categories (3 sources: transfers from abroad, transfers from inside the country, loans; 4 destinations: ceremonies, schooling, health care, daily living/not earmarked), and 9 expenditure categories (consumption/daily living, health care, schooling, religion, transportation, machines, transfers, purchase of seeds, purchase of animals)
5	Merge*.do	Merging of variables from different STATA files.	Merging of income data, four time-invariant individual characteristics (date of birth, sex, ethnic group, family), and all surveyed time-variant individual characteristics.
6	Module_0_1_IndividualFile*.do	All valid individual level information of the main module and module 1 are stored.	Deleting the records of individuals who left the survey; correcting erroneous entries for SORTIE (SORTIE = YES means that the individual left the survey); default values are set to the correct value.
7	IndividualFile*.do	Transforming the data into one final individual level version.	Merging all variables relevant for analysis (original variables and generated variables) into one final individual level file; alphanumerically coded variables are coded numerically and labeled accordingly; creation of several dummies typical for a large number of analyses (sex dummy, dummies for marital status, occupational status, etc.); linking household level variables to the respective individuals (e.g. household income, household food consumption, etc.)
8	Panel.do	Simply combining the data of wave 1 and wave 3.	Wave 1 comprises data on 6.380 individuals, constituting 802 households; 575 individuals (24 households) left the survey, 411 individuals were born or moved into existing households, such that wave 3 comprised 6.216 individuals in 778 households. The balanced panel consists of 5.805 individuals (778 households), the unbalanced panel consists of 6.791 individuals and 802 households.

*The respective do-file exists in two versions: *filename1.do* (concerning the data for wave 1) and *filename3.do* (concerning the data for wave 3).

Additionally to the creation of dozens of variables, the data had to be transformed appropriately to be able to analyze it. The ACCESS data base model was designed to store the information collected in the field in a compact way, avoiding redundancies and following more or less the structure of the questionnaire. The analysis of the data required a re-organization of the data in some respects. The data on agricultural products, for example, was stored in the ACCESS data base in a way that for each product an individual cultivated (rice, cotton, etc.), the table ProdAgriT stored one entire row, i.e. every individual could have several rows in the respective table. To calculate the money value of the harvest of an individual – apart from the pecuniary evaluation of the different products – it was first necessary to rectangularize the table such that exactly one row existed for each individual.

The first step in this process of cleaning and transforming the data base was the conversion of the data format. Using the software STAT/TRANSFER, the original ACCESS tables were converted into 22 STATA data sets. Each of these data files was then again split into three different data files, each of them consisting of the respective data for one of the three waves that had been accomplished until then. At this step, a first error in the data was removed. Due to errors during data entry, some records were assigned to survey waves that had not been administrated so far (e.g. survey wave 4 or 12). Since it was not possible to identify the correct wave that information belonged to, these records were deleted. Records consisting of information on modules that were only administered in wave 1 and 3, but were assigned to wave 2 were also deleted. In wave 2, only morbidity information was assessed. Thus, the following description will concentrate on wave 1 and 3, since the morbidity information of wave 2 was not the focus of analysis at that time.

The process from the original ACCESS data base to the final STATA data set for analysis was a process that involved at the same time the transformation of the data and – following consistency checks that had to be developed during the process – the cleaning of the data. Schedule 5 gives an overview of this process. The main STATA Do-files (small computer programs that can be run under STATA) are listed, describing their contribution to the creation of new variables and to consistency checking and the cleaning of the data.

4. Income Sources and Constructed Variables

4.1 Individual Income

The next step was to rearrange the income-relevant data. The five files that contained income-relevant data (AgrProd.Dta, ProdSale.Dta, MonInc.Dta, MonTrans.Dta, and Expend.Dta) were organized as 1:*n* data files, i.e. in each data file, several rows could belong to the same individual. Do-Files were writ-

Schedule 6

Data Organization of AgrProd.Dta

Before Rectangularization

Individual ID	Produced Anything	Numord	Product	Quantity	Unit
100060001	YES	1	COTTON	1	CART
100060001	YES	2	RICE	6	BOX
100060001	YES	3	BEANS	3	JAR
108000020	NO	1	NAP*	97*	NAP
100000070	YES	1	PEANUTS	3	JAR
100000070	YES	2	MILLET	4	SAC
...	...	...	...	...	...

After Rectangularization

Individ. ID	Prod. Anyth.	Max-Num	Prod1	Quant1	Unit1	Prod2	Quant2	Unit2	...
100060001	YES	3	COT	1	CART	RICE	6	BOX	...
108000020	NO	0	NAP	97	NAP	NAP	97	NAP	...
100000070	YES	2	PEA	3	JAR	MIL	4	SAC	...
...	...	...	...	...	...	...	...	...	...

*"Not Applicable" is coded as "97" in numerical fields and as "NAP" in alphabetical fields. RWI ESSEN

ten to clear and rectangularize these data files. In AgrProd.Do, for example, the data were first sorted by Individual ID and the variable Numord. Numord indicated the consecutive number of the record per individual (Schedule 6 depicts the data organization of AgrProd.Dta before and after rectangularization). Subsequently, some consistency checks were undertaken: All records were deleted that contained only default values for an individual if another record existed that contained *valid* entries for the respective individual. This case occurred repeatedly in the 1:*n* files. These records were obviously redundant. Furthermore, records were deleted that indicated that the respective individual did not cultivate anything (the variable "Produced Anything" equaled "No"), if i) another record existed that was also set to "NO" (the entry was redundant) or if ii) another record for the same individual existed that was set to "YES" and contained valid information (which would indicate that the No-entry was wrong).

Since for some individuals, Numord started to count from zero onwards, and for other individuals, it counted from one onwards, a small algorithm was written to re- number Numord uniformly. The highest number indicated the maximum amount of agricultural products an individual had produced in the last harvest. This number was used by the file Reshape. Do to rectangularize the data as depicted in Schedule 6. The same procedure was used to transform the data on agricultural products sold (ProdSale.Dta), money income

(MonInc.Dta), transfers and pensions (MonTrans.Dta), and expenditures (Expend.Dta).

In a next step, the quantity information had to be evaluated with the corresponding estimated prices. As explained above, these price figures had been calculated as mean prices from the additionally collected price information. The STATA Do-file MoneyValues.Do converted the quantity information on animals and goods into money terms. To convert the agricultural production of the last harvest into one numerical monetary value, an EXCEL spread sheet was used. The results of the transformations in EXCEL were then again converted into a STATA data format.

During this step, more consistency checks were done and errors in the data were removed. One of the bigger problems of the data base was that a major part of the "Zero"- or "No"-Cases had not been recorded properly. For some individuals, a record existed if the respective individual DID NOT cultivate anything or DID NOT own any animals. But for a large part of the sample this information was missing in the data. If we had treated these cases as missing values, we would have lost between 20 % and 40 % of the data. Unfortunately, the CRSN never fully understood this problem. They stated that if an individual was missing in the data, this would imply that he was a Zero-case and not a missing value. A missing value would have gotten a special code. Notwithstanding, if an individual did not get an entry in a specific table at all, it is still not clear if the data entry clerk *forgot to* codify the respective individual's entry as missing value or if the individual in question *really* was a Zero-case. Nevertheless, we followed the CRSN in its reasoning that in the vast majority of cases, if an individual had no entry in a certain table, this individual was a Zero-case. With this assumption made, the rectangular files were completed to contain information on *all* individuals of the sample.

As a further error checking routine, potential outliers were reported to the CRSN and verified with the help of the original questionnaires. In a lot of cases, outliers could be identified as typing errors of the data entry clerks. Some individuals, for example, were reported to own 9 cars. Recourse to the questionnaire revealed that the question was not applicable since, for example, the individual was 2 years of age (the question on goods owned was only administered to individuals 10 years and older). Obviously, the data entry clerk wanted to enter a 97 for "Not Applicable".

During the survey, the focus of the assessment of information was not solely on getting the information relevant for analysis. A strong focus of the way how information was assessed was on avoiding measurement error and on completeness of information. To give an example: in the Nouna area, one wouldn't necessarily get reliable results if the interviewer asked the respondent "How much money did you earn through the sale of agricultural products?" One

would have to be much more precise in the formulation of the question and ask it in a way that helps the respondent to remember all his financial transactions related to the sale of agricultural products.

Firstly, the relevant time horizon has to be specified. In the NHDHS, two recall periods were used: the last month and the five months preceding the last month. The intuition behind this choice was that for the last month, the respondents should be able to reliably recall all sale transactions. In the poor subsistence economy of Nouna, though, money transactions occur very rarely, and people usually recall these transactions quite well. Plus, if we only asked for transactions of the last month, we potentially missed a lot of transactions since they are comparably rare events. Therefore, we used two recall periods to be able to combine a reliable, short recall period with a longer recall period for the sake of completeness of information. During the cleaning process of the data, we compared the figures of the five-month-recall with the one-month-recall figures times 5. The data were surprisingly plausible. A longer recall did not seem to worsen the quality of the data. Furthermore, through the longer recall period (one plus five), the for Nouna typical seasonal income and consumption pattern could be observed that otherwise would possibly have stayed obscure. The months after the harvest around November/December are a comparatively rich time of the year (survey wave 3 was administered in January/February 2001) whereas the months of May and June are a time of the year where the resources are lowest (wave 1 was administered in June/July 2000). Disposable income per capita in December 2000 (5.95 $, Disp1_3) is higher than disposable income per capita per month for the whole six-month-recall period (4.09 $, Disp15_3), whereas disposable income per capita in June 2000 (3.63 $, Disp1_1) is lower than disposable income per capita per month for the whole six-month-recall period (4.02 $, Disp15_1) (figures in Table 5).

Secondly, often a whole series of questions has to be asked to assess one item of the questionnaire, and the questions have to be more specific. In the NHDHS, the interviewers were trained to ask whether the respondent received any money income through the sale of 24 different products or product groups. Knowing the situation in the field, the CRSN developed a comprehensive list of codes. Each product had to be mentioned to facilitate that the respondent recalls everything he sold. Additional to obtaining more complete data, this form of assessment of information also led to the possibility to analyze the income data more precisely. While the information on animals, goods, and the money value of the last harvest finally resulted in one single variable for each item, the information on sold products, money income, transfers, and expenditures resulted in sets of variables that had to be reorganized to come up with respective overall figures.

Money income was divided into regular income, pensions, and occasional income. Income through the sale of products was also divided into three catego-

ries: the sale of agricultural products, the sale of gardening products, and the sale of animals. Expenditures were split up into nine expenditure categories: expenditures on education, religion, health care, transfers, transportation, consumption related to daily living, and the purchase of seeds, animals, and machines. Transfers were first split up regarding their destination and their purpose. With respect to their purpose, four categories were distinguished: transfers for education, health care, ceremonies such as funerals and weddings, and uncommitted transfers for daily living. Regarding the source of transfers, three separate variables were stored: loans, transfers from abroad, and transfers from inside Burkina Faso. Hence, to sum up all transfers an individual received, one had to pay attention to sum up only the source side or the purpose side to avoid double-counting.

Table 3 and 4 display the quantitative relationships between the different income and expenditure variables as calculated for wave 1 (wave 3). The figures for the one-month-recall period are added to the five-month-recall period to get a reference period of six-months. About 57 % (55 %) of total cash income originates from money income, 33 % (40 %) from the sale of products, and roughly 10 % (5 %) from transfers. Occasional income is the main money income source with 61.5 % (67.7 %) of total money income. Agricultural products are the main income source in the category "Sale of Products" with 63 % (59 %) of the subtotal for this category. Loans make up 67.5 % (45.9 %) of total transfers. The majority (90.4 % (81.7 %)) of transfers are transfers that are not earmarked for any specific purpose.

As expected, the Nouna area is predominantly a subsistence economy. The market value of the harvest represents more than three times total cash income. On average, a household in the study area has a cash income of 211.69 $ (an equivalent of 158,868 Franc CFA, the Franc of the *Communauté Financière Africaine*), whereas the market value of the household's harvest amounts to 688.29 $. Thus, the harvest value adds up to 80.4 % of total subsistence income, calculated as the harvest value plus total cash income minus income through the sale of agricultural products. Because of the bad harvest in 2000, the figures of wave 3 are not as clear in this respect as the figures for wave 1, though.

Looking at the per capita values, it again becomes obvious that the Nouna Health District is a very poor area with a per capita cash income of 26.61 $ per 6 months (4.44 $ per month) in wave 1 and 25.75 $ (4.29 $) in wave 3. Taking into account the high percentage of children in the population, we calculated the respective means for adults above 16 years of age. The per adult cash income then amounts to 52.49 $ in wave 1 and 49.72 $ in wave 3. The harvest value per adult amounts to 171.76 $ per half-year in wave 1 and only to 30.47 $ per half-year in the bad harvest of wave 3. On average, an adult in the study region earns 29.80 $ (27.46 $ in wave 3) per 6 months, sells products for 17.35 $

Table 3

Income Components[1]

	Per Adult[2]	Per Capita	Per Household	Category	Total Cash Income	Subsistence Income[3]
		$			share, %	
			Wave 1			
Money Income	29.80	15.11	120.19	100.0	56.8	14.0
Regular Income	9.65	4.85	38.61	32.1	18.2	4.5
Occasional Income	18.24	9.30	73.95	61.5	34.9	8.6
Pensions	1.91	0.96	7.63	6.3	3.6	0.9
Sale of Products	17.35	8.79	69.91	100.0	33.0	3.0
Agricultural Products	10.93	5.54	44.07	63.0	20.8	-
Gardening Products	2.69	1.36	10.82	15.5	5.1	1.3
Animals	3.73	1.89	15.02	21.5	7.1	1.8
Transfers (Source)	5.35	2.71	21.60	100.0	10.2	2.5
From Abroad	0.97	0.49	3.90	18.1	1.8	0.5
From Inside Burkina Faso	0.73	0.39	3.13	14.5	1.5	0.4
Loans	3.65	1.83	14.57	67.5	6.9	1.7
Transfers (Purpose)	5.34	2.71	21.59	100.0	10.2	2.5
Education	0.10	0.05	0.42	1.9	0.2	0.0
Health Care	0.19	0.10	0.77	3.6	0.4	0.1
Ceremonies	0.20	0.11	0.87	4.0	0.4	0.1
Uncommitted	4.85	2.45	19.53	90.4	9.2	2.3
Total Cash Income	52.49	26.61	211.69		100.0	19.6
Value of the harvest (6 months)	171.76	86.50	688.29		325.1	80.4
Value of Animals	92.59	46.51	369.99		174.8	
Value of Goods	137.10	68.87	547.90		258.8	
			Wave 3			
Money Income	27.46	14.20	113.46	100.0	55.1	40.0
Regular Income	7.26	3.74	29.89	26.3	14.5	10.5
Occasional Income	18.54	9.61	76.76	67.7	37.3	27.1
Pensions	1.66	0.85	6.81	6.0	3.3	2.4
Sale of Products	19.85	10.30	82.31	100.0	40.0	12.0
Agricultural Products	11.68	6.05	48.34	58.7	23.5	0.0
Gardening Products	1.90	0.99	7.91	9.6	3.8	2.8
Animals	6.27	3.26	26.06	31.7	12.7	9.2
Transfers (Source)	2.41	1.26	10.02	100.0	4.9	3.5
From Abroad	0.83	0.43	3.45	34.4	1.7	1.2
From Inside Burkina Faso	0.46	0.25	1.97	19.7	1.0	0.7
Loans	1.12	0.58	4.60	45.9	2.2	1.6
Transfers (Purpose)	2.41	1.25	10.03	100.0	4.9	3.5
Education	0.28	0.14	1.14	11.4	0.6	0.4
Health Care	0.06	0.03	0.25	2.5	0.1	0.1
Ceremonies	0.10	0.05	0.44	4.4	0.2	0.2
Uncommitted	1.97	1.03	8.20	81.7	4.0	2.9
Total Cash Income	49.72	25.75	205.80		100.0	55.6
Value of the harvest (6 months)	30.47	15.76	125.90		61.2	44.4
Value of Animals	98.02	51.94	381.41		185.3	
Value of Goods	145.90	75.70	564.80		274.4	

Author's own computations. – [1]One-month-recall period plus five-month-recall period. – [2]16 years and older. – [3]Total cash income plus value of the harvest (6 months).

Table 4

Distribution of Expenditures across Expenditure Categories

	Per Adult		Per Capita		Per Household		Percent	
			$				%	
	Wave 1	Wave 3	Wave 1	Wave 3	Wave 1	Wave 3	Wave 1	Wave 3
Daily Living	20.64	27.47	10.82	14.27	86.15	114.05	67.1	73.9
Health Care	1.54	1.10	0.78	0.57	6.23	4.52	4.9	2.9
Education	0.42	1.16	0.21	0.60	1.68	4.81	1.3	3.1
Religion	2.12	0.93	1.09	0.49	8.67	3.90	6.8	2.5
Transportation	1.39	1.51	0.70	0.78	5.56	1.46	4.3	0.9
Machines	2.84	3.05	1.43	1.57	11.38	12.58	8.9	8.2
Seeds	0.45	0.22	0.23	0.12	1.81	0.92	1.4	0.6
Animals	1.37	1.42	0.69	0.73	5.46	5.84	4.3	3.8
Transfers	0.35	0.36	0.18	0.18	1.40	6.22	1.1	4.0
Total	31.1	37.2	16.1	19.3	128.34	154.3	100.0	100.0

Author's own computations. – [1]One-month-recall period plus five-month-recall period.

(19.85 $), and receives transfers with a total value of 1.70 $ (1.29 $). He owns animals worth 92.59 $ (98.02 $) and goods worth 137.10 $ (145.90 $).

The majority of expenditures concern the consumption of daily living. For wave 1 (wave 3), 67.1 % (73.9 %) of total expenditures fall in this category. The next highest expenditure category is "Machines" with 8.9 % (8.2 %). On average, a NHDHS household spends only 6.23 $ (4.52 $) per six months on health care, and 1.68 $ (4.81 $) on education. The corresponding per capita values are 0.78 $ (0.57 $) and 0.21 $ (0.60 $). In wave 1 (wave 3), 60.5 % (75.0 %) of total cash income (calculated with the per capita figures) is spend in the same month. The internal consistency of these income and expenditure figures, and the similarity of the respective values for wave 1 and wave 3 give us considerable confidence in the high quality of the income and expenditure data of the NHDHS.

In the Do-File Merge.Do, the income-relevant data was combined into one single data file, together with four time-invariant individual characteristics out of the former ACCESS table MembreT (date of birth, sex, ethnic group, and family relationship), and the basic individual characteristics of Member.Dta (the former ACCESS table SrcEnqMembT). As such, all individual level data of the main module and of module 1 were stored in one single STATA file called Module_0_1_IndividualFile.Dta. Finally, all individuals were deleted from the file that did not have a valid entry. Since the NHDHS was designed as a panel survey, a variable "Sortie" (French for *Left*) stored the information whether an individual had left the survey or not. If "Sortie" was set to DEF (default), but valid entries existed for the respective individual, we re-coded it to NO. All other records where "Sortie" was set to YES were deleted.

Since the survey gathered information on many different income sources together with two distinct recall periods, it was possible to calculate several income variables focussing on different aspects of individual income. As "disposable" or "cash income", the following components were summed up: total *money income* (pensions, and regular and occasional money income), all *transfers* to the individual except loans, income through the *sale of agricultural products*, income through the *sale of gardening products*, income through the *sale of animals, minus expenditures for seeds*, and *minus transfers* the individual sent either to people inside or outside the study population. Expenditures for seeds were subtracted, since they represented operating expenses. Transfers given away were subtracted firstly for consistency reasons, since transfers to the individual were included as income source. Secondly, transfers neither really represent consumption nor savings. Furthermore, in the study area, they are most probably fixed arrangements that diminish the disposable income of the individual – the amount that is at the individual's disposal for either consumption or savings.

The trading of animals posed a special problem. In the absence of functioning formal credit markets for most of the population (in wave 1 (3), only 1.78 % (2.81 %) of the population above 16 years of age reported to receive money through loans), people save and dissave through the purchase and the selling of animals. If the purchase of animals is a form of savings, then these expenditures should not be subtracted from disposable income. Moreover, the money individuals receive through the selling of animals is dissaving and, consequently, should not be regarded as income source. On the other hand, animals reproduce themselves, which could be regarded as a natural form of interest. Interests, though, are income. Furthermore, for stock-breeder and animal traders, the selling of animals is a very important source of income, and purchases of animals are operating expenses that should be subtracted from disposable income.

We decided to treat the selling of animals generally as an income component. For animal traders, we subtracted the purchase of animals as operating expenses. The definition of an animal trader was done on a household basis, since it could be possible that one household member was in charge of the purchase of animals whereas another one was specialized in the sale of animals. As such, an animal trader was somebody living in a household where in the same reference period animals were both sold and purchased. Following this definition, about 5 % of the population was trading animals. For these people, the purchase of animals was subtracted from their disposable income.

The variable "disposable" or "cash income" calculated in this fashion neglected a very important part of income in our study population, namely the self-consumed part of the harvest. We therefore calculated the variable "sub-

sistence income", consisting of the *money value of the last harvest*, plus total *money income*, plus incoming *transfers*, plus the income through the *sale of gardening products*, plus the income through the *sale of animals, minus expenditures for seeds, minus outgoing transfers*, and, as above, *minus* expenditures for the *purchase of animals* if the respective individual lived in a household that traded animals. To avoid double-counting, the income through the sale of agricultural products was not added to the subsistence income. As a consistency check, we verified on household level if a household reported a higher value of income through the selling of agricultural products than was the market value of the harvest. Again, the logic for this check on household level was potential intra-household specialization: one household member being responsible for the harvest, another one for market sales. If the income through the sale of agricultural products was higher than the harvest value, we assigned the sales income instead of the harvest income to the respective individual, assuming underreporting of the harvest. This assignment was done on individual level and not on household level, since we wanted to get internally consistent individual income records.

With respect to the different recall periods, variables for *subsistence income* and *disposable income* have been generated in the following versions: the variable Disp1_1 (Disp1_3) subsumes disposable income for the one-month-recall period of wave 1 (3), the variable disp15_1 (Disp15_3) subsumes disposable income of the last six-months preceding wave 1 (3), adding up the respective figures of the one-month-recall period and the five-month-recall period. The variable Sub1_1 (Sub1_3) subsumes subsistence income for the one-month-recall period of wave 1 (3), plus one twelfth of the harvest value of 1999 (2000). The variables Sub15_1 and Sub15_3 record subsistence income of the last six-months-preceding the respective wave, thereby including half the value of the respective harvest. As such, for each wave disposable income and subsistence income are stored once as a monthly income variable and once as the income of the last six months.

To construct annual income, either the monthly variables can be multiplied by twelve, or the six-months variables by two. A preferable alternative to smooth seasonal fluctuations, though, are the variables Sub99, Sub00, and Disp1515. They add up the recall periods of wave 1 and wave 3 to get the information for one complete year. Wave 3 was administered in January 2001. Respondents were asked to recall what they earned in December 2000 (1-month-recall), and between July and November 2000 (five-months-recall). The harvest information of wave 3 concerned the harvest 2000. Wave 1 was administered in July 2000. The one-month-recall pertained to June 2000, the five-month-recall to the time from January to May 2000. The questions on the harvest concerned the harvest in the autumn of 1999. As such, the NHDHS collected income information on one whole calendar year (2000). This information can be re-

Table 5

Comparison of Income Variables

	Per Adult	Per Capita	Per Adult	Per Capita
	$		$ per Month	
DISP1_1	6.98	3.63	6.98	3.63
DISP15_1	46.80	24.15	7.80	4.02
SUB1_1	13.60	7.02	13.60	7.02
SUB15_1	80.05	41.32	13.34	6.89
DISP1_3	11.65	5.95	11.65	5.95
DISP15_3	48.10	24.56	8.02	4.09
SUB1_3	12.68	6.48	12.68	6.48
SUB15_3	67.50	34.42	11.25	5.74
SUB99	165.53	85.96	13.79	7.16
SUB00	137.18	71.10	11.43	5.92
DISP1515	97.15	50.42	8.10	4.20

Author's own computations. RWI ESSEN

trieved as subsistence income including the harvest of 1999 (Sub99) or including the harvest of 2000 (Sub00), or as disposable income including the agricultural products sold throughout the year 2000 (Disp1515).

Table 5 displays the actual figures for the different income variables. The values for the reference period of six months are not systematically lower than the figures for the recall period of one month, which gives us some confidence that the longer recall period of five months led to valid results. As expected, subsistence income is higher than disposable income alone, with the difference being less marked for wave 3 because of the bad harvest in the year 2000. Our results suggest that the per capita cash income per month in the study region lies somewhere between 3.63 and 5.95 $, whereas the per capita subsistence income lies between 5.74 and 7.16 $ per month.

4.2 Household Income and Equivalent Income

Ideally, *individual income* should – for the specified period of time – reflect the money value of all inflows an individual receives that constitute the individual's potential to either consume or save. Unfortunately, in part this might not necessarily be the case for the individual income variables described above (section 4.1). Especially the individual's potential to consume might also depend a lot on the income flows of the household as a whole, since household members pool their income to a certain extent. Farm households usually have a granary out of which the household head takes an amount of grains for the preparation of the daily meals. On the other hand, it is also common in the stu-

dy area that individual household members cultivate their own piece of land or breed animals on their own account. It is not unusual that mothers, for example, make their own money which they use if one of their children needs health care, since their husband would not be willing to spend money on the health care of her children.

To be exact, the individual income variables sum up what the individual *reports* as his or her own income flows. In most cases, this reported individual income is a good proxy for the theoretical construct of individual income as described above. Additionally, individual reporting leads to a much more accurate assessment of *household income*. With the individual information at hand, calculating household income is a very simple task. For each variable (disposable and subsistence income in the different versions) the respective household income variable is simply the sum of the individual income values for each household.

A much more difficult task is the calculation of "equivalent income". Before describing the technical process of the calculation of equivalent income, some conceptual remarks are warranted. The theoretical concept of equivalent income attempts to take into account welfare considerations in the calculation of an income figure. The crucial question with every statistic is: what exactly is the purpose of the statistical measure? Income per capita, for example, is – among other imaginable purposes – one possible measure to express individual's welfare. Usually, this statistic is compared with the per capita figures of other countries or with the per capita figures of the same country over time. Let's assume that a small country *A* has a GNP of 10 Mio. $, and a population of 1 Mio. inhabitants. A second country *B* has a GNP of 10 Mio. $, but a population of 0.9 inhabitants. For two reasons it is not really obvious that country *B's* inhabitants enjoy a higher welfare than country *A's* inhabitants. Firstly, country *A* might have a totally different demographic structure with a much higher percentage of children in the population. Secondly, the population of country *A* might live together in households with much bigger household sizes, and therefore might enjoy much higher economies of scale, because they can share a lot of products within the household.

Deaton (1997) states that "the obvious solution is a system of weights, whereby children count as some fraction of an adult, with the fraction dependent on age, so that effective household size is the sum of these fractions, and is measured not in numbers of persons, but in numbers of adult equivalents. Economies of scale can be allowed for by transforming the number of adult equivalents into 'effective' adult equivalents, (...)". Unfortunately, even though consensus exists that per capita expenditures decrease with household size (Kuznets 1979; Deaton 1997), there is no consensus in the literature on how such an *equivalence scale* should look like. After discussing the theoretical founda-

tions and different empirical strategies to estimate equivalence scales, Deaton (1997) suggests to take a scaling weight of 0.4 for young children aged from 0 to 4, and 0.5 for children aged from 5 to 14. Even though this seems to be very arbitrary, he argues that there is no convincing theory and no practicable empirical identification strategy to estimate an equivalence scale. Nevertheless, using these figures would be better than ignoring economies of scale and varying needs depending on the household's demographic structure.

In the case of the NHDHS, the author developed an equivalence scale that takes up some basic ideas discussed in Deaton (1997) and extends them to a consistent framework tailored to the specific situation in the study population. Taking into account the extreme poverty of the Nouna area, one can assume that a household has to assign a high percentage of total income to food consumption. This not only results from Engel's Law (Engel 1895). It is also confirmed by the staff of the CRSN, knowing the situation in the field, and it can be seen in the NHDHS data. Only roughly 57 % of the NHDHS households have a higher annual income than would be needed to buy as many millet as necessary to satisfy the household's annual calorie requirements if only millet, the local staple food, would be eaten. The household's annual calorie requirements were calculated following Bender/Bender (1995). One kg of millet has a mean nutritional value of 3,540 kcal (www.landwirtschaft-mlr.baden-wuerttemberg.de/).

If the household's basic concern is to feed its members, a natural equivalence scale should be the calorie requirement of each household member. If two households have the same household income, the household with the lower calorie requirements should be the one that is better off. Consequently, equivalent scales were calculated that reflected the calorie requirements depending on age and sex, the basic biological determinants of varying metabolic rates. As standard unit, a male adult aged from 19 to 59 with a daily calorie requirement of 2,550 kcal was chosen and received the weight of 1.0. Other household members received their weight accordingly such that finally, the household size n could be expressed in *male adult equivalents* n_{equ}. As a first result, individual equivalent income could be calculated as $y_{equ} = y / n_{equ}$, with y being household income. For welfare comparisons, this measure should be much more appropriate than household income per household member ($y_{hm} = y/n$).

A further refinement incorporated economies of scale. In principle, economies of scale can be expressed in terms of exponents of the household size in the simple formula

$$y_{equ,\theta} = y / n_{equ}^{\theta}.$$

The scale factor θ reflects the magnitude of the scale effect for the household. A commonly used equivalence scale in developed countries, sometimes known as the *OECD Equivalence Scale*, simply applies the square root to the

household size (Atkinson et al. 1995). This method is supposed to capture at the same time economies of scale and the household's demographic structure. Individual equivalent income would then simply be $y_{equ,0.5} = y/n^{0.5}$. This OECD scale implies rather high economies of scale. Especially for bigger household sizes which are very common in the Nouna area, an exponent of 0.5 seems to lie at the higher end of the range of possible scale factors for our study region. As lower end of this range, a scale factor of $\theta = 1$ is a natural candidate. A scale factor of one would imply zero economies of scale.

As a new idea that we did not find in the literature, we are suggesting to let θ vary across households. Existing equivalence scales assume constant economies of scale for every household. This assumption is debatable. If – like for a large share of households in the Nouna area – the majority of total household income is devoted to food, it is questionable if economies of scale exist at all, since food is a private, depletable good. The smaller the share of food in the household's budget, though, the more likely the household consumes goods that are nondepletable. Clothes, for example, can be given from one child to the next; and means of transportation can be used by several household members at the same time or consecutively.

Consequently, we modeled the scale factor θ as a function of the share of food in the household's total budget. Starting from 0.5 for the household with the lowest food share, θ increases with food share until it reaches its maximum value of 1.0. Since we did not assess the food share in the data, we had to use a proxy instead. As already mentioned above, we calculated the amount of money that would be needed to buy as much millet as necessary to satisfy the household's annual calorie requirements if only millet would be eaten. This amount of money was divided by the household's annual income. The higher this ratio, the larger should be the household's food share. Households with an income equal or lower than the annual calorie requirement in millet expressed in money terms received a scale factor of 1. This was the case for roughly 43 % of all households in the sample.

Finally, as equivalent income variables, three sets of variables have been generated for each wave and for each of the seven income variables (Schedule 7). One set of income variables represent equivalent income including household-dependant economies of scale ($y_{equ,0.5} = y/n^{0.5}$), one set of variables represent equivalent income without economies of scale (y/n_{equ}), and the third set of variables represent household income per household member (y/n).

4.3 Additional Constructed Variables

Additional to the income and expenditure variables, a set of further variables had to be created out of the raw data of the NHDHS. Since the raw data did not contain a Household Identifier, a unique *numerical HH ID* was created

out of the location information of the survey. As mentioned before, in the original data base, the location information for a household was stored in two sets of variables. One set was used to identify the household. It contained the village code, and the courtyard, household and sector number of the place where the household was encountered in the first wave of the DSS. A second set of variables stored the current location of the household to be able to locate the household at its current place of residence. To generate a unique numerical *HH ID*, the following simple command was implemented as a STATA Ado-file (Hid.Ado):

*gen hhid = numsecte**1 + *codmen**10 + *numconce**100 + *codvilla**100000.

In a preliminary step, the alphabetical household codes (*A, B, C, ...*) were translated into numbers (1, 2, 3, ...), such that finally, the household residing in Nouna (village code 42) in sector 3, courtyard 067, and household number 1 was given the *HH ID* 4206713. Implementing this command as Ado-file allowed to simply evoke it by typing *HID* in the STATA command line instead of running a Do-file for each of the seven data files containing household information.

Another variable that is often used in the analysis of the health status of children is the *education of the mother*. In the design of the NHDHS, the aim was to gather the information on family relationships such that more or less the whole family pattern could be represented in the data. To do this, two variables were used. One variable stored the family status itself (father, mother, brother, etc.) The second variable stored the information of the *relationship* by storing the household rank of the individual to whom the family status belonged. If the first variable was coded as "WIFE", the second would store the rank of the husband. If the two variables would read 'WIFE' of "1", for example, this would indicate that the individual whose record was analyzed, is the wife of the individual having household rank "1" (Table 6 illustrates this example). Family status was always recorded with respect to the household head (household head himself, or father, mother, brother etc. of household head) except for children who were linked to their mother (son or daughter of the respective mother).

The author wrote a small STATA do-file (Figure 4) that used two loops to link the education of the mother to the respective son or daughter. In the first loop, STATA was looking for individuals that were coded as "Son" or "Daughter". In the second loop, the variable Momscol was replaced with the value of the variable Yrschool of that individual that had the same HH ID (lived in the same household), and displayed exactly the rank that was given in the Of Whom column of the son or daughter identified in the first loop[2].

[2] Even though the program itself was rather simple, STATA needed a full day on a PC with an AMD K6-III 400 MHz processor to execute the program until its termination.

Table 6

Example of the Representation of Family Relationships in the Data

HH ID	Individual ID	Age	Household Rank	Family Status	Of Whom
701110	100060682	38	1	HH HEAD	1
701110	100061683	31	2	WIFE	1
701110	100062684	14	3	DAUGHTER	2
701110	100063685	12	4	DAUGHTER	2
701110	100064686	10	5	SON	2
701110	100065687	6	6	SON	2

RWI ESSEN

Figure 4

STATA Do-File to Link Education of Mother and Children

```
USE INDIVIDUALFILE1.DTA, CLEAR
SET MORE OFFF
GEN MOMSCOL=
SORT HHID
LOCAL A=1
WHILE´A' <0&$== {
IF (FAMILY[´A']=3 | FAMILY[´A']=$ {
    LOCAL B=1
    WHILE´B' <=6400 {
        IFHHID[´B'] = HHID[´A'] & RANG[´B']=PARENTAQ[´A'] {
        REPLACE MOMSCOL=YRSCHOOL[´B'] IN ´A'
        }
    LOCAL B = ´B'+1
     }
}
LOCAL A=´A'+1
}
LABEL VARIABLE MOMSCHOL "YEARS OF SCHOOLING OF MOTHER"
SAVE MOMSCOL1.DTA, REPLACE
```

Further crucial variables for the analysis of health-related issues are *nutritional status* and *hygiene and sanitation*. Both of these variables are rather difficult to assess in one numerical value. To assess the nutritional status of individuals, usually anthropometric indicators are used (Gibson 1990; Shetty, James 1994). The author spent a lot of effort in establishing an anthropometric module in the NHDHS – from fund-raising to the preparation of the logistic implementation and the communication with the CRSN. Unfortunately, for political reasons, the anthropometric module has not been implemented until today.

The NHDHS contains a section on the assessment of the nutritional status on the household level, though. Basically, this subsection consists of a food frequency table. Distinguishing twelve different food categories, the frequency

and the amount of food a household consumes is recorded. The food categories are Basic Cereals, Beans, Peas, Yams/Potatoes/Manioc, Sauce, Salad, Vegetables, Fruits, Milk, Meat, Fish, and Bread. As frequency, different codes are given that range from "More than two times a day" to "Never". Quantities are coded in measurement units that are usually used in the study area (box, pile, kilogram, etc.). Theoretically, if we knew the mean calorie (vitamin, fat, mineral, etc.) content of each food category, we could calculate the mean calorie (vitamin, fat, mineral, etc.) consumption for each household.

As a simpler and more feasible approach, the author developed a food indicator that combines food variation and food frequency in one single measure. Food variation should reflect a better nutritional status, since different nutrients are consumed. And a higher food frequency should be positively correlated with food quantity, which should also result in a better nutritional status. Basically, the food indicator is a weighted sum of how many food categories the household incorporates in its diet, following the simple equation

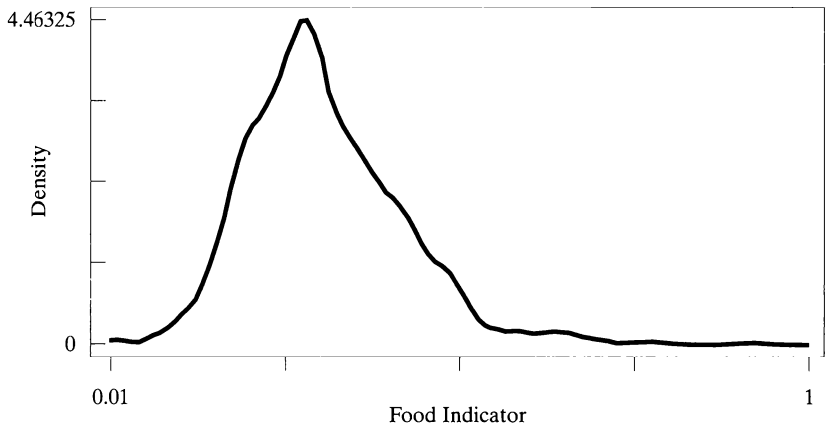
$$f = (g_1 + g_2 + g_3 + ... + g_{12}) / 12,$$

where the weight g_i depends on the frequency with which food of the food category i is consumed. If food of a certain food category is consumed at least once per day, the respective weight is 1; once and twice per week results in a weight of 0.5, and so forth. The weight 0 is assigned if a food category is never part of the household's diet, or only once a year or once in six months. As such, a household's food indicator can be at maximum 1 if the household's diet contains all food categories at least once a day. The minimum value of 0 would indicate that the household would not consume any food of the given food categories more often than once all six months. A case that would obviously lead to starvation if the food categories are comprehensive which should be the case for the study region.

Figure 5 displays the graph of a kernel density estimate of the food indicator variable. It demonstrates that there seems to exist a lot of variation across households which might be able to explain differences in health status or other potential endogenous variables of interest. The mean of the food indicator is 0.312, the standard deviation is 0.110. The maximum of this variable lies at 0.917, its minimum at 0.008.

To assess the *hygiene and sanitation* situation of a household of the study region, the author developed a set of questions that were asked in the main module of the questionnaire of the NHDHS. A subsection on housing collected information on the type of dwelling of the household (building, round hut, etc.), and the nature of its walls, roof, and floor. The number of rooms the household lived in was asked for, which – together with the number of household members – might be informative to judge on the probability of the transmission of

Figure 5
Kernel Density Estimate of the Food Variable



Author's own calculations.

infectious diseases within the household. In addition to a question on the type of toilet the household was using, an interviewer judgement on the overall cleanliness of the household's home completed this section.

Complementary to the section on housing, a section on water and sanitation assessed further information critical for the hygienic situation of the household. It collected information on the water source the household was using in the rainy and in the dry season, as well as on trash and on used water disposal. Further questions concerned the transport of water, water conservation, and the number of days the household stored water until it was replaced. The section concluded with questions addressed to the interviewer: the interviewer was asked whether animals lived in the courtyard (as potential hosts for diseases and parasites), and whether there were heaps of rubbish in the courtyard. Finally, he was supposed to give a judgement on the cleanliness of the kitchen.

Comparable to the creation of the food indicator, we investigated whether it was possible to create a weighted indicator of all the different aspects of hygiene and sanitation that would reflect the household's hygienic situation in one numerical value. In contrast to the food indicator, though, where the weighted sum has an obvious interpretable meaning, no clearly meaningful weights could be identified that would be able to combine the different components of hygiene and sanitation assessed in the two sections of the questionnaire. To avoid a more or less arbitrary amalgamation of the information, a different strategy was applied. The information collected in the questionnaire was merely transformed in such a way that it could be directly used in an empirical

analysis. Alphanumerically coded variables were re-coded into numerical variables and labeled accordingly, and a set of dummies was created that could potentially serve as proxies for hygiene and sanitation. Examples in case are a dummy that is "1" if the household in question always stores its water in covered vessels. Another dummy is "1" if the household stores its water in pumpkins.

5. Final STATA Data Set

Two STATA Do-files (IndividualFile1.Do and IndividualFile3.Do) were written to finally merge all the variables that had been generated with the different Do-files described above and to take the last steps to prepare the data for analysis. Alphanumerically coded variables had to be re-coded numerically. The variable schooling, for example, contained the alphanumerical codes PR1, PR2, etc. for the different levels of educational attainment "Primary1", "Primary 2", etc. This variable was re-coded such that it contained only numerical values (1, 2, etc.) that were labeled PR1, PR2, etc. Furthermore, a set of dummies was created: village dummies to be able to analyze the influence of geographic location (or social interaction or whatever might be the relevant effect causing the correlation), dummies for ethnic group, for sex, education level, and all other sorts of potential effects that could be interesting to analyze in future regression analyses. In addition, household variables were linked to the respective individuals. Depending on the analysis of interest, in some cases it might be more plausible that the household variable (e.g. household income) influences the potential variable of interest (e.g. individual morbidity), than the variable on individual level. Some variables like household food consumption for example, existed only on household level. Other variables had to be added up on household level and then linked to the individual.

The final STATA files for wave 1 and wave 3 are IndividualFile1.Dta and IndividualFile3. Dta. IndividualFile1.Dta contains information on 6,380 individuals living in 802 households. The information is stored in 193 variables (Schedule 7). Altogether 24 households left the survey, such that the data for wave 3 only comprises 778 households and 6,216 individuals. While 575 individuals left the survey either because they died or moved away, 411 individuals were born or moved into existing survey households. Since the questions on water and sanitation have only been asked in wave 1, IndividualFile3.dta comprises only 136 variables. To completely exploit the panel structure of the NHDHS, the file Panel.Dta contains the information on both waves in one file. The panel waves, though, are only six months away, such that it still has to be verified whether the full advantages of a panel can already be utilized before further waves are completed. Until now, the balanced panel comprises 5,805 individuals, whereas the unbalanced panel consists of 6,791 records.

Schedule 7

Variables of IndividualFile1.Dta

Topic	Variable Name	Variable Type	Variable Description
Identification	idindivi	long	Individual ID
	hhid	float	Household ID
Household	hhsize	float	Household size
	codvilla	int	Village code
	numconce	int	Courtyard in village
	codmenag	string	Household (HH) code in courtyard
	numsecte	int	Sector (if HH resides in Nouna; 0 = village)
	idchm	long	Individual ID of HH head
Individual Characteristics	rank	byte	Rank of individual (identifier inside HH)
	age	float	Age
	sex	float	Sex
	female	float	Female Dummy
	family	float	Family relationships
	ofwhom	byte	Family relationship to whom (rank)
	chef	float	Dummy - Household head
Health & Food	vtrsante	byte	Health utility
	acute	float	Dummy – Acute illness
	chronic	float	Dummy – Chronic illness
	handicap	float	Dummy – Handicap
	useprev	float	Dummy – Did individual use preventive care?
	typsoinp	string	Type of preventive care used
	smoke	float	Smoking Dummy
	food	float	Food consumption indicator
Assets	animals	float	Animals owned by individual
	goods	float	Goods owned by individual
	wealth	float	Animals plus goods
	hanimals	float	Animals of HH
	hgoods	float	Goods of HH
	hwealth	float	Wealth of HH
Income	disp1_1	float	disposable income, 1-month recall period
	disp15_1	float	disposable income, 1-month + 5-months recall period
	sub1_1	float	subsistence income, 1-month recall period
	sub15_1	float	subsistence income, 1-month + 5-months recall period
	sub99	float	annual subsistence income with harvest 1999
	sub00	float	annual subsistence income with harvest 2000
	disp1515	float	annual disposable income
	hdis1_1	float	disposable household income, recall period as above
	hdis15_1	float	disposable household income, recall period as above
	hsub1_1	float	subsistence household income, recall period as above
	hsub15_1	float	subsistence household income, recall period as above
	hsub99	float	annual subsistence household income with harvest 1999
	hsub00	float	annual subsistence household income with harvest 2000
	hdis1515	float	annual disposable household income
	n_equ	float	hhsize in male adult equivalents
	theta	float	scale factor (economies of scale)
	edisp1_1	float	equiv. income incl. economies of scale(y / n_equ^theta)
	edisp15_1	float	equiv. income incl. economies of scale(y / n_equ^theta)
	esub1_1	float	equiv. income incl. economies of scale(y / n_equ^theta)
	esub15_1	float	equiv. income incl. economies of scale(y / n_equ^theta)
	esub99	float	equiv. income incl. economies of scale(y / n_equ^theta)
	esub00	float	equiv. income incl. economies of scale(y / n_equ^theta)
	edisp1515	float	equiv. income incl. economies of scale (y / n_equ^theta)
	fdisp1_1	float	equiv. income w.out economies of scale (y / n_equ)
	fdisp15_1	float	equiv. income w.out economies of scale (y / n_equ)
	fsub1_1	float	equiv. income w.out economies of scale (y / n_equ)
	fsub15_1	float	equiv. income w.out economies of scale (y / n_equ)
	fsub99	float	equiv. income w.out economies of scale (y / n_equ)
	fsub00	float	equiv. income w.out economies of scale (y / n_equ)
	fdisp1515	float	equiv. income w.out economies of scale (y / n_equ)
	gdisp1_1	float	HH income per HH member (y / hhsize)
	gdisp15_1	float	HH income per HH member (y / hhsize)
	gsub1_1	float	HH income per HH member (y / hhsize)
	gsub15_1	float	HH income per HH member (y / hhsize)
	gsub99	float	HH income per HH member (y / hhsize)
	gsub00	float	HH income per HH member (y / hhsize)
	gdisp1515	float	HH income per HH member (y / hhsize)

Schedule 7 (continued)

Variables of IndividualFile1.Dta

Topic	Variable Name	Variable Type	Variable Description
Religion	relig	float	Religion
	oth_rel	byte	Dummy: Religion = Other
	animist	byte	Dummy: Religion = Animist
	muslim	byte	Dummy: Religion = Muslim
	catholic	byte	Dummy: Religion = Catholic
	protest	byte	Dummy: Religion = Protestant
Villages	toni	float	Village Dummy – Toni
	boron	float	Village Dummy – Boron
	bourasso	float	Village Dummy – Bourasso
	cisse	float	Village Dummy – Cisse
	denissa	float	Village Dummy – Denissa
	dion	float	Village Dummy – Dionkongo
	goni	float	Village Dummy – Goni
	kemena	float	Village Dummy – Kemena
	koro	float	Village Dummy – Koro
	lekui	float	Village Dummy – Lekui
	ouette	float	Village Dummy – Ouette
	pa	float	Village Dummy – Pa
	sien	float	Village Dummy – Sien
	sobon	float	Village Dummy – Sobon
	solimana	float	Village Dummy – Solimana
	tonsere	float	Village Dummy – Tonsere
	dara	float	Village Dummy – Dara
	bank	float	Village Dummy – Bankoumani
	nouna	float	Village Dummy – Nouna
Ethnic Group	ethnic	float	Ethnic Group
	oth_ethn	byte	Dummy: Ethnic group = Other
	bwaba	byte	Dummy: Ethnic group = Bwaba
	dafing	byte	Dummy: Ethnic group = Dafing
	mossi	byte	Dummy: Ethnic group = Mossi
	peulh	byte	Dummy: Ethnic group = Peulh
	samo	byte	Dummy: Ethnic group = Samo
Education	read	float	Ability to read and write
	english	byte	Dummy: Read = English
	french	byte	Dummy: Read = French
	arabic	byte	Dummy: Read = Arabic
	analphab	byte	Dummy: Read = None
	local	float	Dummy: Read = One of the local languages
	alphabet	float	Dummy: Ability to read/write in any language
	school	float	Level of Education
	alpha	float	Dummy – Alphabetized
	primary	float	Dummy – Primary School
	second	float	Dummy – Secondary School
	superior	float	Dummy – Superior Education
	yrschool	float	Years of Schooling
	chmscol	float	Years of schooling of HH head
	momscol	float	Years of schooling of mother
Marital Status	marstat	float	Marital Status
	married	float	Dummy – Married
	celibate	float	Dummy – Celibate
	divorced	float	Dummy – Divorced
	widow	float	Dummy – Widow
Occupational Status	occstat	float	Occupational Status
	below11	float	Dummy – Below 11 years of age
	occupied	float	Dummy – Occupied
	houskeep	float	Dummy – Housekeeper
	student	float	Dummy – Student
	unemp	float	Dummy – Unemployed
	retired	float	Dummy - Retired
	occup1	float	Occupation in first job
	agrar	float	Dummy: First job is in agriculture
	white	float	Dummy: First job is white collar job
	rest	float	Dummy: First job is neither WHITE nor AGRAR
	chmocc	float	Occupation of HH head in first job
	chmagrar	float	Dummy: First job of HH head is in agriculture
	chmwhite	float	Dummy: First job of HH head is WHITE

Schedule 7 (continued)

Variables of IndividualFile1.Dta

Topic	Variable Name	Variable Type	Variable Description
	chmrest	float	Dummy: First job of HH head is neither AGRAR nor WHITE
	occup2	float	Occupation in second job
	empsit1	float	Employment situation in first job
	empsit2	float	Employment situation in second job
Housing	housing	byte	Type of housing
	walls	byte	Nature of the walls
	roof	byte	Nature of the roof
	floor	byte	Nature of the floor
	rooms	byte	Number of rooms inhabited
Hygiene	sani	byte	Type of sanitation
	clean	long	Interviewer judgement on cleanliness
	wc_lat	float	Dummy – WC or improved latrine
	latrine	float	Dummy – Ordinary latrine
	nature	float	Dummy – In nature
	changwat	byte	Days to change water
	jar	byte	Dummy – Water stored in jars
	seal	byte	Dummy – Water stored in seals
	pumpkin	byte	Dummy – Water stored in pumpkins
	litter	byte	Dummy – Litter in the courtyard
	cleankit	byte	Interviewer judgement on cleanliness of kitchen
	usedwat	float	Evacuation of used water
	usedwat1	byte	Dummy: Usedwat = Courtyard
	usedwat2	byte	Dummy: Usedwat = Outside courtyard
	usedwat3	byte	Dummy: Usedwat = Pit
	usedwat4	byte	Dummy: Usedwat = Improved pit
	usedwat5	byte	Dummy: Usedwat = Chemical pit
	waste	float	Evacuation of waste
	waste1	byte	Dummy: Waste = Trashbin outside courtyard
	waste2	byte	Dummy: Waste = Trashbin inside courtyard
	waste3	byte	Dummy: Waste = Pile outside courtyard
	waste4	byte	Dummy: Waste = Pile inside courtyard
	waste5	byte	Dummy: Waste = Pit
	waste6	byte	Dummy: Waste = Improved pit
	animyard	float	Dummy - Animals living in courtyard
Water	transwat	float	Transportation of water
	tranwat1	byte	Dummy: Transwat = Barrel
	tranwat2	byte	Dummy: Transwat = Canari
	tranwat3	byte	Dummy: Transwat = Seal
	tranwat4	byte	Dummy: Transwat = Can
	tranwat5	byte	Dummy: Transwat = Basin
	covered	float	Water conservation in covered vessel
	dpwat	float	Water source dry period
	rpwat	float	Water source rainy period
	dpwat1	byte	Dummy: Dry period, water source at home
	dpwat2	byte	Dummy: Dry period, water source outside home
	dpwat3	byte	Dummy: Dry period, water source public fountain
	dpwat4	byte	Dummy: Dry period, water source drilling
	dpwat5	byte	Dummy: Dry period, water source mechanic well at home
	dpwat6	byte	Dummy: Dry period, water source mechanic well outside home
	dpwat7	byte	Dummy: Dry period, water source ordinary well at home
	dpwat8	byte	Dummy: Dry period, water source ordinary well outside home
	dpwat9	byte	Dummy: Dry period, water source surface water
	rpwat1	byte	Dummy: Rainy period, water source at home
	rpwat2	byte	Dummy: Rainy period, water source outside home
	rpwat3	byte	Dummy: Rainy period, water source public fountain
	rpwat4	byte	Dummy: Rainy period, water source drilling
	rpwat5	byte	Dummy: Rainy period, water source mechanic well at home
	rpwat6	byte	Dummy: Rainy period, water source mechanic well outside home
	rpwat7	byte	Dummy: Rainy period, water source ordinary well at home
	rpwat8	byte	Dummy: Rainy period, water source ordinary well outside home
	rpwat9	byte	Dummy: Rainy period, water source surface water

Chapter 3

Measuring the Local Burden of Disease – A Study of Years of Life Lost in Sub-Saharan Africa[1]

1. Introduction

An effective health policy necessitates a reliable characterization of the burden of disease (BOD) and its distribution by cause. The *Global Burden of Disease Study* (GBDS; Murray, Lopez 1996a) is a major step towards the development of such a rational information-based health policy. It provides a comprehensive assessment of epidemiological conditions and the disease burden for all regions of the world, in an attempt at facilitating priority setting in health policy and research, and the development of cost-effective health interventions.

A fundamental problem for less developed regions, in particular those of SSA, is the dearth of epidemiological and demographic data (Kaufman et al. 1997). In the absence of routine vital event registration in most of this region, the GBDS extrapolated the epidemiological data that was available (mainly from a vital registration system in South-Africa), using cause-of-death models and expert judgements (Murray, Lopez 1996b). These results await validation by thorough analyses of mortality and morbidity in SSA.

In this chapter we present the results of a study measuring the BOD in a health district in rural Burkina Faso. In a study population of 31,000 people under demographic surveillance, deaths are recorded via a *Vital Events Registration System*, and causes of death are assigned through *Verbal Autopsy* (VA). Our principal objective is the analysis of locally measured BOD by cause of death, age, and sex in direct comparison with the GBDS results. A special emphasis is laid on the ranking of diseases by disease burden. We ask whether local health

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policy needs to be based on local BOD measurement. Furthermore, providing estimates based on two different indicators (*YLL* and deaths) and on two alternative *YLL*-specifications concerning age-weighting and discounting, we investigate the robustness of our conclusions.

2. Study Population and Methods

As already mentioned, Burkina Faso had an estimated population of approximately 10.7 mio in 1998. This small West African state is divided into 11 administrative health regions, which comprise 53 health districts overall, each covering a population of 200 to 300 thousand individuals. At least one health care facility in each district is a hospital with surgery capacities. The districts themselves are again sub-divided in smaller areas of responsibility which are organized around either a hospital or a CSPS, the basic health care facility in the Burkinian health system.

The Nouna health district, which is identical to the province of Kossi, covers 16 CSPS, one district hospital and a population of roughly 230 thousand inhabitants. In this district a DSS has been implemented, surveying the population of four CSPS with a study population of 31,280 inhabitants (mid-year population 1998). Periodically updated censuses (the first census was performed in 1992, a first control census in 1994, and a second control census in 1998) are supplemented by a Vital Events Registration System, recording approximately every three months births, deaths and migrations. For each recorded death, the cause of death is determined through Verbal Autopsy. Age was assessed through identifying the date of birth. This was done either based on birth certificates (only in a relatively small number of cases), or using a "local events calendar" which incorporates seasonal landmarks, feasts, political events, and village events.

Some 4–16 weeks after a death is recorded, a structured questionnaire is administered to the best informed relative(s) of the deceased by lay persons having a minimum education of 10 years of schooling. The review of the questionnaires is performed independently by two physicians. Three causes of death can be assigned to each case. An underlying cause has to be assigned, which is used as the cause of death in our study, since our results are aimed at informing health policy. In the case of malnutrition, for example, a child might die from a supervening acute disease, but to be successful, health policy must aim to improve nutrition instead of promoting intervention against the supervening disease. Additionally, one associated cause of death and one immediate cause of death can be assigned. If the two physicians do not agree on the underlying cause of death, a third physician is consulted as a referee. If his determination agrees with one of the initial diagnoses, the case is coded accordingly. If not, the case is coded as undetermined.

Of the 464 deaths analyzed, 10 deaths (2.2 %) were not classified according to the ICD-10, and for 76 deaths (16.4 %) a cause of death could not be ascertained. Instead of distributing the undetermined cases proportionately across the disease categories as was done in the GBDS, we left them in a separate residual category. A proportional redistribution of these cases would only overstate the precision of our estimates.

Numerous conceptually different measures have been proposed for measuring the BOD, for instance mortality rates, different forms of *YLL* (a comprehensive discussion of the *YLL* indicator can be found in Gardner, Sanborn 1990; Lee 1998; *Disability-Adjusted Life Years* (DALY); Murray 1996), with the latter comprising *YLL* as one of their major elements. We concentrate on standard *YLL* according to the methodology proposed in the GBDS. On the one hand, we want to ensure comparability, and on the other hand, deaths and remaining life expectancy can be measured relatively reliably by cause and typically contribute most to the overall BOD in SSA. The GBDS, for example, attributes 77 % of overall BOD in SSA to *YLL*, whereas only 23 % are attributed to *Years Lived With Disability* (YLD), the morbidity measure of the GBDS.

For our analysis individual *YLL* were calculated for all recorded 464 deaths in the Nouna Health District over a period of 17 months (November 1997 to March 1999), and cross-classified by age, sex, and cause of death. The measure is not standardized according to population size or age (see Marlow 1995; Sasieni, Adams 1999 for further details on standardization), since our major objective is the characterization of the local BOD in Burkina Faso, not a cross-country comparison of standardized figures.

For each individual *i*, *Years of Life Lost* due to premature death are calculated as

$$YLL_i(r,k) = \int_{x=a}^{x=a+L(a)} kxe^{-\beta x} \cdot e^{-r(x-a)}\,dx,$$

where a is the age of the individual, $L(a)$ is the remaining life expectancy at age a, r is the discount rate, and k and β are the parameters of the age-weighting function. In particular, $k = 1$ implies full age-weighting, and $k = 0$ no age-weighting. The $YLL(0.03,1)$ are the benchmark mortality measure in the GBDS.

To test the possibility that the deviations of our results from the GBDS can be explained through mere sample variation, we applied a χ^2 goodness-of-fit test. The distribution of the null hypothesis is the multinomial distribution of deaths over distinct disease categories of the GBDS. The test statistic is

$$\chi^2 = \sum \frac{\left(0_j - E_j\right)^2}{E_j},$$

with $E_j = n^* p_j$, where p_j is the expected probability of disease category j as published by the GBDS and n is the sample size. O_j is the number of deaths of category j that occur in the sample. The test is based on the distribution of deaths over distinct cause-of-death categories instead of YLL, since a test statistic computed with YLL would not be χ^2-distributed. The test is asymptotically valid if $E_i \geq 5 \forall i$. Categories with an expected occurrence of deaths of less than 5 were grouped together to fulfill this prerequisite.

3. Results

Table 7 documents YLL by cause of death, sex, and age group, using a format identical to the tables presented in the GBDS. The classification system is the one used in the GBDS, which can basically be translated into the ICD-10 system. Overall mortality is divided into the three broad disease categories I (communicable, maternal, perinatal, and nutritional conditions), II (non-communicable) and III (injuries). Their respective BOD shares are 90.0 % for Nouna as compared to 76.7 % for the GBDS for group I, 4.2 % for group II compared to 12.9 % and finally 5.8 % and 10.5 % for group III, respectively. (In this calculation we excluded YLL caused by war from the GBDS figures to ensure comparability in a case where the deviation can obviously and easily be reduced.)

The differences across sex between our results and the GBDS are minor. We estimated that 53.9 % of the BOD is carried by men, whereas for SSA the GBDS reported this share to be 53.2 %. However, 51.0 % of the population in Nouna are men, as opposed to 49.4 % in the GBDS. Therefore, in relative terms BOD is slightly lower for men in Nouna.

Figure 6 displays the distribution of the results across age groups. The two bottom bars contrast the standard $YLL(0.03,1)$ for Nouna with the GBDS results. Young age groups (up to 14 years of age) account for the overwhelming majority of both the estimated YLL for Nouna and in the GDBS, however, their relative fraction is somewhat smaller in our Nouna study. The most striking difference occurs for small children (0–4 years), with the GBDS attributing almost 7 percentage points more to this age group (60.6 % as compared to 53.7 %). The two upper bars of Figure 6 are discussed below.

Table 8 provides a ranking of diseases by YLL that they have caused. For the GBDS, the ranking is also shown if the BOD is measured in DALY. In both our study and the GBDS the same three diseases occupied the first three places if measured in YLL, only varying in the specific rank. In our study population

Table 7

YLLs by Age, Sex and Cause
464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
Mid-year population 1998	31.287	15 884	15 403	2.710	4.890	3 965	2 118	1 266	538	397	2.613	4 507	3.655	2 252	1 416	561	399
All Causes*	10 949,9	5 896,9	5. 53,0	3 328,1	1 070,2	273,5	444,5	318,4	254,1	208,1	2 552,6	664,5	807,5	360,9	307,3	225,2	135,0
I. Communicable, maternal, perinatal and nutritional conditions	8 190,5	4 557,4	3 633,1	2 883,3	663,2	169,0	374,6	183,0	142,4	142,0	1 999,7	515.7	608,5	102,4	153,5	163,0	90,4
A. Infectious a. parasitic diseases	6 363,9	3 568,0	2 796,0	2 165,0	625,7	169,0	278,7	117,2	117,8	94,7	1 381,4	442,3	510,4	79,3	140,8	163,0	78,9
1. Tuberculosis	57,2	47,6	9,6	–	–	–	28,4	14,8	–	4,5	–	–	–	–	–	–	9,6
2. STDs excluding HIV	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3. HIV	168,1	115,1	53,0	–	–	63,3	47,3	–	–	4,5	–	–	–	53,0	–	–	–
4. Diarrhoeal diseases	2 244,4	1 222,5	1 021,9	930,5	147,5	–	22,1	64,1	32,6	25,6	552,7	183,6	133,8	–	77,8	51,8	22,2
5. Childhood-cluster diseases	242,9	136,1	106,8	136,1	–	–	–	–	–	–	69,4	37,4	–	–	–	–	–
a. Pertussis	34,0	34,0	–	34,0	–	–	–	–	–	–	–	–	–	–	–	–	–
b. Poliomyelitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
c. Diphteria	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
d. Measles	176,0	69,2	106,8	69,2	–	–	–	–	–	–	69,4	37,4	–	–	–	–	–
e. Tetanus	33,0	33,0	–	33,0	–	–	–	–	–	–	–	–	–	–	–	–	–
6. Bacterial Meningitis	266,5	148,1	118,4	103,4	37,1	–	–	–	7,6	–	–	37,1	70,6	–	–	10,7	–
7. Hepatitis B and hepatitis C	65,3	33,6	31,6	–	–	–	26,5	–	7,1	–	–	–	31,6	–	–	–	–
8. Malaria	3 033,9	1 749,0	1 284,9	994,9	441,1	105,6	78,2	38,3	35,9	54,9	724,6	147,4	274,3	26,2	–	79,4	33,0
9. Tropical-cluster diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10. Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11. Dengue	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13. Trachoma**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
14. Intestinal nematode infections	243,4	108,4	134,9	–	–	–	76,3	–	27,0	5,2	–	36,8	–	–	63,0	21,1	14,1
15. Other infectious and parasitic	42,3	7,6	34,7	–	–	–	–	–	7,6	–	34,7	–	–	–	–	–	–
B. Respiratory infections	1 281,4	649,3	632,1	378,2	37,5	–	95,8	65,8	24,6	47,4	482,0	36,8	65,9	23,1	12,8	–	11,5
1. Lower respiratory infections	1 281,4	649,3	632,1	378,2	37,5	–	95,8	65,8	24,6	47,4	482,0	36,8	65,9	23,1	12,8	–	11,5
2. Upper respiratory infections	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Maternal conditions	32,2	–	32,2	–	–	–	–	–	–	–	–	–	32,2	–	–	–	–
D. Perinatal conditions	232,2	166,0	66,2	166,0	–	–	–	–	–	–	66,2	–	–	–	–	–	–
1. Low birth weight	66,0	66,0	–	66,0	–	–	–	–	–	–	–	–	–	–	–	–	–
4. Other perinatal conditions	166,1	100,0	66,2	100,0	–	–	–	–	–	–	66,2	–	–	–	–	–	–
E. Nutritional deficiencies	280,8	174,2	106,6	174,2	–	–	–	–	–	–	70,0	36,6	–	–	–	–	–

Table 7 (continued)

YLLs by Age, Sex and Cause
464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
1. Protein-energy malnutrition	280,8	174,2	106,6	174,2	–	–	–	–	–	–	70,0	36,6	–	–	–	–	–
II. Noncommunicable diseases	385,9	149,2	236,7	–	–	35,0	23,3	33,1	42,1	15,7	67.8	37,2	–	67,5	32,8	22,5	8,9
A. Malignant neoplasms	25,8	3,9	21,9	–	–	–	–	–	–	3,9	–	–	–	21,9	–	–	–
B. Other neoplasms	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Diabetes mellitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
D. Endocrine disorders	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. Neuro-psychiatric conditions	49,3	7,6	41,7	–	–	–	–	–	7,6	–	–	37,2	–	–	–	–	4,4
F. Sense organ disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
G. Cardio-vascular diseases	198,0	83,4	114,7	–	–	–	23,3	33.1	18,0	9,0	33,1	–	–	21,9	32,8	22,5	4,4
2. Ischaemic heart disease***	4,4	–	4,4	–	–	–	–	–	–	–	–	–	–	–	–	–	4,4
4. Inflammatory heart disease	142,0	31,7	110,2	–	–	–	–	17,1	9,5	5,2	33,1	–	–	21,9	32,8	22,5	–
5. Other cardiovascular	51,7	51,7	–	–	–	–	23,3	16,0	8,5	3,9	–	–	–	–	–	–	–
H. Respiratory diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
I. Digestive diseases	51,2	16,5	34,7	–	–	–	–	–	16,5	–	34,7	–	–	–	–	–	–
2. Cirrhosis of the liver	16,5	16,5	–	–	–	–	–	–	16,5	–	–	–	–	–	–	–	–
4. Other digestive	34,7	–	34,7	–	–	–	–	–	–	–	34,7	–	–	–	–	–	–
J. Genito-urinary diseases	37,8	37,8	–	–	–	35,0	–	–	–	2,8	–	–	–	–	–	–	–
1. Nephritis and nephrosis	37,8	37,8	–	–	–	35,0	–	–	–	2,8	–	–	–	–	–	–	–
K. Skin diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
L. Musculo-skeletal diseases	23,7	–	23,7	–	–	–	–	–	–	–	–	–	–	23,7	–	–	–
1. Rheumatoid arthritis	23,7	–	23,7	–	–	–	–	–	–	–	–	–	–	23,7	–	–	–
M. Congenital anomalies	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. Oral conditions	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
III. Injuries	522,3	363,6	158,7	69,2	258,7	–	25,9	–	–	9,9	35,3	–	–	56,2	49,8	11,7	5,7
A. Unintentional injuries	473,8	360,1	113,8	69,2	258,7	–	25,9	–	–	6,3	35,3	–	–	27,5	35,5	11,7	3,8
B. Intentional injuries	48,5	3,6	44,9	–	–	–	–	–	–	3,6	–	–	–	28,7	14,3	–	1,9
Causes not compatible to the GBDS classification system	199,0	83,5	115,5	33,0	37,5	–	–	–	9,5	3,6	34,1	–	32,2	29,3	12,8	–	7,1
Cause of death undetermined	1 652,3	743,2	909,1	342,6	110,9	69,5	20,8	102,3	60,2	36,9	415,7	111,5	166,9	105,5	58,5	28,0	23,0

Notes: *Including YLLs caused by undetermined cases or cases that were not classified according to the GBDS classification sytem. – **Diseases like japanese encephalitis that are not prevalent in the study region have been excluded from the table. – ***For disease category II and III, only subgroups with positive entries have been included.

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Table 8

Ranking of Diseases by Burden of Disease Caused

Diseases	GBD Classification	Nouna		GBDS		
		Rank	% of total BOD	Rank	% of total BOD	Rank if measured in DALYs
Malaria	I A 8	1	27,7	3	10,8	4
Diarrhoeal diseases	I A 4	2	20,5	1	13,8	1
Lower respiratory infections	I B 1	3	11,7	2	13,0	2
Unintentional injuries	III A	4	4,1	6	7,3	3
Protein-energy malnutrition	I E 1	5	2,6	15	1,5	17
Bacterial Meningitis	I A 6	6	2,4	27	0,3	30
Intestinal nematode infections	I A 14	7	2,2	38	0,0	34
Perinatal conditions	I D	8	1,8	5	7,6	6
Measles	I A 5 d	9	1,6	4	8,8	5
HIV	I A 3	10	1,5	8	3,1	10
Intentional injuries[1]	III B	17	0,4	9	2,8	12
Tuberculosis	I A 1	15	0,5	7	4,2	8
Malignant neoplasms	II A	25	0,2	10	2,6	13
Neuro-psychiatric conditions	II E	18	0,5	26	0,4	7
Maternal conditions	I C	13	0,6	11	2,4	9

Notes: Diseases are listed according to rank: first rank 1 to 10 for Nouna, then the rest of the top ten diseases for the GBDS that are missing under the top ten of Nouna. – [1] *YLLs* from war have been excluded from the GBDS results.

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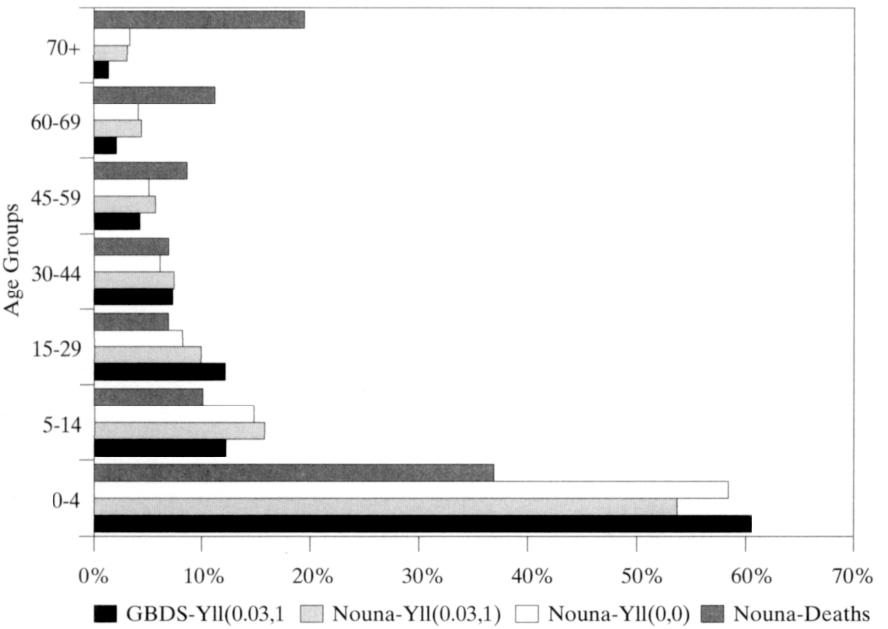
27.7 % of all estimated *YLL* were caused by malaria in contrast to 10.8 % for SSA as given by the GBDS, where it only takes rank 3 (rank 4 in terms of DALY). In Nouna, malaria is followed by diarrhoeal diseases with a share of 20.5 % of total disease burden, and by lower respiratory infections with a share of 11.7 %. In the GBDS diarrhoeal diseases take rank 1 and lower respiratory infections take rank 2, in *YLL* as well as in DALY; in terms of DALY, unintentional injuries outrun malaria in taking rank 3.

An apparent feature of the data is that for the GBDS the BOD is much more evenly distributed across the diseases, whereas for Nouna more than half of the BOD measured in *YLL* was caused by the three major causes of death. Beyond rank 3, substantial differences emerge. Three of the ten leading causes of *YLL* in the GBDS are not among the major ten causes of *YLL* in Nouna (intentional injuries, tuberculosis and malignant neoplasms), and the same holds for three of the ten leading causes of DALY (tuberculosis, neuro-psychiatric conditions, and maternal conditions). Protein-energy malnutrition occupies rank 5 in Nouna but only rank 15 in the GBDS, intestinal nematode infections are at rank 7 in Nouna but only at rank 38 in the GBDS. Meningitis is at rank 6 in Nouna in contrast to rank 27 for the GBDS.

Figure 6

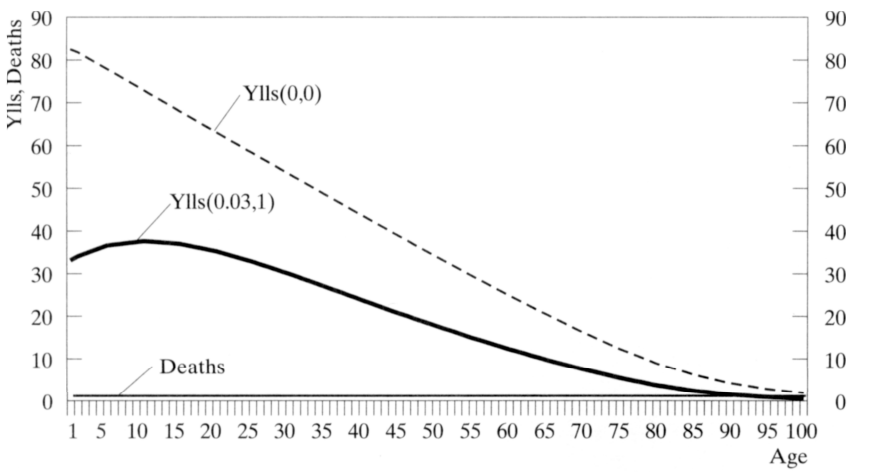
Ylls by Age Group



Author's own computations.

Figure 7

Ylls(0.03,1) vs. Ylls(0,0) and Deaths



Author's own computations.

Table 9

YLLs(0,0) by Age, Sex and Cause (No Discounting, No Age-weighting)
464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–-14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
Mid-year population 1998	31 287	15 884	15 403	2 710	4 890	3.965	2 118	1 266	538	397	2 613	4 507	3 655	2 252	1 416	561	399
All Causes*	23 340,8	12 491,2	10 849,6	7 626,7	2 089,4	471,6	770,2	580,5	499,9	453,0	6 001,3	1 357,4	1 446,3	654,2	602,6	467,9	319,8
I. Communicable, maternal, perinatal and nutritional conditions	17 688,7	9 783,2	7 905,6	6 601,3	1 318,0	291,3	648,2	335,3	280,6	308,6	4 706,3	1 068,5	1 090,4	185,8	301,2	338,9	214,4
A. Infectious a. parasitic diseases	13 642,5	7 622,5	6 020,0	4 949,1	1 247,6	291,3	481,6	215,7	232,0	205,1	3 244,2	913,6	915,9	143,3	275,5	338,9	188,7
1. Tuberculosis	107,3	85,4	21,9	–	–	–	48,5	27,3	–	9,6	–	–	–	–	–	–	21,9
2. STDs excluding HIV	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3. HIV	295,7	199,9	95,8	–	–	108,0	82,3	–	–	9,6	–	–	–	95,8	–	–	–
4. Diarrhoeal diseases	4 923,8	2 685.9	2 237,9	2 117,5	291,6	–	38,7	116,7	64,5	56,9	1 297,8	386,8	239,6	–	152,4	107,6	53,8
5. Childhood-cluster diseases	551,8	316,1	235,7	316,1	–	–	–	–	–	–	161,7	74,0	–	–	–	–	–
a. Pertussis	79,4	79,4	–	79,4	–	–	–	–	–	–	–	–	–	–	–	–	–
b. Poliomyelitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
c. Diphteria	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
d. Measles	392,5	156,7	235,7	156,7	–	–	–	–	–	–	161,7	74,0	–	–	–	–	–
e. Tetanus	80,0	80,0	–	80,0	–	–	–	–	–	–	–	–	–	–	–	–	–
6. Bacterial Meningitis	540,7	322,3	218,4	234,8	72,4	–	–	–	15,2	–	–	69,0	127,2	–	–	22,2	–
7. Hepatitis B and hepatitis C	116,1	59,9	56,2	–	–	–	45,6	–	14,4	–	–	–	56,2	–	–	–	–
8. Malaria	6 538,6	3 742,5	2 796,1	2 280,8	883,6	183,3	134,8	71,7	70,2	118,1	1 703,8	306,8	492,9	47,4	–	165,6	79,5
9. Tropical-cluster diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10. Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11. Dengue	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13. Trachoma**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
14. Intestinal nematode infections	472,4	195,3	277,1	–	–	–	131,8	–	52,7	10,9	–	77,0	–	–	123,1	43,6	33,5
15. Other infectious and parasitic	96,0	15,2	80,9	–	–	–	–	–	15,2	–	80,9	–	–	–	–	–	–
B. Respiratory infections	2 796,1	1 371,5	1 424,7	863,0	70,4	–	166,6	119,5	48,6	103,4	1 136,4	77,0	117,3	42,6	25,7	–	25,7
1. Lower respiratory infections	2 796,1	1 371,5	1 424,7	863,0	70,4	–	166,6	119,5	48,6	103,4	1 136,4	77,0	117,3	42,6	25,7	–	25,7
2. Upper respiratory infections	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Maternal conditions	57,2	–	57,2	–	–	–	–	–	–	–	–	–	57,2	–	–	–	–
D. Perinatal conditions	564,4	399,4	165,0	399,4	–	–	–	–	–	–	165,0	–	–	–	–	–	–
1. Low birth weight	160,0	160,0	–	160,0	–	–	–	–	–	–	–	–	–	–	–	–	–
4. Other perinatal conditions	404,4	239,4	165,0	239,4	–	–	–	–	–	–	165,0	–	–	–	–	–	–
E. Nutritional deficiencies	628,6	389,9	238,7	389,9	–	–	–	–	–	–	160,8	78,0	–	–	–	–	–

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Table 9 (continued)

YLLs(0,0) by Age, Sex and Cause (No Discounting, No Age-weighting)
464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–-14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
1. Protein-energy malnutrition	628,6	389,9	238,7	389,9	–	–	–	–	–	–	160,8	78,0	–	–	–	–	–
II. Noncommunicable diseases	766,9	278,6	488,3	–	–	60,4	40,6	60,1	82,9	34,5	163.4	70,0	–	124,8	63,5	46,1	20,5
A. Malignant neoplasms	49,2	8,5	40,6	–	–	–	–	–	–	8,5	–	–	–	40,6	–	–	–
B. Other neoplasms	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Diabetes mellitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
D. Endocrine disorders	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. Neuro-psychiatric conditions	95,4	15,2	80,3	–	–	–	–	–	15,2	–	–	70,0	–	–	–	–	10,3
F. Sense organ disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
G. Cardio-vascular diseases	398,2	155,2	243,0	–	–	–	40,6	60,1	35,1	19,4	82,5	–	–	40,6	63,5	46,1	10,3
2. Ischaemic heart disease***	10,3	–	10,3	–	–	–	–	–	–	–	–	–	–	–	–	–	10,3
4. Inflammatory heart disease	293,0	60,2	232,8	–	–	–	–	31,0	18,4	10,9	82,5	–	–	40,6	63,5	46,1	–
5. Other cardiovascular	95,0	95,0	–	–	–	–	40,6	29,1	16,7	8,5	–	–	–	–	–	–	–
H. Respiratory diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
I. Digestive diseases	113,5	32,7	80,9	–	–	–	–	–	32,7	–	80,9	–	–	–	–	–	–
2. Cirrhosis of the liver	32,7	32,7	–	–	–	–	–	–	32,7	–	–	–	–	–	–	–	–
4. Other digestive	80,9	–	80,9	–	–	–	–	–	–	–	80,9	–	–	–	–	–	–
J. Genito-urinary diseases	67,0	67,0	–	–	–	60,4	–	–	–	6,6	–	–	–	–	–	–	–
1. Nephritis and nephrosis	67,0	67,0	–	–	–	60,4	–	–	–	6.6	–	–	–	–	–	–	–
K. Skin diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
L. Musculo-skeletal diseases	43,5	–	43,5	–	–	–	–	–	–	–	–	–	–	43,5	–	–	–
1. Rheumatoid arthritis	43,5	–	43,5	–	–	–	–	–	–	–	–	–	–	43,5	–	–	–
M. Congenital anomalies	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. Oral conditions	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
III. Injuries	1 026,0	711,0	315,0	156,7	488,8	–	44,6	–	–	20,9	79,9	–	–	100,7	96,5	24,0	13,9
A. Unintentional injuries	933,2	703,0	230,2	156,7	488,8	–	44,6	–	–	12,9	79,9	–	–	49,4	68,1	24,0	8,9
B. Intentional injuries	92,8	8,0	84,8	–	–	–	–	–	–	8,0	–	–	–	51,3	28,5	–	5,0
Causes not compatible to the GBDS classification system	410,7	176,8	233,9	80,0	70,4	–	–	–	18,4	8,0	81,8	–	57,2	52,3	25,7	–	16,9
Cause of death undetermined	3.448,6	1 541,7	1 906,8	788,6	212,2	119,9	36,7	185,1	118,1	81,1	969,8	219,0	298,7	190,7	115,7	58,9	54,1

Notes: *Including YLLs caused by undetermined cases or cases that were not classified according to the GBDS classification sytem. – **Diseases like japanese encephalitis that are not prevalent in the study region have been excluded from the table. – ***For disease category II and III, only subgroups with positive entries have been included.

Table 10

Deaths by Age, Sex and Cause

464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
Mid-year population 1998	31 287	15 884	15 403	2 710	4 890	3 965	2 118	1 266	538	397	2 613	4 507	3 655	2 252	1 416	561	399
All Causes*	464	254	210	97	29	8	18	20	30	52	74	18	24	14	20	22	38
I. Communicable, maternal, perinatal and nutritional conditions	332	186	146	84	18	5	15	12	17	35	58	14	18	4	10	16	26
A. Infectious a. parasitic diseases	260	141	119	63	17	5	11	8	14	23	40	12	15	3	9	16	24
1. Tuberculosis	5	3	2	–	–	–	1	1	–	1	–	–	–	–	–	–	2
2. STDs excluding HIV	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3. HIV	7	5	2	–	–	2	2	–	–	1	–	–	–	2	–	–	–
4. Diarrhoeal diseases	89	47	42	27	4	–	1	4	4	7	16	5	4	–	5	5	7
5. Childhood-cluster diseases	7	4	3	4	–	–	–	–	–	–	2	1	–	–	–	–	–
a. Pertussis	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
b. Poliomyelitis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
c. Diphteria	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
d. Measles	5	2	3	2	–	–	–	–	–	–	2	1	–	–	–	–	–
e. Tetanus	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
6. Bacterial Meningitis	9	5	4	3	1	–	–	–	1	–	–	1	2	–	–	1	–
7. Hepatitis B and hepatitis C	3	2	1	–	–	–	1	–	1	–	–	–	1	–	–	–	–
8. Malaria	120	67	53	29	12	3	3	3	4	13	21	4	8	1	–	8	11
9. Tropical-cluster diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10. Leprosy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11. Dengue	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13. Trachoma**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
14. Intestinal nematode infections	18	7	11	–	–	–	3	–	3	1	–	1	–	–	4	2	4
15. Other infectious and parasitic	2	1	1	–	–	–	–	–	1	–	1	–	–	–	–	–	–
B. Respiratory infections	56	35	21	11	1	–	4	4	3	12	14	1	2	1	1	–	2
1. Lower respiratory infections	56	35	21	11	1	–	4	4	3	12	14	1	2	1	1	–	2
2. Upper respiratory infections	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Maternal conditions	1	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–
D. Perinatal conditions	7	5	2	5	–	–	–	–	–	–	2	–	–	–	–	–	–
1. Low birth weight	2	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
4. Other perinatal conditions	5	3	2	3	–	–	–	–	–	–	2	–	–	–	–	–	–
E. Nutritional deficiencies	8	5	3	5	–	–	–	–	–	–	2	1	–	–	–	–	–

Table 10 (continued)

Deaths by Age, Sex and Cause
464 Deaths (November 1997 – March 1999)

Cause	Total	Male	Female	Males							Females						
				0–4	5–14	15–29	30–44	45–59	60–69	70+	0–4	5–14	15–29	30–44	45–59	60–69	70+
1. Protein-energy malnutrition	8	5	3	5	–	–	–	–	–	–	2	1	–	–	–	–	–
II. Noncommunicable diseases	25	13	12	–	–	1	1	2	5	4	2	1	–	3	2	2	2
A. Malignant neoplasms	2	1	1	–	–	–	–	–	–	1	–	–	–	1	–	–	–
B. Other neoplasms	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
C. Diabetes mellitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
D. Endocrine disorders	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. Neuro-psychiatric conditions	3	1	2	–	–	–	–	–	1	–	–	1	–	–	–	–	1
F. Sense organ disease	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
G. Cardio-vascular diseases	14	7	7	–	–	–	1	2	2	2	1	–	–	1	2	2	1
2. Ischaemic heart disease***	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1
4. Inflammatory heart disease	9	3	6	–	–	–	–	1	1	1	1	–	–	1	2	2	–
5. Other cardiovascular	4	4	–	–	–	–	1	1	1	1	–	–	–	–	–	–	–
H. Respiratory diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
I. Digestive diseases	3	2	1	–	–	–	–	–	2	–	1	–	–	–	–	–	–
2. Cirrhosis of the liver	2	2	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–
4. Other digestive	1	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–
J. Genito-urinary diseases	2	2	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–
1. Nephritis and nephrosis	2	2	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–
K. Skin diseases	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
L. Musculo-skeletal diseases	1	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–
1. Rheumatoid arthritis	1	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–
M. Congenital anomalies	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. Oral conditions	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
III. Injuries	21	12	9	2	7	–	1	–	–	2	1	–	–	2	3	1	2
A. Unintentional injuries	17	11	6	2	7	–	1	–	–	1	1	–	–	1	2	1	1
B. Intentional injuries	4	1	3	–	–	–	–	–	–	1	–	–	–	1	1	–	1
Causes not compatible to the GBDS classification system	10	4	6	1	1	0	0	0	1	1	1	0	1	1	1	0	2
Cause of death undetermined	76	39	37	10	3	2	1	6	7	10	12	3	5	4	4	3	6

Notes: *Including deaths caused by undetermined cases or cases that were not classified according to the GBDS classification sytem. – **Diseases like japanese encephalitis that are not prevalent in the study region have been excluded from the table. – ***For disease category II and III, only subgroups with positive entries have been included.

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A χ^2 goodness-of-fit test explores whether the differences in ranking between Nouna and the GBDS can be explained through mere sample variation, thus indicating whether, if we observed another sample, we would probably get the same ranking. The computed test statistic is $\chi^2 = 391$, while the critical value is $\chi^2_{(k=18, 0.995)} = 37.2$. The null hypothesis is rejected. There clearly seems to be a statistically significant different cause-of-death pattern in the health district of Nouna. To generate a hypothetical situation most favorable for the GBDS, in a sensitivity analysis we redistributed the residual cases according to the GBDS results and performed the appropriate χ^2 test once more. Our results are retained.

To analyze the sensitivity of our results to the particular choice of parameters and health-status indicators, we also calculated two alternative measures of the BOD: $YLL(0,0)$ and the number of deaths (Tables 9 and 10). In principle, one could imagine that the parameter and indicator choice matters a lot, especially with respect to age, since the difference between $YLL(0.03,1)$, $YLL(0,0)$ and deaths is substantial across most of the age range (Figure 7).

Returning to Figure 6, the three upper bars compare the distribution of the three measures of BOD for Nouna across age groups. For the number of deaths, one can see the U-shaped pattern which is typical for developing regions. BOD measured using crude deaths is concentrated in older age groups and in the age group 0–4 (infant and child mortality). In contrary, both YLL bars are constantly decreasing from younger to older age groups. The differences between $YLL(0.03,1)$ and $YLL(0,0)$ are less pronounced, with $YLL(0,0)$ attributing a higher share of the BOD to the youngest age group (58.4 % as opposed to 53.7 %), and consequently lower shares to the remaining age groups.

With respect to sex, no substantial differences can be observed. While $YLL(0.03,1)$ attribute 53.9 % of the BOD to men, the corresponding figures are 53.5 % for $YLL(0,0)$ and 54.7 % for deaths, respectively. This result confirms the intuition, since it would be surprising if the particular choice of sex-insensitive indicators made a large difference.

Similar observations hold for the distribution across the three ICD-10 disease categories. Group I comprises 90.0 % of the BOD measured with $YLL(0.03,1)$, 90.8 % with $YLL(0,0)$, and 87.8 % with deaths. For group II the shares are 4.2 %, 3.9 % and 6.6 % respectively, and for group III 5.8 %, 5.3 % and 5.6 %. While $YLL(0.03,1)$ and $YLL(0,0)$ do not display perceptible differences, when using deaths as the indicator a relatively larger share of the BOD is attributed to noncommunicable diseases. This is a reasonable result, since these diseases tend to be an important cause of death for older people.

Table 11 reports how the ranking of the leading causes of the BOD varies with the chosen health-state measure. There is almost no difference in ranking by

Table 11

Ranking of Diseases by Burden of Disease Caused

Diseases	*YLLs*(0.03,1)		*YLLs*(0,0)		Deaths	
	Rank	in %	Rank	in %	Rank	in %
Malaria	1	27,71	1	28,01	1	25,86
Diarrhoeal diseases	2	20,50	2	21,13	2	19,18
Lower respiratory infections	3	11,70	3	11,98	3	12,07
Unintentional injuries	4	4,09	4	4,00	5	3,66
Protein-energy malnutrition	5	2,56	5	2,69	8	1,72
Bacterial Meningitis	6	2,43	6	2,32	6	1,94
Intestinal nematode infections	7	2,22	8	2,02	4	3,88
Perinatal conditions	8	1,82	7	2,06	10	1,29
Measles	9	1,61	9	1,68	12	1,08
HIV	10	1,54	10	1,27	9	1,51
Inflammatory heart disease	11	1,30	11	1,26	6	1,94

Author's own computations. RWI ESSEN

cause of death whether or not age and time weighting is implemented. Only rank 7 and 8 change places, the rest retain their positions. Not only does the ranking stay almost the same, but also the shares in total BOD differ only slightly. For rank 1, there's a difference of 1.1 %, for rank 2 the difference is 3.0 % and for rank 3 it is 2.3 %. The highest proportional difference is for HIV (17.5 %), but given its small share in total BOD (1.5 % and 1.3 % respectively) even the largest relative difference among the ten major causes of death does not seem to be remarkable.

While the choice between $YLL(0.03,1)$ and $YLL(0,0)$ is apparently not instrumental, results change somewhat when we use deaths as the BOD indicator. The first three causes of death retain the same ranking, but there is less agreement between YLL and the number of deaths after rank 3.

4. Discussion

We have to acknowledge that with our approach we cannot really validate the GBDS study, since so far we can't give explicit figures on the validity of our implemented VA system itself. However, the results we obtain raise serious doubt that for the health district we are looking at, the GBDS would be the right information base for a local health policy. Moreover, it is plausible to argue that this could very likely be true also for other regions of SSA.

In our analysis we operate with a limited sample size – we are distributing 464 deaths over more than 40 disease categories. This necessarily restricts our ability to accurately estimate the prevalence or incidence of single diseases, even

though our number of reported cases is relatively high compared to other mortality studies in SSA. For example there are no reported deaths from tuberculosis in women below age 70. Findings like this are most probably merely a result of chance. For this reason, we will not discuss the detailed results (Table 7). Yet our data enable us to discuss the aggregate findings on the distribution of BOD by age and sex and to present a ranking of the most prevalent causes of death.

With respect to sex and age the Nouna results confirm more or less the general BOD structure reported by the GBDS for SSA as a whole, even if the GBDS seems to overstate the fraction of infant and child mortality compared to the Nouna results. The ranking of diseases by the share of disease burden, however, displays considerable differences. Basically, ranking – and thereby priority setting in health policy – depends on three things: the choice of indicator, the values incorporated in the indicator (age and time preferences) and the epidemiological data base that is used. Our results demonstrate a significant difference in ranking between the GBDS and Nouna, whereas the ranking by cause for Nouna shows little variation if a different indicator or different age and time weights are used.

Three competing explanations might be offered for the divergence between the Nouna and the GBDS data. First, instead of being an ideal weighted average of local BOD estimates over all regions of SSA, the GBDS results are an extrapolation of mortality data from a few parts of Africa, using cause-of-death models and a variety of expert judgements. Thus, while being a convincing pragmatic approach in the absence of local data, the GBDS might misrepresent the BOD structure of SSA as a whole. Only further local BOD analysis for other SSA regions would be able to validate the GBDS results as reliable mean estimations for SSA.

Second, measurement errors might have biased our estimates. For example, the large BOD shares attributed to the major diseases suggest that the medical doctors who reviewed the VA-questionnaires might have tended to cluster deaths in the major categories they experienced in their daily work. While it seems unlikely that this problem could fully account for the observed differences to the GBDS, further validation studies of the VA-method are warranted. In the literature the potential and the limitations of VA methods are examined critically (Snow et al. 1992; WHO 1994a;, Chandramohan et al. 1998; Ronsmans et al. 1998). On balance, it is argued that the VA-method is the best option in a situation where the majority of deaths occur without recourse to modern health care facilities.

Another measurement error problem could be the overrepresentation of the months November through March, since we used the whole available sample size of 17 months. To check whether this would affect our conclusions, we re-

calculated our results on a 12-month-basis (January to December 1998). The conclusions remain unchanged.

The third explanation for the divergence between the GBDS and our results could be that rural Burkina Faso might be very different from other parts of SSA. There is evidence that it is poorer and less developed than the average SSA country (World Bank 2000a), implying a relatively young population, fewer medical facilities, low vaccination coverage, a lower quality of housing, water supply and storage facilities, and generally a low level of hygiene. Not only will this have consequences for the high BOD share of disease category I (Nouna seems to lag behind in the epidemiological transition), but also for the high occurrence of protein-energy malnutrition and intestinal nematode infections.

Furthermore, Burkina Faso lies inside the meningitis belt, which is of course not the case for SSA as a whole, and it is a region of high malaria transmission. Malaria is probably endemic in most regions of SSA, but its endemicity varies widely. Chandramohan et al. (1998), for example, report the BOD shares of meningitis and malaria to be 11.4 % and 8.9 % in a region in Tanzania, 15.7 % and 2.0 % in Ethiopia and 4.3 % and 14.2 % in Ghana, respectively.

Thus, even if the GBDS provided an accurate portrait of SSA as a whole, SSA would be quite heterogeneous in terms of BOD. Burkinian deviations from this typical BOD structure could not be an isolated phenomenon, but would have to be outweighed by countervailing deviations in other SSA regions. Overall, these arguments clearly underscore the need for local BOD measurement and priority setting. The available expert estimates from the GBDS are apparently not sufficient to provide a characterization of the BOD in SSA which is detailed and accurate enough to provide a basis for local health policy.

Chapter 4

Obtaining Disability Weights in Rural Burkina Faso Using a Culturally Adapted Visual Analogue Scale[1]

1. Introduction

BOD estimates used to foster local health policy require disability weights that represent local preferences for different health states. However, the GBD study presumes that disability weights are universal and equal across countries and cultures (Murray, Lopez 1996). In a recent commentary, James/Foster (1999) argue that health is so influenced by culture and economic differences that agreement on universal disability weights may prove to be impossible. Furthermore, a recent study among health professionals in 14 countries ranking a set of 17 health states with regard to their severity concluded that the resulting rank order differences are large enough to shed doubt on the assumption of universality of disability weights (Ustun et al. 1999). This indicates the need for measuring local disability weights across nations and/or cultures.

The question arises as to whether existing valuation instruments can be used to elicit such locally-meaningful disability weights (Power et al. 1999). The authors of the GBD study (Murray, Lopez 1996), argue that utility measurement techniques such as *Time-Trade-Off* (TTO), *Standard Gamble* (SG), and *Person-Trade-Off* (PTO) are cognitively demanding and become increasingly difficult to use with less educated individuals: "If large scale empirical assessments in many different countries to inform health state valuations for the GBD are to be achieved, instruments that are reliable and valid for populations with widely varying educational attainments need to be developed" (Murray, Lopez 2000). In this chapter, we agree with this point of view and argue that there is a need for locally-meaningful valuation instruments, i.e. to evaluate BOD-relevant disease states by culturally-appropriate instruments,

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including meaningful health state and disability scenarios and feasible scaling procedures (Sommerfeld et al. 2001). However, little research has been done in developing countries on the development of such instruments (e.g. Fox-Rushby et al. 1995; Amuyunzu et al. 1995; Kirgia 1998; Sadana 1998). The present chapter asks whether a health state valuation instrument can be developed that produces meaningful disability weights for population groups with lower levels of formal education attainment as, in our case, that of rural Burkina Faso. We introduce a culturally-adapted Visual Analogue Scale (VAS), and evaluate the instrument using the psychometric concepts of practicality, reliability and validity (Brazier, Deverill 1999). We suggest to use this instrument for BOD studies on a broader scale.

Furthermore, this chapter debates whose health states preferences should be considered. Should one consider community (lay people's) values, given the premise that the issue at stake refers to the allocation of societal resources, or should one, like it has been done in the GBD study, merely apply those of health professionals, since they have a better understanding of a wide range of health states? Williams (1999) warns that the GBD study should "make it possible to bring lay opinion to bear on matters that are dangerous to leave to experts". Health professionals' valuations may diverge as they might give too much weight to functional status and inadequately take into account more subtle and subjective influences of an illness. Moreover, they may not constitute a representative cross-section of the general public with regard to age, income, and socio-economic status (Gold et al. 1996). In this chapter, we ask whether health professionals' valuations can be used as a proxy for those of the community.

2. Utility Measures to Evaluate Disability Weights

Among utility measures, the SG, TTO and VAS have been used most often in health economics research in Western settings. They all measure preferences for health states on a scale from 0 (death) to 1 (full health) (a comprehensive review can be found in Torrance 1986). The SG asks the respondent to make a hypothetical choice between the certainty of continued life in the health state of interest and a gamble between varying probabilities of death and full health. The TTO presents the respondent with the task of determining what amount of time they would be willing to give up to be in a better versus a poorer health state. The VAS requires respondents to assign a number to each health state, usually on a scale from 0 (least desirable health state) to 100 (most desirable health state). Visual aids such as a "feeling thermometer" are used to support this task.

A recent critical commentary raised doubts about the cross-cultural applicability of utility measures (James, Foster 1999). Although universal utility meas-

ures would be highly desirable, they may be regarded as cultural artifacts themselves as they transport Western values, notions of time, and concepts of science (e.g. Bulmer 1988; Adam 1998). Knowledge and attitudinal surveys such as health valuation surveys appear to be particularly prone to cultural reinterpretation of survey questions by respondents and thus to contextual bias (Stone, Campbell 1984). For example, Yu et al. (1993) showed great discrepancies in responses to different scales across various cultures and concluded that attitude measures such as the Likert scale and semantic differential scales are "culture-specific, emic instruments" which largely depend upon a subject's interpretation of the measures. Utility measures based on statistical or objective probability introduce subjective or personal considerations of uncertainty and risk that are highly culture-bound.

In populations with low levels of formal education, another problem may arise from using numbers and thus reducing or transforming "lived" experience, knowledge, and attitude into a single numerical value. A quantified valuation is never a "value-free" act, and is based on lay or folk interpretations of numbers, statistics and probabilities, in other words, a lay epidemiology (Adelsward, Sachs 1996). The question, therefore, is how far a population's relative degree of numeracy is developed, i.e. how far people are able to think in numbers and use them.

Another concern addresses the acceptability of methods to a particular culture under study. Of particular interest is the question of whether discrete choice instruments are acceptable in a respective culture and whether respondents are used to discrete choice responding. Varying culture-specific norms of self-disclosure and respondent burden may affect the measurement and thus produce variation in response (Herdman et al. 1997).

Prior formative research focused on the feasibility of administering the SG, TTO and VAS in a rural Burkinian context (Sommerfeld et al. 2001). In the SG exercise, respondents appeared to have difficulties in understanding the concept of risk taking, and often related „risk" to destiny. By believing that man's fate ultimately lies "in the hands of God", respondents were expressing excessive "risks" or "no risk" at all. Furthermore, both in the SG and TTO method, the respondents' behavior was strongly influenced by family interest and social values. In the TTO exercise, for example, respondents were not willing to trade-off life years if they still had to care for family members, but were eager to trade-off life years when they felt they were a burden on the family. It was concluded that one should be very cautious when applying SG and TTO for the purpose of obtaining health state valuations in the context of rural Burkina Faso. Regarding the VAS, it was observed that respondents seemed to easily rank order health states but tended to maintain identical proportions between the health states concerned in the valuation exercise. The valuation of

one's own health state by the VAS showed a relative low test-retest reliability of 0.64.

These observations led us to the development of a culturally-adapted Visual Analogue Scale – an alternative instrument to measure health states in a setting where the level of formal education is low – that seems more capable of expressing the beliefs and values of the community and transforming those into numerical values.

3. Methods

3.1 Country and Study Population

Burkina Faso is a land-locked country, representing a multi-cultural and multi-linguistic setting, characterized by a strong oral culture. In spite of a state education system, there is a high level of formal illiteracy. Because of the (French) colonial history, there is a coexistence of African and Western values. The GDP per capita is estimated to be 150 $ per year, and more than 95 % of the population live on subsistence farming. The high levels of infant and child mortality (219 per 1 000 and 105 per 1 000 respectively; Institut Nationale de la Statistique et de la Démographie 1999) reflect large unmet needs. Our study was performed in the research area of the Nouna Health Research Center. In this region, malaria, diarrhea and respiratory diseases are estimated to be the most important contributors to the total numbers of years of life lost (Würthwein et al. 2001a).

3.2 Study Procedure

Nine hypothetical health states were selected. Four of these health states were adapted from the 22 indicator conditions of the GBD study. The nine health states include asthma, back pain, blindness, deafness, diabetes, heart problems, paraplegia, major depression, and severe mental disorder. Formative anthropological research led to the development of cultural and linguistic equivalents of these health states, including definitions of locally-meaningful disability scenarios (Schedule 8). Ultimately, these health state descriptions reflected perceived illness rather than bio-medically defined disease notions. The health states were illustrated using locally designed images.

Our scaling procedure retains the simplicity of the traditional VAS in which valuations are clearly visualized but replaces the difficult part of metric scaling – a concept unknown to most residents in rural Burkina Faso. Instead, it applies a culturally more adequate approach of representing valuations by physical units. The instrument expresses the degree of disability of a health state in terms of numbers of physical units (in our case 6 cm long wooden blocks), with 0 units representing the best health state imaginable, and 10 units representing

Schedule 8

Nine Hypothetical Health States as Explained to the Respondents

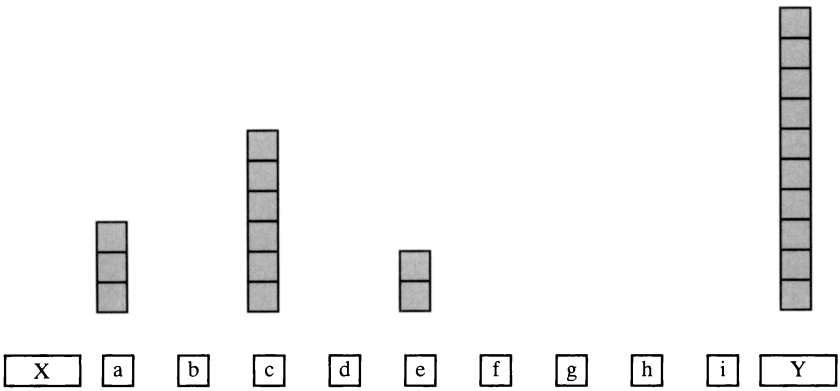
Health state	Local expression	Description
Asthma	Sinsan	The individual has difficulty breathing and experiences moments when he/she does not get enough air, especially when lying down. The individual works normally when he or she is having no episodes. The individual is frightened that one day his breathing will stop and that he/she will die.
Back pain	Ko dimi	The individual has problems getting up in the morning because his back feels stiff. When the individual wants to lift something, he/she feels strain at waist-level. The individual has many problems working in the field because he or she has to rest every now and then. Females have difficulties preparing food or sweeping the courtyard.
Deafness	Bobo	The individual does not hear well. Only when somebody shouts very loud can the individual hear.
Diabetes (Type I)	Sukaro bana	The individual eats and drinks often. The individual urinates often, up to 4 times per night. The individual has problems with his feet. The individual needs to go to the hospital once per week for an injection. The individual often feels tired and cannot work well for that reason.
Heart problems	Dusu kun dimi	The individual experiences pain in the chest with sensations like needle-sticks. The individual has difficulty breathing when walking or working. The individual cannot work properly in the field or, in the case of a woman, doing activities in the household like sweeping the courtyard or preparing food. The individual is afraid of dying because of these problems.
Paraplegia	Muruku bana	The individual cannot walk because his legs are paralyzed. The individual can do some domestic activities. The individual does not have a wheelchair to move around.
Major depression	Nimisa gwèlen	The individual experiences loss of interest or pleasure in nearly all activities. The individual is introverted, and has difficulties thinking and concentrating. The individual also experiences a loss of appetite.
Severe mental disorder	Fatoya	The individual shows strange behavior and often talks with people who can only be seen by him. The individual does many things in the wrong order.
Blindness	Fientoya	The individual is unable to distinguish the fingers of a hand at the distance of 3 meters. The individual cannot see well at dusk. During the day, the individual can work well in the fields, but he/she cannot see far.

the worst health state imaginable (Figure 8). Because of the explicit comparative nature of the exercise, one might hypothesize that this approach possesses interval properties. A further advantage is that the respondents are less intuited to retain identical proportions between the evaluated health states than in the traditional VAS, because the various states are not valued on one and the same visual scale.

For the valuation exercise, the respondents were instructed to (i) consider the disability for some sort of "average" case, i.e. a person of 40 years of age in a family with children; (ii) consider the person living in that health state during the period of one year; (iii) consider the prognosis of the health state to be unknown; and (iv) evaluate the disability regarding productive, religious, and social activities. Each valuation exercise was conducted in two steps. In the first step, the valuation procedure was performed on an individual basis. In the second step, the principle of elaboration (Murray 1996) was applied, and respon-

Figure 8

Culturally Adapted Visual Analogue Scale



Boxes X and Y represent images of the best imaginable health state and the worst imaginable health state respectively. The handicap of the worst imaginable health state is defined by 10 units. Boxes *a–i* represent locally designed picture cards of 9 health states. The respondent must rate the severity of health states *a–i* by placing the number of units in question to the corresponding image of the health state. For example, health states represented by images *a*, *c*, and e are given disability weights of 0.3, 0.6, and 0.2, respectively.

dents shared their valuations in a group and were encouraged to discuss these to arrive at wellthought valuations that better represent their preferences. The aim of the group session was not the development of group consensus but rather the encouragement of reflection. To test the impact of this "elaboration", respondents' valuations before and after the group discussion were recorded. In addition to the valuation exercise, respondents were asked to rank the health states in terms of disability. To assess the test-retest reliability, the same exercise was conducted four weeks later.

Four panel sessions were held with lay people, combining 39 individuals altogether. Each group session involved five women and five men (except in one panel where one woman did not finish the exercise). The mean age of the 39 individuals was 40 years (with a standard deviation (SD) of 8.5), and the majority of the respondents were illiterate (61%). Two panel sessions were held with health professionals with a total of 17 individuals, including 13 nurses and 4 medical doctors. Mean age was 34 years (SD = 5.8). The average number of years of practical experience was 10 (SD = 5.4). Sessions with lay people spent, on average, 74 minutes on the description of the hypothetical health states and the explanation of the instrument. The respondents spent, on average, 52 minutes to arrive at their individual valuations. The group discussions took 47 minutes, on average, after which individuals made their final assessments in an average of 12 minutes. For health professionals, these activities lasted, on average, 30, 50, 55, and 10 minutes, respectively.

The individual assessments from the panel sessions were converted to weights V using the following formula: $V(Q) = score(Q) / 10$, where Q refers to the health states. The average disability weights were calculated from the individual weights assigned by all individuals in the panel sessions.

4. Results

Inter-panel reliability was assessed after the second step of elaboration in two ways: by the extent of agreement between the panels on the average weights (ANOVA) and by the extent of agreement between the panels on the ranking of the weights (Spearman rank correlation coefficient). The average weights of the four panels of lay people do not appear to diverge strongly (Table 12). Univariate testing revealed that, nevertheless, six weights differed significantly between the panels. However, these differences were never larger than 0.23. The ranking of the weights assigned by the four panels of lay people did not vary much, indicated by an average Spearman rank correlation coefficient of 0.90. The average weights elicited by the three panels of health professionals differed significantly for four health states (Table 13) but were never larger than 0.27. The average Spearman rank correlation coefficient was 0.72. Because of the small sample sizes, no further panel subgroup analyses were carried out.

Test-retest reliability, indicating the stability of respondents' valuations over time, appeared to be high. The average individual test-retest Pearson correlation was 0.90 and 0.89 for lay people and health professionals, respectively. Average test and retest disability weights for the nine health states differed only slightly.

Table 12

Interpanel Comparison of Disability Weights as Elicited by Lay People[1]

Health state	Panel												ANOVA	
	I (n = 10)			II (n = 10)			III (n = 9)			IV (n = 10)			F	p
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank		
severe mental disorder	0,89	0,03	1	0,88	0,06	1	0,90	0,00	1	0,89	0,09	1	0,19	0,900
major depression	0,70	0,11	2	0,72	0,08	2	0,76	0,07	2	0,79	0,09	2	2,06	0,124
heart problems	0,62	0,09	3	0,49	0,09	4	0,54	0,07	4	0,50	0,13	6	3,53	0,025[a]
low back pain	0,59	0,11	4	0,41	0,10	5	0,50	0,00	6	0,53	0,11	5	6,58	0,001[a]
asthma	0,53	0,12	5	0,60	0,14	3	0,70	0,05	3	0,63	0,11	3	3,91	0,016[a]
diabetes	0,51	0,09	6	0,37	0,07	7	0,51	0,14	5	0,59	0,15	4	6,26	0,002[a]
blindness	0,46	0,16	7	0,29	0,07	8	0,23	0,07	8	0,41	0,13	8	7,97	0,000[a]
paraplegia	0,41	0,13	8	0,41	0,10	5	0,37	0,10	7	0,48	0,11	7	1,71	0,184
deafness	0,15	0,05	9	0,17	0,05	9	0,10	0,00	9	0,23	0,08	9	9,02	0,000[a]

Author's own computations. – [1]Disability weights as measured after the second step of elaboration. – [a]Significant difference, equal variances not assumed. – SD: Standard deviation. RWI ESSEN

Table 13

Interpanel Comparison of Disability Weights as Elicited by Health Professionals

Health state	Panel									ANOVA	
	I (n = 7)			II (n = 6)			III (n = 4)			F	P
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank		
severe mental disorder	0,70	0,20	1	0,88	0,04	1	0,88	0,05	1	3,65	0,053
paraplegia	0,57	0,10	2	0,43	0,23	5	0,70	0,00	3	3,98	0,043[a]
major depression	0,57	0,19	2	0,68	0,13	2	0,80	0,00	2	3,15	0,074
asthma	0,53	0,10	4	0,38	0,10	6	0,33	0,10	6	6,73	0,009[a]
heart problems	0,53	0,14	4	0,58	0,10	3	0,33	0,17	6	4,75	0,027[a]
low back pain	0,43	0,11	6	0,50	0,11	4	0,25	0,06	8	7,44	0,006[a]
diabetes	0,36	0,11	7	0,28	0,08	8	0,38	0,05	5	1,60	0,236
blindness	0,34	0,10	8	0,32	0,08	7	0,45	0,06	4	3,35	0,065
deafness	0,10	0,00	9	0,10	0,00	9	0,13	0,05	9	1,78	0,204

Author's own computations. – [a]Significant difference, equal variances not assumed. – SD: Standard deviation. RWI ESSEN

Construct (convergent) validity of the weights was studied by a comparison with the results of the implicit rank order following from the final evaluation with an explicit rank order exercise, carried out after the final evaluation. The Spearman rank correlation coefficient equaled 0.86 and 0.94 for lay people and health professionals, respectively, indicating that both panels were consistent in their evaluations, and thus understood the valuation procedure. Based on these results, it can be concluded that the scale values derived at the panel level are sufficiently valid and reliable.

The impact of elaboration was assessed by comparison of mean disability weights between the weights of the individual valuation (step 1) and of the group discussion (step 2). For the panels of lay people, mean values of two out of nine health states (blindness and paraplegia) changed significantly, with a maximum of 0.06. Group discussion halved the variance of the responses from 0.024 to 0.012. The Spearman rank order correlation coefficient of 0.85 indicates that the ranking was not substantially affected by the elaboration. For the health professionals' panels, only the mean value for deafness changed significantly (0.05). The variance of responses decreased from 0.032 to 0.018, and the Spearman rank order correlation coefficient equaled 0.82.

Mean disability weights for the nine health states as elicited by lay people and health professionals are reported in Table 14. In comparison to that of the lay people, health professionals rated seven out of nine health states as slightly to moderately less severe. A student t-test of the difference was significant for six out of nine health states: diabetes, low back pain, severe mental disorder, asthma, paraplegia, and deafness. The differences in mean disability weights ranged from 0.05 to 0.18 and can, therefore, be regarded as small to moderate. The

Table 14

Disability Weights for the Different Health States According to Lay People and Health Professionals

Health state	Lay people			Health professionals			Student t	
	Mean	SD	Rank	Mean	SD	Rank	t-value	P
severe mental disorder	0,89	0,06	1	0,81	0,16	1	2,16	0,045
major depression	0,74	0,09	2	0,66	0,17	2	1,79	0,089
asthma	0,61	0,12	3	0,43	0,13	5	5,05	0,000
heart problems	0,54	0,11	4	0,50	0,16	4	0,89	0,381
low back pain	0,51	0,11	5	0,41	0,14	6	2,55	0,017
diabetes	0,49	0,14	6	0,34	0,09	8	5,06	0,000
paraplegia	0,42	0,11	7	0,55	0,17	3	–2,94	0,008
blindness	0,35	0,14	8	0,36	0,09	7	–0,23	0,816
deafness	0,16	0,07	9	0,11	0,02	9	4,57	0,000

Author's own computations. – [a]Significant difference, equal variances not assumed. – SD: Standard deviation. – RWI ESSEN

average Spearman rank correlation coefficient for the disability weights equaled 0.78.

5. Discussion

This study has shown the feasibility of eliciting disability weights in a rural African setting using a culturally-adapted VAS instrument. Even if there are some concerns on the theoretical validity of the use of VAS-scores in economic evaluation, since they are not choice-based methods and they do not have a basis in economic theory, evidence shows that instruments that are more deeply rooted in economic theory do not produce reasonable results when applied in a population with a low level of formal education (Froberg, Kane 1989). Earlier studies in the same context showed that respondents had problems understanding the underlying concepts of trading off time, trading off persons, and gambling in alternative, choice-based instruments such as TTO, PTO, SG (Sommerfeld et al. 2001). Our approach, exhibiting meaningful health state and disability scenarios and feasible scaling procedures seems more appropriate in the socio-cultural conditions under study. Furthermore, regarding the high response rate and consistent results, the instrument appears to be more practical than the above mentioned cognitively-demanding techniques. The instrument scores well on inter-panel and test-retest reliability and appears to possess interval properties.

Health professionals' views matched those of lay people to a considerable extent. The rankings of the disabling effect of health states were relatively stable between the two groups, although the rankings of the intermediate states

showed more variability than that of the states at both ends of the range. In comparison to that of the lay people, health professionals rated the majority of the presented health states as less severe. These findings are less convincing than those of the Dutch Study on Disability Weights (Stouthard et al. 1997) and that of a literature review (Froberg, Kane 1989) which concluded that it makes little difference whether panels to elicit disability weights are composed of health professionals or lay people.

This leads to the question of which preferences should then be used to obtain disability weights for the calculation of DALYs. Our study has shown that the evaluation of nine (frequently occurring) health states by lay people required lengthy in-depth and cognitively-demanding descriptions. Measuring health state valuations of the population for every possible health state seems therefore impractical (Murray, Lopez 2000). Our study results suggest that the application of health professionals' preferences seems an acceptable alternative to elicit disability weights on a wide range of health states, at the expense of small deviations from (and most likely under-ratings of) lay people's valuation of disability weights. However, because of our small sample size, these conclusions are only tentative and more research is needed before more general conclusions can be drawn. Another alternative, in the long run, is to develop predictive models (multi-attribute utility schemes) that allow an analyst to impute health state valuations from information about the levels on various domains of health status associated with a particular state (Murray, Lopez 2000). This would certainly decrease the workload as – after the initial collection of utility weights for the various domains of health states – health states only need to be described in terms of scores on domains in order to arrive at valuations. There is little experience with health profiles in developing countries (Shumaker, Berzon 1995), and more conceptual, methodological and empirical work is needed to develop robust models for this purpose. The present research can act as a first step towards this approach to obtain culturally-adapted, practical, valid and reliable utility instruments.

The process of elaboration did not considerably change the aggregate mean values but affected the responses at the individual level and decreased its variation. The question arises whether health state valuation instruments like the culturally-adapted VAS can then be used to collect rapidly lay people's preferences on disability weights of their own health state or hypothetical health states in household surveys. Our research has shown that respondents needed considerable time to understand and carry out the basic (individual) exercise, and that group discussion did alter their valuations, indicating the need for careful procedures. Furthermore, health states should preferably be valued in comparison to other health states: earlier research has shown that it is easier for people to give a value to an object if it can be compared to other objects (Murray 1996). This means that, even when measuring preferences

about an individual's own health state, one should include other hypothetical health states. Rapid procedures seem, therefore, to result in less appropriate results.

There is no agreement on the role of health profiles in the context of describing health states. The GBD study only applied bio-medically defined diagnostic labels, whereas the Dutch Study on Disability Weights has shown the importance of adding (EuroQol 5D+) functional descriptions to ease the valuation task of respondents (Stouthard et al. 1997). We found that the provision of locally-meaningful disability scenarios including locally designed illustrations was a necessity in the case of lay respondents. However, health professionals in our study found the descriptions somewhat approximate, which may explain the relatively large variation in their valuations compared to that of the panels of lay people.

The culturally-adapted VAS instrument has been developed for the context of rural Burkina Faso to produce locally-meaningful BOD estimates to foster local health policy. However, because of its explicit explorative nature, this study has only paid minor attention to the representativeness of its results to the overall population in Burkina Faso. Future research should include larger sample sizes and should assess to what extent the study sample represents the overall population. Moreover, it should include a comprehensive list of health states in order to produce results that are useful for policy making. A further step should be to carry out more empirical studies to test whether the proposed methodology is feasible and applicable in other cultural contexts. If so, it would represent a critical advancement in acquiring BOD estimates that would be locally-meaningful.

Chapter 5

Identifying the Private Return to Education in the Subsistence Economy of Nouna

1. Introduction

Departing from a simple OLS model for the standard Human Capital Earnings Function (HCEF) proposed by Mincer (1974), I try to identify the return to education in the poor, rural subsistence economy of Nouna. To estimate the causal effect of education on income, I employ different identification strategies such as a Panel approach, Instrumental Variables (IV), a selection model, and a model of household income. The particular appeal of the study environment is to analyze whether there is a private return to education in an economy that is mainly characterized by subsistence farming. Schultz (1975) argues that "the value of schooling in farming depends on the opportunities that farmers have to modernize their production." In areas with traditional agriculture, he postulates, "there are no significant gains in output from schooling."

Moreover, individuals face high opportunity costs of education in the study area since their decision framework is to either work on the family farm to guarantee food supply for the current year, or to attend school and be unproductive in the short run. The study area exhibits a crude death rate that is as high as 14.2/1 000. The child mortality rate amounts to 33.6/1 000 (Kynast-Wolf et al. 2001). To give a comparison: the estimates of the United Nations for the United States are 8.5/1 000 and 8.3/1 000, respectively (www.grid.unep.ch/data). The political implication of the study question is readily at hand: Is education a feasible policy to foster economic growth in a very poor subsistence economy, or do we first need rudimentary economic development to be able to benefit from formal education at all.

Empirical research partly confirms the perception of low returns to education in poor communities. Psacharopoulos (1994) estimates that the return to education is lowest (6.4 %) in low income countries. He defines a low income country as a country with a mean annual per capita income of less than 610 $.

The study area exhibits a mean annual per capita income of roughly 170 $. For SSA, he estimates a return to education of 5.9 %. There exist only few studies on SSA, though. Ram/Singh (1988) estimated returns to education for Burkina Faso in the order of 8–10 %. Their results are questionable, though, since they rely on 51 observations only. Siphambe (2000) presents a more recent study for Botswana (Southern Africa). Using data for 1993/94 on 3,608 households, he estimates a return to education of 12 % for men and 18 % for women. Controlling for family background – the education of the household head is used as control variable – these estimates drop to 3 % and 14 %, respectively. Furthermore, his findings support increasing returns to education. The highest return is apparently attained for upper secondary level (185 %), the lowest for primary education (7 %). Lower secondary education has an estimated return of 83 %, and tertiary education of 38 %.

The data set I am using covers 1,751 individuals between 20 and 50 years of age. These individuals are members of some 689 households. The data have been collected in June 2000 and February 2001. A special advantage of the data is the detailed measurement of subsistence and cash income. To address the important role of household formation and composition for production and income distribution within households, I estimate separate returns to education for men and women who are not household heads, and for male household heads. Furthermore, since the sensible income concepts are so diverse, I estimate returns to education for both subsistence income and disposable income (cash income). Subsistence income is – as mentionet in chapter 2 – roughly cash income plus the value of the self-consumed part of the harvest. This part constitutes approximately 80 % of total income on the average. My working hypothesis follows Schultz (1975) in that the returns to education should be higher for disposable income than for subsistence income since education might have a greater effect on the individual's ability to generate money income than on the individual's productivity on the family farm. I believe that the data situation is not untypical for a substantial part of SSA, especially for the poorer regions of SSA where rich and complex data sets are scarce.

The chapter is organized as follows. The next section describes the study population to be able to better understand the setting in which I try to estimate the return to education. The measurement of income has been described in chapter 2. Section 3 describes the strategies employed to identify the return to education and section 4 describes the results of the regression models. Section 5 concludes.

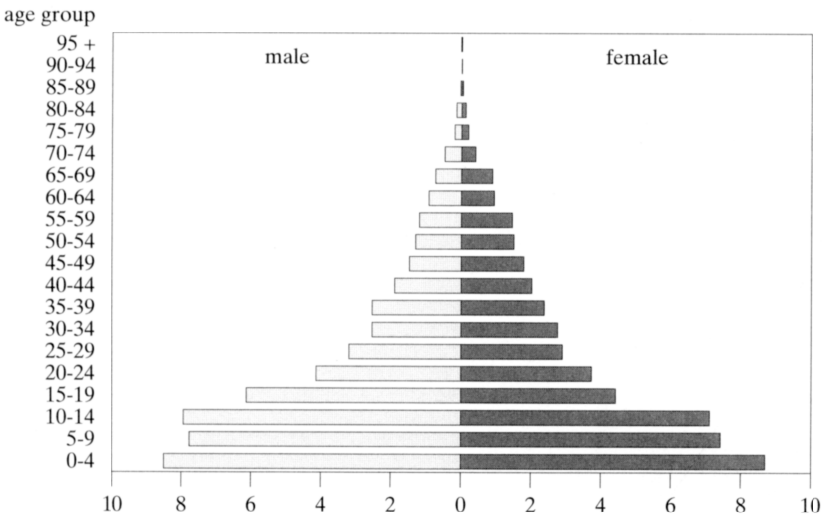
2. The Nouna Health District Household Survey

As expected, the Nouna area exhibits the typical pyramidal demographic pattern of a developing country (Figure 9). About 17 % of the population are be-

Figure 9

Demographic Pattern of the Nouna Population

June 2000; in % of total population



Author's own computations.

low 5 years of age, and almost half of the population are below 15 years of age. Individuals between 20 and 60 years of age make up only roughly 37 % of the population. The mean (median) age in the study population is 23 (16) years with a standard deviation of 18.7 years. About 51.1 % of the population is male and 48.9 % is female. The average household size is 8.0 with a standard deviation of 5.80. Household sizes range from 1 household member to a maximum of 54 household members. Only 5.5 % of all households are one-person households. Out of the 653 married household heads of the sample, 24 % report to live in a polygamous marriage, the residual 76 % are monogamous. Unfortunately, we could only identify the household head in our data in 774 out of the 802 households.

More than five ethnic groups are represented in the Nouna area, the biggest being the *Dafing* with a population share of about 49 %, followed by the *Bwaba* (20 %), the *Mossi* (13 %), the *Peulh* (9 %), the *Samo* (8 %), and some small minorities that make up the resulting 1 % of the population. Consequently, more than five different local languages are spoken. But there exists a local *lingua franca* (Dioulla) that is spoken by most of the inhabitants of the region. The predominant religion in the study area is the Islam with a population share of nearly 63 %. Some 28 % of the inhabitants are catholic, and 3 % are protestant. Even though only 6 % of the population report themselves as follo-

Table 15

Adult Illiteracy Rates and Illiteracy Rates Per Age Bracket

	Obs.	Ill. Rate	Std.Dev.
Total	3,346	75.5	0.0074
By Sex			
Male	1,716	65.0	0.0115
Female	1,630	86.6	0.0084
Rural/Urban			
Nouna	1,192	60.7	0.0141
Villages	2,154	83.7	0.0080
Per Age Bracket			
below 6	1,298	98.8	0.0030
6 – 7	192	89.6	0.0220
7 – 8	184	70.7	0.0336
8 – 9	181	69.1	0.0344
9 – 10	199	57.3	0.0351
10 – 20	1,626	61.8	0.0121
20 – 30	887	72.8	0.0149
30 – 40	652	77.9	0.0162
40 – 50	457	74.4	0.0204
50 – 60	348	87.9	0.0175
60 – 70	223	90.6	0.0196
above 70	109	93.6	0.0235

Author's own computations. RWI ESSEN

wers of traditional local religions, traditional beliefs play an important role in the everyday life of most of the inhabitants of the Nouna area.

Out of the 4,257 individuals above 10 years of age who have a valid entry for the variable occupational status, only 13 report to be unemployed or in search of employment. More than 87 % report to be employed or to be housewife, 2.6 % report to be retired, and 8.5 % are still enrolled in formal education. Over 90 % of the population report to gain their main revenue in agriculture, some 4 % work in commerce, 4.5 % report to work in a profession such as butcher, bricklayer or blacksmith, and only a small minority of less than 0.5 % work in white collar jobs such as policeman or teacher.

The study population is characterized by very high illiteracy rates (Table 15). Following the definition of the World Bank (2000b), who defines the adult illiteracy rate as the illiteracy rate in the population 15 years of age and older, the overall adult illiteracy rate in the sample of the Nouna Health District is 75.5 %. Even within SSA, the World Bank estimates the adult illiteracy rate to be only 32 % for men and 49 % for women. The overall adult illiteracy rates for the whole world are estimated to be 18 % for men and 32 % for women,

whereas the respective estimates for Europe and Central Asia amount to 2 % and 5 %, only.

In Nouna, the adult illiteracy rate in the villages is as high as 83.7 %, whereas the province capital Nouna still exhibits an adult illiteracy rate of 60.7 %. There also exists a pronounced difference in the adult illiteracy rate between sexes. The male adult illiteracy rate is 65.0 %, whereas the female rate amounts to 86.6 %. Looking at age brackets, Table 15 shows that the illiteracy rates decrease with age until the age bracket 10–20 where an illiteracy rate of 61.8 % is reached. Then, the illiteracy rate rises again very sharply, which raises the suspicion that school enrollment has improved only recently and still has to improve strongly to attain illiteracy rates in the Nouna area that are comparable to the rest of SSA.

To identify the private return to education in the rural subsistence economy of Nouna, I used a sub-sample of the data that comprised every individual of the sample in the age range from 20 to 50 years. More or less every individual in the chosen sub-sample should have completed his or her education and be economically active. Individuals above 50 years of age have been excluded because of the extraordinarily high illiteracy rates in these age brackets (87.9 % and higher). The exact sample sizes of the regressions vary slightly because of the differing number of missing values for the different endogenous and exogenous variables used. At maximum, the sub-sample comprises 2,001 individuals (994 women and 1,007 men) constituting 726 households altogether. Out of the 436 household heads, 406 are male and only 30 are female. Obviously, a high share of household heads are older than 50.

Table 16 depicts the distribution of education levels and years of schooling for the chosen sub-sample. Three quarters of the individuals reported to have had no formal education. There is a pronounced difference between sexes and whether an individual is a household head or not. Slightly more than 85 % of the woman had no formal education, whereas the respective share in the male part of the sub-sample amounts to 64.4 %. The share for household heads is slightly lower than that for men with 59.2 %.

A little more than 8 % of the total sub-sample participated in an alphabetization program. These government-run programs are held at irregular intervals in the villages. Their main purpose is not only to impart basic literacy skills. Their curriculum also covers topics in agriculture, health care, and general knowledge. The participants of these literacy programs are predominantly male adults: 14.0 % of the male sub-sample participated in such a program, whereas the respective share for women amounts to 2.2 % only. Household heads have the highest share with 16.9 %. The same pattern can be observed for primary, secondary, and superior education. On average, household heads have a higher education than men and women who are not household head. Almost 17 % of

Table 16

Distribution of Education Levels and Years of Schooling

	Total		Male				Female				HH Heads	
			All		No HH Heads		All		No HH Heads			
	%	obs.	%	obs.	%	obs.	%	obs.	%	obs.	%	obs.
No Education	75.0	1,494	64.4	645	68.2	378	85.8	849	85.7	788	59.2	255
Alphabetized	8.1	162	14.0	140	10.8	60	2.2	22	2.3	21	16.9	73
01		3		2		1		1		1		1
02		7		4		4		3		3		–
03		31		16		7		15		15		8
04		25		20		12		5		3		8
05		27		20		11		7		7		9
06		135		89		46		46		42		45
Primary	11.4	228	15.1	151	14.6	81	7.8	77	7.7	71	16.5	71
07		10		4		3		6		6		1
08		17		7		5		10		10		1
09		16		7		5		9		9		2
10		28		20		10		8		8		9
11		10		8		5		2		2		3
12		5		3		2		2		2		1
13		14		12		5		2		–		9
Secondary	5.0	100	6.1	61	6.3	35	3.9	39	4.0	37	6.0	26
14		1		–		–		1		1		–
15		1		–		–		1		1		–
16		2		2		–		–		–		2
17		1		1		–		–		–		1
18		1		1		–		–		–		1
19		1		–		–		1		–		1
20		1		1		–		–		–		1
Superior	0.4	8	0.5	5	0.0	0	0.3	3	0.2	2	1.4	6
Total[1]	100.0	1,992	100.0	1,002	100.0	554	100.0	990	100.0	919	100.0	431

Author's own computations. – [1]Due to missing values for the variable education and the variable HH head, the total does not always represent the total for the respective column of the sub-sample as a whole. Furthermore, the fact that there are 990 female observations and 919 females who are not HH head does not imply that 71 women are HH heads. Only 30 women are HH heads. The remaining difference is due to missing values for the variable HH head.

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the household heads have a primary education, 6.0 % a secondary education, and 1.4 % a superior education. The respective shares for women are 7.8 %, 3.9 %, and 0.3 %. The respective shares for men are 15.1 %, 6.1 %, and 0 %. Altogether, only 8 individuals received a superior education; five of them are male household heads and one is a female household head. The remaining two are women who are not the head of their household.

Some selected years of education coincide with the graduation from an education level, such as secondary education. A striking feature of the data on the

number of years of schooling is that apart from primary education there is almost no heaping at those years. Even for the level of primary education, only about 60 % of those who ever attended primary school finished primary school. For secondary and superior education, the distribution across years almost resembles a uniform distribution. The reason for this observation is straightforward. It is very common in the study area that people attend school for as long as they can afford it, irrespective of the achievement of degrees. If they cannot continue to pay the school fees or – in the case of primary education where no school fees have to be paid – they cannot afford the costs of living at the place where they attend the school, they simply stop attending school hoping to resume schooling at some later time when their financial constraints allow it again.

Table 17 depicts the mean subsistence and disposable annual income conditional on the different education levels for men and women, and for men and women who are not household heads. In addition, the unconditional mean for the whole sub-sample and for the four subgroups is given. As expected, women have a much lower income, whether they are household heads (which is only the case for 25 out of 871 women) or not. Because of the small numbers of female household heads, the conditional means for this demographic group should be regarded with caution.

As mentioned above, the mean disposable income is always lower than the mean subsistence income. This is typical for a subsistence economy where a major part of the harvest is consumed by the household members themselves. The unconditional mean subsistence income for the whole sub-sample is 168.7 $, the unconditional mean disposable income amounts to 103.1 $. On average, male household heads command a subsistence income of about 500 $. By contrast, men who are not household head reported a much lower mean subsistence income of only 112.1 $. The 25 women who are heading their households have a mean subsistence income of 383.9 $, whereas the women who are not household head have the lowest mean subsistence income of about 44 $.

For the four demographic groups as a whole, mean income rises with education level. The mean subsistence income for all individuals who received no formal education is 124.4 $. The mean subsistence income for those who attended an alphabetization program amounts to 325 $. The mean for primary education is slightly lower with 235.1 $, whereas the mean for secondary education is again higher with 352.7 $ and the mean for superior education is the highest with 1,690.3 $. The higher mean for individuals who attended an alphabetization program than for individuals with primary education could possibly be explained by the higher effectiveness of these programs. Alphabetization programs cover more practically relevant subjects and the participants of these

Table 17

Mean Annual Income Conditional on Schooling

	Total	Male		Female	
		HH Heads	No HH Heads	HH Heads	No HH Heads
		Total			
Observations	1,760	387	502	25	846
Subsistence Income[1], $	168.7	500.6	112.1	383.9	44.1
Disposable Income[1], $	103.1	273.0	73.7	326.1	33.9
		No Education			
Observations	1319	229	341	18	731
Subsistence Income, $	124.4	404.3	113.2	221.0	39.5
Disposable Income, $	69.6	186.0	71.8	158.7	29.8
		Alphabetized			
Observations	145	69	56	1	19
Subsistence Income, $	325.0	582.1	98.7	506.7	48.7
Disposable Income, $	179.0	314.7	54.0	450.4	40.5
		Primary Education			
Observations	206	66	74	3	63
Subsistence Income, $	235.1	509.3	136.1	344.4	59.0
Disposable Income, $	150.2	300.9	96.4	310.7	47.8
		Secondary Education			
Observations	80	18	29	2	31
Subsistence Income, $	352.7	1,092.8	68.8	1540.7	111.8
Disposable Income, $	304.7	936.8	43.8	1519.0	103.4
		Superior Education			
Observations	5	4	0	1	0
Subsistence Income, $	1,690.3	1,863.1	–	999.4	–
Disposable Income, $	1,687.2	1,859.2	–	999.4	–

Author's own computations. – [1]Subsistence Income refers to the variable SUB99. Disposable Income refers to the variable DISP1515.

programs are at an age where they might profit more from the imparted knowledge. But these considerations are only speculative. It is difficult to talk about causality by looking at conditional means. The results of the models below should clarify whether there is a causal effect of education on earnings and should quantify this effect.

More or less the same pattern that can be observed for the *marginal* distributions across demographic groups and across education levels can be observed *within* the cells depicted in the matrix given in Table 17. Male household heads' mean subsistence income rises from 404.3 $ for individuals without any formal education to 1,863.1 $ for individuals with superior education. Their female counterparts experience a similar education-related increase in income, even though – as mentioned above – these results should be regarded with

caution because of the small number of observations for these cells. The same pattern is again repeated for women who are not household heads, albeit on a much lower level. The mean subsistence income rises from 39.5 $ for women without formal education to 111.8 $ for women with a secondary education.

A slightly different picture can be observed for men who are not household heads. Their mean subsistence income stays more or less constant or seems to even decrease with the number of years of schooling. This finding could be a spurious finding caused by sample variation and the relatively small number of observations within cells. Nevertheless, another interesting explanation could drive these results. The question is: why are these relatively highly educated men not household heads in a population where 75 % of the inhabitants have no formal education at all? It could be the case that these men have a low income potential because of unobserved individual characteristics that also led to the fact that they are not household heads. The mean subsistence income for this demographic group is 113.2 $ for those who have no formal education, 98.7 $ for those who attended an alphabetization program, 136.1 $ for those with primary education, and 68.8 $ for those with secondary education. All men with superior education are household heads.

3. Identification Strategy

When estimating the private return to education, any empirical analysis is confronted with two main problems. Firstly, a crucial variable that determines the income of an individual is usually omitted from the wage equation since it is very difficult to measure: the individual's ability (Griliches 1977). A more able individual will most probably be more successful in economic life whether he or she receives education or not. Furthermore, he or she will most probably receive more education because education is less costly to him or her. This process of self-selection into treatment (education) obscures the net effect of education. As a consequence, the private return to education will be overestimated since it reflects both education and ability.

The second problem is the measurement error. Card (1999) estimates the reliability of self-reported schooling to be about 90 %. Even though this number is a rough estimate for surveys in industrialized countries and it is impossible to verify this value for the survey, it is not unlikely that the schooling data is also not free of measurement error. Following Griliches (1977), the measurement error in schooling would be expected to lead to a downward bias of the OLS estimate of the coefficient of schooling in a regression of income on schooling. Most of the recent literature argues that the causal effect of education may in effect be larger than proposed by the standard OLS estimate. By contrast, it would have to be smaller if the endogeneity problem described above were the more important data problem (e.g. Card 1995).

To be able to judge on the quality of a good identification strategy, it is helpful to first sketch out what the ideal identification strategy would be. The ideal framework in which the net effect of education could be isolated, would be a randomized controlled trial where individuals are randomly selected into a treatment group that receives education and into a control group that does not receive education. If the sample size is large enough, the random selection process would balance out observables and unobservables and the difference in income between the treatment group and the control group would be a consistent estimator of the treatment effect (see Schmidt 1999; Vella, Verbeek 1999; Ginther 2000 for a more technical representation of the identification and estimation of the treatment effect in a counterfactual identification framework).

Since such an experimental identification strategy is not feasible for ethical and logistic reasons, one has to resort to a non-experimental identification strategy. As a starting point and benchmark with which the estimates of more sophisticated models can be compared, Card (1999) suggests to use a simple OLS regression of income on schooling and work experience. As specification, the *Standard Human Capital Earnings Function* (HCEF) as proposed by Mincer (1974) has proven to be both theoretically convincing and empirically tractable (Heckman, Polachek 1974).

In such a model, the logarithm of income is regressed on a constant, on the number of completed years of schooling, on a quadratic function of work experience, and a set of control variables (or other variables that affect income):

$$(1) \qquad \log y_i = \alpha + \beta S_i + \gamma_1 E_i + \gamma_2 E_i^2 + X_i \delta + \varepsilon_i .$$

It is supposed that the usual assumptions of a standard OLS model apply; in particular the assumption that the disturbance term ε is uncorrelated with *S*. This functional form imposes the restriction of linear returns to the years of schooling. This restriction is debatable for the data if you look at the conditional means as given in Table 17. Therefore, I also used a variant of the specification given in equation (1), where I allowed for nonlinear returns for the different education levels:

$$(2) \qquad \log y_i = \alpha + \beta_0 alpha_i + \beta_i primary_i + \beta_2 secondary_i + \beta_3 superior_i + \gamma_1 E_i + \gamma_2 E_i^2 + X_i \delta + \varepsilon_i .$$

Dummies represent the different education levels. *Alpha*, for example, takes on the value "1" for individuals who participated in an alphabetization program, *primary* is "1" for individuals whose highest education level is primary school, and so on.

As a more advanced identification strategy, panel data could in principle be used to identify the treatment effect (the return to education) in the presence of unobservable heterogeneity. Individual-specific effects – modeled as random (in a Random Effects Model) or fix (in a Fixed Effects Model) – then capture all time-invariant individual characteristics, including ability, ambition, or motivation. I estimated a Random Effects Model using the first two waves of the NHDHS that contain socio-economic information. The results more or less reproduce the OLS estimates. However, in a Hausman test, the null hypothesis that the Random Effects model produces consistent estimates was rejected. Therefore, I also estimated a Fixed Effects model. But as expected, the Fixed Effects model produced futile results. The two panel waves lie only six months apart. It would be surprising if the within-variation of these two waves could explain the relationship between income and schooling. Consequently, I do not report these results here. They are available on request, though.

In the recent literature, the most prominent approach to identify the return to education is the Instrumental Variable method (IV) (Card 1995, 1999) reviews some recent studies that use IV to identify the return to schooling). To implement this method, a variable – referred to as an instrument – is needed that is correlated with schooling but uncorrelated with ability. The influence of this variable on income should only operate through schooling, otherwise the instrument and income should be uncorrelated. In the literature, school proximity is often used as such an instrument. The distance of an individual's home to the nearest school should naturally have no effect on the individual's ability, but most probably school proximity has an influence on individual schooling choice.

Technically, the IV method is identical to a two stage least squares regression. Schooling is regressed on the instrument (or set of instruments) to isolate the exogenous part of the variation of schooling. The prediction emanating from the first-stage regression is then used instead of the schooling regressor in the income regression. In the second stage, only that part of the variation of schooling is used in the income regression that is exogenous and not influenced by the individual's ability. Intuitively, the IV method can also be seen as a method to re-construct a randomized controlled trial in observational data. Distance is then regarded as a random assignment into treatment (schooling) that balances out observables and unobservables.

Additionally to the NHDHS data, I gathered the information on the distance to the nearest primary school both at the time of the survey and 14 years ago. Since we did not collect information on where the individual lived 14 years ago, though, in using this information I have to assume that people did not move much over time. This is most probably true for the major part of the population. But even if this assumption does seem debatable, the information on

the distance to the nearest primary school 14 years ago is nevertheless very valuable. The reason is the following: Out of the 18 villages sampled in the survey, only seven had their own primary school 14 years ago. Instead, at the time of the survey, only 4 villages did *not* have their own primary school.

Thus, there has been much more variation in schooling 14 years ago which most probably had a much bigger "ability-independent" impact on schooling choice than today. As a third instrument, the distance to the nearest secondary school was investigated. In the past as well as today, the only secondary school in the Nouna area was and is located in Nouna itself. Consequently, this variable equals the distance from the villages to Nouna, the province capital and therefore the economic center of the region. This circumstance poses a problem concerning the interpretation of the third instrument variable. Does the instrument variable really filter exogenous variation of schooling or does it introduce another aspect that has to do with the proximity to labor and goods markets. Whatever the case may be, I run the IV regressions with and without the third instrument. The results were the same. So at least, it does not make any numerical difference.

As described above, in the NHDHS, every individual above ten years of age is asked a set of questions on his individual income sources. Even though pooling of income exists, it is common in the study area that individual household members cultivate their own piece of land or have their own small commerce. Nevertheless, not every household member reports positive income. About 13 % of the individuals of the analyzed sub-sample report zero income. Since the Human Capital Earnings Function à la Mincer uses the logarithm of income as regressand, this information is lost if OLS or IV is used as regression method.

If somebody receives – or reports – his or her own income or not will depend a lot on his or her status inside the household. Other influencing factors could be the ethnic group or religion of the household members. In Muslim households, for example, it is less common that women have their own income than in Christian households. The individuals who report zero income in the NHDHS might have a high income potential and in fact contribute substantially to overall household income, but their individual contribution might lie in housekeeping and other functions inside the family farm. These activities do not directly generate income that would be reported and measured in a survey, though.

To put it more formally, there seems to be a selection process that determines whether an individual reports positive income or not. What we actually want to identify is the return to education, i.e. the enhancement of productivity through schooling. This productivity gain should lead to a higher income either because a higher wage can be achieved in the labor market or because –

in a subsistence economy – the production of the self-employment family farm increases. Thus, we are interested in the increase in income y^*, but we observe y^* only if a variable z^* exceeds a certain threshold. The variable z^* could be seen as something like power or status inside the family. Let us call it self-assertion to simplify the discussion in the following. The selection process can be modeled in the usual way:

$$z_i^* = W_i \eta + v_i, \tag{3}$$

where W_i is a vector that collects all variables that influence the individual's self-assertion, and v_i the corresponding disturbance term. An individual reports positive income ($z_i = 1$) if $z_i^* \geq 0$, and zero income ($z_i = 0$) if $z_i^* < 0$. Income is specified similar to equation (1) as

$$y^* = \log y_i = \alpha + \beta S_i + \gamma_1 E_i + \gamma_2 E_i^2 + X_i \delta + \varepsilon_i, \tag{4}$$
$$\text{with } (v_i, \varepsilon_i) \sim [0,0,1,\sigma_\varepsilon, \rho].$$

Even though income is specified as given in equation (4), a simple OLS regression of equation (4) would produce inconsistent results since the variable y^* is incidentally truncated. The correct regression model is given by

$$E[y_i^* | z_i = 1] = \alpha + \beta S_i + \gamma_1 E_i + \gamma_2 E_i^2 + X_i \delta + \rho \sigma_\varepsilon \lambda, \text{ with } \lambda = \frac{\phi(W_i \eta)}{\Phi(W_i \eta)}, \tag{5}$$

ϕ being the density function and Φ the cumulative density function of the standard normal distribution. Equation (5) is a standard selection model and can be estimated with the two-step procedure proposed by Heckman (1974) or with Maximum Likelihood. The interesting twist to the standard model in our case is the adaptation of the standard selection model to the situation in a subsistence economy where some individuals do not report positive income even though they might contribute substantially to the household income of the family farm.

Schultz (1993) points out that the crucial prerequisite for identification in a selection model is to find a *selection instrument* – in our case a variable that influences the probability to report non-zero income, but that does not affect reported income. In the analyzed sub-sample, more than 60 % of those who reported zero income are women. Inspired by the literature on female participation in the labor market, I used the number of children as the selection instrument. Because of the special cultural background in which the study is rooted, I additionally included a dummy for Christian women. About 22.8 % of the Christian women in the sub-sample report zero income, whereas for Muslim women the respective share is 24.4 %.

The problem of the measurement of individual income straightforwardly leads to another alternative to identify the private return to education: a model of household income and household investments in human capital. If individual income is given by

$$y_i^* = \alpha + \beta S_i + \gamma_1 E_i + \gamma_2 E_i^2 + \varepsilon_i, \tag{6}$$

simple calculus leads to the following specification of the HCEF for household h:

$$y_h^* = \sum_j \left(\alpha + \beta S_j + \gamma_1 E_j + \gamma_2 E_j^2 + \varepsilon_j\right), \tag{7}$$

where $j = 1, ..., k$ denotes the single household members of household h. Household income is therefore a function of the total number of years of schooling attained by the different household members, plus the total number of years of work experience and work experience squared. As a consequence of the summation across household members, the disturbance term is no longer homoscedastic, but depends on the household size. Therefore, OLS would be inefficient and GLS should be used instead. Since the form of heteroscedasticity is known, it is simple to correct for heteroscedasticity by weighing the observations (now on household level) according to the household size of the respective observation (household).

In the regression models for individual income described above I included a female dummy and a dummy for household heads. Additionally, interaction terms between these two dummies and schooling were introduced. In doing so, I allowed for different intercepts and different returns to education for household heads and for men and women. In the household model, it was obviously not necessary to include a dummy for the household head, since – by definition – every household has exactly one household head. Furthermore, I did not include a regressor that controlled for the share of women inside the household, and I did not include interaction terms.

It is not unlikely that it makes a difference for total household income who acquired the human capital. Household heads, for example, might use their human capital more effectively, since they make the important economic decisions. But on the other hand, the specification of equation (7) has the considerable advantage that it is easily interpretable. The main focus was to investigate if the measurement of income distorts the results of the income regressions on individual level. If the results of the household model would be close to the results of the individual income regressions, I would take that as evidence that the individual regressions are not misspecified. The results suggest that the individual regressions are not misspecified in this regard. The estimates of the household model were consistent with the results of the individual regressions. The results are given in detail below.

4. Results

As a starting point and benchmark with which the results of the more sophisticated models can be compared, I estimated a simple version of the HCEF. The model has already been introduced in equation (6) but shall be repeated here for convenience:

$$\log y_i = \alpha + \beta S_i + \gamma_1 E_i + \gamma_2 E_i^2 + \varepsilon_i . \quad (8)$$

Table 17 has already shown that the income means conditional on education level vary substantially for men and women. They also vary considerably according to whether only household heads are considered or whether household heads are excluded from the analysis. Thus, I estimated the simple model for the following three subgroups: men who are not household heads, women who are not household heads, and male household heads. The group of female household heads is so small that the results will not be discussed here in detail. They can be obtained on request.

An interesting variation of the results originates from the fact that I could use different income variables as endogenous variables. As described above, seven different income variables have been generated in the NHDHS, depending on the reference period used in the survey and whether subsistence income or disposable income is calculated. This variation can be used in two ways. Firstly, it can be used as sensitivity or robustness analysis. The number of observations used to generate the different income variables varies because of the differing numbers of missing values for the different variables that make up the components of the income variables.

To keep the exposition clear, I am presenting only the results for the variables Sub99 and Disp1515. The variable Disp1515 adds up the disposable income as reported in wave 1 and wave 3. Thus, Disp1515 supposedly represents the most robust variable for disposable income. Seasonal fluctuations should be balanced out because of the large reference period. The variable Sub99 basically is the variable Disp1515 minus the sale of agricultural products, plus the value of the harvest in 1999. I took the figures for 1999 since the harvest of 2000 was exceptionally bad. Disposable income as measured by Disp1515 amounts to roughly 60 % of subsistence income (as measured by Sub99), indicating that the share of the self-consumed part of the harvest is fairly high.

Secondly, the return to education might differ whether disposable income or subsistence income is used as regressand. As working hypothesis, I expected that individuals would have a higher return to education for disposable income. The logic behind this argument is that education might have a greater effect on the individual's ability to generate money income than on the individual's productivity on the family farm.

Table 18

Standard OLS Models for the Human Capital Earnings Function

	Men (excl. HH Heads)		Women (excl. HH Heads)		Male HH Heads	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
Schooling	0.0621 (0.0340)[a]	0.0460 (0.0312)	0.1485 (0.0276)	0.1589 (0.0268)	0.1063 (0.0175)	0.1706 (0.0253)
Experience	0.1062 (0.0579)	0.0956 (0.0533)	0.0777 (0.0358)	0.0971 (0.0345)	0.0129 (0.0409)	0.0494 (0.0598)
Experience^2	–0.0013 (0.0012)	–0.0015 (0.0011)	–0.0010 (0.0006)	–0.0015 (0.0006)	–0.0001 (0.0007)	–0.0007 (0.0010)
Constant	9.0262 (0.6949)	9.0553 (0.6374)	8.4306 (0.4867)	8.0305 (0.4693)	11.882 (0.6141)	10.284 (0.8936)
Obs.	374	368	689	682	316	308
F-Test	5.46	2.17	11.21	11.80	14.84	19.53
Adj. R^2	0.0346	0.0095	0.0426	0.0454	0.1164	0.1533

Author's own computations. – [a]Standard errors are given in parenthesis.

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Table 18 depicts the results of the standard OLS models for the HCEF for the three demographic groups given above. For convenience, I will talk of "men" if I refer to the results of the subgroup "men who are not household heads", of "women" if I refer to the group of "women who are not household heads", and of "household heads" if I refer to the group of male household heads. Roughly 93 % of all household heads are male. For subsistence income, women have the highest return to education with 14.9 %. The return to education for men is 6.2 % and for household heads 10.6 %. The return to education for disposable income is higher than the return to education for subsistence income for women (15.9 %) and for household heads (17.1 %). For men, the estimated coefficient amounts to 4.6 %. This coefficient is the only one that is not significant at the 10 % level. The coefficients for women and for household heads are significant at the 5 % level.

The "work experience-earnings profile" has the expected inverted U-shape for men and for women. Income rises with work experience with a decreasing rate until it finally decreases with age. The coefficient of the second order term is rather small, though, and only significant (at the 5 % level) for women and disposable income. The income of household heads doesn't seem to decrease with age, which is plausible. Because of their status and power inside the household, they will still report a big majority of household income even if they become less productive in the daily work in the fields. Another point which has to be considered is that the analyzed sub-sample only comprises individuals that are younger than 50. Thus, there might not be much evidence for the decreasing part of the age-earnings-profile in the sample. The estimated coefficients for the constant represent what has already been documented in

Table 19

OLS Models for the Human Capital Earnings Function with Interaction Terms

	Standard OLS		Excluding Superior Education	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
Schooling	0.0425	0.0427	0.0402	0.0396
	(0.0237)	(0.0241)	(0.0240)	(0.0244)
Schooling if Female	0.1088	0.1093	0.1137	0.1156
	(0.0283)	(0.0289)	(0.0291)	(0.0297)
Schooling if HH Head	0.0787	0.1256	0.0826	0.1276
	(0.0278)	(0.0283)	(0.0300)	(0.0306)
Experience	0.0819	0.0792	0.0818	0.0789
	(0.0234)	(0.0240)	(0.0234)	(0.0240)
Experience^2	–0.0011	–0.0012	–0.0011	–0.0012
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Constant	9.4344	9.2020	9.4362	9.2089
	(0.3157)	(0.3230)	(0.3168)	(0.3241)
Female	–1.0516	–0.8826	–1.0539	–0.8853
	(0.0859)	(0.0881)	(0.0861)	(0.0883)
HH Head	1.3294	0.7104	1.3256	0.7094
	(0.1082)	(0.1113)	(0.1093)	(0.1125)
Obs.	1403	1382	1398	1377
F-Test	152.65	86.26	147.06	79.59
Adj. R^2	0.4309	0.3017	0.4226	0.2856

Author's own computations. – *Standard errors are given in parenthesis.

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Table 17: across education levels, the mean annual income is the highest for household heads and the lowest for women.

To be able to estimate the returns to education with more precision, I imposed the restriction that the coefficients for experience and experience squared would be the same for men, women, and household heads. Thus, I estimated an OLS model with two interaction terms. The results are given in Table 19. For subsistence income, the reference group of men who are not household head has a return to education of 0.043. The coefficient of the interaction term between schooling and the female dummy is 0.109, implying a return to education of 0.151 for women who are not household head. The coefficient of the interaction term between schooling and the dummy for household heads amounts to 0.079, implying a return to education of 0.121 for male household heads and 0.230 for female household heads.

Almost all coefficients are significant at the 5 % level, most of them are significant at the 1 % level. The coefficients on schooling for the male reference group are only significant at the 10 % level. The results of the F-Tests confirm the significance of the overall model both for subsistence income and disposable income. Both models achieve a comparably high model fit. For subsistence

income, the model explains 43.1 % of the overall variation. For disposable income, the respective adjusted R^2-value amounts to 0.302.

Table 17 demonstrated a comparatively high mean annual income for those few individuals with superior education. Their mean income amounts to 1,690.3 $ as compared to 352.7 $ for individuals with secondary education. To verify if the results of the OLS models are driven by this artifact of the data, I rerun the regressions with interaction terms excluding the observations for superior education. The results did not change noticeably. In fact, the returns to education were even higher if the observations for superior education were excluded.

The HCEF implies constant returns to education for each year of schooling, no matter at what education level the school year was attained. To allow for a non-linear relationship between income and the number of years of schooling, I estimated a functional form that included dummies for each education level (see equation (2)). The dummies also took on the value "1" if an individual did not attend the respective school long enough to attain the final degree. In the Nouna area, there most probably is a rather small "sheepskin effect" if at all. The final degree does not necessarily lead to a "wage" premium as is the case in industrialized countries with an established labor market (Card 1999).

As mentioned above, people attend school as long as they can afford it. Not attending school until the final degree of the respective school does not represent a signal for low productivity or perseverance. For higher than primary education, there is even no observable heaping effect at those years where the respective degree would be obtained. Therefore, the question whether there is a return to education in a poor subsistence economy has its own interesting focus, because it directly addresses the issue whether education leads to an increase in productivity. This question has a slightly different focus than the question whether labor markets reward the achievement of a degree, which could also be a signaling effect instead of the effect of an increase in productivity.

In the models of the form of equation (8), I did not include those individuals who took part in an alphabetization program since it is not evident how to convert the alphabetization programs into the classical frame of number of years of schooling. These programs last less than a year and are typically frequented by individuals that have zero formal education. Nevertheless, they cannot be compared to one year of primary school since they cover a broader range of topics and those who attend the program are not young children but predominantly male adults. Furthermore, the total of individuals who attended an alphabetization program have a higher mean annual income than the total of individuals who attended primary school, even though primary school lasts six years instead of six months (Table 17). This empirical finding is confirmed if

Table 20

OLS Models for HCEF That Allow for Varying Returns to Education

	Men (excl. HH Heads)		Women (excl. HH Heads)		Male HH Heads	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
Alpha	0.1878 (0.2284)	–0.1052 (0.2122)	0.1748 (0.3265)	0.3386 (0.3104)	0.4050 (0.1231)	0.3659 (0.1851)
Primary	0.2797 (0.2074)	0.1796 (0.1924)	0.7402 (0.1888)	0.7582 (0.1831)	0.3529 (0.1336)	0.4249 (0.1984)
Secondary	0.7998 (0.4032)	0.4823 (0.3726)	1.4848 (0.3417)	1.5526 (0.3255)	1.2275 (0.2460)	2.0386 (0.3646)
Superior[a]	– (–)	– (–)	– (–)	– (–)	1.9167 (0.4590)	2.9397 (0.6802)
Experience	0.1209 (0.0551)	0.0916 (0.0510)	0.0811 (0.0373)	0.0953 (0.0357)	0.0126 (0.03922)	0.0601 (0.0586)
Experience^2	–0.0017 (0.0011)	–0.0014 (0.0010)	–0.0010 (0.0006)	–0.0014 (0.0006)	–0.0001 (0.0006)	–0.0011 (0.0010)
Constant	8.8833 (0.6622)	9.0990 (0.6110)	8.3628 (0.5072)	8.0306 (0.4859)	11.981(0.584 7)	10.421 (0.8711)
Obs.	415	409	705	698	384	374
F-Test	3.71	1.45	7.09	7.15	8.40	10.13
Adj. R^2	0.0317	0.0055	0.0415	0.0422	0.1038	0.1280

Author's own computations. – [a]There are no men with superior education that are not household head. For the two women who are not household head but have a superior education I do not have a valid value for the variables SUB99 and DISP1515. The table displays the estimates of the coefficients. Marginal effects are obtained by (e^{coeff} –1). Standard errors are given in parenthesis.

only the subgroup of household heads is considered. I could have attached a higher number of years to the alphabetization programs to correct for their higher effectiveness, but the question would be: what number? If I adapted the duration of the alphabetization programs according to the higher mean income of its participants, I would have influenced more or less arbitrarily the results of the HCEF regressions. Consequently, I only included the individuals who attended an alphabetization program in the regressions that used dummies for the different education levels.

The results of these regressions (Table 20) confirm the findings of the standard OLS models for the HCEF. There exists a U-shaped age-earnings-profile in Nouna and income rises with education. The education-related increase in income is more pronounced for women than for men, and more pronounced for household heads than for individuals who are not household head. As Psacharopolous (1994) points out, the coefficients of this specification are not returns to education but rather marginal effects, or to be more precise: in the semi-log specification, the marginal effects are given by (e^{coeff}–1).

Table 21

Returns to Education for Different Education Levels

	Men (excl. HH Heads)		Women (excl. HH Heads)		Male HH Heads	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
Alpha	20.7	–10.0	19.1	40.3	49.9	44.2
Primary	4.8	3.0	13.1	13.5	6.1	7.3
Secondary	9.6	5.2	18.7	20.0	16.9	32.5
Superior*	–	–	–	–	23.5	43.0

Author's own computations. RWI ESSEN

Therefore, for men (women), the marginal effect of an alphabetization program on subsistence income is 0.207 (0.191), i.e. a male (female) individual who attended an alphabetization program has an income that is 20.7 % (19.1 %) higher than the income of an individual who has no formal education. The marginal effect of primary education is 0.323 (1.096), and the marginal effect of secondary education amounts to 1.225 (3.414). For male household heads, the marginal effect of an alphabetization program on subsistence income is 0.499. For primary education, the marginal effect amounts to 0.423, and for secondary education 2.413. The marginal effect of superior education on subsistence income is as high as 5.798, its effect on disposable income even amounts to 17.910. The estimates of the marginal effects for men have to be interpreted with caution, though, since they are not significant, except the marginal effect of secondary education on subsistence income. For women, only the marginal effects of alphabetization programs are not significant. For male household heads, all estimates are highly significant.

Following Siphambe (2000), I calculated rates of return to education for the different levels of education. In contrary to the simple approximation given there, I calculated the rates as $\left[1+\left(D_k - D_{k-1}\right)\right]^{1/n_k} - 1$, with D_k being the marginal effect of education level k, and n_k the number of years of schooling of education level k. I assigned one whole year of education for the alphabetization programs. Table 21 displays the resulting rates of return to education for the different education levels. Apart from the outlier for men for disposable income, the returns for an alphabetization program are extraordinarily high.

For subsistence income, the respective rates are 20.7 % for men, 19.1 % for women, and 49.9 % for male household heads. For disposable income, the respective rates amount to –10.0 %, 40.3 %, and 44.2 %. The rates for primary education are 4.8 % for men, 13.1 % for women, and 6.1 % for male household heads if the log of subsistence income is used as regressand. The respective rates for secondary education are 9.6 %, 18.7 %, and 16.9 %. Only male household heads attained a superior education. For this demographic group, the

rates of return to superior education amount to 23.5 % for subsistence income, and 43.0 % for disposable income. The interesting result of this calculation is that even if I control for the duration of education, the rates of return are higher for higher education levels. In the subsistence economy of Nouna, there seem to be increasing rather than diminishing returns to education.

The finding that the disposable income of an individual with superior education is more than 18 times higher than that of an individual without formal education is quite surprising and would shed doubt on the results if they were obtained from European data. For Nouna, though, this result is plausible. A household head without any formal education does not gain much disposable income. A big share of his "total" income would be the agricultural production dedicated for self-consumption. A household head with superior education, though, would earn a salary comparable to the standards of Ouagadougou, the capital of Burkina Faso. Such a salary could well be 18 times higher than the disposable income of a subsistence farmer.

But another question is raised by this finding: Why should somebody who is able enough to do so not attain superior education if he can expect his income to be 6 to 18 times higher? The theory on schooling choice (see the representation in Card 1999) states that an individual will choose his or her level of schooling inside a utility-maximizing framework. The (expected) income of the individual depends positively on his or her level of education, with decreasing returns to education. Furthermore, education is costly, both in terms of money (that has to be spend on books etc.) and in terms of opportunity costs (e.g. time that has to be spent learning instead of working on the family farm or enjoying as leisure time). Thus, an optimum will be chosen that balances out costs of and returns to education. In the poor area of Nouna, it is obvious that people often cannot bear the mere pecuniary costs of the investment in human capital out of their pockets. Furthermore, there are no functioning credit markets that would finance their education even if the return were high enough to repay a loan (at world market or comparable interest rates). Individuals choose their optimal level of schooling in dependence of the expected return of education.

Individuals who expect a higher return to education will choose a higher education. This selection into treatment makes the identification of the pure treatment effect difficult. An OLS model simply reflects the empirical correlation between income and schooling, but it does not answer the question of causality. The following more sophisticated models try to answer this question. In the following models, the education variable is not specified as a string of dummies (as in Table 20). Instead, the standard HCEF as proposed by Mincer (1974) is used to facilitate the interpretation of the coefficients as returns to education and to be able to compare them with the findings of other studies (especially those reviewed in Psacharopolous 1994).

Table 22

Instrumental Variables for HCEF

	Men (excl. HH Heads)		Women (excl. HH Heads)		Male HH Heads	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
Schooling	0.4883 (0.1705)	0.1076 (0.1269)	0.3971 (0.1197)	0.7154 (0.1338)	0.0799 (0.0718)	0.4533 (0.1197)
Experience	0.5442 (0.1836)	0.1590 (0.1376)	0.2240 (0.0781)	0.4313 (0.0893)	–0.0060 (0.0646)	0.2501 (0.1086)
Experience^2	–0.0092 (0.0034)	–0.0027 (0.0025)	–0.0033 (0.0013)	–0.0068 (0.0015)	0.0002 (0.0009)	–0.0031 (0.0015)
Constant	3.1252 (2.4376)	8.2030 (1.8208)	6.1731 (1.1729)	2.9032 (1.3343)	12.290 (1.243)	5.9240 (2.0775)
Obs.	374	368	689	682	316	308
F-Test	5.79	1.67	5.09	9.58	2.92	7.92

Author's own computations. – *Standard errors are given in parenthesis.

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Currently, the most prominent method to identify the return to education is the IV method. IV potentially corrects the omitted variable bias (upward bias) that results from the omission of the variable "ability" in the standard HCEF. Additionally, it potentially corrects the downward bias caused by measurement error of the variable 'schooling'. The IV estimates obtained for our data are much higher than the corresponding OLS estimates (Table 22). For subsistence income, for men, the estimated return to education is as high as 48.8 %. Even though the respective estimate for disposable income only amounts to 10.8 %, it is still more than two times higher than the OLS coefficient. For women, the return to education for subsistence income is 39.7 %, the respective estimate for disposable income amounts to 71.5 %. For male household heads, the return to education for subsistence income and disposable income are 8.0 % and 45.3 %, respectively.

The age-earnings-profile of the IV estimates is also much more pronounced than the age-earnings-profile of the OLS estimates. All coefficients are significant at the 5 % level, except the coefficients for disposable income for men and those for subsistence income for male household heads. As expected, the precision of the estimates is lower than the precision of the OLS estimates.

In many comparable studies the IV estimates of the education coefficients are higher than the corresponding OLS results. Usually, the differences are not that pronounced, though. Unfortunately, there is no clear decision rule or test that helps to clarify the question whether the IV results really represent the causal effect, or whether the instrument might not be valid. Therefore, I decided to implement additional identification strategies that should help to make a more profound statement.

Table 23

Selection Models for HCEF

	Subsistence Income		Disposable Income	
	Income Equation	Selection Equation	Income Equation	Selection Equation
Schooling	0.0424 (0.0237)	0.0009 (0.0226)	0.0391 (0.0255)	0.0057 (0.0219)
Schooling if Female	0.1089 (0.0282)	0.0067 (0.0263)	0.1186 (0.0305)	–0.0087 (0.0254)
Schooling if HH Head	0.0789 (0.0277)	–0.0243 (0.0290)	0.1267 (0.0301)	–0.1341 (0.0273)
Experience	0.0810 (0.0242)	0.0519 (0.0248)	0.0462 (0.0258)	0.0568 (0.0238)
$Experience^2$	–0.0011 (0.0004)	–0.0003 (0.0005)	–0.0008 (0.0005)	–0.0006 (0.0004)
Constant	9.4578 (0.3604)	–0.1523 (0.3185)	10.084 (0.3596)	–0.1872 (0.3088)
Female	–1.0504 (0.0866)	–0.4333 (0.1000)	–0.8548 (0.0939)	–0.3170 (0.0940)
HH Head	1.3249 (0.1127)	0.6500 (0.1521)	0.5470 (0.1217)	0.4871 (0.1314)
Number of Children	– (–)	0.2807 (0.0570)	– (–)	0.1589 (0.0508)
Christian Woman	– (–)	0.1772 (0.1060)	– (–)	0.2360 (0.0919)
Obs.	1 751		1 751	
Censored Obs.	349		370	
Uncensored Obs.	1 402		1 381	
$\rho\sigma_\varepsilon$	–0.0245 (0.1918)		–0.9641 (0.1190)	

Author's own computations. – *Standard errors are given in parenthesis.

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Table 23 depicts the results of two selection models – one for subsistence income and one for disposable income. The specification of the income equation is the same as the specification underlying Table 19. The selection equation includes all variables of the income equation plus two variables that are considered as selection instruments. I tested if these variables are insignificant in an income equation. They are both highly insignificant. In the selection equation, the number of kids is significant at the 5 % level in both models. The dummy for Christian women is significant at the 5 % level in the model for disposable income, and at the 10 % level in the model for subsistence income.

In contrary to the usual results for female labor market participation in Europe or the U.S. (Dustmann, Schmidt 2000), the number of children has a positive influence on the selection probability. The more children a woman has, the more likely it is that she will report positive income. This result is very plausible in the Nouna area, though. Children augment the status of a woman inside

the household. It is more likely that she will receive her own field where she can cultivate crops for her (and her children's) personal needs. Christian women most probably have a positive selection probability because of cultural reasons. The coefficient of lambda, the correction term for the incidental truncation, is negative in both models. In the model for disposable income, the coefficient is significant at the 5 % level.

The coefficient estimates of the income equation confirm more or less the results of the simple OLS models. In any case they are lower than the IV estimates. A thorough comparison of the results of the different models will follow below (Table 25). For subsistence income, the return to education for a man who is not household head is 0.042. For a woman, the return to education amounts to 0.151, for male household heads 0.121, and for female household heads 0.230. For disposable income, the respective estimates are 0.039, 0.158, 0.166 and 0.284.

An issue that challenges the results obtained so far is the way how income is measured in the NHDHS. It is not clear whether the design of the NHDHS really allows to analyze individual income. The income of household heads might be overstated because they probably report too big a share of household income and the individual income of the other household members might consequently be understated. Therefore, I estimated two models where I regressed household income on the number of years of schooling completed by all household members and the total working experience of the household.

The results are given in Table 24. For subsistence income, the return to education irrespective of who attained the schooling amounts to 0.070. The respective estimate for disposable income is 0.103. In the second model I separately summed up the number of years of schooling attained by men who are not household head, by women, and by the household head. The respective coefficient estimates are 0.027, 0.041, and 0.113 for subsistence income, and 0.041, 0.073, and 0.156 for disposable income. The age-earnings-profile again has the usual U-shaped pattern. The ascent and the descent are less pronounced though, which might be a consequence of the accumulation of working experience across all household members. Except for the standard OLS models with interaction terms, the adjusted R^2-values are higher than those for the other models. They range from 0.256 to 0.292. The same is true for the values of the F-Tests which range from 55.31 to 80.52. The household models seem to exhibit a fairly good model fit.

A very important result of the household models is that they confirm the results of the models for individual income. I take this as evidence that the measurement of income as implemented in the NHDHS does not prohibit the analysis of individual income. Furthermore, the results confirm the higher returns for disposable income than for subsistence income.

Table 24

Modeling of Household Income

	Standard HCEF		Distinguishable Human Capital Shares	
	Subsistence Income	Disposable Income	Subsistence Income	Disposable Income
HH Schooling	0.0697 (0.0072)	0.1033 (0.0085)	0.0265 (0.0134)	0.0408 (0.1583)
Schooling of Women	– (–)	– (–)	0.0410 (0.0140)	0.0732 (0.0166)
Schooling of HH Head	– (–)	– (–)	0.1130 (0.0126)	0.1558 (0.0149)
HH Experience	0.0314 (0.0036)	0.0282 (0.0044)	0.0339 (0.0036)	0.0317 (0.0043)
HH Experience^2	–0.0007 (0.0001)	–0.0007 (0.0001)	–0.0007 (0.0001)	–0.0008 (0.0001)
Constant	11.590 (0.0764)	10.853 (0.0919)	11.498 (0.0771)	10.730 (0.0922)
Obs.	689	686	689	686
F-Test	80.04	80.52	55.31	57.50
Adj. R^2	0.2563	0.2583	0.2830	0.2920

Author's own computations. – *Standard errors are given in parenthesis.

Table 25 compares the results of the different models that I estimated. For the majority of the models, the returns to education for disposable income are higher than the returns for subsistence income. This confirms the working hypothesis that education has a greater effect on the individual's ability to generate money income than on the individual's productivity on the family farm. But also for subsistence income – which is the more important income magnitude for the majority of the population – education matters. The return to education for men who are not household head is 6.21 % for the standard OLS model of the HCEF, 4.25 % for the standard OLS model with interaction terms, 4.24 % for the selection model, and 2.65 % in the household model. The first three coefficients are significant at the 10 % level, the coefficient of the household model is significant at the 5 % level.

This result is consistent with the result published by Psacharopolous (1994) who estimates a return to education for low income countries of 6.4 %, and for SSA of 5.9 %. The IV estimate of 48.8 % is extraordinarily high, though. Technically, IV is a very appropriate method to deal with the problem of endogeneity and measurement error. This is the principal reason, why IV is often used in studies on the return to education. Typically, these studies report the IV estimates to be higher than the OLS estimates. In our case, I am somewhat skeptical about the magnitude of the coefficients. At least, I take the results as a confirmation that the returns are not necessarily lower than proposed in our other models.

Table 25

Comparison of "Return To Education"-Estimates

	Men		Women		HH Heads	
	Sub-Sample excluding HH Heads	Interaction Terms	Sub-Sample excluding HH Heads	Interaction Terms	Male HH Heads only	Interaction Terms
			Standard OLS			
Subsistence Income	0.0621 (0.0340)	0.0425 (0.0237)	0.1485 (0.0276)	0.1513 (0.0520)	0.1063 (0.0175)	0.1212 (0.0515)
Disposable Income	0.0460 (0.0312)	0.0427 (0.0241)	0.1589 (0.0268)	0.1520 (0.0530)	0.1706 (0.0253)	0.1683 (0.0524)
			IV			
Subsistence Income	0.4883 (0.1705)		0.3971 (0.1197)		0.0799 (0.0718)	
Disposable Income	0.1076 (0.1269)		0.7154 (0.1338)		0.4533 (0.1197)	
			Selection Model			
Subsistence Income		0.0424 (0.0237)		0.1513 (0.0519)		0.1213 (0.0514)
Disposable Income		0.0391 (0.0255)		0.1577 (0.0560)		0.1658 (0.0556)
			Modeling of HH Income			
Subsistence Income		0.0265 (0.0134)		0.0675 (0.0274)		0.1395 (0.0260)
Disposable Income		0.0408 (0.1583)		0.1140 (0.1749)		0.1966 (0.1732)

Author's own computations. – *Standard errors are given in parenthesis.

For women, the returns to education are higher than those for men. Except for the model of household income where the coefficient estimate is 6.8 %, I estimated the return to education for women to be around 15 %. The estimate of the standard OLS model is 14.9 %. The estimate of the OLS model including interaction terms as well as the estimate of the selection model amount to 15.1 %. The causal interpretation of these high returns is problematic. It is difficult to identify whether women with a higher education *report* more income because of their higher status inside the household or whether they *are* more productive because of their education. In any case, the result for the woman herself might be the same, whether the effect is indirect via her status or direct via an increased productivity. The effect for the household makes a difference, though, if the reporting of income is mutually exclusive. The result of the household model could therefore maybe seen as a hint that the net productivity effect for women might be lower than 15 %. In practice it could well be an effect of both: the educated woman might be "clever enough" to generate her own income and have the status to report this income as her own income.

For male household heads, the estimate of the standard OLS model is 10.6 %, the estimate for the OLS model including interaction terms is 12.1 %, and the estimates for the selection model and the household model are 12.1 and 14.0, respectively. The higher return for male household heads than for men who are not household heads is plausible for the Nouna area. In general, it is the household head who makes the economic decisions inside the household. His education seems to be used more effectively than the education of a household member who is not household head.

5. Conclusion

Similar to the findings of Card (1999), the OLS models seem to provide very useful results. They are very close to the results of the selection models and the models of household income, and therefore do not necessarily seem to be biased if one believes that the more advanced models provided consistent estimates of the private return to education. The comparison of the coefficient estimates for disposable income and subsistence income confirms the working hypothesis that the returns for the former are higher than those for the latter. Formal education seems to have a bigger impact on the productivity of labor that generates cash income than on the productivity of traditional farming. Nevertheless, also for those individuals who mainly gain their income from traditional farming, returns to education are noticeable.

For subsistence income which is the income magnitude that matters the most for the vast majority of the population, the return to education for men who are not household head is around 4–6 %. Women experience a considerably higher return to education with roughly 15 %. The return to education for male household heads amounts to 10–12 %. For men who are not household heads, my results confirm the findings of Psacharopoulos (1994): in fact, education seems to have a lower return in SSA. But a more differential investigation of the issue reveals that there are returns to education that are as high as in Western countries. Even in a community that is dominated by subsistence farming, women and household heads seem to benefit as much from education as participants of modern labor markets.

Again similar to the findings of Card (1999), my IV results are higher than the results of the OLS models. In my case, the increase is a bit large, shedding doubt on the validity of the instruments used. The coefficient estimates for men, women, and male HH heads are 49 %, 40 %, and 8 %, respectively. In my OLS models that use dummies for the different education levels, I find extraordinarily high returns to education for alphabetization programs. For subsistence income, men experience a return of 20.7 %. The estimates for women and male household heads are 19.1 % and 49.9 %, respectively. From a policy perspective, alphabetization programs seem to be a very effective and efficient

way to both raise the education level and the income of a country's population.

My results confirm some of the findings of Siphambe (2000): the returns to schooling increase with education level. For male household heads, primary education has a return of 6.1 %, secondary education 16.9 %, and superior education has a return of 23.5 %. Because of the lack of observations for superior education for men and women who are not household head, I could only estimate the return to education for primary and secondary education for these demographic groups. The respective values for men (women) are 4.8 % (13.1 %) and 9.6 % (18.7 %). These findings raise the question why people invest so little in education if investments in education are that profitable. One obvious reason is that the inhabitants of the Nouna region just cannot afford it. Moreover, in the absence of functioning credit markets, it is not possible to finance education through borrowing money. My results therefore entail the policy implication that there is room for public interventions in the education sector.

Chapter 6

Summary

The success of health economics and its guidance for health policy heavily rests on the availability of reliable empirical evidence on the demographic, economic, and epidemiological environment, on behavioral relationships, and on the impact of policy interventions. For Sub-Saharan Africa (SSA), especially the epidemiological situation is unclear, since comprehensive systems of mortality and health statistics are often absent. There is a growing literature on the design and analysis of health surveys, indicating the increasing demand for health surveys in academia and politics.

This study intends to produce empirical evidence on the measurement of the burden of disease, the structure of income, and returns to education in rural West Africa. It deals with the collection and analysis of mortality, morbidity, and socio-economic data in the *Nouna Health District* in the North-West of Burkina Faso.

There are practically no papers in peer-reviewed journals that deal with the conceptualization and implementation of a sound survey, even though this would be *the* crucial basis for any sound empirical research. Therefore, the intention of chapter 1 was to suggest a prototype for the collection of morbidity and household data. Furthermore, a strong focus was placed on what research on survey methodology has contributed to the respective matter (e.g. questionnaire writing) and on the theoretical aspects of the particular topic (e.g. nutritional assessment). Ultimately, this focus on survey methodology also led to a reference list that can be used as a comprehensive bibliography on the essential aspects of survey and questionnaire design.

Very few mortality data are available for SSA. The primary sources of information are model-based extrapolations and national statistics. The situation is still worse for morbidity data. Clinical morbidity data threatens to be even more strongly biased than clinical mortality data (since the population seeks hospital treatment only for some severe diseases) and even less data collection has been accomplished thereupon. The *Nouna Health District Household Sur-*

vey (NHDHS) intends to fill this gap. It comprises a module on morbidity that combines the collection of population-based data on reported illness with the effort to diagnose morbidity on the basis of symptoms.

But obtaining a high quality data set for quantitative analysis is an endeavor that demands more than a sound survey design. The supervision process of the data was a difficult task. A special focus during the transformation of the raw data was placed on the construction of income data out of the different income-relevant parts of the raw data.

The results of the data cleaning process were reassuring. The data seemed to be internally consistent and consistent with national data sources. Depending on the specific variable used (eleven different income variables were constructed depending on reference period and content), mean annual per capita subsistence income ranges from 69–86 $. The overall adult illiteracy rate is 75.5 %, and the age distribution exhibits the pyramidal pattern typical for developing countries. Roughly 62.7 % of the population are Muslim, 30.8 % are Christian, and 6.5 % report to follow traditional beliefs. Compared to other rural regions of Burkina Faso, the Nouna area exhibits a big mixture of ethnic groups. The biggest ethnic group are the Dafing, constituting almost half of the population. The remaining 50 % of the population are formed by the Bwaba (20 %), the Mossi (13 %), the Peulh (9 %), and the Samo (8 %).

The study also dealt with the measurement of the burden of disease (BOD) in SSA. In the *World Development Report 1993*, the *World Bank* published a compilation of BOD figures for the eight World Bank regions of the world. As health status indicator, a new health measure was introduced – the *Disability Adjusted Life Year* (DALY). It is a composite health measure that combines the disease burden caused by years of life lost due to premature death (*YLL*) and years of life lived with a disability caused by a disease (*YLD*). It thus integrates health loss caused by mortality and health loss caused by morbidity in one single health measure. The DALY has attracted considerable attention in the epidemiological as well as in the health economics literature.

In 1996, the *World Health Organization* and the *Harvard School of Public Health* published the *Global Burden of Disease Study* (GBDS). The GBDS aims at informing decision makers on global and regional level and thus intends to influence priority setting and policies in the health sector. Because of the lack of measured BOD data for SSA in particular, the GBDS figures for SSA relied on extrapolations of South-African data and on epidemiological models and expert guesses.

In chapter 3, the results of a study were presented where the model-based BOD figures of the GBDS were validated using measured BOD data of the Nouna Health District. For Nouna, only mortality data was available. Thus,

YLL were used as health indicator. The *YLL* figures of the GBDS were compared with *YLL* figures for Nouna. The Nouna data exhibit the same qualitative BOD pattern as the GBDS results regarding age and gender. 53.9 % of the BOD is carried by men, whereas the GBDS reported this share to be 53.2 %. The ranking of diseases by BOD share differs substantially, though. Malaria, diarrhoeal diseases and lower respiratory infections occupy the first three ranks in the Nouna study as well as in the GBDS, only differing in the respective order. But protein-energy malnutrition, bacterial meningitis and intestinal nematode infections occupy rank 5, 6 and 7 in Nouna and rank 15, 27 and 38 in the GBDS.

To investigate the influence of different age and time preference weights on the results, the BOD pattern was again estimated using, first, *YLL* with no discounting and no age-weighting, and, second, mortality figures. The results were not sensitive to the different age and time preference weights used. Specifically, the choice of parameters mattered less than the choice of indicator. The conclusion is that local health policy should rather be based on local BOD measurement instead of relying on extrapolations that might not represent the true BOD structure by cause.

Chapter 4 dealt with a methodological issue of the measurement of the BOD in DALYs. The GBDS presumes that disability weights are universal and equal across countries. Nevertheless, a recent study among health professionals in 14 countries ranking a set of 17 health states with regard to their severity concluded that the resulting rank order differences are large enough to shed doubt on the assumption of universality of disability weights. This indicates the need for measuring local disability weights across nations and/or cultures.

The question arises as to whether existing valuation instruments can be used to elicit such locally-meaningful disability weights. The authors of the GBDS argue that utility measurement techniques such as Time-Trade-Off (TTO), Standard Gamble (SG), and Person-Trade-Off (PTO) are cognitively demanding and become increasingly difficult to use with less educated individuals.

In chapter 4 this point of view was shared and argued that there is a need for locally-meaningful valuation instruments, i.e. to evaluate BOD-relevant disease states by culturally-appropriate instruments, including meaningful health state and disability scenarios and feasible scaling procedures. Little research has been done in developing countries on the development of such instruments. Therefore a culturally-adapted *Visual Analogue Scale* (VAS) was introduced, and the instrument was evaluated using the psychometric concepts of practicality, reliability and validity.

The reliability of the valuation instrument was assessed by performing the valuation exercise in four teams consisting of lay people and three teams of health professionals. Additionally, the valuation exercise was repeated four weeks later to assess test-retest reliability. The divergence between the assessment teams was acceptable for most of the health states that were rated. Moreover, the results were stable over time. Construct (convergent) validity of the weights was studied by a comparison of the results of the implicit rank order following from the valuation exercise resulting in disability weights with an explicit rank order exercise. The Spearman rank correlation coefficient equaled 0.86 and 0.94 for lay people and health professionals, respectively, indicating that both panels were consistent in their evaluations, and thus understood the valuation procedure. Based on these results, it can be concluded that the scale values derived at the level of the assessment teams are sufficiently valid and reliable. We suggest to use this instrument for BOD studies on a broader scale.

Chapter 5 was addressed to a more orthodox economic study question: Both health and education can be regarded as investments in human capital. These investments in turn have an effect on the individual's income potential. Chapter 5 investigated whether the investments in education have a noticeable effect on income in a setting that is predominated by traditional subsistence farming. Departing from a simple OLS model for the standard *Human Capital Earnings Function* (HCEF), the study tried to identify the return to education in the poor, rural subsistence economy of Nouna. To estimate the causal effect of education on income, different identification strategies were employed such as a Panel approach, Instrumental Variables (IV), a selection model, and a model of household income.

In the Nouna area, individuals face high opportunity costs of education since their decision framework is to either work on the family farm to guarantee food supply for the current year, or to attend school and be unproductive in the short run. The Nouna area exhibits a crude death rate that is as high as 14.2/1000. The child mortality rate amounts to 33.6/1000. To give a comparison: the estimates of the United Nations for the United States are 8.5/1000 and 8.3/1000, respectively. The political implication of the study question is readily at hand: Is education a feasible policy to foster economic growth in a very poor subsistence economy, or is rudimentary economic development a necessary prerequisite to be able to benefit from formal education at all.

There exist only few studies on the return to education in SSA. The data set used here to estimate returns to education covers 1,751 individuals between 20 and 50 years of age. These individuals comprise 689 households. The data have been collected in June 2000 and February 2001. A special advantage of the data is the detailed measurement of subsistence and disposable income (cash income). Separate returns to education were estimated for men and women

who are not household heads, and for male household heads; furthermore, for subsistence income and disposable income. Subsistence income was calculated as cash income plus the value of the self-consumed part of the harvest which constitutes around 80 % of total income. Estimating separate returns for subsistence income and disposable income allowed to additionally investigate the hypothesis that the returns to education should be higher for disposable income than for subsistence income since education should have a greater effect on the individual's ability to generate money income than on the individual's productivity on the family farm.

The data situation of Nouna is not untypical for a big part of SSA, especially for the poorer regions where rich and complex data sets are scarce. Therefore this study can fill a research gap in contributing to the empirical evidence on the private return to education in poor, rural subsistence economies.

The OLS models seem to provide very useful results. They are very close to the results of the selection models and the models of household income, and therefore do not necessarily seem to be biased if one believes that the more advanced models provided consistent estimates of the private return to education. The comparison of the coefficient estimates for disposable income and subsistence income confirms the working hypothesis that the returns for the former are higher than those for the latter. Formal education seems to have a bigger impact on the productivity of labor that generates cash income than on the productivity of traditional farming. Nevertheless, also for those individuals who mainly gain their income from traditional farming, returns to education are noticeable.

For subsistence income – which is the income magnitude that matters most for the vast majority of the population – the return to education for men who are not household head was estimated to be around 4–6 %. Women experience a considerably higher return to education with roughly 15 %. The estimate for the return to education for male household heads amounted to 10–12 %. Thus, for men who are not household heads, education seems to have a lower return in SSA than for men in industrialized economies. But a more differential investigation of the issue reveals that for other demographic groups, there are returns to education that are as high as in Western countries. Even in a community that is dominated by subsistence farming, women and household heads seem to benefit as much from education as participants of modern labor markets.

The IV results are higher than the results of the OLS models. For the Nouna data, though, the increase is a bit large, shedding doubt on the validity of the instruments used. The coefficient estimates for men, women, and male household heads are 49 %, 40 %, and 8 %, respectively. For the OLS models that use dummies for the different education levels, extraordinarily high returns to ed-

ucation were found for alphabetization programs. For subsistence income, the estimate for men is 20.7 %. The estimates for women and male household heads are 19.1 % and 49.9 %, respectively. Thus, from a policy perspective, alphabetization programs seem to be a very effective and efficient way to both raise the education level and the income of a country's population. Furthermore, the results confirm former findings concerning the increase of the returns to schooling with education level. For male household heads, the coefficient estimate for primary education is 6.1 %, the estimate for secondary education is 16.9 %, and the estimate for superior education amounts to 23.5 %. Because of the lack of observations for superior education for men and women who are not household head, only the return to education for primary and secondary education for these demographic groups could be estimated. The respective figures for men (women) are 4.8 % (13.1 %) and 9.6 % (18.7 %).

These findings raise the question why people invest so little in education if investments in education are that profitable. One obvious reason is that the inhabitants of the Nouna region just cannot afford it. Moreover, in the absence of functioning credit markets, it is not possible to finance education through borrowing money. The results therefore entail the policy implication that there is room for public interventions in the education sector.

Appendix

In the following, the full questionnaire of the Nouna Health District Household Survey is supplied as it was used in the first wave of the survey in July 2000. The original language of the questionnaire is French, apart from some codes that are available in Dioulla also. Translation of the questionnaire was provided by myself. I am grateful to Osman A. Sankoh for helpful comments and proof-reading of the translation.

Questionnaire 1

MINISTRY OF HEALTH

GENERAL SECRETARIAT

NOUNA HEALTH
RESEARCH CENTER

BURKINA FASO

Unité – Progrès - Justice

QUESTIONNAIRE OF THE

NOUNA HEALTH DISTRICT HOUSEHOLD SURVEY

I. Identification of Household

Date of Visit |_|_|/|_|_|/|_|_| **Sheet Nr.** |_|

Community/Village _____ **Code:** |_|_| **Total Nr. of Sheets** |_|

Sector/Quarter _____ **Code:** |_| **Sample** |_|

HH ID |_|_|/|_|_|_|/|_|

Household Head _____ **ID HH Head** |_|_|/|_|_|_|/|_|_|_|

Principle Respondent _____ **ID Princ. Resp.** |_|_|/|_|_|_|/|_|_|_|

Interviewer	Field Supervisor	Data Entry Clerk	Supervisor of Data Entry
Code |_|_|_|	Code |_|_|_|	Code |_|_|_|	Code |_|_|_|
Date |_|_|/|_|_|/|_|_|	Date |_|_|/|_|_|/|_|_|	Date |_|_|/|_|_|/|_|_|	Date |_|_|/|_|_|/|_|_|
Signature	Signature	Signature	Signature

Questionnaire 2

II. Information on Household Members

HH ID |_|_|_|_|_|_|_|_|

Every HH member											Members aged 6+		
Nr.	Rank	Name and Individual ID	Parental relation-ship	To whom	Sex	Date of birth	De-ceas-ed (Yes / No)	State of resi-dence	Ethnic group	Religion	Knows to read and write? If yes, in what language?	Instruction level	Marital status
1	2	3	4	5	6	7	8	9	10	11	12	13	14
...													

New Household Members

Questionnaire 3

Members aged 10+									Every HH member			
Occu-pational status	Princi-pal occu-pation	Situation in princi-pal occu-pation	Secondary occupation	Situation in secon-dary occu-pation	Smoker? Yes / No	How many cigarettes per day?	How many pipes per day?	Since how many years?	What do you think of your health state in general?	Do you have an acute illness (now or in past month)?	Do you have a chronic illness?	Do you have a handicap?
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
•••												
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘

New Household Members

└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘
└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┴┘	└┴┘	└┴┘	└┴┘	└─┘	└┴┴┘	└┴┴┘	└┴┴┘

Questionnaire 4

III. Housing (Note: Only one single cross for each question)

Type of dwelling	Nature of walls	Nature of roof	Nature of floor	Total No. of rooms occupied	Toilet
H1	H2	H3	H4	H5	H6
Building |_|	Hard |_|	Concrete |_|	Tiles |_|	Count the rooms the HH occupies, incl. bedrooms and living rooms.	WC w. running water |_|
Villa |_|	Semi-Hard |_|	Sheet |_|	Cement |_|		Latrines w. ventilated pit |_|
Single-family home |_|	Banco,impr. |_|	Tiles |_|	Beaten ground |_|		Ordinary latrines |_|
Several huts and houses |_|	Banco |_|	Beaten ground |_|	Sand |_|		In nature |_|
Round huts |_|	Straw |_|	Straw |_|	Other |_|	|__|__|	Other |_|
Other |_|	Other |_|	Other |_|			

The following question has to be answered by the interviewer.

H7 Judge on the general state of the dwelling: Has it been

Very clean	|__|	Dirty	|__|
Clean	|__|	Very Dirty	|__|
Clean enough	|__|		

IV. Water and Sanitation

Water source			Water disposal	Trash disposal	Water conservation
E1			E2	E3	E4
	Rainy season	Dry season	Courtyard |_|	Dustbin, inside |_|	*Pots or earthenware jars*
Running water				Dustbin, outside |_|	Always covered |_|
At home	|__|	|__|	Outside courtyard |_|	Heap of rubbish, inside |_|	Sometimes covered |_|
Outside home	|__|	|__|		Heap of rubbish, outside |_|	
Public fountain	|__|	|__|	Absorbing well |_|	Ditches |_|	*Seals*
Drilling (pump)	|__|	|__|		Vat |_|	Always covered |_|
Mechanic well			Gutters |_|	Street |_|	Sometimes covered |_|
At home	|__|	|__|		Other |_|	
Outside home	|__|	|__|	Septic tank |_|	**After how many days do you normally change your water ?**	*Water-bottle*
Ordinary well				E5	Always coverd |_|
At home	|__|	|__|	Other |_|	(in days) |__|	Sometimes covered |_|
Outside home	|__|	|__|			
Rivers and backwaters	|__|	|__|			
Other	|__|	|__|			

Questionnaire 5

E5 If the HH fetches water outside the house, how does he transport the water? In barrels |_| In 'canaris' |_| In seals |_| In cans |_| In basins |_|	**E6**	The following questions have to be answered by the interviewer himself: Are there heaps of rubbish in the courtyard ? A lot |_| Quite a bit |_| Some |_| Little |_| None |_|
	E7	Are there animals living in the courtyard (except chicken)? Yes |_| No |_|
	E8	The kitchen / the place where one prepares the meals is Very clean |_| Clean |_| Clean enough |_| Dirty |_| Very dirty |_|

Questionnaire 6

MODULE 1: SOCIO-ECONOMIC INFORMATION

Village |__|__| **Name of household head** ______________________ **HH ID** |__|__| |__|__|__| |__|

Date of visit |__|__| |__|__| |__|__|__|__| **Name of Interviewer** ______________________ **Code** |__|__|__|

<u>Section 1 :</u> Animals and goods of household

1.1) Animals

How many animals does every HH member own at the moment?

Rank	Name of HH member	Member owns animals? YES/NO	Poultry	Sheep	Goats	Cattle	Don-keys	Pigs	Horses
1	2	3	4	5	6	7	8	9	10

Questionnaire 7

1.2) Durable goods

Ask **every** HH member if he owns any of the goods given below!

Rank	Name of HH member	Member owns something Yes / No	Ploughs	Carts	Bicycles	Mopeds	Motor-bikes	Cars	Radios	TV sets	Telephone	Fridge	Modern kitchen	Other
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Questionnaire 8

<u>Section 2:</u> Household revenue
2.1) Agricultural production during last season *(1999/2000)*.

Ask the following question to every HH member aged 10+:
In the last season did you cultivate any of the products I'm reading to you now? (As given in the code list.)

Rank	Name of HH member	Cultivated anything? Yes / No	Agricultural Product	Quantity	Unit of measure-ment
1	2	3	4	5	6

Codes for agricultural products

MIL = Millet
SOR = Sorgho
MAI = Maize
RIZ = Rice
FON = Fonio
ARA = Peanuts
SES = Sesame
HAR = Beans
PEP = Peas
CAL = Melons
TAB = Tobacco
COT = Cotton
AUT = Other (specify)

Codes for units of measurement

BOI = Box
TIN = Jar
SAC = Sac
CHA = Cart
KIL = Kilogram
NOM = Number
TON = Ton

Questionnaire 9

2.2) Money income through the selling of agricultural products

Attention interviewers:: Column 6 is not the product of column 5 times 5, but the actual amount of money each HH member received during the 5 months preceding the last month. Make sure you clarified this point for the respondent.

Rank	Name of HH member	Received any money income? Yes / No	Agricul-tural products	Amount received last month	Amount received the 5 months preceding the last month
1	2	3	4	5	6

Codes for income source

ARA = Peanuts and related products
MIL = Millet/ sorgho and related products
COT = Cotton and related products
MAI = Maize and related products
RIZ = Rice and related products
FON = Fonio
NIE = Niébé and related products
SES = Sesame
IGN = Yam, potato
AUC = Other crops
MAR = Gardening crops(tomatoes, onions, etc.)
FRU = Fruit
KAR = Karité (oil and butter)
NER = Néré (grains and soumbala)
AUP = Other wild-grown products (honey, tamarind) and hunting products
BIV = Sale of bivins
CAP = Sale of caprins
OVI = Sale of sheep products
POR = Sale of porcine
ASI = Sale of asins
VOL = Sale of poultry
AUA = Sale of other animals
PAN = Sale of animal products (eggs, milk, leather, etc.)
PEC = Sale of fish

Questionnaire 10

2.3) Transfers and pensions

Ask **every** HH member: *Did you receive any money from the sources and for the destinations I am going to read to you now?* (see code list!)
Attention interviewers:: Column 5 is not the product of column 4 times 5, but the actual amount of money each HH member received during the 5 months preceding the last month. Make sure you clarified this point for the respondent.

Rank	**Name of HH member**	**Received any money?** Yes / No	**Amount of last month**	**Amount received the 5 months preceding the last month**	**Source**	**Desti-nation**
1	**2**	**3**	**4**	**5**	**6**	**7**

Codes for source of money

PAR = relatives
EPA = emigrated relatives
AMI = friends
EAM = emigrated friends
CRE = Credit
AUT = other sources

Codes for destination of money

SOU = transfers without specific destination
FET = ceremonies like weddings, baptism, funerals etc.
SOI = medical care
SCO = school fees
AUT = other destinations

Questionnaire 11

2.4) Money income

Ask **every** HH member: *Did you receive any money from any of the income sources I'm going to read to you now?* (see code list!)
Attention interviewers:: Column 5 is not the product of column 4 times 5, but the actual amount of money each HH member received during the 5 months preceding the last month. Make sure you clarified this point for the respondent.

Rank	**Name of HH member**	**Money income?** Yes / No	**Amount of last month**	**Amount received the 5 months preceding the last month**	**Source**
1	**2**	**3**	**4**	**5**	**6**

Codes

SAR = regular salary
SAO = occasional salary
SAJ = daily salary
VPN = selling of non-agricultural goods
COM = trade
PEN = Pension of any kind
AUT = other sources

Questionnaire 12

<u>Section 3:</u> Household expenditures

Ask **every** HH member: *Did you spent money on any of the things I'm going to read to you now?* (see code list!)

Rank	Name of HH member	Expenditures? Yes / Non	Last month		5 months preceding last month	
			Expenditure on	Amount	Expenditure on	Amount
1	2	3	4	5	6	7

Codes for expenditures

LOY = rent
BOI = drinking
TRA = transport
EDU = education
REL = religious expenditures
VIV = daily living (food etc)
CER = ceremonies (funerals, weddings etc)
ENP = seeds/pesticide
ENV = money transfers
ANI = animals
SON = medical care
OUT = tools for agriculture etc.
MAT = construction materials (tiles, bricks, etc)
VET = clothing
AUT = other destinations
MOT = Means of transport
AQP =Other equivalent expenditures

Questionnaire 13

Section 4 : Food and nutrition

Ask these questions to the woman that runs the household.

How many times do you eat the following food I'm going to read to you now? (as given below in the 1st column of the table!) Indicate also the quantities and the units of measurement.

Food	Frequency	Number	Unit
Basic cereals (Millet, Sorgho, Maize, Rice, Fonio)	___	__	___
Beans	___	__	___
Peas	___	__	___
Yam, Potatoes, Manioc etc.	___	__	___
Sauce	___	__	___
Salad	___	__	___
Vegetables (like cabbages, tomatoes etc.)	___	__	___
Fruits (Bananas, Mangos, Oranges, other wild fruits)	___	__	___
Milk	___	__	___
Meat	___	__	___
Fish	___	__	___
Bread	___	__	___

Codes for frequencies

Per day:
2JR = more than 2 times a day
2PJ = 2 times a day
1PJ = once a day

Per week:
1PS = once per week
2PS = twice a week
34S = 3 or 4 times per week
56S = 5 or 6 times per week

Per month (rare food):
QFM = some times per month
13M = once all 3 months
16M = once in half a year
1AN = once in a year
JAM = Never

Codes for units of measurement

BOI = box (garibout gongho)
TAS = pile
BOL = cup
KIL = kilos
BOU = balls
NOM = numbers
LIT = liters

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Questionnaire 14

MODULE 2: MORBIDITY AND HEALTH CARE

Village |__|__| **Name of HH head** _____ **HH ID** |__|__|__|__|__|__|__|__|

Date of visit |__|__|__|__|__|__|__|__| **Name of interviewer** _____ **Code** |__|__|__|

Section 1: Inventory of handicaps

Ask the HH members who said that they have a handicap (Col. 26 Mother questionnaire) what kind of handicap they're having if it's not visible.

Rank	Name of HH member	No. of health problem	What handicap do you have?	What caused the handicap?	How did you get to know the cause of the handicap?	Date when it started	Limitations
1	2	3	4	5	6	7	8
|__|__|		|__|	|__|__|__|	|__|__|__|	|__|__|__|__|__|__|	|__|
|__|__|		|__|	|__|__|__|	|__|__|__|	|__|__|__|__|__|__|	|__|
|__|__|		|__|	|__|__|__|	|__|__|__|	|__|__|__|__|__|__|	|__|
|__|__|		|__|	|__|__|__|	|__|__|__|	|__|__|__|__|__|__|	|__|
|__|__|		|__|	|__|__|__|	|__|__|__|	|__|__|__|__|__|__|	|__|

Codes for handicaps

PAI = paralyzed, legs
PAS = paralyzed, arms
AVE = blind
MAN = missing arm
HAM = mentally handicapped
STE = sterility
NSP = don't know
MUE = mute
SOU = deaf
UJA = missing leg

Codes for column 6

EVI = obvious (for example in the case of an accident)
NSP = don't know
MPD = mother or father told me
PDS = health personnel told me
AUP = others told me
MOM = by myself

Codes for 'Cause of handicap'
see manual for disease codes

Codes for limitations

6 = needs assistance for eating and personal hygiene
5 = limitations in daily activities like preparing meals, house-keeping or looking after live-stock
4 = can't work in the fields or do handicraft
3 = limitations in several domains like recreational activities, sports, education, and reproduction
2 = limitations in ONE of the domains given above
1 = no limitations at all

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Questionnaire 15

Section 2: Inventory of chronic diseases (diseases somebody is having for more than 3 months).

Apart from the diseases we just talked about, did you have a disease in the last month that lasted already for more than 3 months ?

Rank	Name of HH member	No. of health pro-blem	What chronic disease did you have?	Code for chronic disease	How do you know?	Symptoms	Date when it started	Date when it stopped	Disease over? Yes / No	Seve rity of dise-ase	Li-mi-ta-tions
1	2	3	4	5	6	7	8	9	10	11	12

Codes for chronic diseases

see code book

Codes for symptoms

see code book

Codes "How do you know ?"

EVI = obvious (for example in the case of an accident)
NSP = don't know
MPD = mother or father told me
PDS = health personnel told me
AUP = others told me
MOM = by myself

Codes for severity

5 = very bad
4 = bad
3 = bad enough
2 = not bad
1 = absolutely not bad

Codes for limitations

6 = needs assistance for eating and personal hygiene
5 = limitations in daily activities like preparing meals, house-keeping or looking after live-stock
4 = can't work in the fields or do handicraft
3 = limitations in several domains like recreational activities, sports, education, and reproduction
2 = limitations in ONE of the domains given above
1 = no limitations at all

Questionnaire 16

Section 3: **Inventory of acute diseases of last month**

Apart from the diseases we were just talking about, did you, during the last month, have any diseases that didn't last very long ?

Rank	Name of HH member	No. of health pro-blem	What acute disease did you have?	Code for acute disease	How did you know?	Symptoms	Date when it started	Date when it stopped	Disease over? Yes / No	Seve rity of dise ase	Li-mi-ta-tions
1	2	3	4	5	6	7	8	9	10	11	12

Codes for acute diseases	Codes for symptoms
see code book	see code book

Questionnaire 17

Section 4: Severity of health problem and how they coped with it

Rank	Name of HH member	No. of health problem	Did the health problem threaten your life? Yes / No	Was it a social problem for you? Yes / No	Did it hinder you from working? If yes For how long? (D,W,M,Y) If no Col 7	During your illness, did other HH members care for you? If yes Col 08 If no Col 10	Did it prevent them from working? If yes Col 09 If no Col 10	How to cope with the work	If you had any expenditures (medicaments, consultation, etc.) how did you cope with that?	Could somebody of your HH not go to school because of your illness? He/she didn't go to school at all Yes Col.12 No Col. 13	How long did he/she not go to school? (H,D)	Why did he/she not go to school at all?
1	2	3	4	5	6	7	8	9	10	11	12	13
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			
								1 2 3	1 2 3			

Codes for working arrangements (question 9)

1 = we had help from people outside the HH without paying them
2 = other HH members did the work
3 = we employed persons from outside of our HH
4 = we did nothing
5 = other (specify)

Codes money arrangements (question 10)

1 = we sold goods / animals
2 = we got free medical care
3 = we got money as a gift
4 = we borrowed money
5 = we used cash / savings
6 = extra work against payment
7 = other (specify)

Code 'Why not going to school' (question 13)

1 = we needed the money dedicated for school purposes to pay the expenditures related to the disease
2 = we didn't earn the money we needed for school purposes because we couldn't work because of the disease
3 = he/she had to help at home
4 = he/she had to take care of the sick person
5 = other (specify)

Questionnaire 18

<u>Section 5:</u> Demand for health care

Rank	Name of HH member	Disease code (refer to section 2 and 3)	No. of health pro-blem	Did you treat the disease? Yes / No If yes Col 6 If no Col 12	Who treated the disease?			Where did the treatment take place?			Why did you choose this kind of treatment?		
					1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Code 'Who treated the disease ? (Question 6-8)

MOM = self-treatment
FAM = family member
AMI = friend, neighbor
INF = nurse
MAT = matron
PHA = pharmacist
SAG = midwife
ASV = village health worker
MED = medical doctor
GUE = traditional healer
AUP = other persons

Codes Place of treatment (question 7)

MAI = at home CKO = CSPS of Koro
VIL = this village CBO = CSPS of Bourasso
AVI = other village CDA = CSPS of Dara
CHD = Dédougou hospital CTO = CSPS of Toni
CMD = Dédougou central hospital
NCO = Nouna hospital
NNE = external consultation at Nouna hospital
AUT = Other

Code Why this choice ? (question 12-14)

ARG = not enough money for something else
CON = trust in his/her competence
PRO = nearest health service
AUT = other reason (specify)
PAI = 1st/2nd treatment didn't help
GRA = disease was very severe

Questionnaire 19

<u>Section 5</u> : Demand for health care (continued)

Rank	Initials of name of HH member	No. of health pro-blem	What was the quality of the treatment?			Expenditures for transportation?			Duration of travel/transport (in hours)?		
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
1	2	3	15	16	17	18	19	20	21	22	23

Codes for Quality of treatment (questions 15-17)

5 = very good
4 = good
3 = medium
2 = bad
1 = very bad

Questionnaire 20

Section 5: Demand for health care (continued)

Rank	Initials of name of HH member	No. of health problem	Costs of stay / daily living			Costs of treatment / consultation			Costs of medicaments and material used		
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
1	2	3	24	25	26	27	28	29	30	31	32

Questionnaire 21

Section 5: **Demand for health care (continued)**

Rank	Initials of name of HH member	No. of health problem	Other expenditures			Success of treatment			Have you been in hospital because of this disease? If yes, how long? (D,W,M) If no: next section	How much did you pay for the hospital?
			1st	2nd	3rd	1st	2nd	3rd		
1	2	3	33	34	35	36	37	38	39	40

Codes 'success of treatment' (questions 36-38)

5 = totally cured
4 = partly cured
3 = relief
2 = no improvement
1 = worse than before

Questionnaire 22

<u>Section 6:</u> Helpers of the sick person

During the illness episode of the respondent, did some HH members help/assist him/her? If yes, fill in the table below.

Rank	Initials of sick person	No. of health problem		Rank	Initials of sick person	No. of health problem		Rank	Initials of sick person	No. of health problem
__ __	____________	__ __		__ __	____________	__ __		__ __	____________	__ __
Rank	**Initials of helper / assistant**	**Time lost (H,D,W)**		**Rank**	**Initials of helper / assistant**	**Time lost (H,D,W)**		**Rank**	**Initials of helper / assistant**	**Time lost (H,D,W)**
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
Rank	**Initials of sick person**	**No. of health problem**		**Rank**	**Initials of sick person**	**No. of health problem**		**Rank**	**Initials of sick person**	**No. of health problem**
__ __	____________	__ __		__ __	____________	__ __		__ __	____________	__ __
Rank	**Initials of helper / assistant**	**Time lost (H,D,W)**		**Rank**	**Initials of helper / assistant**	**Time lost (H,D,W)**		**Rank**	**Initials of helper / assistant**	**Time lost (H,D,W)**
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __
__ __		__ __ __		__ __		__ __ __		__ __		__ __ __

Questionnaire 23

MODULE 3: PREVENTIVE CARE AND GENERAL HEALTH

Village |__|__| **Date of visit** |__|__| |__|__| |__|__|__|__|

Name of HH head ______________________ **HH ID** |__|__| |__|__|__| |__|

Name of interviewer ______________________ Code |__|__||__|

Section 1: Preventive care *(This section applies to every HH member)*

Rank	**Name of HH member**	**In the last 3 months, did you use any preventive care** (from the list I'm going to read to you now)? Yes / No If yes Col 5 If no End	**No. of preven-tive care**	**What kind of preven-tive care was it?**	**Who did you con-sult?**	**Where?**	**Why this choice?**	**Duration of travelling there in hours**	**Judge on the qualit y of treat-ment you got**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Codes Place of treatment (question 7)

MAI = at home
VIL = this village
AVI = other village
CHD = Dédougou hospital
CMD = Dédougou central hospital
NNE = external consultation at Nouna hospital
CKO = CSPS of Koro
CBO = CSPS of Bourasso
CDA = CSPS of Dara
CTO = CSPS of Toni
NCO = Nouna hospital
AUT = Other

Code Why this choice ? (question 8)

ARG = not enough money for something else
CON = trust in his/her competence
PRO = nearest health service
AUT = other reason (specify)

Code for preventive care (question 5)

Vaccinations
BCG = BCG (Tuberculoses)
POL = Polio (Poliomyelitis)
DTC = DTC (Diphtheria, Tetanus, Whooping cough
ROU = Measles
FIE = Yellow fever
TET = Tetanus
MEN = Meningitis
AUV = Other vaccination

Code 'Who did you consult ? (Question 6)

MOM = self-treatment
FAM = family member
AMI = friend, neighbor
INF = nurse
MAT = matron
PHA = pharmacist
SAG = midwife
ASV = village health worker
MED = medical doctor
GUE = traditional healer
AUP = other persons

Code Quality of treatment (question 10)

5 = very good
4 = good
3 = medium
2 = bad
1 = very bad

Questionnaire 24

Section 1: Preventive care

Rank	Name of HH member	No. of preventive care	Costs of transportation	Costs of the stay	Costs of treatment/ consultation ?	Costs of medicaments and material	Other costs	If you had any costs, how did you cope with them?	Do you use family planning? Yes / No	If yes, what methods do you use?
1	2	3	11	12	13	14	15	16	17	18

Codes money arrangements (question 16)

1 = selling goods/animals
2 = received free treatment
3 = received money as a gift
4 = borrowed money
5 = used cash, liquid savings
6 = worked for the money
7 = other (specify)

Codes family planning (Question .18)

AUC = nothing
DIU = DIU/coil
INJ = Injection
MGC = Mousse/Gel
MTR = traditional methods
STF = female sterilization
STM = male sterilization
ABS = Abstinence
CON = Condom
AUT = other

Questionnaire 25

MODULE 4: ANTHROPOMETRICS

Date of visit |__|__|__|__|__|__| **Village** |__|__| **HH ID** |__|__| |__|__|__| |__|

Name of household head _____

Name of anthropometrist _____ **Code** |__|__|__|

No.	Name of HH member	Weight (in kilograms)	Height (in cm)
01		|__|__|,|__|	|__|__|__|
02		|__|__|,|__|	|__|__|__|
03		|__|__|,|__|	|__|__|__|
04		|__|__|,|__|	|__|__|__|
05		|__|__|,|__|	|__|__|__|
06		|__|__|,|__|	|__|__|__|
07		|__|__|,|__|	|__|__|__|
08		|__|__|,|__|	|__|__|__|
09		|__|__|,|__|	|__|__|__|
10		|__|__|,|__|	|__|__|__|
11		|__|__|,|__|	|__|__|__|
12		|__|__|,|__|	|__|__|__|
13		|__|__|,|__|	|__|__|__|
14		|__|__|,|__|	|__|__|__|
15		|__|__|,|__|	|__|__|__|
16		|__|__|,|__|	|__|__|__|
17		|__|__|,|__|	|__|__|__|
18		|__|__|,|__|	|__|__|__|
19		|__|__|,|__|	|__|__|__|
20		|__|__|,|__|	|__|__|__|

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